

University of Wollongong - Research Online

Thesis Collection

Title: Psychophysiology of positive and negative affect

Author: Kerrie Wilde

Year: 1999

Repository DOI:

Copyright Warning

You may print or download ONE copy of this document for the purpose of your own research or study. The University does not authorise you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site.

You are reminded of the following: This work is copyright. Apart from any use permitted under the Copyright Act 1968, no part of this work may be reproduced by any process, nor may any other exclusive right be exercised, without the permission of the author. Copyright owners are entitled to take legal action against persons who infringe their copyright. A reproduction of material that is protected by copyright may be a copyright infringement. A court may impose penalties and award damages in relation to offences and infringements relating to copyright material.

Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.

Unless otherwise indicated, the views expressed in this thesis are those of the author and do not necessarily represent the views of the University of Wollongong.

Research Online is the open access repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

University of Wollongong Thesis Collections

University of Wollongong Thesis Collection

University of Wollongong

Year 1999

Psychophysiology of positive and
negative affect

Kerrie Wilde
University of Wollongong

Wilde, Kerrie, Psychophysiology of positive and negative affect, Doctor of Philosophy thesis, Department of Psychology, University of Wollongong, 1999.
<http://ro.uow.edu.au/theses/1674>

This paper is posted at Research Online.

NOTE

This online version of the thesis may have different page formatting and pagination from the paper copy held in the University of Wollongong Library.

UNIVERSITY OF WOLLONGONG

COPYRIGHT WARNING

You may print or download ONE copy of this document for the purpose of your own research or study. The University does not authorise you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site. You are reminded of the following:

Copyright owners are entitled to take legal action against persons who infringe their copyright. A reproduction of material that is protected by copyright may be a copyright infringement. A court may impose penalties and award damages in relation to offences and infringements relating to copyright material. Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.

PSYCHOPHYSIOLOGY OF POSITIVE AND NEGATIVE AFFECT

A thesis submitted in fulfilment of the
requirements for the award of the degree

DOCTOR OF PHILOSOPHY

from

UNIVERSITY OF WOLLONGONG

by

KERRIE WILDE BSc, BEd (Hons), MSc.

DEPARTMENT OF PSYCHOLOGY
1999

UNIVERSITY OF WOLLONGONG

Candidate's Certificate

I certify that the thesis entitled “Psychophysiology of Positive and Negative Affect”, and submitted for the degree of Doctor of Philosophy in Psychology, is the result of my own research, except where otherwise acknowledged, and that this thesis (or any part of the same) has not been submitted to any other university or institution.

Signed _____

Date_____

ACKNOWLEDGEMENTS

*Discovery and exploration imply transcendence,
a going beyond the known, a stretching of one's self toward
new dimensions of skill and competence.*

(Csikszentmihalyi, 1975)

The path of discovery is rarely taken alone. In this respect I would like to acknowledge my sincere gratitude to my supervisor and mentor, Bob Barry. As well as providing academic expertise, Bob supported me with interest, enthusiasm and friendship throughout my research studies. His guidance, good nature and patience were the key to my persistence with this research thesis.

I would also like to thank my husband Stephen Tremble, who encouraged me to step beyond what is comfortable, and my family who gave me the confidence to do so.

ABSTRACT

Based on Fowles' 1980 explanation for the fractionation of the autonomic cardiac and electrodermal measures, this thesis explores the patterns of heart rate (HR) and skin conductance level (SCL) activity accompanying positive and negative emotion. A second aim of this thesis is to explore the psychophysiological changes experienced during challenging adventure activities, and whether these changes reflect changes in state anxiety and self esteem.

A preliminary study carried out on the Ropes Course, an Outdoor Education adventure activity, indicated that participants experienced strong emotional and physiological changes during this activity. Dissociation of HR and blood pressure measures was found in this Study, with only systolic blood pressure reflecting group changes in state anxiety. In the main field studies, children aged 10-12 years participating on a Ropes Course activity were monitored "in situ" for HR and SCL changes using an ambulatory monitor with laboratory levels of precision. Fractionation of the HR and SCL measures was confirmed in the second study, with different HR and SCL response patterns found across the Ropes Course element epochs. In contrast to predictions based on Fowles' (1980) hypothesis, analyses of the physiological and emotion data in Study 3 found that the average HR and SCL levels recorded on the six elements of the Ropes Course differentially reflected levels of negative and positive emotion (respectively). These findings were confirmed in Study 5 after consideration of motility (movement) effects on the HR and SCL measures. Further studies using the Ropes Course activity indicated that increases in self esteem were associated with either higher SCL or lower HR levels during some of the more challenging elements of the Ropes Course. These data imply a relationship between self esteem and the experience of emotion during the successful completion of challenging adventure activities.

In the laboratory, adult students participated in 10 one minute imagery sessions that were used to evoke positive and negative emotions of various intensity. The Positive and Negative Affect Schedule (PANAS; Watson, Clark and Tellegen, 1988) confirmed that students experienced emotions that were significantly different from a baseline state. The NA and PA scores were used to plot each imagery session on the experimental “affective space”. Analyses of the physiological data in both laboratory studies supported the association of HR with negative emotion. The SCL measure was found to be not as responsive under imagery conditions, although greater sensitivity in this measure was found for positive emotion. In the second laboratory study, the PA and NA scores were also used to calculate an arousal, valence and emotion intensity score for each imagery session. Exploratory regression analyses indicated that HR reflected both emotion intensity and arousal emotion characteristics

The field and laboratory studies described in this thesis support linkages of HR with negative emotion and SCL with positive emotion contradicting Fowles’ hypothesis. Together, these studies present a unique and more theoretical approach to the study of emotion. In addition, the field studies illustrate the benefits of psychophysiological research in Outdoor Education and the value of “in situ” monitoring.

OVERVIEW

Influenced by the work of the Laceys (1967, 1970), early studies exploring the psychophysiology of emotion have focused on the physiological patterns accompanying discrete emotion states (e.g., Averill, 1969; Ekman, Levenson & Friesen, 1983). These earlier studies were largely unsuccessful, with only the cardiac system response to anger and fear providing some consistent findings (Schwartz, Weinberger & Singer, 1981; Roberts & Weerts, 1982). Following Gray's (1975) work on emotion systems and his own research in motivation and psychopathology, Fowles (1980) hypothesised that heart rate and skin conductance activity were linked to the activation of the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS) (respectively). This thesis adopted Fowles' (1980) hypothesis as a theoretical platform from which to explore heart rate (HR) and skin conductance level (SCL) changes as a function of positive and negative emotion.

This investigation into the psychophysiology of emotion involved both field and laboratory studies. The first five studies measured the psychological and physiological changes of 10-12 year old child participants on a challenging outdoor activity, the Ropes Course. The Ropes Course forms a major component of a five day primary (elementary) Outdoor Education program offered at the Broken Bay Sport and Recreation Centre near Sydney, Australia. The pilot study, Study 1, demonstrated dissociation between the cardiac measures of heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP). This initial study indicated a relationship between SBP and state anxiety, and more importantly, confirmed that the Ropes Course would be a suitable vehicle for a more detailed investigation into the behavior of psychophysiological measures as a function of positive and negative emotion.

Using an ambulatory monitor, Studies 2 and 3 monitored HR and SCL changes across the six elements of the Ropes Course. Study 2 indicated that the two physiological indices showed fractionation over the elements of the Ropes Course. Study 3 indicated significant physiological changes between the elements, and these changes were found to reflect element differences in positive and negative emotion. In contrast to predictions based on Fowles' hypothesis, the Study 3 findings clearly indicated links of HR with negative emotion and SCL with positive emotion. These findings were confirmed in a separate Study where the effect of movement on the HR and SCL data from the Ropes Course was examined (Study 5).

Illustrating some possible applications of this type of research to Outdoor Education and related areas, two field studies examined the psychological and physiological data for differences associated with participant changes in self esteem (SE). Using the Coopersmith Self Esteem Inventory School Form (Coopersmith, 1981), Study 4 confirmed that participants showed an increase in Total SE and General SE during the period of the Outdoor Education program. Study 5 indicated that participants showing an increase in General SE had recorded lower HR and higher SC levels on the more challenging elements of the Ropes Course than the participants showing a decrease or no change in General SE. These differences were interpreted in terms of their emotional experience on these elements.

Following these findings, two laboratory studies (Study 6 and Study 7) were conducted to confirm the relationship between HR and SCL with negative and positive emotion, using the PANAS scale (Watson, Clark & Tellegen, 1988) to measure positive (PA) and negative affect (NA). Imagery was used to evoke emotions in adult subjects, and the accompanying HR and SCL activity was examined for changes that reflected valence (positive versus negative) and level (high versus low) effects. While the physiological changes measured during the imagery sessions were not as strong as those

obtained on the Ropes Course, the findings from both laboratory studies largely supported the main findings from the Ropes Course. A convincing relationship between HR and negative emotion was demonstrated, while the SCL measure was found to be somewhat sensitive to variation in positive emotion only. A set of multiple regression exploratory analyses carried out on the data from Study 7 suggested that average HR levels reflected emotion intensity and arousal characteristics. In this thesis emotion intensity was introduced to describe the valence strength of an emotion, and like the arousal and valence scores, was calculated using the PA and NA scores.

In summary, the studies described in this thesis present a unique approach to the study of the psychophysiology of emotion. The main findings point to links of HR change with negative emotion and SCL change with positive emotion. Equally important, however, is the successful investigation of emotion using both field and laboratory studies and the novel emotion selection and measurement procedures adopted for the two laboratory studies. These factors will influence future approaches to the study of emotion, and may result in more reliable and consistent outcomes in regard to the physiological data. In addition, the influence of such psychophysiological effects upon the experiential outcomes is of particular interest to the Outdoor Educator. The use of psychophysiological measures in Outdoor Education research may contribute to greater understanding of the links between challenge, emotion, and self esteem, which underpin the objectives of Outdoor Education programs involving adventure activities.

TABLE OF CONTENTS

	PAGE
Candidate’s Certificate ...	i
Acknowledgements ...	ii
Abstract ...	iii
Overview ...	v
Table of Contents ...	viii
Chapter Outline ...	ix
List of Tables ...	xiv
List of Figures ...	xvi
List of Appendices ...	xxii

CHAPTER OUTLINE

Chapter 1.	The Study of Emotion: Inside and Outside the Laboratory	
1.1	General Introduction	1
1.2	Thesis Synopsis	
1.2.1	Background Literature	5
1.2.2	Psychophysiological Changes on the Ropes Course	9
1.2.3	Imagery and Emotion: The Laboratory Studies	13
1.3	Summary	18
Chapter 2.	Fractionation of Autonomic Arousal Measures	
2.1	Introduction	20
2.2	Cardiac and Electrodermal Measures: Physiology and Measurement	
2.2.1	Heart rate	20
2.2.2	Blood Pressure	24
2.2.3	Skin Conductance	25
2.3	Fractionation of Autonomic Measures: HR and SCL	
2.3.1	The General Arousal Theory Questioned	27
2.3.2	Fowles' (1980) Hypothesis	32
Chapter 3.	Psychophysiology of Emotion: Literature Review	
3.1	Introduction	40
3.1.1	The Nature of Emotion	42

3.2 The Psychophysiology of Emotion: Laboratory Studies	45
3.2.1 Early Investigations	46
3.2.2 Multi-modal Recording	50
3.2.3 Short Term and Prolonged Imagery	52
3.2.4 Valence and Arousal Effects: A New Approach	54
3.2.5 Summary	64
3.3 Ambulatory Monitoring	64
Chapter 4. Outdoor Education and the Ropes Course	
4.1 Outdoor Education defined	
4.1.1 Introduction	68
4.1.2 The Notion of Challenge	70
4.1.3 Research in Outdoor Education	74
4.1.4 Summary	78
4.2 The Ropes Course	
4.2.1 The Development of the Ropes Course Activity	79
4.2.2 The Broken Bay Ropes Course	81
Chapter 5. BP, HR and State Anxiety Changes on the Ropes Course	
5.1 Study 1	
5.1.1 Introduction	96
5.1.2 Method	101
5.1.3 Results	102
5.1.4 Discussion	105

Chapter 6.	Psychophysiological Changes Along the Ropes Course	
6.1	General Introduction	110
6.2	Study 2	
6.2.1	Introduction	116
6.2.2	Method	116
6.2.3	Results	119
6.2.4	Discussion	121
6.3	Study 3	
6.3.1	Introduction	122
6.3.2	Method	124
6.3.3	Results	125
6.3.4	Discussion	132
Chapter 7.	Psychophysiological Changes during the Ropes Course: Implications for Self Esteem	
7.1	General Introduction	137
7.2	Study 4	
7.2.1	Introduction	139
7.2.2	Method	142
7.2.3	Results	142
7.2.4	Discussion	145
7.3	Study 5	
7.3.1	Introduction	146
7.3.2	Method	149

	7.3.3 Results	150
	7.3.4 Discussion	173
	7.4 General Summary of Field Studies	181
Chapter 8.	HR and SC Changes Accompanying High and Low Levels of Positive and Negative Emotions evoked through Imagery	
	8.1 Study 6	
	8.1.1 Introduction	188
	8.1.2 Method	196
	8.1.3 Results	198
	8.1.4 Discussion	251
Chapter 9.	HR and SC Changes Accompanying 10 High-Pole Affective States evoked through Imagery	
	9.1 Study 7a	
	9.1.1 Introduction	268
	9.1.2 Method	273
	9.1.3 Results	275
	9.1.4 Discussion	313
Chapter 10	Arousal, valence and emotion intensity characteristics	
	10.1 Study 7b	
	10.1.1 Introduction	325
	10.1.2 Method	332
	10.1.3 Results	332
	10.1.4 Discussion	341

10.2 General Summary of Laboratory Studies	346
10.3 Some Methodological Concerns	349
10.3.1 Emotion Elicitation	350
10.3.2 The Identification and Selection of Emotion	353
Chapter 11 Psychophysiology of Emotion in Review	
11.1 Introduction	356
11.1.1 HR and SCL activity as a Function of Positive and Negative Affect	357
11.1.2 Fowles' Hypothesis Questioned	363
11.2 The Psychophysiology of Emotion: Future Directions	367
Chapter 12 Final Discussion	
12.1 Introduction	372
12.2 Outdoor Education: Psychophysiological Measures and Emotion	373
12.2.1 Outdoor Education and Ambulatory Monitoring	375
12.3 Psychophysiology of Emotion: Implications for other Research Areas	379
12.4 General Conclusion	383
References	386
Appendices	429

LIST OF TABLES

Chapter 4

<u>Table 4.1</u> The Broken Bay Ropes Course-Element length and height at mid-point	88
---	----

Chapter 5

<u>Table 5.1</u> Values of psychological and physiological measures at the two measurement occasions for each group, together with ANOVA outcomes	104
---	-----

Chapter 6

<u>Table 6.1</u> Correlations between HR and SCL values over 29 epochs for individual subjects on the Ropes Course	119
<u>Table 6.2</u> Element descriptor ratings for the six elements of the Ropes Course (n=20)	127
<u>Table 6.3</u> HR and SCL means and SDs (in brackets) for the six elements of the Ropes Course	129

Chapter 7

<u>Table 7.1</u> Study 4 Coopersmith Self Esteem Scores (n=70) for Group 1 (29 boys) and Group 2 (41 girls)	143
<u>Table 7.2</u> Element descriptor ratings for the six elements of the Ropes Course and analysis outcomes	152
<u>Table 7.3</u> Average HR, SCL and MOT levels for the six elements of the Ropes Course	154
<u>Table 7.4</u> Study 5 General SE scores and analyses outcomes for gender effects	160
<u>Table 7.5</u> Study 5 General SE scores for Group 1 (increased in General SE) and Group 2 (decreased in General SE)	162
<u>Table 7.6</u> Study 5 Element descriptor ratings for Group 1 (n=20) and Group 2 (n=12)	164
<u>Table 7.7</u> Study 5 FE and CHW ratings on the six Ropes Course elements for Group 1 and Group 2	166

<u>Table 7.8</u> Study 5 Group effects on HR, SCL and MOT responses across the six elements of the Ropes Course	172
---	-----

Chapter 8

<u>Table 8.1</u> Imagery Session Descriptor Ratings: Ratings on the five descriptors for each imagery session	200
---	-----

<u>Table 8.2</u> Imagery Session PANAS Scores Study	204
---	-----

<u>Table 8.3</u> Study 6 Statistical Outcomes for Analyses Set 1	212
--	-----

<u>Table 8.4</u> Study 6 Statistical Outcomes for Analyses Set 2	224
--	-----

<u>Table 8.5</u> Study 6 Statistical Outcomes for Analyses Set 3	234
--	-----

<u>Table 8.6</u> Study 6 Statistical Outcomes for Analyses Set 4	244
--	-----

Chapter 9

<u>Table 9.1</u> Imagery Session Descriptor Ratings: Ratings on the five descriptors for each imagery session	277
---	-----

<u>Table 9.2</u> Imagery Session PANAS Scores Study 7	280
---	-----

<u>Table 9.3</u> Study 7a Statistical Outcomes for Analyses Set 1	287
---	-----

<u>Table 9.4</u> Study 7a Statistical Outcomes for Analyses Set 2	297
---	-----

<u>Table 9.5</u> Study 7a Statistical Outcomes for Analyses Set 3	304
---	-----

Chapter 10

<u>Table 10.1</u> Average arousal and valence scores with emotion intensity and valence sign for the 10 imagery sessions	335
--	-----

<u>Table 10.2</u> Imagery Session PANAS Scores for the subset of good imagers (n=25)	338
--	-----

<u>Table 10.3</u> Computations for the imagery session arousal, valence and emotion intensity scores (n=25)	339
---	-----

LIST OF FIGURES

Chapter 2

- Figure 2.1 Schematic drawing showing the general arrangement of the autonomic nervous System. From Groves, P.M. and Rebec, G.V. (1992). *Introduction to Biological Psychology*, 4th Ed. (p172). 21

Chapter 3

- Figure 3.1 Fear, sadness, joy and pleasant relaxation presented in an “affective space” defined by the valence and arousal dimensions. Adapted from Witvliet & Vrana, (1995), (p441). 62

Chapter 4

- Figure 4.1 The neutral, positive and negative feedback loops of the risk taking and competence effectance model. Adapted from Priest and Gass, (1997) *Effective Leadership in Adventure Programming*, (pp 55 and 56). 78

- Figure 4.2 A schematic representation of the elements of the Broken Bay Ropes Course. 89

- Figure 4.3a A Ropes Course participant on the Bridge (E1). 90

- Figure 4.3b A Ropes Course participant on the Tyre Walk (E2). 91

- Figure 4.3c A Ropes Course participant on the Spider Web (E3). 92

- Figure 4.3d A Ropes Course participant on the Postmans Walk (E4). 93

- Figure 4.3e A Ropes Course participant on the Flying Fox (E5). 94

- Figure 4.3f A Ropes Course participant on the Exit Ladder (E6). 95

Chapter 6

- Figure 6.1 Schematic diagram showing the Ropes Course element epoch (a-e) location for data collection and analysis. Each epoch represents 4 seconds. 118

- Figure 6.2 Electrodermal and cardiac levels of three representative subjects, shown in order of increasing correlation between the measures. Mean data are shown from each measurement epoch over the elements. 120

<u>Figure 6.3a</u> <u>Fun</u> and <u>excitement</u> ratings for the six Ropes Course elements.	128
<u>Figure 6.3b</u> <u>Challenge</u> , <u>hard</u> and <u>worry</u> ratings for the six Ropes Course elements	128
<u>Figure 6.4a</u> Mean HR levels for elements representing high FE and low FE	131
<u>Figure 6.4b</u> Mean SC levels for elements representing high FE and low FE	131
<u>Figure 6.5a</u> Mean HR levels for elements representing high CHW and low CHW	132
<u>Figure 6.5b</u> Mean SC levels for elements representing high CHW and low CHW	132
Chapter 7	
<u>Figure 7.1</u> Changes in Total SE, General SE, Social SE, Home SE and School SE scores	144
<u>Figure 7.2a</u> <u>Fun</u> and <u>excitement</u> ratings for the six Ropes Course elements	153
<u>Figure 7.2b</u> <u>Challenge</u> , <u>hard</u> and <u>worry</u> ratings for the six Ropes Course elements	153
<u>Figure 7.3 a-c</u> Means of cardiac (a), electrodermal (b) and motility (c) levels on elements representing high FE and low FE	156
<u>Figure 7.4a-c</u> Means of cardiac (a), electrodermal (b) and motility (c) levels on elements representing high CHW and low CHW	157
<u>Figure 7.5a</u> General SE changes for the boys (n=14) and girls (n=18) on the modified Coopersmith SEI	160
<u>Figure 7.5b</u> Lie Scale changes for the boys (n=14) and girls (n=18) on the modified Coopersmith SEI	161
<u>Figure 7.5c</u> General SE changes for Group 1 (n=20) and Group 2 (n=12) on the modified Coopersmith SEI	162
<u>Figure 7.5d</u> Lie scale changes for Group 1 (n=20) and Group 2 (n=12) on the modified Coopersmith SEI	163

<u>Figure 7.6a</u> FE descriptor ratings for Group 1 versus Group 2	165
<u>Figure 7.6b</u> CHW descriptor ratings for Group 1 versus Group 2	165
<u>Figure 7.7a</u> Study 5 HR changes across the Ropes Course for Group 1 and Group 2	167
<u>Figure 7.7b</u> Study 5 SCL changes across the Ropes Course for Group 1 and Group 2	167
<u>Figure 7.7c</u> Study 5 MOT changes across the Ropes Course for Group 1 and Group 2	168
<u>Figure 7.8a</u> Study 5 HR changes across the six Ropes Course elements for Group 1 and Group 2	169
<u>Figure 7.8b</u> Study 5 SCL changes across the six Ropes Course elements for Group 1 and Group 2	169
<u>Figure 7.8c</u> Study 5 MOT changes across the six Ropes Course elements for Group 1 and Group 2	170
 Chapter 8	
<u>Figure 8.1a</u> <u>Fun</u> (F) and <u>excitement</u> (E) descriptor ratings for the 10 high (abbreviated in upper case) and low level imagery sessions	201
<u>Figure 8.1b</u> <u>Challenge</u> (C), <u>hard</u> (H) and <u>worry</u> (W) descriptor ratings for the 10 high (abbreviated in upper case) and low level imagery sessions	201
<u>Figure 8.2</u> PA and NA scores for the 10 imagery sessions plotted in the experiment “affective space”. High level imagery sessions are abbreviated in upper case lettering	203
<u>Figure 8.3a</u> HR changes averaged over the four clusters; high FE, low FE, high CHW and low CHW	211
<u>Figure 8.3b</u> HR changes averaged for the high (high FE + high CHW) and low (low FE + low CHW) clusters	213
<u>Figure 8.3c</u> HR changes averaged for the FE (high FE + low FE) and CHW (high CHW + low CHW) clusters	214
<u>Figure 8.3d</u> HR changes for the high FE, low FE, high CHW and low CHW clusters	215

<u>Figure 8.3d i)</u> HR changes for the high FE, low FE, high CHW and low CHW clusters from a baseline at epoch 4	216
<u>Figure 8.3e</u> SCL changes averaged over the four clusters; high FE, low FE, high CHW and low CHW	217
<u>Figure 8.3f</u> SCL changes averaged for the high (high FE + high CHW) and low (low FE + low CHW) clusters	219
<u>Figure 8.3f i)</u> SCL changes averaged for the high (high FE + high CHW) and low (low FE + low CHW) clusters from a baseline at epoch 5.	219
<u>Figure 8.3g</u> SCL changes averaged for the FE (high FE + low FE) and CHW (high CHW + low CHW) clusters	220
<u>Figure 8.3h</u> SCL changes for the high FE, low FE, high CHW and low CHW clusters	221
<u>Figure 8.3h i)</u> SCL changes for the high FE, low FE, high CHW and low CHW clusters from a baseline at epoch 5	221
<u>Figure 8.4a</u> HR changes for the high FE and low FE clusters	223
<u>Figure 8.4b</u> HR changes for the high CHW and low CHW Clusters	226
<u>Figure 8.4b i)</u> HR changes for the high CHW and low CHW clusters from a baseline at epoch 4	227
<u>Figure 8.4c</u> SCL changes for the high FE and low FE clusters	229
<u>Figure 8.4d</u> SCL changes for the high CHW and low CHW Clusters	230
<u>Figure 8.5a</u> HR changes averaged over the four clusters; high PA, low PA, high NA and low NA	235
<u>Figure 8.5b</u> HR changes averaged for the high (high PA + high NA) and low (low PA + low NA) clusters	236
<u>Figure 8.5c</u> HR changes averaged for the PA (high PA + low PA) and NA (high NA + low NA) clusters	237
<u>Figure 8.5d</u> HR changes for the high PA, low PA, high NA and low NA clusters	234

<u>Figure 8.5d i)</u> HR changes for the high PA, low PA, high NA and low NA clusters from a baseline at epoch 4	238
<u>Figure 8.5e</u> SCL changes averaged over the four clusters; high PA, low PA, high NA and low NA	240
<u>Figure 8.5f</u> SCL changes averaged for the high (high PA + high NA) and low (low PA + low NA) clusters	241
<u>Figure 8.5g</u> SCL changes averaged for the PA (high PA + low PA) and NA (high NA + low NA) clusters	242
<u>Figure 8.5h</u> SCL changes for the high PA, low PA, high NA and low NA clusters	242
<u>Figure 8.6a</u> HR changes for the high PA and low PA clusters	245
<u>Figure 8.6b</u> HR changes for the high NA and low NA clusters	247
<u>Figure 8.6c</u> SCL changes for the high PA and low PA clusters	248
<u>Figure 8.6d</u> SCL changes for the high NA and low NA clusters	250
Chapter 9	
<u>Figure 9.1a</u> <u>Fun</u> (F) and <u>excitement</u> (E) descriptor ratings for the 10 imagery sessions	278
<u>Figure 9.1b</u> <u>Challenge</u> (C), <u>hard</u> (H) and <u>worry</u> (W) descriptor ratings for the 10 imagery sessions	279
<u>Figure 9.2</u> PA and NA scores for the 10 imagery sessions plotted in the experiment “affective space”	281
<u>Figure 9.3a</u> HR changes averaged over the four clusters; high FE, low FE, high CHW and low CHW	288
<u>Figure 9.3b</u> HR changes averaged for the high (high FE + high CHW) and low (low FE + low CHW) clusters	289
<u>Figure 9.3c</u> HR changes averaged for the FE (high FE + low FE) and CHW (high CHW + low CHW) clusters	290
<u>Figure 9.3d</u> HR changes for the high FE, low FE, high CHW and low CHW clusters	291

<u>Figure 9.3e</u> SCL changes averaged over the four clusters; high FE, low FE, high CHW and low CHW	292
<u>Figure 9.3f</u> SCL changes averaged for high (high FE + high CHW) and low (low FE + low CHW) clusters	293
<u>Figure 9.3g</u> SCL changes averaged for the FE (high FE + low FE) and CHW (high CHW + low CHW) clusters	294
<u>Figure 9.3h</u> SCL changes for the high FE, low FE, high CHW and low CHW clusters	295
<u>Figure 9.4a</u> HR changes for the high FE and low FE clusters	298
<u>Figure 9.4b</u> HR changes for the high CHW and low CHW clusters	299
<u>Figure 9.4c</u> SCL changes for the high FE and low FE clusters	301
<u>Figure 9.4d</u> SCL changes for the high CHW and low CHW clusters	302
<u>Figure 9.5a</u> HR changes for the high pole PA and low pole PA clusters	305
<u>Figure 9.5b</u> HR changes for the high pole NA and low pole NA clusters	307
<u>Figure 9.5c</u> SCL changes for the high pole PA and low pole PA clusters	309
<u>Figure 9.5d</u> SCL changes for the high pole NA and low pole NA clusters	311

Chapter 10

<u>Figure 10.1</u> The relationship between arousal, valence and emotion intensity as represented on an “affective space”. The two case examples of “high fun” and “low worry” were taken from Study 6	330
<u>Figure 10.2</u> The 10 imagery sessions plotted in an affective space (n=50) defined by the PA and NA axes, and the arousal and valence dimensions	333

LIST OF APPENDICES

<u>Appendix 1</u>	School form Spielberger State-Anxiety Inventory (STAI, 1991)
<u>Appendix 2</u>	Study 1 HR, SBP, DBP and state anxiety scores
<u>Appendix 3</u>	Study 2 HR and SCL means over 29 epochs for six subjects
<u>Appendix 4</u>	Element Ratings Questionnaire
<u>Appendix 5</u>	Study 3 Element Ratings data
<u>Appendix 6</u>	Study 3 HR and SCL data
<u>Appendix 7</u>	Study 3 Statistical outcomes
<u>Appendix 8</u>	The Coopersmith Self Esteem Inventory (SEI) School Form (Coopersmith, 1981)
<u>Appendix 9</u>	Study 4 Self Esteem scores
<u>Appendix 10</u>	Study 4 Statistical outcomes
<u>Appendix 11</u>	AMSO3 printout for one subject
<u>Appendix 12</u>	Study 5 Element Ratings data
<u>Appendix 13</u>	Study 5 HR, SCL & MOT raw data
<u>Appendix 14</u>	Study 5 Statistical outcomes
<u>Appendix 15</u>	The PANAS Questionnaire (Watson, Clark & Tellegen, 1988)
<u>Appendix 16</u>	Study 6 Ratings and PANAS raw data
<u>Appendix 17</u>	Study 6 HR and SCL raw data
<u>Appendix 18</u>	Study 6 Statistical outcomes
<u>Appendix 19</u>	Bett's Questionnaire Upon Mental Imagery (QMI) (Sheehan, 1967)
<u>Appendix 20</u>	Study 7a Ratings, PANAS and QMI scores
<u>Appendix 21</u>	Study 7a HR and SCL raw data
<u>Appendix 22</u>	Study 7a Statistical outcomes
<u>Appendix 23</u>	Arousal, valence and emotion intensity score calculations for "anxious"
<u>Appendix 24</u>	Study 7b average HR and SCL scores and statistical outcomes

CHAPTER 1

The Study of Emotion: Inside and Outside the Laboratory

1.1 GENERAL INTRODUCTION

In Outdoor Education programs participants are exposed to a number of challenging adventure activities set in an outdoor environment. For the most part, successful participation in these activities is not related to physical ability, but rather the ability to face and successfully deal with a challenging situation. According to Outdoor Education theorists, if the activity presents the participant with a certain level of challenge, and this challenge is overcome, participants will re-evaluate their own capabilities in a more positive light (O'Brien, 1989; see also Smith, Roland, Havens & Hoyt, 1992; Priest & Gass, 1997). This positive re-evaluation can contribute to positive changes in self esteem and the overall personal and social development of the participant (Coopersmith, 1975; Humberstone, 1990). The question remains as to what sort of psychological and physiological changes take place during these activities, and their relation to the emotional and self esteem changes reported by the participants.

The changes in the emotional state of participants during these sorts of activities has been reported by many Outdoor Education staff and theorists (e.g., Mortlock, 1984; Nettleton & Dickinson, 1989; Ewert, 1989), and recorded in a number of recent studies relying on self-report questionnaires (Dickinson, 1989; Neill & Heubeck, 1995b; see review in Neill, 1997). Research monitoring psychophysiological changes during the activities is limited, yet such changes taking place during the activities could provide the most valuable information for the Outdoor Education practitioner. For example, this information could benefit the design and facilitation of Outdoor Education activities, and it could also encourage a more scientific approach to the justification and evaluation

of Outdoor Education programs.

There has been little research monitoring psychophysiological changes during challenging adventure activities due to two factors. The first factor relates to the practical difficulties associated with conducting research in an outdoor environment and the availability of ambulatory monitoring equipment able to monitor and store data with scientific levels of precision (Ewert, 1987). The psychophysiological literature documents a number of parachute studies carried out by the defence force laboratories in the United States (Fenz & Epstein, 1967; Reid, Doerr, Doshier & Ellertson, 1971) that attempted to provide "in situ" measures. These studies examined cardiac, respiration and electrodermal levels of military parachutists monitored at specified points prior to and after the jump. These physiological data were examined for novice and expert differences, and provided valuable information for the training of parachutists. A study reported in the psychophysiological literature by Lewis, Ray, Wilkinson and Ricketts (1984) examined cardiac activity and anxiety levels of participants on a Zip-wire, an element typically found on a Ropes Course. Encouraged by the work of Nettleton and Dickinson (1989), other recent research studies in Outdoor Education are now attempting to monitor emotional changes at various stages of the adventure activity (e.g, Dickinson, 1997; Maynard, MacDonald & Warwick-Evans, 1997). The small number of these studies, most of which rely on monitoring cardiovascular changes only before and immediately after the activity, reflects the practical considerations and equipment limitations for conducting this type of research in Outdoor Education.

The second factor underlying the lack of psychophysiological research in Outdoor Education is the selection of suitable physiological indices to monitor the changes in emotion, and the ability to interpret and understand these physiological changes as related to challenging activities. In more simple terms, what measures should

be used and what do they mean? As mentioned above, research studies of challenging activities have largely relied on monitoring only cardiac activity. Laboratory studies investigating the psychophysiology of emotion have demonstrated links between cardiac measures (e.g., heart rate and blood pressure) with negative emotions such as fear and anger (Schwartz, Weinberger & Singer, 1981; Roberts & Weerts, 1982). Evidence of elevated HR levels accompanying positive emotions (Averill, 1969) and the lack of any consistent or reliable findings in electrodermal measure changes (e.g., de Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993) indicate that the study of autonomic changes as a function of different types of emotions is far from conclusive. As concluded in a number of papers (e.g., Wagner, 1989; Witvliet & Vrana, 1995), the study of the psychophysiology of emotion is in its developmental stages, although it is likely that with attention to methodological concerns and increased collaboration between researchers in this area, more reliable and consistent findings will emerge.

It is evident in the emotion literature that study of the psychophysiology of emotion has not been theoretically based. Early studies simply monitored autonomic changes accompanying discrete emotional states such as fear, worry, excitement and joy (Ax, 1953; Funkenstein, King & Drolette, 1954; Ekman, Levenson & Friesen, 1983). Influenced by the work of Gray (1975), Fowles (1980) put forward an explanation for the fractionation of two measures, heart rate (HR) and skin conductance level (SCL), as a function of two motivational systems: the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS). Fowles (1980) proposed linkages of the BAS with HR and the BIS with SCL. This proposal held implications for the study of the psychophysiology of emotion since the work of Gray (Gray, 1975; 1976) and other emotion theorists (e.g., Tellegen, 1985, Larsen & Ketelaar, 1991; see also Fowles, 1993) supported an association of the BAS and the BIS with positive and negative emotions respectively. Fowles' hypothesis therefore provided a theoretical position from which to investigate HR and SCL activity as a function of positive and negative emotion.

The following empirical investigation of the psychophysiology of emotion involved seven studies conducted in both laboratory and "real-life" environments. Five of these studies monitored psychological and/or physiological changes of child participants on a Ropes Course activity. As indicated by emotion descriptor ratings, this activity evoked strong levels of positive and negative emotions, and these were related to significant changes in the physiological measures monitored during the activity. The physiological measures were examined for significant changes that reflected the presence of positive or negative emotions. The data gathered from these studies also provided detailed psychophysiological profiles of Ropes Course participants, and evidence of differing physiological patterns relating to group differences in regard to changes in state anxiety and self esteem.

The two studies carried out in the laboratory used imagery to evoke positive and negative emotions. The emotions elicited during the imagery sessions were monitored using rating scales of emotion descriptors and a standardised questionnaire, the Positive Affect and Negative Affect Schedule (PANAS, Watson, Clark & Tellegen, 1988). According to Watson and his colleagues (e.g., Watson & Tellegen, 1985; Watson, Clark & Tellegen, 1988), Positive Affect (PA) and Negative Affect (NA) can be used to describe one's pleasurable or unpleasurable engagement with the environment. As in the Ropes Course studies, HR and SCL data were examined for changes that reflected the presence of positive and negative emotions. Analyses of the data collected in the second laboratory study also examined whether HR and SCL changes reflected valence, arousal and emotion intensity characteristics, thereby incorporating the most recent approach to the study of the psychophysiology of emotion.

Before the experimental hypothesis and other details for each of the seven studies are addressed in detail, it is important to understand the benefits of conducting research such as this in Outdoor Education and other related fields such as Sport

Psychology. This research carried out on the Ropes Course activity provided psychophysiological and emotional profiles of participants across this activity, and this information is invaluable to both the psychophysiological and the Outdoor Education practitioner. For example, the Ropes Course activity provided a unique opportunity to study emotion, as it evoked strong levels of both positive and negative emotions under more natural circumstances than in the laboratory environment. Also, during this activity, the physiological changes accompanying these emotions could be monitored with minimal intrusion, and the data stored for later analysis. For the Outdoor Education practitioner, information gained from these psychophysiological studies, particularly those incorporating self esteem and anxiety changes, provides data crucial to the design and implementation of such activities, as well as to the overall justification of Outdoor Education programs. In summary, research studies carried out on adventure activities such as the Ropes Course may help clarify the physiological responses accompanying different emotions, while providing scientific evidence of the types of psychophysiological changes that occur during these adventure activities.

1.2 THESIS SYNOPSIS

1.2.1 Background Literature

There is ample evidence that the Autonomic Nervous System (ANS) is capable of a number of different patterns of activation. Support for this notion has been found in the neural structure of the ANS (Groves & Rebec, 1992), the neurochemistry of the ANS (see Wagner, 1989) and of course empirical findings (e.g., Lacey, Kagan, Lacey & Moss, 1963; DiCara & Miller, 1968). Chapter 2 provides a brief description of the ANS, and the physiology underlying cardiac (HR; systolic blood pressure, SBP; diastolic blood pressure, DBP) and electrodermal (SCL) measures. The differing patterns of behavior and association between these measures is discussed with reference to studies

in a number of areas, such as environmental intake/rejection (Lacey, 1967), cardiac-somatic coupling (Elliot, 1974; Obrist, Lawler & Gabelein, 1974) and the body of research examining the psychophysiology of emotion (e.g., Ax, 1953; Funkenstein King & Drolette, 1954, Roberts & Weerts, 1982; Ekman, Levenson & Friesen, 1983). While the studies of emotion demonstrated differing patterns of behavior for the HR and SCL measures, the question remains as to whether these patterns are reliably associated with different emotions, or different groups of emotions.

Based on two motivational systems described by Gray (1975), the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS), Fowles (1980) provided a theoretical explanation for the fractionation of HR and SCL. Fowles postulated linkages between cardiac and electrodermal levels with the respective activation of the BAS and the BIS. Chapter 2 describes in detail the theoretical perspective underlying Fowles' hypothesis, and presents some findings in the motivation and incentive effects literature that either supports (e.g., Fowles, Fisher & Tranel, 1982) or doesn't support (e.g., Sosnowski, Nurzynska & Polec, 1991) Fowles' hypothesis. This chapter also provides information concerning the nature of the BAS and BIS, and their association with Positive Affect (PA) and Negative Affect (NA) respectively (e.g., Larsen & Ketelaar, 1991). As mentioned earlier, PA and NA refer to one's pleasurable or unpleasurable engagement with the environment, and therefore are linked to the presence of positive and negative emotions respectively. This association between the activation systems and the presence of positive or negative emotions supports the use of Fowles' hypothesis as a base from which to investigate patterns of HR and SC activity as a function of emotion.

Fowles' work can be linked to a number of research studies examining the psychophysiology of emotion. These studies have identified different patterns of physiological activity, in particular in the cardiovascular measures, that reflect different

emotional states. A detailed discussion of the methodological developments and results from a number of these studies are presented in Chapter 3. For example Chapter 3 describes the pioneering studies of Ax (1953), Funkenstein, King and Drolette (1954) and their colleagues who used rudimentary experimental techniques to study the physiological responding in strong emotions such as anger and fear. Reflecting advances in methodological developments, research studies during the 1960s and 1970s used film and imagery to induce a broader range of emotions (Sternbach, 1962; Averill, 1969; Schwartz, Weinberger & Singer 1981, Roberts & Weerts, 1981) These studies reported mixed success, with only the cardiovascular measures accompanying anger and fear proving consistent. With further improvements in recording technology, later studies involving multimodal recording (e.g., Ekman, Levenson & Friesen, 1983; Sinha, Lovallo & Parsons, 1992) were more successful and marked a resurgence of interest in the psychophysiology of emotion. Psychophysiological studies carried out over the last decade have again focused on methodological concerns and improvements to data treatment and analyses (e.g., Vrana, 1993; De Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993). A number of these studies have been influenced by the emotion literature (Watson & Tellegen, 1985), reflecting interest in the valence and arousal characteristics of emotions (e.g., Lang, Greenwald, Bradley & Hamm, 1993; Johnsen, Thayer & Hugdahl, 1995; Witvliet & Vrana, 1995).

Chapter 3 also details a small number of ambulatory studies that monitored physiological changes accompanying emotions such as anxiety and stress experienced outside the laboratory environment. For example, subjects in these studies were monitored while parachuting (Fenz & Epstein, 1967; Reid, Doerr, Doshier & Ellertson, 1971), riding a Zip-wire (also termed a Flying-Fox) (Lewis, Ray, Wilkinson & Ricketts, 1984), presenting a speech to classmates (Matthews, Manuck & Saab, 1986) or simply going about their daily lives (James, Yee, Harshfield, Blank & Pickering, 1986). Studies such as these highlight the benefits of studying genuine emotions elicited during "real-

life" activities, due to the elicitation of strong and pure emotions that are accompanied by marked physiological responding at different stages of the activity.

Four studies in this thesis monitored the psychophysiological changes of children participating on a Ropes Course activity. The Ropes Course activity forms an important component of the week-long Outdoor Education program conducted at the Broken Bay Sport and Recreation Centre near Sydney, Australia. The Broken Bay Centre is one of 12 centres run by the New South Wales (NSW) state Department of Sport and Recreation that attract school groups from all areas of NSW. A number of private schools (e.g., Knox Grammar, SCEGGS Redlands) and private organisations run similar Outdoor Education programs for school groups to satisfy curriculum requirements. Approximately 160 children aged 10-12 years attend the program each week at Broken Bay throughout the school year.

Chapter 4 provides the reader with information concerning the nature of Outdoor Education and, given the numbers of children participating in these programs, addresses the importance and value of research activities exploring the strong psychological changes and processes that take place during Outdoor Education activities. This chapter outlines the work of Nettleton and Dickinson (1989) who attempted to provide a "psychological or emotional" profile of participants involved in adventure activities using data gathered during the activity itself. Their investigative research, presented at National Outdoor Education conferences held bi-annually over the last decade, heralded a new interest in the effects of individual activities on participants involved in Outdoor Education programs in Australia. The Broken Bay Ropes Course is described in detail and the aims and objectives for this activity, as applied to an educational context, are also listed in that chapter.

1.2.2 Psychophysiological Changes on the Ropes Course

As mentioned earlier, four studies described in this thesis examined the psychophysiological changes of child participants on the Broken Bay Centre Ropes Course activity. The location of this activity at the camp, along with the availability of suitable monitoring equipment, enabled the collection and storage of cardiac and electrodermal measures to be carried out with laboratory levels of precision. Analyses of these physiological confirmed that the Ropes Course activity elicited strong levels of emotion and resulted in significant cardiovascular changes. Different patterns of HR and SCL activity were also identified during the Ropes Course activity, suggesting that it provided a unique environment to study the fractionation of these two measures as a function of emotion.

Chapter 5 presents the findings from the first study carried out on the Ropes Course. This small study was carried out to test whether emotional and physiological changes could be monitored along the Ropes Course during the normal course of the lesson, and to identify any practical concerns associated with the monitoring process in this challenging environment. Using a portable automatic sphygmomanometer, the study investigated the use of systolic blood pressure, diastolic blood pressure and heart rate measures as indices of state anxiety. The child subjects were grouped according to the direction of change in state anxiety over the first four elements of the Ropes Course, as indicated by the Spielberger State Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1970). Dissociation of the cardiovascular measures was demonstrated. Each of the cardiovascular measures was tested for differences reflecting the group changes in state anxiety. It was found that only systolic blood pressure reflected group differences in the change in state anxiety.

Study 1 provided evidence of cardiac changes along the Ropes Course, even

though sampling was restricted to two Ropes Course platforms accessible by ladder. The use of the sphygmomanometer under these experimental conditions was limited and only provided information concerning cardiac activity. The second study in the Ropes Course used the recently developed Heart Rate and Galvanic Skin Response Monitor (HGM1) (Barry, Moroney, Orlebeke & de Vries, 1991) to continuously monitor and store HR and SCL during the Ropes Course attempt.

Chapter 6 describes the use of the HGM1 and the investigation of HR and SCL changes in relation to significant differences in positive and negative emotions experienced on the Ropes course. In a preliminary study, Study 2, HR and SCL were averaged for 29 five second epochs spread over the six elements of the Ropes Course. The data for six subjects established that HR/SCL fractionation did occur on the Ropes Course. In Study 3, 20 child subjects were monitored for HR and SCL changes and were administered an Element Ratings Questionnaire. This questionnaire was used to identify the differences between the individual elements for the descriptors challenge, hard, worry, fun and excitement. Elements were grouped according to significant differences in challenge/hard/worry (CHW) and fun/excitement (FE). Based on Gray's (1975) description of the BIS and the BAS, and the description of NA and PA provided by Watson and his colleagues (Watson and Tellegen, 1985, Larsen & Ketelaar, 1991) the two groups of descriptors (CHW and FE) were taken to imply differential involvement of the BIS and the BAS.

The HR and SCL data from Study 3 were analysed for linkages with the BAS and BIS as hypothesised by Fowles (1980). The results showed that, contrary to predictions based on Fowles' hypothesis, the HR measure discriminated between elements eliciting significantly different levels of challenge, hard and worry, while the SCL discriminated between elements eliciting significant differences in fun and excitement. These data questioned Fowles' hypothesis as it applied to a challenging

environment, and instead suggested linkages between HR and NA and between SCL and PA .

In Study 4, changes in self esteem of children attending the five day Outdoor Education program at Broken Bay Centre were examined. The Coopersmith Self-esteem Inventory (Coopersmith, 1981) was used to determine the change in total self esteem (Total SE) and for the General SE, Home SE, Social SE, School SE, Lie SE subscales of the child subjects over the five day Outdoor Education program. This preliminary study, involving 70 children, found significant increases in Total Self Esteem and for the General SE and Home SE subscales.

Extending on Study 3 findings, Study 5 examined the psychophysiological changes experienced during the Ropes Course activity, and whether these changes reflected changes in self esteem. As outlined in Chapter 7, the aims of this final study on the Ropes Course were to test some of the findings in Study 3 in relation to movement effects, and to illustrate the applicability and benefits of psychophysiological research to some important aspects of Outdoor Education. The availability of an updated version of the HGM1 (AMS03) enabled Motility levels to be measured and stored for later analyses regarding the effect of movement on HR and SCL changes.

Similar to Study 3, analyses in Study 5 compared the HR and SCL averages on the elements identified as significantly high and low in CHW and FE. The results confirmed linkages between SCL and positive emotion (FE) and HR with negative emotion (CHW), with one exception. Significantly higher HR levels were recorded on the Flying Fox (**high FE**) than the Bridge and Exit Ladder elements (**low FE**). While this finding in HR is in the same direction as that obtained in Study 3, the HR level difference between the elements representing high and low FE was not significant in Study 3. In regard to the motility data, significantly larger motility levels were recorded

on the **high CHW** elements than the **low CHW** elements, but additional analyses with motility as the covariate confirmed the significant result in the HR measure described earlier. The significant difference in motility for the FE elements was in the opposite direction to the HR and SC levels, with larger motility levels found for the low FE elements. In summary, the findings on the motility data indicated some variation in HR due to motility effects, however, these effects did not over-ride the effect of emotion in either the HR or SCL measures.

The emotion ratings and physiological data in Study 5 were tested for differences that related to changes in self esteem. Using a slightly modified Coopersmith SEI (Coopersmith, 1981) subjects were grouped according to whether they increased in General SE (Group 1) or decreased/showed no change in General SE (Group 2). Analyses of the descriptor ratings data showed that there were no group (Group 1 versus Group 2) differences in the FE or CHW descriptor ratings for any of the six Ropes Course elements. In contrast, group differences were obtained in the physiological response recorded across the Tyre Walk, Spiders Web and Postmans Walk elements. Group 1 showed a significantly larger SCL increase on the Postmans Walk while Group 2 recorded a significantly stronger HR increase on the Tyre Walk and Postmans Walk. Based on previous results in the physiological data, one interpretation of these findings is that they reflected the higher levels of positive emotion and negative emotion experienced by Group 1 and Group 2 (respectively) during the more challenging elements of the Ropes Course.

Together, the four studies on the Ropes Course confirmed different patterns of HR and SCL activity reflecting changes in positive and negative emotion. Study 3 showed linkages of HR with negative emotion and SCL with positive emotion. In light of the unexpected finding in the HR measure for the FE elements in Study 5, the complete acceptance of the HR and SCL measures as indices of NA and PA levels

respectively was questioned, and further research activity exploring the behavior of these measures under more controlled circumstances was commenced. With consideration to concurrent developments in laboratory studies examining emotional states (e.g., Sinha, Lovallo & Parsons, 1992; Vrana, 1993), investigation of the psychophysiology of emotion was continued in the laboratory, where imagery was used to evoke emotional states similar to that reported by the Ropes Course participants.

1.2.3 Imagery and Emotion: The Laboratory Studies

As illustrated in Chapter 3, the developments in the study of the psychophysiological of emotion are paralleled by technological changes and developments in the theoretical approach to the study of emotion. Emotion studies carried out outside the laboratory incurred difficulties associated with the nature of the environment and the availability of suitable portable scientific precision monitoring equipment. Laboratory based studies of emotion encountered other problems relating to the induction of emotion, the verification of the presence of specific emotions, the intensity of these emotions, sampling of the emotions (time intervals chosen) and baseline information. It is believed that problems such as these are largely responsible for the limited success of studies examining the psychophysiology of emotion (Wagner, 1989).

The induction and identification of the presence of genuine emotion in the laboratory environment is itself challenging. On the Ropes Course, subjects gave clear behavioral signs indicating their experience of strong emotions (e.g., shaking, crying, smiling). Unable to resort to the unethical shock techniques used by Ax and his colleagues (Ax, 1953; Funkenstein, King & Drolette, 1954) during the early emotion studies, subsequent laboratory based studies of emotion have relied on imagery, picture and film methodology to evoke emotions (e.g., Averill, 1969; Ekman, Levenson &

Friesen, 1983; Lang, Greenwald, Bradley & Hamm, 1993). While self-report has been traditionally used to identify the types of emotion experienced, it is difficult to control the emotions experienced by subjects, and to pinpoint the timing of specific emotions. For example, a subject instructed to imagine a joyous situation may have imagined an exam situation in which the final result was good. While an overall sense of joy is reported by the subject, the subject may have experienced a different type of emotion (e.g., anxiety) during the course of imagery. The intensity or level at which the emotions are experienced would also impact on the accompanying physiological activity. These factors were taken into consideration in the two laboratory studies undertaken in this thesis to examine HR and SC changes accompanying positive and negative emotional states.

The first laboratory study described in Chapter 8 investigated HR and SCL changes accompanying different emotions evoked by imagery. Five descriptors challenge, hard, worry, fun and excitement were used to direct subjects to imagine situations that evoked high and low levels of positive and negative emotions. Similarly to the usage on the Ropes course studies, these five descriptors were explored in a simple questionnaire to determine those imagery sessions representative of a positive or negative emotional experience. The PANAS questionnaire (Watson, Clark & Tellegen, 1988) provided a standardised score in regard to Positive Affect (PA) and Negative Affect (NA) for each of the ten imagery sessions.

Using the descriptor ratings and the PA and NA scores, two different groups of imagery session clusters were selected, representing high and low levels of positive and negative emotions (**high CHW, low CHW, high FE, low FE and high NA, low NA, high PA, low PA**). HR and SCL changes were tested for differences between the imagery session clusters for the time (epoch 1 to epoch 12), level (high versus low) and valence (positive versus negative) factors using four sets of analyses. These analyses

confirmed heightened physiological activity for the "high level" imagery sessions, and a significant HR difference between the high and low level clusters. A significant level X time interaction was observed in both the CHW and NA clusters across the entire imagery period (epoch 0 to epoch 12) and for the HR deceleration phase described between epoch 4 and epoch 12. The PANAS questionnaire confirmed that the imagery evoked significantly different subjective emotional states and suggested that, with the use of stronger emotions, further investigation of the psychophysiology of emotion using imagery was warranted.

While differences in the physiological measures were observed between the high and low level imagery sessions, the physiological measures were not sensitive to the valence characteristics of the emotional states examined. Presented in Chapter 9, the second laboratory experiment, Study 7, paid special attention to imagery methodology and the experimental procedure to encourage greater physiological responding. This study examined HR and SCL changes accompanying 10 different high-pole and low-pole PA and NA states elicited in the laboratory using imagery methodology. In addition to the five descriptors of challenge, hard, worry, fun and excitement, a further five: anxious, distress, calm, drowsy and enthusiasm were adopted in this final study. The additional five descriptors were selected from the emotion literature (Watson & Tellegen, 1985), which identified them with the extreme ends of the NA and PA dimensions. Subjects were instructed to imagine themselves physically involved in the situation to increase physiological responding (Lang, Kozak, Miller, Levin & McLean, 1980) and to provide a closer similarity to the types of emotions elicited on the Ropes Course.

Similarly to Study 6, imagery sessions were grouped into clusters and explored for differences reflecting the time, level and valence factors. A first set of analyses confirmed stronger physiological activity than in the previous laboratory study, with

higher HR and SCL levels that peaked 40 and 30 seconds respectively into the imagery period. Significant level differences in HR were found in the CHW clusters although there were no significant level differences in the SCL measure for either the FE or CHW clusters. The third set of analyses tested for HR and SCL differences between imagery session clusters that differed in PA and not NA, and in NA and not PA, thus controlling secondary emotion effects. This analyses confirmed significant differences in HR level between the **high NA** and **low NA** clusters and a weaker HR difference for the **high PA** and **low PA** clusters. Only the PA clusters produced a difference in the SCL measure that approached significance.

Chapter 10 describes additional analyses carried out on the Study 7 data (Study 7b). In these final analyses, the PA and NA scores were used to compute an arousal, valence and emotion intensity score for each of the 10 imagery sessions. The term emotion intensity was introduced to describe the degree to which a person felt emotional, irrespective of the positive or negative characteristics of the emotions experienced. The study of the physiological changes as a function of the valence and arousal characteristics of groups of emotions has been explored in concurrent research studies (e.g., Witvliet & Vrana, 1995; Johnsen, Thayer & Hugdahl, 1995). These studies reflect the new approach to the study of emotion based on the identification of discrete emotional states in an affective space defined by arousal and valence dimensions (Watson & Tellegen, 1985). While past studies have relied on subject ratings to identify valence and arousal levels (e.g., Lang, Greenwalk, Bradley & Hamm, 1993), this study adopts a unique geometrical approach (described in Chapter 10) using the PA and NA scores to compute a valence, arousal and emotion intensity score, thus providing a more objective measure of these emotion characteristics. Correlation analyses confirmed the statistical independence of the arousal, valence and emotion intensity dimensions.

A series of multiple regression analyses performed on the HR and SCL averages

for each imagery session with the arousal, valence and emotion intensity scores as predictors indicated a relationship between HR and emotion intensity, and to a lesser extent with arousal. These exploratory analyses failed to show any significant results in the SCL measure. The same analyses was repeated on the data for a subset of subjects (n=25) who scored relatively high on a test of imagery vividness (Sheehan, 1967). The results for the relatively good imagers largely reflected the findings obtained for the total subject group.

Similarly to the studies on the Ropes Course, the laboratory studies provided some consistent findings in the HR measure for the negative clusters (CHW and NA). Results in Study 7b suggested that this measure may also be sensitive *to* emotion intensity and arousal effects. This would explain the elevated HR levels for the high level FE and CHW imagery sessions in Study 6 and Study 7, and the higher HR levels found on the elements representing **high FE** in Study 3 and Study 5. The lack of significant differences in the SCL measure in the laboratory studies is consistent with other research (e.g., De Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993) and is perhaps a result of imagery methodology. Issues regarding the use of imagery to evoke emotion and other problems associated with the study of emotion in the laboratory are discussed in Chapter 10.

Chapter 11 provides a detailed discussion of the findings across the seven studies in regard to the behaviour of the HR and SCL measures as a function of positive and negative emotion. The final chapter of this thesis, Chapter 12, provides a brief overview of the main findings in this thesis. The discussion also draws attention to the benefits associated with the use of both field and laboratory studies to investigate HR and SCL as a function of emotion, as demonstrated in these studies. Based on these experimental findings, some recommendations regarding future research activity in the psychophysiology of emotion and Outdoor Education fields are discussed.

1.3 SUMMARY

In summary, the aim of this thesis was two-fold. The first aim was to provide an explanation for the fractionation of HR and SCL activity as a function of positive and negative emotion. The second aim was to demonstrate the benefits of psychophysiological research outside the laboratory in areas such as Outdoor Education and Sport Psychology. As demonstrated in the studies involving the Ropes Course activity, these two aims are closely related, and research examining psychophysiological changes of participants involved in challenging activities provides a unique context in which to examine the autonomic activity accompanying strong positive and negative emotions.

The first study on the Ropes Course was used to confirm the presence of significant levels of emotion and physiological changes along the Ropes course, and the suitability of this outdoor activity for the use of ambulatory monitoring. In the light of Fowles' hypothesis concerning electrodermal and cardiac measure fractionation, Studies 2 and 3 examined HR and SCL changes along the Ropes Course. These changes were examined for differences reflecting positive and negative emotions. Extending on Study 3, Study 5 carried out on the Ropes Course monitored the psychophysiological changes of two groups of subjects that differed in the direction of self esteem change. This study re-examined the main findings from Study 3, and illustrated the benefits of conducting psychophysiological research in Outdoor Education activities.

Compared to the studies carried out on the Ropes Course, the laboratory studies using imagery to evoke emotions did not obtain equivalent levels of physiological changes for the HR and SCL measures. However, using the PANAS questionnaire these studies enabled the more accurate detection of different affective states, and in Study 7b, the calculation of arousal, valence and emotion intensity scores for each of the 10

imagery sessions. While influenced by the types of emotions experienced on the Ropes Course, the approach to the study of emotion used in the laboratory studies also incorporated the most recent developments described in the emotion literature concerning arousal/valence models of emotion (Witvliet & Vrana, 1995). The use of both laboratory and "real-life" environments for this investigation of the psychophysiology of emotion provided some interesting and convincing results that have not been obtained in the more traditional laboratory studies. Together, these seven studies present a unique and more theoretically based approach to the study of the psychophysiology of emotion. Along with other concurrent research developments along this line (e.g., Witvliet & Vrana, 1995) these data are expected to influence future research activities in this area.

In regard to Outdoor Education activities, the set of studies conducted on the Ropes Course strengthens our understanding of the magnitude and types of psychological and physiological changes that occur during these sort of activities. The studies clearly illustrated the depth of knowledge to be gained from monitoring psychophysiological changes during challenging adventure activities, and the value of conducting further research activities employing a number of evaluative measures. The success of the monitoring program employed on the Broken Bay Ropes Course activity should encourage more quantitative and "scientific" research activities in Outdoor Education. In addition to the anecdotal and qualitative research studies, psychophysiological research activities could provide strong confirmation of the significant affective and personal developmental changes that take place with participation in Outdoor Education activities.

CHAPTER 2

Fractionation of Autonomic Arousal Measures

2.1 INTRODUCTION

The popular use of the autonomic measures of heart rate, blood pressure and skin conductance stems from their relative ease of measurement and their general acceptance as indices of arousal. The main features of the autonomic nervous system and detailed descriptions of the electrodermal and cardiac measures are addressed in detail in a number of psychophysiology texts (e.g., Martin and Venables, 1980; Coles, Donchin & Porges, 1986; or for a more simplified account, Andreassi, 1989; see also Figure 2.1). The following discussion will briefly describe the innervation and measurement of tonic aspects of the cardiac (heart rate and blood pressure) and electrodermal (skin conductance level) systems. The second part of this chapter examines research areas that have demonstrated different response activity for the autonomic measures, in particular for the electrodermal and cardiac measures. Fowles' (1980) explanation for this fractionation phenomenon involving two measures, HR and SCL, is also addressed in detail.

2.2 CARDIAC AND ELECTRODERMAL MEASURES: PHYSIOLOGY AND MEASUREMENT

2.2.1 Heart Rate

The role of the heart is analogous to that of a double pump, responsible for the transportation of oxygenated blood via arteries to the body's tissues and the removal of deoxygenated blood via the body's veins. The deoxygenated blood is transported to the

Figure 2.1 Schematic drawing showing the general arrangement of the autonomic nervous system: sympathetic projections (solid lines) and parasympathetic projections (broken lines) to lower parts of the brain (the projections from the hypothalamus to the pituitary gland are omitted); portions of the brain stem and sacral region of the spinal cord from which the preganglionic parasympathetic fibres leave (shaded area); cranial nerves (Roman numerals); sympathetic outflow from the thoracic and upper lumbar regions (labelled); autonomic fibres to organs of the head and trunk (right hand side); and the sympathetic outflow to blood vessels, sweat glands and smooth muscle fibres attached to hairs (left hand side). From Groves, P.M. and Rebec, G.V. (1992).

Introduction to Biological Psychology, 4th Ed. (p.172).

Please see print copy for image

lungs for oxygenation, before returning to the heart to begin its journey again. Stroke volume refers to the volume of blood ejected from the heart at each contraction. Heart rate (HR) describes the inverse of the interbeat interval, the time interval between consecutive ventricular contractions as commonly measured using the R-wave of the Electrocardiogram (EKG or ECG). The efficiency of the cardiac system is influenced by two factors, the energy supplied to the system via the heart in its capacity as a pump and the peripheral resistance encountered during blood transportation. Both stroke volume and heart rate have been used as indices of cardiac efficiency (Siddle & Turpin, 1980).

The usual positive relationship between heart rate, stroke volume and cardiac output does not necessarily always occur. Similar changes in heart rate under different behavioral and physiological conditions have been observed (see Siddle & Turpin, 1980). In addition, depending on the overall state of the cardiovascular system, dissociation between heart rate and other closely related cardiac measures (e.g., blood pressure) can occur under various conditions such as strong emotion (e.g., Schwartz, Weinberger & Singer, 1981) and biofeedback (e.g., Shapiro, Tursky, Gershon & Stern, 1969).

Neural innervation of the heart occurs via both the sympathetic and parasympathetic branches of the autonomic nervous system. The sympathetic pathway consists of adrenergic fibres and starts at the "cardio-acceleratory centre" of the medulla. This pathway continues down the spinal cord and then passes over sympathetic nerves to the heart. Norepinephrine is released at the sympathetic nerve endings, resulting in an increase in the rate of sino-atrial (S-A) node discharge, increased excitability of heart tissue and an increase in the force of contraction of both the atrial and ventricular musculature. This sympathetic response is believed responsible for increases in cardiac output frequently observed in certain emotional situations (Andreassi, 1989). When stimulated by the "cardio-inhibitory centre" of the medulla, the parasympathetic input

involving cholinergic fibres influences both the S-A and atrial-ventricular (A-V) nodes via the vagus nerve, slowing down the heart rate. This influence is produced by the release of the neurotransmitter acetylcholine at the vagus nerve endings. While the medulla is believed to be chiefly responsible for heart rate control, other Central Nervous System (CNS) structures (the hypothalamus, cerebellum and amygdala) also contribute to heart rate responses (Andreassi, 1989; Papillo & Shapiro 1990).

The interactions of parasympathetic and sympathetic stimulation on the cardiovascular system are addressed in detail in Siddle and Turpin (1980). The same authors describe research illustrating the strong influences of respiration and somatic activity (see also Obrist, 1976) on heart rate activity. Mechanisms controlling cardiac activity in response to discrete stimuli are largely mediated by the parasympathetic innervation of the heart (Siddle & Turpin, 1980), however the dominant influence of sympathetic effects on heart rate have been observed in classical conditioning studies (Cohen, 1974) and studies involving aversive stimuli (Obrist et.al., 1972) and emotional stressors (e.g., Ax, 1953; Funkenstein, King & Drolette, 1954).

As mentioned, the EKG is a recording of the electrical events associated with the muscular contraction of the heart. In a clinical diagnostic setting, the EKG may be recorded using up to 12 pairs of leads attached to the chest and limbs. Each pair of leads detects potential differences across the sides of the heart. In the psychophysiological laboratory less intensive monitoring of the EKG is required to determine and monitor heart rate levels. For the active or mobile subject, placement of cardiac electrodes at the Manubrium and Axillary sites is preferred so as to limit movement artifact (Andreassi, 1989).

2.2.2 Blood Pressure

Blood pressure is simply the amount of pressure on the walls of the arteries. Systolic blood pressure (SBP) refers to the maximum pressure exerted on the arterial walls during ventricular systole, the contraction phase of the heart. Diastolic blood pressure (DBP) is related to the ventricular diastole, the relaxation phase. Mean Arterial Pressure (MAP) is the integral of the pressure curve of the entire cardiac cycle divided by the integral time interval. Each pressure cycle remains at the systole level for approximately one third of the total cycle duration and hence MAP can be approximated as $[(SBP-DBP)/3 + DBP]$. The MAP measure reflects the average effective pressure that drives the blood through the circulatory system (Papillo & Shapiro, 1990; see also Steptoe, 1980).

The most direct measurement of blood pressure is by the insertion of a pressure-sensitive transducer into a major artery (cannulization). In the clinical setting, blood pressure is commonly measured using the somewhat less accurate sphygmomanometer. A pressure cuff is attached to the upper arm of the seated subject and is inflated. A stethoscope is used to detect the Korotkoff sounds. As the cuff is slowly deflated from a totally occlusive pressure, the systolic pressure, signalled by the first rushing sounds, is detected and measured with a manometer. The pressure cuff is further deflated until the Korotkoff sounds disappear, marking the diastolic pressure (Larsen, Schneiderman & DeCarlo Pasin, 1986). Compared to the more direct methods of arterial pressure measurement, this technique underestimates both systolic and diastolic measures by up to 10 mmHg (Hassett, 1978). Also, since cuff deflation must be slow, the sampling period and frequency is limited (Larsen et al, 1986).

Innervation of the blood vessels is via the sympathetic vasoconstrictor substance, norepinephrine. This is controlled by the vasomotor centre located in the reticular

formation of the brain. The vasocenter is also susceptible to hypothalamic influences resulting in both inhibitory and excitatory effects. Normally, sympathetic tone keeps all the blood vessels of the body constricted to approximately half their maximum diameter. Increased sympathetic nervous system (SNS) activity results in further constriction, while inhibition of the sympathetic tone results in vessel dilation. Blood pressure is influenced by the efficiency of the heart, peripheral resistance, blood volume, blood viscosity and the elasticity of the arterial walls (Andreassi, 1989).

The baroreceptor reflex is important in regulating transitory changes in arterial pressure. Baroreceptors are located in the aortic arch and the carotid sinus. With pressure increases, these afferent receptors increase their rate of firing and act on centres in the medulla to bring about reflex slowing of the heart and dilation of the arteries, thus lowering blood pressure. Heart rate and blood pressure are thus related through the baroreceptor reflex. Under certain conditions such as exercise and unpleasant situations resulting in extreme emotion, blood pressure and heart rate may increase together (Andreassi, 1989).

2.2.3 Skin Conductance

Electrodermal activity (EDA), or sweat gland activity, is indexed as changes in skin potential (SP) and skin conductance (SC) caused by a variety of situations including those that are emotionally arousing. It is most commonly measured on the palmar surface of the hand and the plantar surface of the foot (see Rickles & Day, 1968), where eccrine glands are most numerous. All eccrine glands have the property of responding to both thermal and signal stimuli. However, their involvement with thermoregulatory control at the palmar and plantar sites is normally only when the ambient temperature exceeds 30 degrees Celcius.

Compared to the cardiac measures, the physiological mechanisms governing the electrodermal response are not fully understood. Peripherally, EDA is known to reflect SNS activity and its utility as an index of arousal and its potential as a tool for differentiating psychological processes is espoused by many (Furedy, 1993). Issues concerning the methodology and reporting of electrodermal activity have slowly become standardised due to the efforts of many psychophysiolgists (e.g., see Edelberg, 1967; Lykken, & Venables, 1971; Fowles, Christie, Edelberg, Grings, Lykken, & Venables, 1981) and investigative studies (e.g., Edelberg, 1983 and Boucsein, Baltissen & Euler, 1984; Scerbo, Freedman, Raine, Dawson, & Venables, 1992) specifically examining the electrodermal system. Venables and Martin (1967) outline a classification scheme for the various terms related to EDA for both the phasic or momentary responses (e.g., skin conductance response, SCR; skin potential response, SPR), and the relatively stable tonic level measures (e.g., skin conductance level, SCL; skin response level, SRL).

Control of electrodermal activity is complex, with a number of control centres in the CNS, including the premotor cortex, the limbic and hypothalamic areas (both of which are concerned with motivation and emotional behavior), and the reticular formation. Innervation of the eccrine glands, responsible for psychologically important electrodermal changes, is solely via the sympathetic branch of the autonomic nervous system. The postganglionic synapse is cholinergic, having acetylcholine (usually associated with PNS functions), rather than the usual sympathetic neurotransmitter, nor-adrenaline (Venables & Christie, 1980; see also Edelberg, 1972 and Fowles, 1986 for more detail). Electrodermal activity therefore reflects SNS activity, and to date, behavioral scientists have interpreted SCL as indicative of arousal level (Barry & Sokolov, 1993) or the emotional reactivity of an organism.

Edelberg (1967) and Venables and Christie (1980) provide detailed information on the factors concerning exosomatic electrodermal activity measurement including site

selection and cleaning, and the appropriate electrodes and electrolyte media.

Silver/silver chloride (Ag/AgCl) electrodes with .05M NaCl electrolyte solution in a neutral medium placed on the more popular volar sites of the medial phalange of the second and third digits is recognised as standard practice although there is a recent suggestion that researchers should return to the use of the distal phalanges (Scerbo, Freedman, Raine, Dawson & Venables, 1992). This site was originally abandoned in favour of the medial phalange following the work of Edelberg (Edelberg & Burch, 1962; Edelberg, 1967; see also Venables & Christie, 1980), which raised concerns about the influence of superficial cuts etc. as are commonly found on the distal phalanges. Some deviations in regard to the selection of electrodes and electrolytes are discussed by Venables and Christie (1980).

2.3 FRACTIONATION OF AUTONOMIC MEASURES: HR AND SCL

2.3.1 The General Arousal Theory Questioned

The ancient Egyptians believed that the heart was the seat of emotion, while the French (e.g., Féré in 1888) showed that electrical activity of the skin could be produced by both physical and emotional stimuli (Hassett, 1978). Early research activities in physiology and medicine resulted in the wide acceptance of cardiac and electrodermal measures as indices of arousal. The easily observed pattern of generalised cardiac and electrodermal response to novel stimuli was interpreted by Cannon (1929) as the body preparing itself for the relevant behavioral response. This sympathetic-adrenal excitation approach taken by Cannon was later interpreted by Duffy (1957, 1962, 1972) as activation or energy mobilisation. According to Duffy and her colleagues (e.g., Malmö, 1959) a description of behavior should incorporate the goal to which the behavior is directed and the level of intensity of the behavior. Derived from the activation theory, a U-shaped relationship between performance and arousal was proposed (Duffy, 1962).

This model predicted that the level of performance rises with increases in physiological activity to an optimal point for a specified task. Thereafter increases in physiological activity in the organism will prove detrimental to the performance level. Continuing research employing these measures did not support this unitary conceptualisation put forward by Cannon and the activation theorists. Research studies demonstrating the bidirectional nature of heart rate, individual differences and the dissociation of the autonomic responses caused concern for the simplistic arousal interpretation. These studies, which will be considered shortly, suggest that psychophysiological activity can better be explained as a set of separate response patterns that reflect different experiences or meanings attached to the situation.

Before addressing individual studies, it should be noted that the literature supporting the fractionation of arousal measures incorporates studies that have examined both tonic and phasic changes (e.g. research work by Obrist, Lacey and their colleagues). To describe the distinction briefly, phasic changes refer to short term adjustments in the physiological measure to the immediate situation, and usually involve intervals of a few successive heartbeats or seconds. Tonic changes are determined over a relatively extended period of time (e.g. half a minute or more) (Elliott, 1969). Many psychophysiological studies have employed tonic and phasic measures (e.g., SCL and SCR) together (e.g., Watts, 1975; Bohlin, 1976; see discussion in Venables & Christie, 1980 and Boucsein, Baltissen & Euler, 1984). It is possible that some of these earlier studies interpreted the behavior of these measures in the same manner, even though they may be measuring different processes. This scenario may have attributed to some inconsistent findings reported in the early literature. The psychophysiology of emotion literature, which is addressed in more detail in the following chapter, describes studies that mostly involve tonic changes, which is the focus of this thesis.

Heart rate acceleration has been demonstrated in studies involving threatening stimuli (e.g., Sternbach, 1960), word association tasks (e.g., Darrow, 1929) and mental arithmetic (e.g., Blair, Glover, Greenfield & Roddie, 1959), while heart rate decelerations have been observed in response to simple stimuli (e.g., Darrow, 1929; Davis, Buchwald & Frankmann, 1955). Both heart rate acceleration and deceleration responses have been demonstrated using classical conditioning paradigms. Such observations led to alternative explanations put forward to describe the relationship between cardiac activity and certain types of behavior. Explanations have focused on areas such as task requirements (e.g., Jennings, Averill, Opton & Lazarus, 1971), environmental intake or rejection (Lacey, 1967) and cardiac-somatic coupling (Elliot, 1974; Obrist, Lawler and Gabelein, 1974).

The detailed work of Obrist and his colleagues' supports the notion that cardiac activity simply reflects the level of somatic movement, that an increase in the metabolic demand of the musculature results in an increase in heart rate. If this holds true, then the usefulness of heart rate in psychophysiological research is limited. However Obrist does cite situations (e.g., active avoidance of aversive stimuli) in which cardiac-somatic coupling is dissociated, with a substantial increase in heart rate observed that is unrelated to the level of somatic responding/activity (Obrist, Howard, Lawler, Galosy, Meyers, & Gaebelein, 1974; Obrist, 1976).

An influential hypothesis concerning the bidirectional nature of cardiac activity was put forward by Lacey (1967). He suggested that the activation or arousal process does not *"... reflect just the intensive dimension of behavior but also the intended aim or goal of behavior.... the nature of the transaction between the organism and its environment..."* (p.25). Essentially, the Lacey environmental intake/rejection hypothesis emphasised the link between the type of situation in which stimulation occurred and the resultant cardiac response. Depending on subject perception and subsequent

interpretation of the situation, heart rate deceleration occurred with environmental intake while heart rate acceleration occurred in situations involving environmental rejection (Lacey, 1967; Lacey & Lacey, 1974). According to Siddle and Turpin (1980) the strength of Lacey's intake/rejection hypothesis is that it provides a functional explanation for the relationship between cardiac activity, cognitive-cortical activity and behavior.

Described by Lacey (1967) as "situational stereotypy", the stimulus situation or context produces different patterns of somatic responses, even when using similar stimuli. Lacey (Lacey, 1967; Lacey & Lacey, 1970) cited neurophysiological and psychophysiological research that demonstrated dissociation between somatic and behavioral arousal, and between different autonomic arousal measures. With the advent of multiple recordings, evidence of differential responding between heart rate and other physiological indices (e.g., blood pressure and skin conductance) caused further concern for the theory of general arousal. Lacey (1959, 1967) employed the term "directional fractionation" to describe different directions of responding by different fractions of the autonomic nervous system. For example blood pressure and heart rate may decrease while other simultaneously recorded variables such as electrodermal and pupillary activity may show sympathetic-like changes (Lacey et al., 1963; Lacey & Lacey, 1970; Libby, Lacey & Lacey, 1973). Laboratory studies on animals (e.g., DiCara & Miller, 1968) provided some of the first demonstrations of the dissociation between the closely related measures of systolic blood pressure (SBP) and heart rate. The independence of heart rate from both SBP (Shapiro, Tursky, Gershon & Stern, 1969; Shapiro, Tursky & Schwartz, 1970) and diastolic blood pressure (DBP) (Shapiro, Schwartz & Tursky, 1972) has been shown in humans using biofeedback and operant conditioning.

The study of the psychophysiology of emotion has yielded a long history of autonomic dissociation and is a good example supporting the pattern approach to

understanding autonomic activity. Dissociation of autonomic arousal measures was evident in early studies conducted by Ax (1953), Funkenstein, King and Drolette (1954), and Schachter (1957), and in later studies by Martin (1961) and Averill (1969). They examined autonomic response patterns for strong emotions such as fear, anxiety, anger and mirth. Later studies (e.g., Schwartz, Weinberger & Singer, 1981; Roberts & Weerts, 1982; Smith, 1989, and more recently, Sinha, Lovallo & Parsons, 1992) used visual imagery methodology to elicit emotions. These studies confirmed previous findings of differentiated patterns of autonomic activity, particularly for the cardiovascular measures. A study by Ekman and his colleagues (Ekman, Levenson & Friesen, 1983) showed that autonomic activity differed between what they termed positive and negative emotions, and also between individual negative emotions. They recorded higher heart rate and finger temperature increases for anger and fear compared with happiness, while skin resistance decreases differed significantly between the negative emotions of sadness, anger and disgust. Chapter 3 reviews in detail studies that have attempted to explore autonomic responding as a function of different emotional states.

While the area of emotion research provided numerous examples of fractionation and autonomic patterning it failed to produce a theoretically based approach to the understanding of the differential behavior observed in autonomic measures. In the closely related field of motivation and incentive effects, Fowles (1980) was able to provide a hypothetical explanation for the behavior of two measures, HR and SCL, based on the activation of two motivational systems. His theoretical explanation attracted great interest from the research community due to its potential ability to provide an explanation for fractionation patterns observed in a range of research areas including the study of emotion.

2.3.2 Fowles' (1980) Hypothesis

Gray's (1973, 1975, 1976) examination of learning theory and other work in psychopathology led him to suggest that emotional states result from the activation of emotional systems through either aversive or appetitive reinforcing stimuli. Gray described two motivational/emotional systems, the Behavioral Inhibition System (BIS) and an approach system, later termed by Fowles (1980) the Behavioral Activation System (BAS). According to Gray, the appetitive motivational system or the BAS is an approach system that responds to positive incentives by "activating" behavior". The BIS system is an aversive motivational system that forms the "substrate" of anxiety. Gray also documented the existence of a third motivational system, namely the flight/fight system. This third system responds to unconditioned punishment and non-reward with extreme levels of activity centering around a defensive attack (fight) or an attempt to escape (flight). Gray associated this third system with Cannon's (1929) work on the emergency reaction (e.g., a cat exposed to an aggressive dog). Gray (1987) described differences between the BIS and the flight/fight system in both the temporal dimension and behavioral effects. The flight/fight system operates under an immediate threat while the BIS is dominant under an anticipated or future threat. The BIS is associated with vigilance and worry while increased vigorous behavior is identified with the fight/flight system (Gray, 1982,1987; see also Fowles, 1984, 1987; 1992)

According to Gray's model, emotional states result from the activation of the motivational systems and the dominant mood is assumed to reflect the strength of the underlying system. Gray (1975, 1976) suggested that fear, anticipatory frustration, disappointment, and anxiety are examples of emotional states identified with BIS activity. Gray did not elaborate further on other specific emotions associated with either the BAS or BIS, nor did he speculate on the physiological correlates of these emotional systems. Fowles (1980, 1987) linked the emotion labels hope/relief and

frustration/anxiety with the motivational states underlying the BAS and the BIS respectively.

A review of the literature examining motivation and incentive effects on autonomic responding prompted Fowles to put forward an explanation for the fractionation of two measures, skin conductance and heart rate, based on the activation of two emotional systems described by Gray. Fowles (1980) postulated linkages between cardiac and electrodermal levels with the respective activation of the Behavioral Activation system (BAS) and the Behavioral Inhibition System (BIS). Fowles' hypothesis provided what he described as a “theoretical bridge” between Gray's statement concerning behavior and psychophysiological data. Fowles' (1980) hypothesis also provided an attractive explanation for the divergent electrodermal and heart rate patterns frequently observed in psychophysiological studies.

Fowles' (1980) paper described a number of studies that supported his hypothesis. These included studies concerned with somatic coupling (e.g., Obrist., Webb, Sutterer, & Howard, 1970; Obrist et. al., 1974), reward and incentive effects (e.g., Ehrlich & Malmö, 1967; Elliot, 1974), classical aversive conditioning (e.g., Roberts & Young, 1971), active-passive coping (e.g., Obrist, 1976) and feedback control (e.g., Lang, 1975; Bouchard & Corson, 1976), all of which described high correlations between HR and behavioral activation under certain conditions. In regard to the proposed relationship between the BIS and electrodermal activity, Fowles cited literature that demonstrated EDA (particularly non-specific fluctuations, and in some cases SCL) increases to threats of punishment and other noxious stimuli (e.g., Kilpatrick, 1972; Bundy & Mangan, 1979). Other studies (see Roberts, 1974) involving stimuli with threat value have produced enhanced electrodermal activity independent of both heart rate and general somatic activity. A study by Elliott, Bankart and Light (1970) using the Stroop test demonstrated an

increase in skin conductance levels with greater levels of difficulty. Fowles' interpretation of this research was that the anticipation of errors with the more difficult tasks resulted in the dominant activation of the BIS.

Later studies involving motivation and incentive effects carried out by Fowles and his colleagues (Fowles, 1983; Fowles, Fisher & Tranel 1982; Tranel, 1983) found supporting evidence for his hypothesis. However, other studies have not been so convincing. A study reported by Sosnowski, Nurzynska and Polec (1991) attempted to test the differential sensitivity of the electrodermal and cardiac systems to some treatments crucial to Gray's model, and thus to Fowles' hypothesis. One experiment, using monetary reinforcement manipulation to induce emotional and motivational states identified with either the BIS or BAS, failed to support Fowles' hypothesis. Conditions employed to elicit the emotional states were: monetary reward, losing the reward, and lack of monetary reinforcement (control). *"The hypothesis was tested that the increase in heart rate would be greatest in reward-conducive conditions, whereas the magnitude of evoked skin conductance response would be greatest when one is at risk of losing the reward (frustration)"* (p.666). The HR and SCL results obtained from this experiment contradicted expectations arising from Fowles' work. Surprisingly, the experimenters attributed their unexpected findings to the experimental procedure and the manipulations concerning monetary reinforcements, rather than questioning Fowles' hypothesis.

In a similar vein, the more recent study by Clements and Turpin (1995) examined heart rate and electrodermal sensitivity to experimental manipulations concerning motivation. Using a sentence verification task, subjects received either performance-related penalties, monetary incentives or no feedback on performance. Feedback was unexpectedly terminated for the second phase of the experiment. According to the authors, on the basis of Fowles' hypothesis, elevated electrodermal

levels were expected for the penalty condition while increased heart rate levels were predicted for the subject group provided with incentives. The authors did note that the two manipulations of motivation may not necessarily be considered as an unambiguous manipulation of the two emotional systems. The electrodermal results failed to provide convincing support for Fowles' predictions in this study. Clements and Turpin suggested that the concentration of the electrode gel (0.5M instead of 0.05M) used in the study may have contributed to the results, but agree that this factor would not have influenced the main between-subjects comparisons in the study. In contrast to the predictions based on Fowles' work, the heart rate data revealed an interaction between feedback and task difficulty. This was interpreted by the authors as reflecting factors concerning the task other than difficulty level (e.g., perceived difficulty) and the nature of the feedback (e.g., type and frequency).

Using different methodology, Wegner, Shortt, Blake and Page (1990) also considered some predictions arising from Fowles' hypothesis. Their study, involving three different experiments, required subjects to "think aloud" different situations (e.g., sex, dancing) that were deemed reflective of various degrees of excitement. The suppression of "exciting" thoughts was examined with the expectation that SCL measures would reflect the inhibition process (Fowles, 1980; Pennebaker & Chew, 1985). Pilot studies showed the SCL measure was the only one of numerous measures that *"...showed sizeable and reliable increments for a relatively long time when subjects were urged to express an exciting thought"* (Wegner et al., 1990, p.416). While SCL proved its worth as an indicator of sympathetic arousal, Wegner and his colleagues failed to find the predicted SCL changes accompanying the suppression of exciting thoughts.

Returning to Fowles' first paper on this topic, Fowles (1980) did acknowledge that not all electrodermal studies have supported a strong link between SCL and the

anticipation of punishment. He suggested that these contradictory findings may have been due to the uncoupling of non-specific fluctuations and skin conductance level, as well as physiological factors such as hydration of the skin. With further investigation, Fowles (1983, 1988) also accepted the ambiguous response of EDA within the appetitive paradigm and suggested the need for further experimentation involving electrodermal changes under motivation and incentive effects. This position was reiterated more recently by Fowles (1993), who suggested that while empirical studies of hyporeactivity among psychopaths showed a weak response in electrodermal activity to the anticipation of punishment (BIS), more studies were needed to compare the electrodermal response to “...*equally stimulating positive and negative stimuli to preclude a more general hyporeactivity hypothesis*” (p.234).

Fowles' (1980) hypothesised link between the BAS and HR is not easily digested either. Traditionally, it has been accepted that anxiety is associated with increased cardiac activity (e.g., Borkovec, Weerts & Bernstein, 1976; Nesse, Curtis, Thyer, McCann, Huber-Smith & Knopf, 1985; see also discussions in Fowles, 1982, 1983, 1992). This would lead us to relate HR to the BIS rather than the BAS, since the BIS is considered to be the “substrate of anxiety” (Gray, 1976). This conflict was addressed by Fowles (1982) in his paper Heart Rate as an Index of Anxiety: Failure of an hypothesis, where research examining the HR response during classical aversive conditioning was suggested as evidence for the view that heart rate activity is controlled by the anticipation and initiation of a particular response rather than the presence of anxiety.

Later, in support of this approach, Fowles (1992) cited the work of Barlow and his colleagues (Barlow, 1988; Barlow & Craske, 1986; Barlow & Cerny, 1988), who delineated two types of anxiety: one preparatory in nature, the other representing an acute response. According to Barlow, the first type of anxiety, or “anxious apprehension”, prepares the organism to cope with the challenges and stresses of

everyday life. It can be characterised as a “...*marked apprehension surrounding the possible occurrence of unpleasant or dangerous events in the future*” (Barlow & Cerny, 1988, p.31). Barlow (1988) noted that “...*this anxious apprehension consists of a diffuse cognitive affective structure including negative affect and is associated with high arousal, perceptions of helplessness or uncontrollability of future events, and worry*” (p 235). The second type of anxiety is likened to an “alarm reaction”, such as that experienced during life-threatening situations. It frequently involves strong behavioral and cardiovascular response, a sense of fear and panic, and, according to Barlow (1988), can be equated to Cannon's "fight or flight response". Fowles (see Fowles, 1992, 1993) proposed that Barlow's first type of anxiety, “anxious apprehension”, paralleled Gray's BIS, while the second type of anxious response, the “alarm reaction”, was linked to Gray's description of the flight/fight system.

To examine the heart rate response in the light of the two types of anxiety described by Barlow (1988), Fowles (1992) again cited the work of Obrist (1976) and other studies (e.g., Taylor et al., 1986) examining cardiovascular changes occurring during panic attacks. Fowles (1992) proposed that heart rate acceleration was more likely to accompany the fight/flight alarm reaction, in connection with the anticipation of somatic activity. In other words, the increase in heart rate activity was expected to be greater during the fight/flight response than that observed during the activation of the aversive motivation system (BIS), given that the levels or intensity of the two types of anxiety experienced is equal.

The relationship between electrodermal activity and anxiety was investigated in a number of studies conducted by Naveteur and Freixa i Baqué, (1987; 1992). Similar to Fowles, the authors attempted to integrate their data with Gray's theory of anxiety. The studies compared electrodermal levels of pathologically anxious subjects identified as high state or high trait anxious and normal controls. In one study, subjects were exposed

to a series of aversive slides. The more anxious subjects (high trait anxiety) showed significantly lower skin conductance levels. While the results suggest that BIS activation resulted in a decrease in EDA responses, some other interpretations addressed by the authors included the possibility that the high trait anxiety subjects implemented coping strategies to calm themselves. Correlation tests on the remaining studies showed that state anxiety was poorly correlated with the EDA measures (see also Naveteur & Roy, 1990). In summary, these results are opposite to those obtained by Sosnowski (Sosnowski et al., 1991) and contrary to the hypothesis concerning the relation between EDA and the BIS promoted by Fowles. The general controversy surrounding the relationship between electrodermal activity and anxiety is outlined by Forgays, Sosnowski and Wrzesniewski (1992).

Gray's description of the two emotional systems, the BAS and the BIS, is based on conditioning paradigms. Turpin and Clements (1995) acknowledged the difficulties in the generalisation of this work to other types of tasks and situations. This is evident in the application of Fowles' and Gray's work to the study of heart rate and electrodermal activity accompanying discrete emotional states. Following the work of Tellegen and his colleagues (Tellegen, 1985; Watson & Tellegen, 1985; Larsen & Ketelaar, 1991), the recent emotion literature supported linkages of the BAS and BIS with (respectively) positive and negative affect. Positive affect (PA) and negative affect (NA) encompass (respectively) emotional states reflective of one's pleasurable (e.g., happy, excited) or unpleasurable (e.g., anxious, worried) engagement with the environment (Tellegen, 1985).

Fowles did not explore or test his hypothesis concerning the fractionation of the HR and SC measures against the emotion studies described in the psychophysiological literature. In addition, he initially was tentative in accepting the proposed link between the BAS and PA, and repudiated the link between the BIS and NA (Fowles, 1987).

Fowles' opposition to this linkage is discussed in more detail in Chapter 6. More recently, his stand on the matter has become somewhat more conciliatory. More than a decade after his first paper, Fowles (1993) conceded the association of the BAS with positive affect (hope, relief) and the BIS and negative affect (anxiety, worry and frustration), as long as the type of anxiety experienced is similar to Barlow's (1988) "anxious apprehension". With this clarification, Fowles' hypothesis concerning the fractionation of HR and SC measures is clear enough to be tested with some confidence in studies of the psychophysiology of emotion.

In summary, Fowles' (1980) hypothesis provided an alternative to the simple arousal-based interpretation of autonomic response activity and offered a base for further psychophysiological investigations. Fowles' work continues to influence research approaches to the examination of heart rate and skin conductance activity in the areas of reward and incentive effects (Wallace & Newman, 1990), feedback and task difficulty (Sosnowski, 1992; Clements & Turpin, 1995), anxiety and other stressful conditions (Sosnowski, 1988; Forgays, Sosnowski & Wrzwesniewski, 1992), and active/passive coping (Sosnowski, Nurzynska & Polec, 1991; Sosnowski, 1992). Fowles (see Fowles, 1982, 1983, 1987, 1988) has continued his research interest in the field of anxiety and motivation, with particular reference to the psychopathic population.

From the above discussion it is evident that Fowles' (1980) hypothetical explanation for the fractionation of the autonomic measures of heart rate and skin conductance warrants further investigation. This thesis does not attempt to test Fowles' hypothesis under incentive and motivation conditions, but rather to use its theoretical base to explore the cardiovascular and electrodermal patterns accompanying different emotions. That is, in the absence of other theoretical approaches, the work of Gray and Fowles provides a suitable platform for the investigation of autonomic patterning as a function of emotion.

CHAPTER 3

The Psychophysiology of Emotion: Literature Review

3.1 INTRODUCTION

“We tramped along in silence and deep within me I was aware of a sensation of joy, but also of a gripping at my heart... and now, having longed so much for this moment, I was afraid... At the foot of the face I clumsily uncoiled the rope. Somewhat frightened and at the same time excited, I roped up.” (p.15)

Gaston Rebuffat 1965

On snow and rock

To varying degrees we are all aware of specific behavioral and bodily activities that accompany different emotions. For example "butterflies of the stomach" and "pounding of the heart" are frequently used to describe our bodily responses accompanying the emotions described as worry and fear. Likewise we "redden" with embarrassment and "tingle" with delight. The activation theorists (e.g., Cannon, 1929; Schachter, 1964; Duffy, 1972) argued that all emotions have the same underlying physiological response set supporting a general state of arousal. In the light of the more obvious overt signs of emotion specificity, others (e.g., James, 1884; Ax, 1953; Ekman, Levenson & Friesen, 1983) have continued the search for autonomic response specificity in measures such as heart rate, blood pressure and skin conductance changes accompanying different emotions.

Comprehensive overviews describing the nature of emotion (Strongman, 1978; Fridja, 1986; see also Ekman & Davidson, 1994, LeDoux, 1996 & Elster, 1999), and in particular the study of the psychophysiology of emotions can be found in numerous references (e.g., Lindsley, 1951; Thompson, 1988; Wagner, 1989). This chapter presents a brief description of the core theories of emotion, and addresses related concepts such as affect, feelings and mood. Most of the chapter, however, is devoted to psychophysiological investigations of emotion, with a selective review restricted to a description of studies that have made a particular contribution in this area.

One important outcome of early conjectures about the nature of emotion is the subtle relation between emotion states and bodily activity. As mentioned above and in the previous chapter, there is, historically two general views regarding this relationship. The James Lange theory developed in the 1880s held that the consciousness of certain bodily reactions is the essential element in emotional experience. That is, perception of the body's. This theory was challenged by Cannon (1929) who argued that emotion occurs when the thalamus sends signals simultaneously to the cortex (creating the conscious experience of emotion) and to the autonomic nervous system (creating visceral arousal). His neurophysiological theory of emotion was based on evidence of physiological arousal without the experience of emotion, the latency period between the conscious experience of emotion and the accompanying visceral changes, and observations of the same visceral changes occurring in quite different emotional states (Weiten, 1998).

With increasing knowledge of the central and peripheral nervous system, Lindsley (1951) notes that these two theories of emotion do not adequately account for the peripheral bodily changes in emotion, and a number of neurobiological and hormonal mechanisms need to be considered. A detailed discussion on the physiology of emotion, including the chemical, neural and peripheral mechanisms, can be found in

Lindsley (1951), Grings & Dawson (1978), Strongman (1987), Thompson (1988) and Heilman (1997). As this thesis' investigation of the psychophysiology of emotion is based on Fowles' hypothesis (Fowles, 1980), the following literature review will focus on those psychophysiological studies of emotion that have used HR or SCL measures.

3.1.1 The nature of Emotion

A complex phenomenon involving an organism's many levels of neural and chemical integration, emotion incorporates an experiential or "feeling" aspect as well as an expressive or behavioral aspect (Lindsley, 1951). Weiten (1998) defines emotion as involving a subjective conscious experience (cognitive component), accompanied by bodily arousal (physiological component) and characteristic overt expressions (the behavioural component). While most definitions of emotion imply that emotion consists of both a mental and physical event, complexities regarding the respective activation and interrelationship of these emotion components continues to fuel philosophical debate as to whether emotion actually exists (Thompson, 1988).

Theories of emotion differ in their emphasis on the innate biological basis of emotion versus a social and environmental basis. For example, the James-Lange theory of emotion (James, 1884) suggested that awareness of arousal caused emotion. Building on this, Schachter's two-factor theory argued that people inferred emotion from arousal, and then labelled it in accordance with their cognitive explanation for the arousal experienced (Schachter, 1964; Schachter & Singer, 1962). In other words situational cues are used to differentiate emotions. Schachter supported Cannon's (1929) view that different emotions yielded indistinguishable patterns of arousal.

Evolutionary theories of emotion consider emotions to be largely innate reactions to certain stimuli. The emotions originate in subcortical brain structures (such

as the hypothalamus and limbic system) that evolved before the higher brain areas in the cortex associated with complex thought. Evolutionary theorists such as Tomkins (1991), Izard (1991) and Plutchik (1962, 1980) concluded that people exhibit eight to ten primary or fundamental emotions, with a common core of six emotions: fear, anger, joy, disgust, interest and surprise. These basic emotions are linked to distinct action tendencies or elementary behavior modes (Fridja, 1986). According to Plutchik (1980), diversity of human emotion is due to blends of primary emotion or variations in intensity. For example, wariness can simultaneously involve interest and moderate fear (Fridja, 1986).

Research involving cross-cultural comparison of people's ability to recognise emotions from facial expressions supports the biological model of emotion. Ekman and Friesen (1975) found that people in highly disparate cultures showed fair agreement in the identification of happiness, sadness, anger, fear, surprise and disgust, based on facial expressions. Cross-cultural similarities have also been found in the cognitive and behavioral components of emotion (Weiten, 1998), although variations in categorisation and display of emotion have been recorded (Russell, 1991).

Fridja (1986) and Lazarus (1991) argue that cognitive appraisal of the situation is an important constituent of the emotional experience, with different emotions corresponding to different situational meaning structures. Appraisals are the cognitions that intervene between environmental stimulation and physiological and behavioral responses. Strongman (1978) notes that, due to its phenomenological emphasis, the resulting hypothetical processes that intervene between stimuli and responses are difficult to test, and perhaps are more relevant to the milder emotions. Smith (1989) examined relations between appraisal and physiological activity in emotion, using imagery. He found that both brow activity and heart rate were affected by effort-related appraisals, and concluded that anticipated effort influenced heart rate while perceived

goal obstacles influenced the eyebrow frown.

The concept of emotion may be extended to include more prolonged states of mood or less specific states like feelings or affect. Kemper (1978) differentiated emotion and affect based on the duration of the emotion experience. He states that emotion is transitory in nature: “...*the stimulus event produces the emotion, and after some relatively short period the somatic and cognitive components die out and the individual can no longer be said to be experiencing the given emotion*” (Kemper, 1978, p.48). By comparison, if an individual is repeatedly activated to the same emotion by a recurring stimulus situation, then the emotion is understood to be ongoing. Kemper (1978) refers to these more enduring emotions as affects.

According to a number of emotion theories described in Strongman (1978), feelings relate to the subjective interpretation of the emotion or situation experienced, are influenced by perception of specific bodily sensations and are seen as relatively long-term. LeDoux (1998) notes “... *feelings constitute the subjective experiences we know our emotions by and are the hallmark of an emotion from the point of view of the person experiencing the feeling*” (p.329). LeDoux (1998) also states that all conscious emotional experiences are feelings. Feelings imply acceptance or nonacceptance of the stimulus or experience itself (Fridja, 1986). The labelling of feelings is an evaluative process, and is influenced by social norms concerning what feelings are appropriate in a given situation (Thompson, 1988).

Ekman and Friesen (1975) describe moods as the experience of the same emotion over a longer period, such as a day. For example, a person remaining angry all day, or who becomes angry a dozen times in one day, is said to be in an angry mood, and could be described as “irritable”. The long term nature of mood is also indicated in the three categories of elicitation: a) after effects of emotions, b) organism conditions

such as illness and fatigue and c) general environmental conditions and side effects of activities (e.g., heat, noise or stressful conditions such as illness), described by Fridja (1986). The structure of mood and self-report of mood is addressed in detail by Zevon and Tellegen (1982) and Tellegen (1985).

The related emotion terms of affect, feelings and mood are often used interchangeably in the emotion literature. For the most part, the literature review that follows will adopt the terms used by the authors. Specific affective or emotional states are underlined to aid their identification and to highlight commonalities in the emotions investigated across the various studies. In the research studies conducted as part of this thesis' investigation of the psychophysiology of emotion, an emotion descriptor is used to categorise the emotion (e.g., worry) or the emotion/feeling (e.g., challenge) under investigation. These descriptors reflect the experience of either a fundamental emotion or a blend of emotions based on subjective interpretation of the emotion experience.

3.2 THE PSYCHOPHYSIOLOGY OF EMOTION: LABORATORY STUDIES

From the psychophysiology of emotion literature, it is evident that some reliable findings are starting to emerge, particularly for the cardiovascular activity accompanying the discrete emotions fear and anger. However, inconsistent findings and methodological concerns continue to plague this area of research. Some methodological issues that will come to light in this review include laboratory difficulties concerning the elicitation of emotions, the identification and monitoring of emotion intensity levels, and finally, the approach to and management of the physiological data. These issues and developments in the study of the psychophysiology of emotion must be viewed within the context of the technological advancements and theoretical perspective underlying the research practices of the particular period in the literature.

3.2.1 Early Investigations

Dissociation of the autonomic arousal measures accompanying individual emotions was evident in the pioneering studies conducted by Ax (1953), Funkenstein, King and Drolette (1954) and Schachter (1957). Using rudimentary experimental techniques (involving electric shock and subject abuse), Ax successfully demonstrated different patterns of physiological responding for the strong emotions of anger and fear. Employing nine different autonomic measures, Ax showed that fear resulted in increases in skin conductance level and respiration rate while anger was accompanied by increases in skin conductance level and diastolic blood pressure, together with a significant decrease in heart rate level. A study carried out by Schachter (1957) obtained similar results, as well as demonstrating a large heart rate increase for fear.

A study carried out by Funkenstein, King and Drollete (1954) subjected adults to a variety of stressors which resulted in the elicitation of two different types of anger: "anger-in" and "anger-out". These two types of anger were shown to be associated with different patterns of physiological activity, with the anger-out condition involving a heightened diastolic blood pressure response. While this study held important implications for the clinical treatment of hypertension (Oken, 1960; James, Yee, Harshfield, Blanke & Pickering, 1986) it also highlighted, at this early stage of emotion investigation, the importance of the relationship between the environment (the source of the emotional stimulus) and the subject.

In a somewhat novel experiment Sternbach (1962) monitored continuously the physiological changes in children viewing the popular film *Bambi*. Ten eight year-old children were asked to categorise the sequences that they found to be the most sad, scary, happy and funny. Analysing the physiological data gathered during these sequences, the author found significant differences for the sad (e.g., increased skin

resistance level and a decrease in blink rate) and happy (e.g., slowing of gastric motility) states. The heart rate measure failed to show reliable differences. While this study attempted to monitor physiological changes accompanying emotions in a more natural environment, the inherent problems of the study attracted more attention in the psychophysiology literature (e.g., Schwartz, Weinberger & Singer, 1981 and Wagner, 1989). These "problems" included the identification of the emotional sequences on completion of the film one hour later, and the use of baseline data, given that subject emotion levels were not monitored during this baseline period.

Using three different film sequences, Averill's (1969) study explored the physiological patterns for the emotions sadness and mirth. A third film, a travel sequence, was used as a neutral stimulus. Eight different measures were monitored including blood pressure (systolic and diastolic), skin conductance (SCL and SCR) and heart rate. Increased blood pressure was unique to the group viewing the sad film while increased respiration and heart rate levels were observed for the group experiencing mirth. Although recognising the influence of the physical act of laughter, Averill suggested that widespread sympathetic activity led to the enhanced levels observed in the mirth group. One major criticism of the study is that the physiological measures were analysed between groups rather than within subjects. It should also be noted that the systolic blood pressure increase observed for the sad group was in the opposite direction to that observed in the study by Sternbach (1962) described above. High levels of skin conductance activity were also observed in the group viewing the sad film. Averill concluded that widespread sympathetic activation may also form part of the sad response. In reviewing these data, Wagner (1989) suggested that it was likely that other emotions such as anger were elicited during this film sequence. This is supported by the experimental subject ratings that scored the sad film higher in anger and interest than the mirth film.

A study carried out by Schwartz and his colleagues (Schwartz, Weinberger & Singer, 1981) examined the effects of exercise on the cardiovascular response to four different emotions: fear, happiness, sadness and anger. Thirty-two college students who had high school or college acting experience were selected as subjects. Imagery was used to evoke the four emotions under two conditions, sitting and exercise. The results showed that anger produced the greatest overall activation of the cardiovascular measures and was distinctly different from the relaxed state. Anger produced large increases in diastolic blood pressure during imagery and greater increases in heart rate and slower recovery of systolic blood pressure following the exercise condition. Fear did not produce a unique cardiovascular response. Except for the higher heart rate obtained during the imagery seated condition, fear was found to be quite similar to happiness. Sadness produced patterns similar to relaxation. However, heart rate and systolic blood pressure were similar in the sitting and exercise conditions. Sadness proved to be the one emotional state likely to interfere with the cardiovascular adjustments following exercise.

Following exercise, large differences in heart rate and systolic blood pressure responses were observed, which were not apparent in diastolic blood pressure. The authors suggested that exercise produced vasodilatation in the muscles and this resulted in peripheral resistance decrease, which may have served to disguise changes occurring in the diastolic blood pressure response accompanying fear and anger. This case illustrates that the cardiovascular patterns in emotion can vary depending upon the skeletal state of the individual. Therefore, to determine the generalisability of the cardiovascular patterns one needs to examine emotional responses in a variety of behavioral situations.

Roberts and Weerts (1982) carried out a study examining the cardiovascular response to the strong emotions of anger and fear. Rejecting the use of film sequences to

evoke emotions, they used imagery in an attempt to overcome difficulties in presenting heterogeneous subjects with standard stimulus situations and hoping that they all respond similarly. Heart rate and blood pressure (DBP and SBP) were monitored while subjects imagined scenes designed to elicit high and low levels of anger and fear. Subjects also imagined two neutral scenes. The results showed increases in all three measures for the high intensity compared to the low intensity imagery sessions. The diastolic blood pressure measure showed a significantly larger increase for high anger than for high fear. Systolic blood pressure was found to be influenced by the intensity of the imagery rather than the emotional content. No significant differences were observed between the high fear and high anger imagery scenes for the heart rate response. These findings essentially support the earlier work of Ax (1953) and Schachter (1957).

The studies reviewed so far have involved the comparisons of physiological changes accompanying a few highly emotive and arousing versus neutral or relaxing affective states. Typically, these illustrate the more consistent and encouraging results found with the cardiovascular response accompanying the emotions anger and fear. The popularity of the cardiovascular measures may be partly due to their relative ease of measurement. The availability of more technologically advanced methods of monitoring as well as the employment of stronger emotion elicitation techniques were to have a significant impact on the methodology of future studies in this area. This is evident in the following studies that simultaneously recorded a number of different physiological measures accompanying the elicitation of a broad range of emotions. The work by Ekman and his colleagues (Ekman, Levenson & Friesen, 1983) also marks the resurgence of interest in the study of the psychophysiology of emotion as denoted by the number of published research papers following their well-received and influential study.

3.2.2 Multi-modal Recording

Examining six different emotions (fear, anger, happiness, disgust, sadness and anger), Ekman, Levenson and Friesen (1983) used a broad range of physiological measures to investigate autonomic response specificity. The subjects (who were professional actors) elicited the target emotion through facial expression manipulation and relived imagery tasks that lasted for 30 seconds. The use of the facial expression manipulation was based on the premise that facial expression is an important component of emotion (Ekman & Friesen, 1975). After each imagery trial subjects rated the intensity of the target emotion on a nine point scale. Data analysis was carried out on those data where the relived target emotion was rated higher than 4 on an 8 point scale and where no other emotions were reported at a similar strength. Only 55% of the data were used. This clearly indicates the difficulties and concerns that need consideration when gathering measures that supposedly reflect a single "pure" target emotion.

The rating scales were used to select the appropriate imagery sessions for analyses. These found that heart rate increases were larger for the "negative emotions" of fear, sadness and anger compared to those obtained for happiness and surprise. Decreases in skin resistance (i.e. skin conductance increases) showed differentiation in the negative emotions, with larger decreases found in sadness than in disgust, anger and fear. It is interesting to note that these significant differences between the negative emotions were not found when all the data, irrespective of imagery ratings, were used for analyses. This illustrates the important role of other psychological measures, such as multiple rating scales, in determining the presence of the target emotion. The use of professional actors may also have contributed to the success of emotion generation with the facial expression manipulation technique in this experiment.

A doctoral study reported by Sinha and her colleagues (Sinha, Lovallo & Parsons, 1992) examined the mechanisms governing cardiovascular changes during the emotions of sadness, joy, fear and anger. A variety of cardiovascular measures were employed during the study, including the popular heart rate and blood pressure measures as well as stroke volume, peripheral vascular resistance and myocardial contractility. These other measures were derived off-line from the recording. An attempt to increase the success of the imagery methodology in evoking emotions was made, with subjects undergoing a training session to develop imagery skills. In addition subjects who scored poorly on the Questionnaire for Mental Imagery (QMI; Sheehan, 1967) were not included in the study.

The results for the heart rate and blood pressure measures were consistent with previous studies. Heart rate and systolic blood pressure increased for all emotions compared to neutral conditions. Anger produced the largest heart rate response compared to the other emotion states, although this difference was not significant. Systolic blood pressure showed a similar trend to the heart rate response. The greatest diastolic blood pressure increase was observed during anger, and this was significantly greater than that observed for sadness. In turn, this measure was found to be significantly greater for sadness compared to fear, action, joy and neutral states. The imagery of physical action produced changes in heart rate and blood pressure similar to those observed during the imagery of fear. The authors suggested that the cardiovascular activity during fear and action is sympathetically mediated, and may be similar to that observed in the defense reactions of cats and the flight response in humans (Sinha, Lovallo & Parsons, 1992).

3.2.3 Short Term and Prolonged Imagery

A detailed study carried out by Vrana (1993) explored the psychophysiology of disgust compared to the emotions of anger, pleasure and joy. A tone-cued imagery procedure with 8 second trials was adopted. Subjects were provided with stimulus material (sentences) for the imagery sessions. This material was selected with consideration to personal relevance and individual ratings regarding the four target emotions. As part of the experimental procedure, subjects did not participate in the recording sessions until they reported vivid images to each of the sentences. Valence, arousal control and vividness ratings were recorded for each imagery session. These ratings confirmed that the valence of joy was more positive than pleasant, which in turn was more positive than anger or disgust. The pleasant imagery session was rated as less arousing than the other three emotions.

Electromyography (EMG) data analyses revealed that negative emotional concepts were characterised by increased corrugator region activity, whereas joy imagery showed increased activity in the zygomatic region. No significant differences for either the heart rate or skin conductance levels were observed in the first four seconds of imagery. The heart rate measure did record some significant differences in the remaining four seconds of imagery, with a significant heart rate increase obtained during disgust, anger and joy compared to pleasant imagery. This heart rate increase was taken to reflect the arousal rating of each emotion. Skin conductance failed to discriminate between any of the four emotions, and consistent with previous studies (e.g., Lang, Levin, Miller & Kozak, 1983), Vrana concluded that perhaps skin conductance is not responsive to imagery manipulations.

Heart rate levels obtained for disgust were unexpectedly high compared to the other negative emotions. This contrasts with anger, which had previously been accepted

as the emotional state resulting in the largest cardiac effect (e.g., Ekman et al., 1983; Levensen et al., 1990). Vrana suggested that this finding was probably related to the experimental methodology, notably the use of "relived" imagery. This compares to previous practices instructing subjects to imagine various situations selected arbitrarily. Expanding on this point, Vrana suggested that the effect of the behavioral situation, that is the amount of physical activity imagined, may also influence or enhance the physiological responses. This suggestion is consistent with the work by Schwartz et al. (1981) and Sinha et al. (1992). However, given the short imagery period used by Vrana (8 seconds), comparisons with other studies must be treated with caution.

Using prolonged (30 minutes) imagery sessions, De Jong-Meyer, Hubert, Ostkamp-Hovekamp and Vennen (1993) examined bodily sensations, facial EMG and autonomic changes accompanying the emotions sad and joy. Subjects participated in an imagery training session. With the aid of personalised scripts, subjects were instructed to imagine themselves as active participants in situations that were of personal significance and which had preferably occurred in the recent past. A selected group of subjects were also required to focus on their bodily responses. Only this group of subjects produced significant differences in the heart rate measure for the joy compared to the sad imagery session. The mean heart rate for the joy imagery was significantly higher than that obtained for sad imagery. Heart rate levels for both the sad and joy imagery sessions decreased below the base level recordings due to the longer imagery session. There were no gender differences in the heart rate data.

The skin conductance level also decreased over time. This measure failed to discriminate between the two valence conditions for either subject group, a finding not dissimilar to that previously observed (e.g., Schwartz et al., 1981). A gender main effect was not observed in the electrodermal data, although some differences were noted. For example, the number of spontaneous fluctuations and the skin conductance level were

higher for males than females during all conditions.

The authors suggested that, after the initial increase, the skin conductance activity simply habituated for both valence conditions. The general decrease observed in the autonomic measures is assumed to be the main effect of prolonged imagery. The authors also suggested that the low physiological response activity may reflect the low "physical activity" content in the imagery of sad and joy situations. In regard to the emotions imaged, the longer exposure may have resulted in conflict for those emotions, such as joy, that are naturally transitory in nature. Some concern was also raised as to whether the emotion imaged was that of pure joy or simply an emotional state that reflected an "absence" of sadness and other negative emotions. Another scenario described by De Jong-Meyer and his colleagues is the possibility that some subjects may have imagined situations that led to a joyous conclusion, but in the process involved emotions that were dissimilar to joy, for example, sitting an examination that resulted in a good grade. The ratings questionnaire may have reflected the average of a variety of emotions experienced over the thirty minute imagery session.

3.2.4 Valence and Arousal Effects: A New Approach.

The studies described so far investigated physiological patterns to discrete emotions. While some studies did describe these emotions collectively as either positive or negative (e.g., Ekman et al., 1983; De Jong-Meyer et al., 1993) the emotions had been investigated for independent and individualised physiological patterns. During the 1980s a different theoretical approach concerning the nature and description of emotions emerged. New two dimensional models proposed that all emotions existed in a space that varied along two bi-polar dimensions: valence (pleasantness-unpleasantness) and arousal (high-low arousal) (Russell 1979, 1980; Watson & Tellegen, 1985). These two dimensions resulted from factor analytic evidence and investigations involving the

“layman’s mental map” of affective space (Russell, 1980). The resulting “circumplex” models of emotion defined by the valence and arousal axes offered a co-ordinate space in which all emotional states could be described.

The impact of this new theoretical perspective is evident in the emergence of psychophysiological studies which focus on physiological pattern differentiation as a function of valence and arousal. Traditional rating scales (Vrana, 1993) and the Self Assessment Manikin (SAM) (Lang, 1980; Hodes, Cook & Lang, 1985) have been used to determine valence and arousal levels of individual emotions. As we shall see in the following, the findings from pictorial studies (e.g., Greenwald, Cook & Lang, 1989; Lang, Greenwald, Bradley & Hamm, 1993) have provided some of the strongest evidence for the relationship between skin conductance and ratings of arousal, as well as suggesting a possible link between heart rate and valence.

In a simple yet innovative study for the time, Haney and Euse (1976) examined skin conductance and heart rate responses to neutral, positive and negative imagery in an attempt to provide information concerning covert behavior therapy procedures. The aims of the study were to examine 1) increases in autonomic activity accompanying the onset and prolongation of negative and positive imagery, 2) features of autonomic activity that may differentiate the negative and positive prolonged imagery and 3) the relationship between level of autonomic arousal and image clarity and controllability. The subjects wrote their own positive and negative scenes and participated in visual imagery exercises as part of the imagery training.

Haney and Euse devoted considerable attention to their experimental procedure. A 12 minute relaxation tape was used to relax subjects and attain a stable baseline. The least reactive images were presented first in an attempt to control residual arousal. A one minute relaxation period was used between the one minute imagery trials. If necessary,

this relaxation period was extended to allow the subjects to return to baseline physiological levels.

The positive and negative imagery produced sustained high levels of skin conductance activity over the one minute imagery session while the neutral imagery resulted in this measure dropping below baseline levels. The positive imagery produced slightly higher responses than the negative imagery (most obvious over the first 15 seconds), but this difference was not significant. The log skin conductance data were averaged for 10 second epochs and examined for significant differences between the three imagery sessions. Significant time main effects with a systematic decrease were observed for the neutral imagery. Analyses of the mean heart rate responses revealed that the mean heart rate for the negative imagery (82.90 BPM) was significantly higher than that obtained for the neutral imagery (80.15 BPM). Although somewhat higher, the positive imagery heart rate average (81.86 BPM) was not significantly higher than for the neutral imagery.

Some worthwhile recommendations evolving from this study included to allow 1) sufficient imagery duration to permit autonomic arousal to peak, and 2) sufficient time for the return of autonomic activity to the baseline when subjects are assumed to be at rest. Their results revealed peaks in skin conductance between 20 and 30 seconds after imagery onset, while on average, subjects took 23 seconds after imagery termination to return to baseline levels.

A more complex study by Lang, Greenwald, Bradley and Hamm (1993) explored affective, facial, visceral and behavioral reactions of subjects exposed to a set of pictures that differed in valence and arousal content. From their review of the more recent literature concerning heart rate and skin conductance activity, Lang and his colleagues hypothesised that skin conductance would reflect the degree of subject arousal, as

indicated by rating scales for each slide, independently of the slide's valence. In addition, due to the more complicated innervation of heart rate (both parasympathetic and sympathetic influences) they proposed that heart rate would reflect the more complex association with picture valence. Lang et al. noted that while there is evidence of HR increases for both unpleasant and pleasant memories, HR deceleration has been more frequently observed to unpleasant scenes/pictures, thus suggesting "...*valence plays the greater role in determining cardiac response during perception*" (p.262).

The experimental procedure involved continuous physiological monitoring of subjects exposed to a variety of slides. Each slide was viewed for six seconds, after which subjects recorded the degree of arousal and pleasantness experienced. The picture slides were also rated for interest but this factor was secondary to arousal in terms of skin conductance covariation. Skin conductance response increased with ranked arousal, and this relationship was significant for 33% of the subjects. Peak heart rate response was found to be larger for the slides/pictures rated as more pleasant. 61% of the subjects recorded a positive correlation between valence judgements and cardiac acceleration, although this trend reached significance for only a few subjects (3%). A factor analysis was carried out on the means of all measures monitored (valence, arousal, interest, corrugator and zygomatic activity, peak heart rate, skin conductance and viewing duration) for each of the 42 pictures. Valence and arousal were identified as the two principle factors accounting for 36% and 31% of the variance respectively. These analyses confirmed the strong relationship between skin conductance and arousal ($r=.81$) and between heart rate and valence ($r=.76$).

Specific emotions were nominated as the prime emotion elicited while viewing each slide. Physiological measures were then investigated as a function of these individual emotions. Tests on these data revealed that HR did discriminate between the emotions, with the sad and disgusting emotions evoking equivalent heart rate changes

that were significantly less than the responses prompted by the other pictures. There were no significant differences observed in the heart rate response for the neutral and positive emotion categories, even though the valence ratings for these were significantly different. The electrodermal response for the specific emotions varied significantly and generally followed the arousal ratings. The disgust emotion produced the largest significant electrodermal response followed by happy/erotic (similar to excitement), sadness and fear, then happy/nurturant (similar to pleasant/happy) followed by the neutral emotion categories.

Significant gender differences were found in this study. Women showed greater concordance between valence judgements and facial action (corrugator and zygomatic responses). With consideration to other research findings (e.g., Schwartz, Brown & Ahern, 1980), Lang et al. suggested that this may be related to richer social communication patterns in women. Conversely, males showed stronger associations among the covariates of the arousal dimension, such as skin conductance levels, interest ratings and viewing times. There were no gender differences observed for the heart rate and valence relationship.

These findings, using a picture viewing methodology, suggest that skin conductance is a suitable index of arousal. Although not as convincing, this study also supports the use of the heart rate measure as an indicator of the emotion valence characteristics, as suggested in other studies (e.g., Libby, Lacey & Lacey, 1973; Winton, Putnam & Krauss, 1984). Such encouraging results instigated the re-examination of the Ekman (Ekman, 1983) emotions and other emotional states (e.g., Johnsen, Thayer & Hugdahl, 1995; Witvliet & Vrana, 1995) in light of their valence and arousal characteristics. These most recent studies reflect the current trend in the investigation of emotion specificity for the physiological measures of heart rate and skin conductance.

The introductory discussion by Johnsen, Thayer and Hugdahl (1995) described how the two models of emotion organisation may be viewed as complementary rather than mutually exclusive. Described as a "hybrid" model, Johnsen et al. suggested that the discrete emotions and the arousal and valence dimensions are hierarchically related, that is, "*the lower-order discrete emotions are seen as located in the space defined by the higher-order dimensions of valence and arousal*" (p.194). Attempting to demonstrate the compatibility of these two models, Johnsen et al.'s study examined the relationship of the dimensional judgements of valence and arousal to skin conductance and heart rate activity accompanying a number of discrete facial expressions of emotion (see Ekman, 1983).

A slide presentation of the Ekman faces (see Ekman, Friesen & Ellsworth, 1972) was used to generate the emotions of happiness, surprise, anger, fear, disgust and sadness. The slides were presented for a 6 second viewing time after which subjects rated the slides on a five point scale (0-4) for the following descriptors; happiness, surprise, anger, fear, disgust, sadness, plus interest, pleasantness, activation, calmness, arousal, relaxation and liking. The published report limits itself to the analyses concerning the arousal and valence ratings.

Skin conductance responses were scored from the first 4 seconds and recorded if they were larger than 0.05 μ S. Heart rate was recorded in beats per minute each second for the 6 second period. The pre-stimulus baseline was calculated as the mean of the heart rate of the last two seconds preceding stimulus onset. The changes were calculated by subtracting the heart rate during presentation of the stimulus from the pre-stimulus baseline. The largest directional change in the six second stimulus presentation period was noted.

Covariance analyses revealed significant linear relationships for heart rate and

skin conductance with the ranking of pleasantness and arousal respectively.

Examination of the heart rate data revealed a main effect of emotion that almost reached significance $F(6,228)=2.01$, $p<.06$, $MS_e = 113.13$. Analyses of heart rate responses to individual emotions showed that angry and disgust facial expressions resulted in larger heart rate decelerations than fear. Heart rate acceleration was observed for happiness and heart rate deceleration was observed for angry expressions. Johnsen et al. noted that these responses are consistent with the findings of other researchers (e.g. Greenwald et al., 1989; Lang, et al., 1993) indicating heart rate acceleration to positive stimuli and heart rate deceleration to negative stimuli. Gender differences were found in the heart rate data. Males generally recorded a larger heart rate deceleration than did female subjects. The sex of the stimulus also influenced the heart rate activity for the angry expression, with a larger heart rate deceleration accompanying the male expression.

Subject gender and sex of the stimulus also influenced the skin conductance data. Female subjects showed larger skin conductance changes than males. An interaction effect for sex of stimulus and emotion was significant, with the male happy expressions resulting in greater skin conductance response magnitudes than the female happy expressions. Male neutral expressions showed larger skin conductance responses (SCRs) than did female happy expressions, male fear expressions showed larger responses than female happy expressions while male happy expressions showed larger SCRs than female happy and sad expressions. The female angry expression showed larger SCRs than male sad, male angry, female disgust, female happy and female sad expressions. These results largely mirrored the results for ratings of arousal and are largely consistent with the responses to discrete emotions mentioned above. In summary, the study by Johnsen et al. (1995) showed that the responses to discrete emotions could be described in terms of both a valence and arousal dimension and that these two dimensions showed correlations with heart rate and skin conductance respectively.

Elevated heart rate activity has previously been demonstrated accompanying negative valence emotions using relived imagery (e.g., Levenson, Ekman & Friesen 1990). Other studies utilising imagery that have considered arousal and valence levels (e.g., Jones & Johnson, 1980; Cook, Hawk, Davis & Stevenson, 1991), have found that heart rate increases are obtained with imagery of high-arousal emotions compared to imagery of low arousal emotions. Pictorial research studies (e.g., Lang et al., 1993) also suggest that arousal is more likely than valence to modulate electrodermal activity. In response to these findings, and a concern regarding the monitoring of the emotional context during imagery and relived emotion methodology, a study carried out by Witvliet and Vrana (1995) examined the relationship between a number of physiological measures and the arousal and valence levels of emotional states elicited under controlled imagery conditions.

In an attempt to disentangle valence and arousal effects on physiological measures, Witvliet and Vrana (1995) used carefully selected stimulus material to generate emotions located in each of the four quadrants of the affective space defined by the valence and arousal axes (Watson & Tellegen, 1985; Russell, 1980). Sentences, previously rated by an independent sample, describing four situations to generate the affective states of fear, sadness, joy and pleasant relaxation, formed the stimulus material. These four affective categories or general states were taken to be representative of high Positive Affect (joy), low Positive Affect (sadness), high Negative Affect (fear) and low Negative Affect (pleasant relaxation). This information is illustrated in Figure 3.1 and is consistent with the information provided by Watson and his colleagues (e.g., Watson & Tellegen, 1985; Watson, Clark & Tellegen, 1988) who define Positive Affect (PA) and Negative Affect (NA) as terms used to describe emotions that reflect one's pleasurable or unpleasurable engagement with the environment respectively.

Figure 3.1 Fear, sadness, joy and pleasant relaxation presented in an “affective space” defined by the valence and arousal dimensions. Adapted from Witvliet & Vrana (1995), Figure 2, p.441.

Please see print copy for image



Forty-eight subjects imagined affective situations during tone-cued eight second trials. The startle reflex and facial electromyogram, as well as the autonomic measures of heart rate and skin conductance level, were examined. The success of the imagery trials in generating target affective states was confirmed by the ratings data. Specific contrasts showed that each emotion differed from each of the others. Subject ratings of valence confirmed fear and sadness as negative, and joy and pleasant relaxation as positive valence. Similarly, the high arousal imagery was given higher arousal ratings than the low-arousal imagery. It should also be noted that higher arousal ratings were given to the negative emotions than to the positive emotions.

Some interesting results were found for the autonomic measures in this study. Data from the 1 s prior to the tone signalling imagery was used as a baseline to determine average changes for each of the physiological measures. Average change in heart rate level was found to be higher for high-arousal affective imagery (fear = 1.91 BPM; joy = 1.51 BPM) compared to low arousal affective imagery (sad = 1.03 BPM; pleasant relaxation = 1.06 BPM). This was significant even when valence and vividness were included in the analysis as covariates. There were no significant effects found for the skin conductance level, although the skin conductance change means showed that high arousal negative valence (0.007 μ S) did produce on average larger changes than the low arousal negative valence (-0.004 μ S). In regard to the positive valence states, skin conductance level changes were similar for both the high arousal and low arousal conditions (-0.009 μ S and -0.008 μ S respectively). The interpretation of these data suggested that the changes in skin conductance level may be influenced by the emotional context of the imagery. This contrasts with the skin conductance latency data which showed that high arousal emotion conditions resulted in faster responses compared to the low arousal conditions, irrespective of the emotional context. In general these findings are similar to previous findings (e.g., Cook, Hawk, Davis & Stevenson, 1991; Lang, Greenwald, Bradley and Hamm, 1993), in that electrodermal activity generally responds to highly arousing stimuli that engage the sympathetic nervous system. Also, for the cardiac response, it has consistently been illustrated that increased heart rate occurs during high-arousal events. From their findings, Witvliet and Vrana (1995) argued that the "ultimate utility" of the arousal /valence models in psychophysiological studies rests on the use of a broader range of emotional contexts located within the PA and NA affective space.

3.2.5 Summary

This literature review charts the development of research tactics and techniques in the struggle to identify autonomic response patterns accompanying different emotions. While some consistent patterns are described for the cardiovascular response accompanying the individual emotional states of fear and anger, the more recent research studies have attempted to examine physiological activity in terms of the valence and arousal characteristics of the emotional states.

The more recent studies adopting the arousal/valence model approach (e.g., Witvliet & Vrana, 1995; Johnsen, Thayer & Hugdahl, 1995) have provided some consistent and promising results, and have opened a new door in regard to the investigation of the psychophysiology of emotion. This has generated a fresh interest in this complex area of emotion research, and it is anticipated that continued research along this line will result in more standardised and fruitful methods of investigation with clearer outcomes regarding the physiological correlates.

3.3 AMBULATORY MONITORING

As evident from the above literature review, research into the psychophysiology of emotion remains concerned with the methodological issues surrounding emotion elicitation. Emotion has an experiential quality and is usually conveyed by self-report. The success of the laboratory environment in generating "real" emotion is understandably questioned, and perhaps the only way to induce real emotion is to use real situations (Ney & Gale, 1988). Ambulatory monitoring provides the best chance to monitor "in situ" and examine the physiological changes accompanying true emotions. A small number of studies have attempted to monitor autonomic responses accompanying different emotions elicited under some unusual and challenging

conditions.

Fenz and Epstein (1967) examined heart rate, skin conductance and respiration rate differences between novice and experienced parachute jumpers obtained from a sequence of events prior to and following a jump. Compared to earlier attempts to monitor physiological changes during "real life" stress situations (e.g. Luria, 1932; Janis, 1958; cited in Fenz and Epstein, 1967) the parachute jump is an activity that enables a certain degree of experimental control that is not normally possible outside the laboratory. The parachuting activity does not require strenuous physical exertion, yet it imposes a considerable psychological stress on the subject. It can be arranged and repeated in accordance with experimental requirements and the effect of subject differences, such as experience, can be identified.

Fenz and Epstein described the parachute jump for the novice as similar to an approach-avoidance conflict. The novice experiences the excitement and thrill associated with any challenge, while on the other hand, fear associated with possible injury or death is also elicited. The level of anxiety in parachutists is easily observed, with subjects showing different stages of cognitive and motor disorganisation, ambivalence and perceptual denial. These responses are noted by Fenz and Epstein as similar to those observed in patients with anxiety disorders.

The primary aim of the experiment was to examine whether the physiological measures of heart rate, skin conductance and respiration paralleled the levels of fear and anxiety experienced. Ratings were used to measure intensity of fear and anxiety at different pre-determined points before and after the jump. Novice jumpers' ratings increased up to the point of jumping then decreased continuously. The ratings of experienced jumpers indicated that their fear levels rose slightly until the morning of the jump then decreased continuously to the moment of the jump. Thereafter, an increase in

fear was found, which continued until after landing. For both groups peak anxiety was rated before the goal act, that is, the jump.

A portable monitor was used to record the three physiological measures during preparation for the jump and immediately prior to jumping. The effect of altitude on the three measures was taken into consideration and the measures were adjusted accordingly. Altitude effects were most noticeable for the heart rate response. Once airborne, skin conductance levels of the novice jumpers continued to increase up to the final altitude whereas the experienced group showed a decrease in skin conductance level until the last point after landing. Heart rate activity was similar for both groups until they boarded the plane. Novice heart rate levels continued to increase up to the final altitude while the heart rate for the experienced group plateaued during the plane ride. Fenz and Epstein noted that with consideration to heart rate adjustment due to altitude effects, heart rate levels of the experienced jumpers actually declined from the end of the take-off period to the final altitude. Breathing rate for the novice parachutists also displayed a continuous increase to the final altitude. An increase was observed in breathing rate for the experienced group, but this soon changed to a decrease towards the final altitude. Surprisingly, given the elevated heart rate levels, Fenz and Epstein found no need to adjust the breathing rate data, as altitude effects were minimal for this measure.

Overall, the novice jumpers reached higher levels of physiological arousal than the experienced co-jumpers. The novice jumpers showed a sharp rise in physiological activity up to the final altitude while experienced jumpers showed a sharp initial rise followed by a decline in the physiological measures before jumping. Fenz and Epstein concluded from this finding that *"...with repeated exposure to threat, expanding gradients of activation and of inhibition develop, the latter with steeper slope. The early rise in activation provides an automatic signal of danger while the inhibitory reaction*

prevents the arousal from becoming excessive, thus providing a highly adaptive mechanism for the mastery of threat." (p.33). Examination of physiological differences in the novice compared to experienced jumpers showed that differences in skin conductance changes were greatest, followed by differences in heart rate and respiration changes. Fenz and Epstein proposed that this finding reflected the ability of these three measures to reflect the inhibitory process, which corresponded to the degree to which the reactions could be controlled by the parachutists. Examination of individual subject data also showed that correlations between these three physiological measures were relatively high under conditions of moderate stress, but were low when tested under conditions of high stress.

A study conducted by Reid, Doerr, Doshier and Ellertson (1971) at the Naval Aerospace Recovery Facility in the United States also examined psychophysiological changes in military parachutists. This technologically-advanced study monitored heart rate and respiration changes in eighteen parachutists throughout the entire jump procedure. The study identified the egress (about to jump), parachute deployment and landing as the three most critical psychophysiological events during free-fall parachuting. Highest heart rate means were found for parachute deployment (157.7 BPM) followed closely by landing (155.7 BPM). These were significantly higher than baseline levels (77.4 BPM) taken one hour prior to jumping. HR acceleration was found to be highest for the three minute period prior to egress, with an average HR increase of 20.6 BPM. According to Reid et al., this validated the subjective impression that egress is a critical and emotionally arousing event during parachuting.

Consistent with the study by Fenz and Epstein (1967), novices were found to display higher heart rate increases than their more experienced counterparts. Heart rate level decreased in a given subject as experience increased. The type of main parachute canopy employed was found to significantly impact on heart rate levels obtained during

the jump. This finding naturally has certain implications for those concerned with the welfare and safety of parachutists. To conclude, with consideration to altitude effects, Reid and his colleagues suggested that the rapid heart rates observed were more likely caused by psychological rather than physiological events. This is supported by subject data showing higher heart rate jump values than from participation in strenuous physical exercise. Continued research in this area will not only contribute to the more practical considerations of parachuting, but also to the understanding of the basic mechanisms governing the tachycardia response. As well as encouraging further research examining anxiety in parachutists (e.g., Roth, Breivik & Elbert, 1991) this type of research influenced the approach to the study of the psychophysiology of mood states and panic attacks (e.g., Roth, Tinklenberg, Doyle, Horvath & Kopell, 1976; Taylor et al., 1986; Taylor et al., 1987) where ambulatory monitoring equipment was used extensively.

A study by Lewis, Ray, Wilkinson and Ricketts (1984) showed some similarities to the research undertaken in this thesis. They examined heart rate responses of participants on a challenging Zip-wire ("flying-fox") activity. Compared to parachuting, this challenging and emotion-evoking activity allows easier access to subjects for the collection of psychological and physiological data monitored "in situ". In addition, a number of trials may be executed in a more practical time period. Anxiety was monitored using self-report rating scales, while heart rate levels were collected using a telemetry system with average HR (in BPM) determined from a 10 second sample. Similar to the parachute studies, data were collected from previously identified seven crucial stages of the zip-wire activity. Eight trials (zip-wire attempts) were performed.

Heart rate data were essentially similar in pattern to that reported in the parachute studies (Fenz & Epstein, 1967; Reid et al, 1971). Significant differences in heart rate levels were obtained between each of the seven pre-determined sampling points. Heart rate levels decreased with successive attempts of the zip-wire task and

heart rate patterns changed between the trials. For example, trial 1 showed a heart rate increase through all stages; peaking with the actual ride on the wire, while trial 6 revealed a heart rate peak while standing on the platform, followed by a dip during take off, and peaking again during the ride. The heart rate pattern obtained for trial 1 was described by Lewis et al. as similar to that observed for novice parachutists.

Some gender differences were found in the self report measures that were not reflected in the physiological data. Heart rate levels were found to be similar for both males and females, even though female reports of anxiety were higher. Other findings showed further inconsistencies between HR levels and the self-reports. This study therefore raises concerns both as to the use of heart rate measure as an accurate index of anxiety, and whether their findings simply reflected underlying problems with the use of questionnaires involving sex differences. Given the nature of the task, it is possible that males may have indicated a more favourable picture of their anxiety levels compared to their female counterparts. This experiment highlights the advantages of standardised questionnaires compared to isolated use of rating scales. Although gender problems are apparent, this study still illustrates the possibilities of research conducted under real-life conditions.

Using a naturalistic stressor (giving a 5 minute speech in class) Matthews, Manuck and Saab (1986) examined the cardiovascular responses (blood pressure and heart rate) of 25 adolescent subjects. Similar to the parachute jumpers, the physiological measures were sampled from five pre-determined stages: time of assessment (baseline), prior to speech, signal of speech, immediately after speech and at the next English class. Subject information collected included type A behavior, trait anxiety, hostility and anger levels, and family hypertension history details. The physiological measures were obtained using an automated electrospygmanometer worn on the non-dominant arm.

Compared to the data gathered during the normal English class, the stress of giving a speech resulted in elevated systolic blood pressure and heart rate levels for the anxious students. Adolescents categorised as angry (that is, those who frequently expressed their anger outwardly) also showed elevated diastolic blood pressure. These results confirmed previous findings examining physiological changes accompanying fear and anger (e.g., Funkenstein, King & Drolette, 1954; Schwartz, 1981; Sinha, 1992) and studies specifically examining the effects of speech anxiety on cardiovascular responses (e.g., Beidel, Turner & Dancu, 1985). The authors caution the reader in regard to complete acceptance of their findings due to the study's uniqueness and size of the subject sample. However, it would seem that the uniqueness and relative success of the study should encourage other researchers to examine psychophysiological responses accompanying different types of real life stressors in varied field and laboratory environments.

The relevance and importance attributed to real life studies is well illustrated by studies examining physiological changes accompanying different emotions as subjects go about their normal daily routines. Such studies hold potential for the treatment of anxious, hypertensive and depressive clinic populations. For example, a study by James and his colleagues (James, Yee, Harshfield, Blank & Pickering, 1986) used ambulatory monitoring to record systolic blood pressure and diastolic blood pressure changes of subjects as they went about their normal daily life. These physiological changes were related to emotional changes as reported by the subjects using the descriptors happy, angry or anxious. Analysis of the physiological data showed that levels of anger, anxiety and happiness were differentially correlated with blood pressure. It was found that systolic pressure decreased as the intensity of happiness increased, and more importantly, diastolic pressure increased with the intensity of anxiety. These different patterns in systolic and diastolic blood pressure generally reflect those previously observed in the laboratory environment and are frequently considered in research on

hypertension (e.g., Dimsdale, Pierce, Schoenfeld, Brown, Zusman & Graham, 1986; Schneider, Egan, Johnson, Drobny & Julius, 1986)

The previous few pages describe studies that have involved ambulatory monitoring of physiological and psychological measures accompanying emotional states elicited under "real-life" conditions. There are comparatively few studies of this nature, yet these studies have consistently demonstrated that heightened autonomic activity reflects situations that are highly arousing. The parachute studies (e.g., Fenz & Epstein, 1967; Reid, Doerr, Doshier & Ellertson, 1971) and the study on the "flying fox" (Lewis, Ray, Wilkinson & Ricketts, 1984) showed that the physiological responses, in particular HR, reflected the different levels of reported anxiety for particular stages of the activity. The cardiac data from the parachute studies also discriminated between the subject groups that differed in levels of experience and the reported pattern of anxiety experienced during the course of the activity. The classroom study carried out by Matthews and her colleagues (Matthews, Manuck & Saab, 1986) recorded HR and BP changes similar to those previously reported in related studies carried out under laboratory conditions. The more detailed study by James and his colleagues (James, Yee, Harshfield, Blank & Pickering, 1986) explored a few more emotions (anger, anxiety and happiness) with results that also proved consistent with previous laboratory findings. In summary, these ambulatory studies have revealed data consistent with their laboratory study counterparts. However, one should realise that these studies have mostly focused on the more reliable cardiac response activity under anxiety conditions. The success of outdoor "real-life" studies may be challenged in the future with the investigation of a wider range of emotions and their accompanying physiological patterns.

While there are inherent problems in conducting such studies away from the carefully controlled laboratory environment, the elicitation of genuine, uninhibited and

strong emotions makes the real life environment appealing as a location in which to study the psychophysiology of emotion. In the light of technological advancements and the provision of more reliable and scientific-precision instrumentation, this method of research investigation certainly warrants continued and enthusiastic attention, as it may well provide the reliable and consistent results that to date have eluded laboratory based studies.

CHAPTER 4

Outdoor Education and the Ropes Course

4.1 OUTDOOR EDUCATION DEFINED

4.1.1 Introduction

Outdoor Education is "a means of approaching educational objectives through guided direct experience in the environment, using its resources as learning materials" (Royce, 1987, as cited in Humberstone, 1990, p.200). Outdoor Education is a term used to describe all learning, social and personal development and the acquisition of skills associated with living in the outdoors or participating in outdoor activities. It provides opportunities for experience and attainment in the three domains of behavior, namely its psychomotor, affective and cognitive aspects. In contrast to the traditional classroom, in Outdoor Education, *challenge* and *adventure* are the primary motivators for learning, and learning is active, cooperative and relevant (Bunting, 1989; Cooper, 1996). Personal characteristics developed through Outdoor Education include self esteem, confidence, motivation, cooperation, communication, decision-making skills, critical and lateral thinking, self-reliance, environmental awareness and appreciation, and the ability to reflect and evaluate. In short, Outdoor Education programs have the potential to affect positive changes in attitude and behaviors towards oneself and the environment (Marsh, Richards & Barnes, 1984; Zook, 1986; McAvoy, Curtis-Schatz, Stutz, Schleien & Lais 1989; Smith, Roland, Havens & Hoyt, 1992; Gray & Perusco, 1993; Cooper, 1996; see also Ewert, 1989)

The term Outdoor Education has been used interchangeably with Adventure Education, Environmental Education, Camp Adventure, Awareness Education and

Experiential Education (Smith, Roland, Havens & Hoyt, 1992). One thing common to all these programs is that learning occurs through personal experiences outdoors (Ford, 1981). Each of these forms of education, and others such as Humanistic Education and Recreation Education have laid the foundations for what Smith, Roland, Havens and Hoyt (1992) described as Challenge Education. In New South Wales, Australia, the state (NSW) Department of Education has endorsed Outdoor Education programs for their contribution to the key learning areas of Personal Development, Health and Physical Education. These key learning areas are outlined in a number of syllabus documents (see NSW Department of Education, Board of Studies, 1991, 1992a, 1992b, 1992c, 1992d). Each year over 50,000 school children from NSW attend Outdoor Education programs operated by the NSW Department of Sport and Recreation to fulfil curriculum requirements. An equal number of children have attended Outdoor Education programs conducted by private organisations (e.g., Outward Bound, The Outdoor Education Group), private schools (e.g., Glengarry, Timbertop) and church groups. Typically, these programs involve adventure and wilderness activities (e.g., Ropes Course, Abseiling, Bivouac), environmental activities (Marine and Earth studies) and recreational pursuits (Initiative games, Bushwalking) that are conducted outdoors and involve personal and group challenges.

The therapeutic value of the wilderness (Miles, 1987; Nettleton, 1987, McAvoy et al., 1989; Scherl, 1989) and the benefits from participation in Outdoor Education programs in areas such as mental health (Neill & Heubeck, 1995b) and personal development (Bouchard, 1973; McIntyre, 1987; Humberstone, 1990) have been supported by research. However, given the number of participants in Outdoor Education programs, and the emphasis placed on deliberately exposing these participants to challenging situations, little research has attempted to understand the processes that take place during these moments of challenge. Gray and Perusco (1993) used the term "black box" to illustrate the lack of knowledge about the complex processes that occur during

challenging activities. Many Outdoor Educators feel that these processes are influenced by factors such as the wilderness setting, timing, the participant's readiness, the leader's personal attributes and skills, and the nature of the program itself. There is, however, little research examining the influence of each of these factors on program outcomes (Neill, 1997) or on the processes occurring.

4.1.2 The Notion of Challenge

"In essence, a person who is confronted by a series of challenges (external demands) and masters them by actual participation (providing direct experience) has their image of themselves strongly enhanced" (O'Brien, 1989, p.9).

One of the main features of Outdoor Education programs and activities is the experience of personal "challenge". According to Bunker (1991), to optimise opportunities for building self-esteem through challenge, children should be exposed to experiences or challenges that match their developmental capabilities. In adventure activities, the relationship between skills, challenge and successful outcomes has been examined in great depth by Priest and his colleagues (see Chapter 4 review in Priest and Gass, 1997). Challenge in Outdoor Education adventure activities is presented to the participants in the form of perceived risk and is most commonly reflected in the participants as negative emotion (e.g., anxiety, worry) (Bunting, Little, Tolson & Jessup, 1986; Nettleton & Dickinson, 1996). According to Outdoor Education theorists (Outdoor Pursuits, 1990; Mortlock, 1984; see also Iso-Ahola, LaVerde & Graefe, 1988), behavioral change is greatest when success is experienced in activities that involve moderate anxiety or arousal levels (Duffy, 1957; see also Priest, 1993). Hanley and La Motta (1988) believe that emotional growth is most lasting when it occurs under challenging conditions which promote difficulty and fear. According to Nadler and Luckner (1992), under difficult or adverse conditions, heightened emotional arousal can

challenge participants and facilitate personal insight into both destructive and constructive behavioral patterns or beliefs.

A study by Iso-Ahola, LaVerde and Graefe (1988) examined the relationship between perceived confidence and the effects of participation in risk recreation activities on self esteem. Their results indicated that it was not the number of experiences, but rather the quality of the experiences gained from risk activities, that raised self esteem. Their data also indicated that, rather than being a stable construct, changes in self esteem did occur and that these changes reflected the level of success experienced during the challenging activities. For the Outdoor Educator, this study illustrates the importance of monitoring participant responses both during and after the challenging activity.

It should be emphasised that it is the perspective of the participant that is important and that challenge does not imply high skill levels or advanced activities. A number of models have described the balance between the level of competence and the degree of difficulty of an activity necessary to gain optimum positive change in behavior (Mortlock, 1984; Priest, 1990; see also Nettleton & Dickinson, 1996). Where the degree of difficulty is slightly above the participants' skill levels, maximum concentration is required and there is usually a degree of both anxiety and excitement. Mortlock (1984) noted that, for many adventure participants, the most memorable experiences were related to varying types of activities that resulted in high levels of anxiety and excitement experienced simultaneously.

From his interviews with a number of persons participating and excelling in activities that demanded intense emotional involvement and challenge, Csikszentmihalyi (1975) identified a state of mind he termed as "flow". This term was used to describe characteristics such as the merging of action and awareness, loss of

self-consciousness, transcendence of individuality or fusion with the world, and a perception of control over self and the environment, that were experienced during challenging adventure activities. This set of characteristics, or rather state of mind, is similar to that described by Maslow (1964) for "peak experiences". Another popular term used in the Outdoor Education literature to describe this beneficial or positive stress experience, that results from the matching of challenge and skills in adventure settings, is "Eustress" (Zuckerman, 1978; Bunting et al., 1986; Priest, 1993; for a detailed discussion see Priest & Gass, 1997). Based on White's (1959) model of competence motivation, Bandura's (1977) social learning theory and Weiner's (1972, 1985) theory of attribution and locus of control, Priest and his colleagues (Martin & Priest, 1986; Priest, 1993; Priest & Klint, 1994) developed a model of "competence effectance" for risk taking behavior. As indicated in Figure 4.1, this model links the challenge (level of difficulty) and personal competence aspects of a challenge or adventure experience with the negative feedback (Distress Loop) and positive feedback (Eustress Loop) experiences.

In the absence of a wilderness environment and/or limitations regarding access to these natural areas, Outdoor Education programs have attempted to incorporate activities (e.g., artificial rock face climbing, Ropes Course) that simulate the experience of natural challenge by exposing participants to "perceived risks". Through challenge, activities are designed to foster success and opportunities for "positive stress" or Eustress. Selection of appropriate levels of challenge for the participants is largely dictated by the emotional behaviors of the participants as well as staff intuition and past experiences. The selection and facilitation of these challenging experiences would be enhanced and more effective if we had an increased understanding of the types of processes that occur during these challenging activities.

Figure 4.1 The neutral, positive and negative feedback loops of the risk taking and competence effectance model. Adapted from Priest and Gass (1997). *Effective Leadership in Adventure Programming* (pp. 55 - 56).

Please see print copy for image

4.1.3 Research in Outdoor Education

The benefits of wilderness adventure have been documented in personal accounts (e.g., Mortlock, 1984; Nettleton, 1997) and research studies employing qualitative methods. Methods such as diary inputs, self descriptions and open-ended questions or peer observations, involving a small number of participants, have been the most popular (e.g., Dickinson, 1989; Nettleton & Dickinson 1989; McAvoy et al., 1989; see also Cason & Gillis, 1994). In his appraisal of the state of research activities involving school Outdoor Education programs, Neill (1997) notes that research activities over the last decade have been largely outcome focused. Most prolific are studies exploring changes in areas of personal development (e.g., Stimpson & Pedersen, 1970; Humberstone, 1990; Gray, Patterson & Linke, 1993; Conrad & Hedin, 1995) and mental health (e.g., Voight, 1988; Neill & Heubeck, 1995b). Only in the last few years has some attempt been made to monitor the changes (e.g., in anxiety) that take place during specific components of these programs (e.g., Neill & Heubeck, 1995a).

In his review, Neill (1997) also noted that many of the study findings showed wide variability, and when considered together, these studies suggested that Outdoor Education programs are not inherently good. Neill's concluding remarks highlight the need for continuous evaluation of Outdoor Education programs, with attention to program characteristics (e.g., program length, client group and program activities) as well as program outcomes. Ewert (1995) also raised concerns regarding the type of research carried out in Outdoor Education. He argued that research activity needed to focus on the process of change, as well as on the outcome, thus providing the Outdoor Educator with a working knowledge and understanding of the situation, the facilitation process and the potential outcomes. The depth of understanding required in the practice of Outdoor Education can only be achieved with qualitative and quantitative research investigations complemented with "in situ" monitoring.

The work by Nettleton and Dickinson (e.g., Nettleton & Dickinson 1989; Dickinson, 1989) presented at the Australian National Outdoor Education Conference provided information concerning the emotional profiles of subjects participating in challenging adventure activities. Their work adopted similar research methods to those used by Klausner (1967). He attempted to plot and analyse the emotional changes experienced by skydivers during their dive. Through the use of diary entries, observations and questionnaires, Dickinson and Nettleton (1989) produced sketches of the emotional profiles of a small group of students aged 20-25 involved in a kayak expedition around Hinchbrook Island in Queensland. The questionnaires administered included a Mood States Questionnaire (McNair, Lorr & Droppleman, 1981), a questionnaire to establish the emotional quality of the Environment (Russell & Pratt, 1980) and measures of stress and arousal (King, Burrows & Stanley, 1983). Through analyses of these questionnaires the study was able to correlate levels of emotion, particularly enthusiasm and fear, with physical obstacles encountered during the adventure, as well as to identify certain periods of time that caused significant emotional changes in the participants.

As highlighted in the study by Nettleton and Dickinson, there are obvious practical limitations to the type of in situ monitoring that can be conducted during adventure activities. *"Although the profiles of fear and enthusiasm were obtained from questionnaires given after the expedition it was clear that different emotions were elicited at different stages of the expedition. From the diaries it also appeared clearly that emotions were involved and these often fluctuated very rapidly in certain situations. It also appeared necessary to develop more satisfactory methods of obtaining this information. The investigation of emotion appears to require a research approach which combines verbal and non-verbal methods"* (Nettleton & Dickinson, 1989, p.77).

The need to monitor transitory emotional changes during adventure activities

was highlighted in a second study by Dickinson (1989). This particular study monitored the levels of arousal and stress that occurred during a short rafting trip down the Tully River in Northern Queensland. A "Linear Arousal and Stress scale" (LASS; Nettleton & Dickinson, 1989) was used to assess relative differences between levels of both stress and arousal during the rafting trip. Another more recent study by Dickinson (1997) explored gender effects in the affective responses of participants involved in a canoeing and walking trip in a wilderness area in the Northern Territory. Using diary entries and a series of questionnaires, Dickinson monitored changes in pleasure/joy, excitement/arousal, stress, anger and fear. Compared to negative emotions, the positive emotions of pleasure/joy and arousal/excitement were reported a greater number of times. In addition, it was found that reports of positive emotions were related to environmental antecedents. Compared to males, female self-report of positive emotion was more frequent and of greater intensity. This last finding may be attributed to the willingness of females to report their emotional experiences. Dickinson concedes that these findings should be treated with caution due to the small sample size and large deviations in some scores.

As discussed in the previous chapter, the continuous monitoring of physiological measures during "real-life" activities has been conducted in other areas of study, such as the psychophysiology of anxiety and stress (e.g., Matthews, Manuck & Saab, 1986; James, Yee, Harshfield, Blank & Pickering, 1986). In the closely related field of Physical Education, HR levels of child participants have been monitored using telemetry during different Physical Education activities, such as indoor soccer and handball. Stratton (1995, 1997) used HR levels as an objective measure of physical activity from which to examine the potential effects of different sporting activities on cardiovascular fitness. In another study, Stratton used HR levels of children playing handball to examine gender and ability differences (Stratton, 1996). In comparison, a study of aerobic fitness improvement due to participation in an extended stay Outdoor Education

program (Okely, Gray & Cotton, 1997) did not attempt to gather measures “in situ”. The authors used a 20 metre shuttle run test to measure teenager’s fitness levels at the initial stage and sixteen weeks into the program. While this study showed that Outdoor Education programs do contribute to fitness levels, it could have provided more useful information (e.g., identification of activities or stages of the program that led to greater improvement in fitness). This would have required monitoring changes at various stages throughout the program rather than relying on before/after measures.

A number of small studies have relied on before/after measures to explore anxiety and stress changes in participants on adventure activities (e.g., Maynard, MacDonald & Warwick Evans, 1997; Neill & Heubeck, 1995a). For example, the study by Maynard and his colleagues explored anxiety levels in novice rock-climbers using a set of questionnaires administered prior to the climb only. While the aim of this study was to examine the effects of relaxation techniques on cognitive and somatic anxiety levels, monitoring anxiety levels both before and during the climb would have provided more information relevant to the activity itself. In addition, the use of ambulatory monitoring equipment to monitor physiological levels during the climb would have provided a unique insight into the type of psychophysiological changes that occur during this activity. Naturally, the availability of suitable monitoring equipment that can be used in these challenging environments has limited this type of research activity.

A portable HGM1 monitoring system (Barry, Moroney, Orlebeke & de Vries, 1991) was used in three studies conducted on the Ropes Course described in this thesis. This equipment provided a relatively unobtrusive means of monitoring and storing HR and SCL data with scientific precision and reliability during the activity. In light of the limited information provided in Outdoor Education research studies such as those described above, it was expected that the use of both physiological and psychological measures monitored during the actual activity would provide insight into the underlying

processes present during these challenging activities.

4.1.4 Summary

Research in Outdoor Education is limited due to the accessibility and nature of the environment as well as the lack of scientific monitoring equipment to be used outdoors. For example, many of the more challenging and “emotional” activities are conducted in remote areas (e.g., wilderness hikes) or under environmental conditions (canoeing, abseiling) unsuitable or impractical for monitoring purposes. With the construction of a number of activities in residential settings (e.g., Ropes Course, Climbing walls) and development of portable scientific monitoring equipment (Treiber, Musante, Hartdagan, Davis, Levy & Strong, 1989; Barry, Moroney, Orlebeke & de Vries, 1991), research investigating the psychophysiological changes that occur during challenging adventure activities is now possible.

While the research studies described above provide some insight into the effects of Outdoor Education activities, the benefits of these studies for the instructor or participant is limited, due to the lack of information addressing the changes that take place during the activity. With the use of both physiological and psychological measures, these changes can be monitored and used to explore the psychological processes, and the emotional changes that occur. This sort of research activity and level of inquiry is necessary if Gray and Perusco's (1993) "black box" is to be opened.

4.2 THE ROPES COURSE

4.2.1 The Development of the Ropes Course Activity

" A challenge Ropes Course is a series of individual and group physical challenges that requires a combination of team work skills and individual commitment. Constructed of rope, cables and wood, courses are constructed outdoors in trees (or using telephone poles) and indoors in gymnasiums"
(Webster, 1989 p.vii).

The introduction of the Ropes Course in the 1800s is credited to a Frenchman, George Herbert (Webster, 1989; Sproul & Priest, 1992). Herbert valued "natural exercise" and thus developed a ropes/obstacle course that he used in the training of French naval recruits. Today, the military continue to make use of the Ropes Course in the development and training of their personnel, as do many other professional and corporate training groups. For example, in 1991, HMAS Penguin at Mosman, Sydney installed a Ropes Course for the training of the naval base personnel. The Ropes Course activity may be used as a training tool to address concerns such as team work, communication skills, leadership, problem solving and safety/risk-taking strategies (Rohnke, 1991). The interest in and use of the Ropes Course in Outdoor Education programs for children stem from its psychomotor, cognitive and affective contribution to the overall development of the child participant. These three domains of behavior may be developed in a variety of physical education activities, but what is unique to the Ropes Course and other similar adventure activities is the absence of a competitive environment, such as is associated with traditional team sports. Research has shown that competition in sport may be perceived as threatening and aversive (Martens & Gill, 1976; Gill & Martens, 1977; Robinson & Carron, 1982; Gill, Dzewaltowski, & Deeter,

1988; see also Bunting, 1989; Smith & Smoll, 1990), and that this is one of the factors influencing a child's participation in physical education activities.

Webster (1989) credits the demand for Ropes Courses to the diversity of community groups now incorporating the Ropes Course into their specific programs. *"Many camps now offer a Ropes Course station as a one to five day option for campers, and numerous Colleges offer Ropes Course programs as part of student leadership training, orientation programs, or as part of teacher education for the Adventure field. From the beginning, youth-at-risk programs and agencies have seen the potential of high impact training offered by the Ropes Course"* (Webster, 1989, pvii). Another recent trend is the use of adventure programming in professional and corporate training. Team-building needs, communication issues, creative problem-solving, risk-taking strategies, stress-reduction techniques, and many other professional-development themes have been addressed through Adventure Education approaches which often use the Ropes Course activity as a training tool.

To date there are, by most estimates, between 2000 and 3000 Ropes Courses in the United States, 1000 of which were constructed by Project Adventure staff. Most of the others have been constructed by organisations using their own staff and initiative. The use of Ropes Courses in Australian state and private Outdoor Education Centres is increasing. In NSW, 8 of the 11 government Sport and Recreation centres offer the Ropes Course activity as part of a five day Outdoor Education program for primary school students.

The following goals for the Ropes Course were obtained from the Project Adventure publication *"Cowtails and Cobras II"* by Karl Rohnke (1989, pp. 11-13). They are endorsed by Project Adventure and many other outdoor Education Programs. They typically illustrate what Outdoor Educators feel will be achieved by participation

on the Ropes Course:

- * increase the participant's sense of personal confidence,
- * increase mutual support within a group,
- * develop an increased sense of agility and physical co-ordination,
- * develop an increased joy in one's physical self and in being with others,
- * develop an increased familiarity and identification with the natural world.

4.2.2 The Broken Bay Ropes Course

The policy statement regarding the use of the Broken Bay Ropes Course (Policy for use of Broken Bay Ropes Course, 1988) provides the rationale for the inclusion of this activity in the Primary Outdoor Education Program offered at the Broken Bay centre. It states that the inclusion of the Ropes Course activity is based on the premise that it can *"...promote a growth in self awareness through the provision of varying levels of challenge. Furthermore, depending on the specific lesson planning which is implemented, an increase in co-operation and the skills of group negotiation may be encouraged"* (p.1).

Preliminary investigation as part of this thesis, using questionnaires at the Broken Bay Sport and Recreation Centre, identified the Ropes Course activity as one of the most challenging activities that the children are exposed to in the five day program. Discussions with the staff also indicated that this activity evoked definite emotional responses in the children, ranging from bursts of excitement to visible shaking, and at the most extreme, tears. In regard to the more-practical concerns regarding the use of the ambulatory monitoring device (HGM1) (Barry, Moroney, Orlebeke & de Vries, 1991), the Ropes Course lesson is conducted over a suitable time period for monitoring and

data storage purposes. It is also conveniently located close to buildings and a power source for computer storage and use.

The Broken Bay Ropes Course was designed and constructed by personnel within the NSW Sport and Recreation Department in 1988. The course consists of six "elements" which are linked together by wooden platforms built on Eucalyptus and Angophora trees. The elements are illustrated in the schematic representation of the Broken Bay Ropes Course shown in Figure 4.2. From left to right are the swinging Bridge (E1), Tyre Walk (E2), Spiders Web (vertical rope net; E3), Postman's Walk (wire tightrope; E4), Flying Fox (Zip Wire; E5), and the free-swinging Exit Ladder (E6). The elements are made of steel cable, wood, bolts, rope and tractor tyres and are block-cabled or bolted to the tree trunks. The fluent nature of the course ensures that participants remain at least 2 m above ground level for the length of the course (approx. 75 m). Table 4.1 shows the list of elements and their approximate length and height at the mid-point. A series of photos (see Figures 4.3a-f) show a Ropes Course participant on each of the six elements of the Course.

At all times whilst on the Ropes Course the participant is required to wear a safety helmet and harness. The participant is connected to a safety belay system suspended above each element using a karabiner device attached to the harness. Another safety feature worth mentioning is that only one child at a time is allowed on each element, to avoid shock loading. This safety feature also (unintentionally) removes the pressure on the anxious child to hurry on the element. During the Ropes Course lesson, a "buddy system" operates, with one child observing the Ropes Course participant from the ground level. This procedure ensures further safety for the participant and encourages co-operation, respect and team-work between the participants.

Consistent with the aims endorsed by Project Adventure, the objectives for child involvement with the Broken Bay Ropes Course are to develop

- “* confidence and self-esteem by successfully completing a challenging activity,
- * decision making skills,
- * the ability to work in groups,
- * an increased awareness of the need for stringent safety procedures in dangerous situations,
- * improved gross motor skills”

(Policy for use of Broken Bay Ropes Course, 1988, p.1)

Table 4.1 The Broken Bay Ropes Course: Element length and height at mid-point.

ELEMENT	Length (m)	Height at mid-point (m)
Bridge (E1)	16.90	1.70
Tyre Walk (E2)	15.20	2.00
Spiders Web (E3)	8.40	2.75
Postmans Walk (E4)	15.00	3.30
Flying Fox (E5)	19.40	4.65
Exit ladder (E6)	7.50	1.67

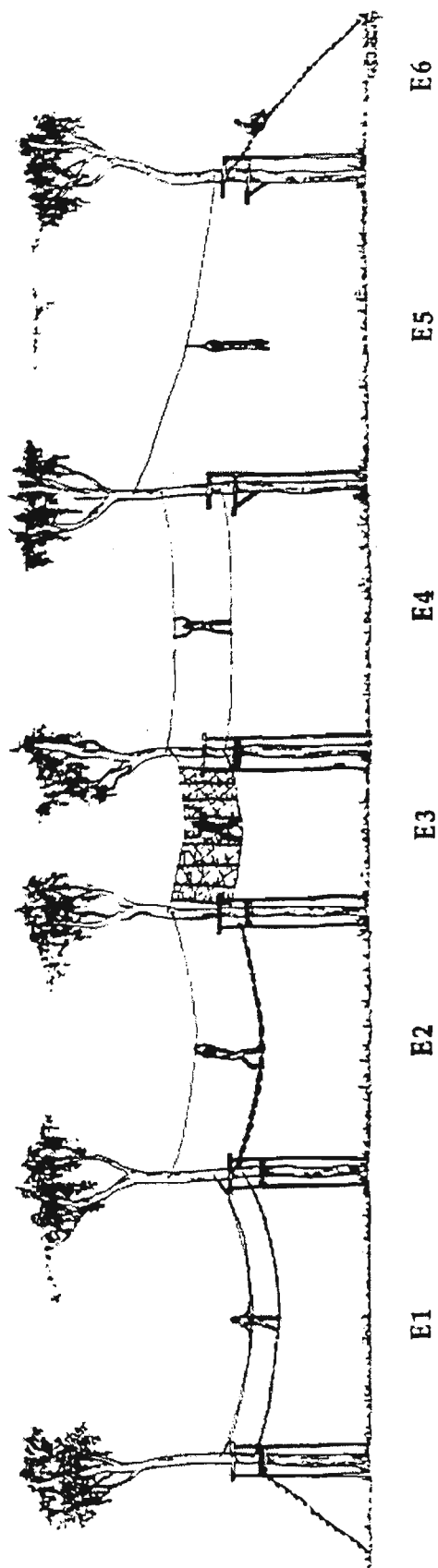


Figure 4.2
Schematic representation
of the Broken Bay Ropes
Course elements: Bridge
(E1), Tyre Walk (E2),
Spiders Web (E3),
Postmans Walk (E4)
Flying Fox (E5) and Exit
Ladder (E6).

Figure 4.3a A Ropes Course participant on the Bridge (E1) at the Broken Bay Sport and Recreation Centre. Note the safety belay system (overhead), and waist bag containing the ambulatory monitor.



Figure 4.3b A Ropes Course participant on the Tyre Walk (E2) at the Broken Bay Sport and Recreation Centre.



Figure 4.3c A Ropes Course participant on the Spiders Web (E3) at the Broken Bay Sport and Recreation Centre.



Figure 4.3d A Ropes Course participant on the Postmans Walk (E4) at the Broken Bay Sport and Recreation Centre.



Figure 4.3e A Ropes Course participant on the Flying Fox (E5) at the Broken Bay Sport and Recreation Centre.



Figure 4.3f A Ropes Course participant on the Exit Ladder (E6) at the Broken Bay Sport and Recreation Centre.



CHAPTER 5

Heart Rate, Blood Pressure and State Anxiety Changes on the Ropes Course

5.1 STUDY 1

5.1.1 Introduction

According to Lacey (1967), patterns of gross behavioral response reflect both the nature of the impinging stimuli and the behavioral demands of the environment. Based on evidence of fractionation between autonomic arousal measures, Lacey (1967) proposed differential patterns of autonomic response in different environmental and emotional situations. Termed by Lacey "situational specificity", such differentiation of autonomic measures is clearly evident in studies examining different emotional states (see Chapter 3), with the most reliable patterns found in the cardiovascular response to the negative emotions of fear and anger (e.g., Funkenstein, King & Drollete, 1954; Schwartz, Weinberger & Singer, 1981; Roberts & Weerts, 1982). However, due to the inconsistent findings and methodological concerns arising from a number of studies (e.g., Sternbach, 1962; Vrana 1993; see also general discussion in Wagner, 1989) a reliable explanation for the sensitivity of arousal measures to the presence of different emotional states, or groups of similar emotional states, has yet to be found.

Compared to the more traditional laboratory studies described in Chapter 3, this thesis' first study used a "real life" situation to explore fractionation of arousal measures as a function of emotion. In this preliminary study, cardiovascular changes (HR, SBP and DBP) of children participating in a Ropes Course activity were examined as a function of group changes in state anxiety. The primary aim of this study was to confirm

that significant emotional and physiological changes occurred during the Ropes Course activity. The secondary aim of this study was to determine whether any of these cardiovascular measures reflected group changes in state anxiety. This study was also conducted in order to confirm the suitability of the Broken Bay Ropes Course activity as a vehicle for more detailed studies exploring the psychophysiology of emotion, and to identify the potential problems associated with monitoring "in situ".

Experimenter observations of children on the Ropes Course activity at the Broken Bay Sport and Recreation Centre and discussions with the Ropes Course instructors indicated that anxiety was one major emotion experienced by children during the Ropes Course attempt, particularly during the middle stages of the Ropes Course activity. According to Spielberger (1975), "State anxiety may be conceptualised as a transitory emotional condition or feeling state that is characterised by subjective, consciously perceived feelings of tension and apprehension and heightened autonomic nervous system activity" (p 719). Anxiety differs from arousal in that it encompasses both a degree of activation/arousal and an unpleasant emotional state. In light of Spielberger's description of state anxiety, it would seem beneficial to employ both physiological and psychological measures to monitor state anxiety changes. The following study on the Ropes Course used a standardised questionnaire (Spielberger State-Trait Anxiety Inventory, STAI; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1970) as well as three cardiovascular measures, HR, SBP and DBP to monitor state anxiety changes. Analyses were carried out on the three physiological measures to test whether they reflected subject group changes in state anxiety.

The dissociation of these seemingly closely linked cardiovascular measures (HR, SBP and DBP) has been demonstrated using instrumental learning and operant conditioning techniques. Using rats paralysed by curare, DiCara and Miller (1968) found that changes in SBP occurred independently of HR. Such dissociation of HR from SBP

(Shapiro et al., 1969, 1970) and DBP (Shapiro et al., 1972) has also been demonstrated in humans using biofeedback and operant conditioning. In these studies, blood pressure levels were modified without corresponding changes in HR. Similar studies (e.g. Schwartz, 1974; Greenstadt, Shapiro & Whitehead, 1986) have confirmed the relative independence of systolic and diastolic Blood Pressure measures in this context.

Different patterns of HR, SBP and DBP activity have also been demonstrated in the more closely related studies investigating the psychophysiology of emotion. As described in Chapter 3, cardiovascular measures were frequently employed in studies exploring the autonomic response activity associated with anxiety and other related emotions such as fear and worry (e.g., Ax, 1953; Funkenstein et al., 1954; Schwartz et al., 1981; Roberts and Weerts, 1982; Ekman, et al., 1983; Sinha et al., 1992; Vrana, 1993). A recent examination of the cardiovascular differentiation of emotions (Sinha et al., 1992) showed differential cardiovascular responses in six different imagery sessions, including fear and anger. The results were consistent with the previous studies, namely that heart rate (HR) and systolic blood pressure (SBP) increased for both fear and anger, whereas diastolic blood pressure (DBP) increased in anger but not in fear. Studies such as this conducted by Sinha and her colleagues (see also Ekman, Levenson & Friesen, 1983) not only demonstrate the dissociation between the autonomic measures as a function of emotion, but also support the use of multiple indices, particularly when the research findings are far from conclusive, and there exists the possibility that one measure may be more sensitive to the target emotion than the other under different environmental conditions (e.g., imagery in the laboratory versus “in situ”).

In light of the small amount of research examining the psychophysiological changes accompanying different emotions evoked during "real life" situations, it seemed appropriate to employ both heart rate and blood pressure measures to monitor anxiety changes on the Ropes Course for this first study. As discussed in Chapter 3, the

ambulatory study carried out by James, Yee, Harshfield, Blank and Pickering (1986) identified an inverse relationship between happiness and systolic blood pressure, while in comparison to the laboratory studies, a relationship between anxiety and diastolic blood pressure was found. In another "real life" study, Matthews, Manuck and Saab (1986) examined anxiety levels of adolescent subjects during a natural stressor, that is, giving a five minute speech to classmates. They found elevated SBP and HR levels during the speech presentation. In addition, adolescents categorised as angry (i.e., those who frequently expressed their anger outwardly) showed elevated DBP. While the authors state that due to the uniqueness of their study and the small sample size ($n=23$) the results should be treated with some caution, this detailed study did reveal similarities between the cardiovascular response accompanying anxiety and that in some of the laboratory studies described above. In addition, the second part of their study showed that subjects recording increases in the cardiovascular measures during other laboratory tasks (e.g., serial subtraction, isometric exercise) also showed, to different degrees, elevated levels of blood pressure and/or heart rate during the natural stressor.

A study by Lewis, Ray, Wilkinson and Ricketts (1984) monitored heart rate responses at different stages during a Zip-wire ("flying-fox") activity. (As described in Chapter 4, the Zip-wire or flying-fox activity is typically used in adventure/outdoor programs. It is the fifth element of the Broken Bay Ropes Course, but was not monitored in Study 1). The authors used self report questionnaires to gauge the anxiety levels of the adult subjects in their study. While HR changes reflected state anxiety changes across different sections of the Zip-wire activity, the results showed that HR levels were similar for both males and females even though female reports of anxiety were higher. Other findings showed further inconsistencies between HR levels and the self-reports. This study raises concerns both as to the sole use of the HR measure as a physiological index of anxiety and whether such findings simply reflect underlying problems involving sex differences in responses to questionnaires. The use of

standardised questionnaires to detect anxiety levels in collaboration with the other measures may have alleviated this problem.

The present study, and the four studies to follow, used children aged 10-12 years old. While few psychophysiological studies have employed children as subjects, studies carried out by Matthews, Rakaczky, Stoney and Manuck (1987) provide evidence that children and adolescents are consistent in their cardiac responses during stressful and challenging tasks. The vocabulary of standardised questionnaires is also a concern when dealing with child subjects. Although the short version Spielberger State Anxiety Inventory (STAI) (Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1970) has been used with 10-15 year old children (Tremayne & Barry, 1990), our pilot studies indicated the need for some modification. For example, statements such as "I feel over-excited and rattled" and "I am jittery" were simplified to "I feel too excited" and "I have butterflies" (see Appendix 1). Subjects were able to seek further explanation while answering the questionnaire in this study.

As mentioned, the main aim of Study 1 was to determine whether the Broken Bay Ropes Course activity evoked emotional and physiological changes, and whether these changes could be measured during the activity. Study 1 therefore presented the experimenter with the opportunity to consider some of the practical aspects associated with monitoring under "real-life" conditions (e.g., subject accessibility and equipment limitations) in preparation for the more detailed monitoring of positive and negative emotional changes in the studies to follow. As indicated in Figure 4.1, the elements located at the middle of the Ropes Course are the highest above ground level and, due to their design, are also more challenging. This information, and accessibility limitations, influenced the two measurement points pre-selected along the Ropes Course for Study 1. The first measurement occasion was on Platform 1, at the start of the Ropes Course. The second measurement occasion occurred on Platform 4, between the Postmans Walk

(Element 4) and Flying Fox (Element 5) elements. This platform was selected for its size, ladder access and location along the Ropes Course.

In light of the mixed findings described in the psychophysiological literature concerning cardiovascular activity accompanying emotion, the second aim of this exploratory study was to examine heart rate and blood pressure changes in relation to group state anxiety changes. Subjects were assigned to two equal sized groups. Group 1 was composed of subjects who increased in state anxiety during the Ropes Course attempt, while Group 2 included those subjects who remained stable or decreased in state anxiety. Based on the findings from the "real-life" studies (e.g., Mathews, Manuck & Saab, 1986) and those described in Chapter 3 it was expected that dissociation between the cardiovascular measures would occur, and that changes in the HR and SBP measures would reflect group changes in state anxiety.

5.1.2 Method

Subjects

Twenty-four subjects (11 boys, 13 girls) aged 10-12 years were randomly selected from a large school group participating in a five day Outdoor Education program at the Broken Bay Sport and Recreation Centre, north of Sydney, Australia. Subjects were monitored for anxiety and cardiovascular changes during their normal participation in the Ropes Course activity. All subjects were informed as to the nature of the study and voluntarily participated in the study with parental and school consent.

Procedure

The physiological measures (HR, SBP and DBP) were recorded on the first platform at the start of the Ropes Course activity and on the platform between the fourth and fifth elements of the Ropes Course. Due to the nature of the testing environment

subjects were evaluated while standing on the platforms after approximately one minute's rest. HR and BP measures were obtained from a portable automatic sphygmomanometer (Lumiscopie Digitronic 100-046) with digital print-out, applied to the non-dominant arm.

Three sets of readings for the HR, DBP and SBP measures were recorded for each subject. The set of HR and BP measures containing the most deviant SBP reading was omitted from analysis, and the HR and BP readings from the two remaining sets were averaged and used for analysis. Such averaging of two consecutive cardiovascular measures is consistent with testing procedures employed in previous studies, such as the 1987 National Institute of Occupational Health Blood Pressure Study and the study carried out by Matthews, Manuck and Saab (1986). The Mean Arterial Pressure (MAP) was calculated using the formula: $MAP = [(SBP-DBP)/3 + DBP]$ (Papillo & Shapiro, 1990).

The modified shortened version of the STAI was administered immediately prior to the collection of the physiological measures on each of the two platforms.

5.1.3 Results

Mean values of STAI, HR, SBP, DBP and MAP are shown in Table 5.1 as a function of group for each measurement occasion. The raw data are presented in Appendix 2. Preliminary analysis of each measure, using a one-way ANOVA over group, was carried out to examine whether group differences occurred at the initial measurement occasion. This indicated that there were no significant differences for the STAI scores ($F(1,23) = 0.03$) or HR ($F(1,23) = 0.24$). There were also no significant differences for the three BP measures: SBP ($F(1,23) = 0.05$), DBP ($F(1,23) = 0.04$) or MAP ($F(1,23) = 0.07$).

The measures of STAI, HR, SBP, DBP and MAP were analysed separately using a two-way ANOVA over time (t1 versus t2, representing the measures on the two platforms) and groups (1 versus 2), with repeated measures on the time factor.

STAI

By definition, the Group 1 STAI mean score increased over the Ropes Course attempt while the Group 2 STAI mean score decreased. This was confirmed by a significant group X time interaction, $F(1,23) = 17.18, p < 0.001$.

Cardiovascular Measures

As indicated in Table 5.1, SBP reflected the state anxiety changes with a significant group X time interaction, $F(1,23) = 8.99, p < 0.01$. That is, while initial SBP values for the groups were similar, SBP increased in Group 1 and decreased in Group 2 over the Ropes Course attempt. DBP showed little change during the activity, with only a slight increase in both groups over the Ropes Course attempt. As expected from its derivation in terms of SBP and DBP, MAP also reflected the changes in group state anxiety shown by SBP, with a significant group X time interaction ($F(1,23) = 5.03, p < 0.05$). The size of this effect was intermediate between the results shown by SBP and DBP.

HR levels increased over the Ropes Course attempt in both subject groups, as shown by a significant time main effect ($F(1,23) = 14.51, p < 0.001$). This measure did not reflect the different directions of change in state anxiety apparent between the two groups.

Table 5.1 Values of psychological and physiological measures at the two measurement occasions for each group, together with ANOVA outcomes.

<u>MEASURE</u>	<u>TIME</u>		<u>EFFECTS (F values)</u>		
	<u>t 1</u>	<u>t2</u>	<u>Group (G)</u>	<u>Time (T)</u>	<u>G X T</u>
STAI Score					
Group 1	18.67	22.00	2.78	0.34	17.18 ***
Group 2	19.08	14.67			
Heart Rate (BPM)					
Group 1	90.71	95.92	0.11	14.51 ***	0.40
Group 2	87.87	95.17			
Systolic BP (mmHg)					
Group 1	111.04	118.42	0.89	1.73	8.99 **
Group 2	112.13	109.25			
Diastolic BP (mmHg)					
Group 1	72.00	73.97	0.00	0.69	0.23
Group 2	72.97	73.50			
MAP (mmHg)					
Group 1	85.01	88.79	0.08	2.63	5.03 *
Group 2	86.02	85.42			

Key

- t1 = time 1 (platform 1)
t2 = time 2 (platform 4)
- *** significant at .001 level
** significant at .01 level
* significant at .05 level

5.1.4 Discussion

This thesis investigation of the psychophysiology of emotion began with a small study examining cardiovascular changes (HR, SBP and DBP) in relation to group changes in state anxiety. The main aims of the study were a) to confirm that subjects experienced physiological and emotional changes on the Ropes Course activity that could be monitored during the activity and b) to examine the HR, SBP and DBP measures for dissociation, and c) to determine whether any of these cardiovascular measures reflected group changes in state anxiety.

The cardiovascular measures were monitored on the first and fourth platforms using a portable sphygmomanometer with an automatic printout. Subject changes in state anxiety were measured using a modified STAI questionnaire administered on the same platforms as the physiological measures. For analysis, subjects were grouped according to whether they increased (Group 1) or decreased (Group 2) in state anxiety. The cardiovascular measures were explored for differences reflecting the group changes in state anxiety.

The STAI scores showed subject differences in state anxiety changes, with 12 subjects recording an increase in state anxiety across the first four elements of the Ropes Course. The remaining 12 subjects showed no change or decreased in state anxiety during their Ropes Course attempt. Significant time and group X time differences were also obtained in the HR and SBP measures respectively. Together, these findings indicated that subjects on the Ropes Course activity did experience different physiological and emotional changes, and that these changes could be monitored with minimal intrusion of the standard Ropes Course lesson.

As indicated in Table 5.1, dissociation of the three cardiovascular measures on

the Ropes Course activity was demonstrated. There was a main effect of time in HR, which was not apparent in SBP or DBP. It was also found that systolic blood pressure reflected subject group differences in regard to the change in state anxiety. Diastolic blood pressure remained relatively stable, while heart rate failed to reflect group changes in state anxiety. These results confirmed the dissociation of the cardiovascular measures in Ropes Course participants, and indicated that only the SBP measure was sensitive to group changes in state anxiety.

These results are consistent with the popular use of BP measures (e.g., Nesse, Curtis, Thyer, McCann, Huber-Smith & Khopf, 1985) and suggest that SBP is a sensitive cardiovascular index of state anxiety, particularly when subjects are involved in a challenging or stressful task. DBP showed only a slight increase for both subject groups. The significant result obtained for the change in MAP is reflective of its close association with SBP, particularly when DBP changes are minimal. The cardiovascular results are similar to those obtained by Sinha et al. (1992) for their fear and physical activity imagery sessions: HR and SBP were elevated while DBP remained relatively stable.

Laboratory studies exploring the cardiovascular response to stressors (or challenges) typically employ tasks that last less than 15 minutes (Krantz, Manuck & Wing, 1986). The study on the Ropes Course monitored changes in anxiety over a longer period of time (15-25 minutes), and subjects were exposed to a number of different stressors/challenges (e.g., four different elements of the Ropes Course) during this period. The use of an extended challenging task may have contributed to the significant finding in the systolic measure for Study 1. The sensitivity of the SBP as an indicator of stress over extended laboratory challenges has been demonstrated by McCann, Carter, Vaughan, Raskind, Wilkinson & Veith (1993). Their study showed that while both BP and HR responses were elevated during the stress sessions, only SBP

continued to respond to stress levels, increasing over the two-hour duration of their laboratory challenge sessions. Both HR and DBP measures showed habituation over the two-hour session, even though a new stressor was introduced after one hour.

Comparison of subject ratings for the stress and control sessions indicated that the stress session was perceived as more difficult, more involving and more arousing. The use of a control group in the study demonstrated that the changes in the cardiovascular measures were not solely attributed to the physical demands of the task (speaking). Comparisons between the two studies should be treated with caution however, as the laboratory study used two challenging cognitive tasks administered in a laboratory setting.

While the SBP and MAP measures successfully reflected state anxiety changes of the Ropes Course participants, it must be considered whether HR was influenced by somatic activity, resulting in an increase in this measure for both subject groups. In regard to participant physical activity, it is emphasised that the Ropes Course does not involve vigorous exercise; while challenging, it is not physically demanding. Also, as previously stated, the activity was carried out at a slow walking pace, with subjects concentrating on balance and overcoming any psychological apprehensions. Further, rest stops on platforms were made between each of the Ropes Course elements, and a delay occurred after reaching the test platform before testing was carried out. Finally, according to many experienced outdoor educators, Ropes Course participants are primarily concerned with coping with the "perceived risk" and personal confidence barriers associated with these sorts of challenge activities. Notwithstanding this, it is apparent that some somatic effects in HR may have occurred independently from the anxiety effects observed in other measures.

Lacey and Lacey (1974) cited numerous studies providing evidence of dissociation between somatic HR effects and other measures of cardiac activity. Research by Obrist and his colleagues (e.g., Obrist et al., 1972) provides an explanation

for the apparently stronger somatic influence on HR than BP. While sympathetic influences are most clearly evidenced in the contractile state of the heart, HR is modulated by the parasympathetic vagal innervation associated with increases in somatic activity. Because HR is controlled by both parasympathetic and sympathetic influences, it may be that more subtle sympathetic changes in HR were masked by the somatic effects experienced on the Ropes Course. In reviewing their findings, McCann, Carter, Vaughan, Raskind, Wilkinson and Veith (1993) suggested that in the context of extended stress, the behavior of the cardiovascular measures, in particular heart rate, is one of autoregulation. This would provide an explanation for the habituation patterns observed in their HR and DBP measures even with the introduction of new stressors. In any case, in the absence of suitable monitoring equipment able to detect and store motility (movement) levels, more detailed monitoring of the HR response along the Ropes Course activity may shed light on the behavior of this complex measure.

It should be noted that due to the preliminary nature of this study and the small sample size, no further analyses were conducted on these data. While this study only investigated group changes and did not explore the generality of the group response profile in individual subjects, it is suggested that future studies could profitably examine SBP as a sensitive index of state anxiety in the individual under "real life" conditions. Finally, until conclusive evidence for the responsiveness of each cardiovascular measure is available with different emotions, it seems appropriate that more than one physiological measure should be employed. The use of multiple measures has been advocated by researchers (e.g. Forgays et al., 1992), and as illustrated in this study, this is particularly applicable to the study of anxiety, where standardised measures of anxiety and advanced physiological monitoring equipment can be used concurrently.

In summary, the data from Study 1 confirmed that a) psychophysiological changes did occur during the Ropes Course attempt, b) dissociation between the

cardiovascular autonomic measures did occur, and c) that the SBP measure was sensitive to subject group changes in state anxiety. The use of the challenge Ropes Course as a "real-life" stressor proved to be a successful tool to demonstrate fractionation of the arousal measures and to examine the cardiovascular response accompanying anxiety changes in children. To conclude, these findings from Study 1 are encouraging, and in regard to the concerns with monitoring "in situ", it would seem that the benefits of research studies using "real life" challenges outweigh the practical and methodological concerns associated with this type of research.

CHAPTER 6

Psychophysiological Changes along the Ropes Course.

6.1 GENERAL INTRODUCTION

From our overview of the literature concerning the psychophysiology of emotion, it is evident that two main concerns continue to hinder this area of research. The first concern arises from the lack of theoretically based explanations for the autonomic response changes accompanying different emotions. The second concern encompasses methodological issues such as the elicitation, identification and measurement of genuine affective states. These two concerns are addressed in the following two studies which again utilised a "real-life" situation, the Ropes Course activity, to explore autonomic changes accompanying both positive and negative emotions.

The pilot study described in Chapter 5 demonstrated different patterns of HR, SBP and DBP changes across two pre-determined points along the Ropes Course in different children. Results from this study indicated that, compared to the other cardiovascular measures, the changes in SBP reflected changes in state anxiety. While Study 1 indicated the suitability of the Ropes Course for further psychophysiological research activity, the findings from the pilot study were limited due to the small number of sampling times, the reliability of the sphygmomanometer measuring device and the monitoring of only one affective state. Using more technically advanced monitoring equipment, the following two studies examined HR and SCL changes along each of the six elements of the Ropes Course in relation to significantly high or low levels of positive or negative emotions. The physiological and psychological data were tested in light of Fowles' (1980) hypothesis concerning the fractionation of cardiac and

electrodermal measures as a function of the Behavioral Activation System and the Behavioural inhibition system.

As outlined in Chapter 3, research studies in the psychophysiology of emotion have largely been exploratory, with researchers examining the physiological data for response patterns associated with individual emotions (e.g., Ax, 1953; Sternbach, 1962; Averill, 1969; Schwartz, Weinberger & Singer, 1981). Reflecting theoretical developments in the identification and description of emotion (e.g., Russell, 1980; Tellegen, 1985; Watson & Tellegen, 1985), some attempts were made to examine the data for differences between positive and negative type emotions (e.g., Haney & Euse, 1976; Ekman, Levenson & Friesen, 1983; Hubert & De Jong Meyer, 1990).

The terms *positive* and *negative* (Ekman et al., 1983; Wegner et al., 1990) or more particularly, *positive affect* (PA) and *negative affect* (NA) (Watson & Tellegen, 1985; Watson, Clark & Tellegen, 1988; Watson, 1988; Larsen & Ketelaar, 1991), are used to describe emotions that reflect one's pleasurable or unpleasurable engagement with the environment. For example, emotion adjectives such as happy, joyful, exciting, enthusiastic, active, alert, versus fearful, anxious, nervous, angry and scornful, are commonly associated with PA and NA respectively. There is a considerable literature examining positive and negative affect and related specific emotions (e.g., Diener & Emmons, 1985; Watson, Clark & Tellegen, 1988), and Watson and Tellegen (1985) provide a convenient summary table of markers of positive and negative affect states.

As discussed in Chapter 2, some researchers (e.g., Tellegen, 1985; Larsen & Ketelaar, 1991) have drawn linkages between Gray's two emotional systems, the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS) with PA and NA respectively. Tellegen (1985) suggested that mood reports of PA and NA can be conceptualised as correlates of the activation of the BAS and the BIS

respectively, while the personality traits of Positive and Negative Emotionality are related to Gray's trait dimensions of reward-signal sensitivity (BAS) and punishment-signal sensitivity (BIS).

This linkage between Gray's emotional systems and the types of resultant emotions is based largely on descriptions by Gray and research work on the study of emotion by Watson and Tellegen and their counterparts (e.g., Russell & Mehrabian, 1977; Russell, 1979, 1980; Zevon & Tellegen, 1982; Tellegen, 1985; Watson & Tellegen, 1985; Larsen & Ketelaar, 1991). Tellegen (1985) found that self-report ratings of current mood are dominated by two large dimensions, Positive Affect and Negative affect. He also identified three personality traits, Positive Emotionality, Negative Emotionality and Constraint (Tellegen, 1982). Positive Emotionality is primarily associated with well being, social potency and achievement scales, is positively correlated with Positive Affect and not correlated with Negative Affect. Tellegen (1982) showed that Negative Emotionality is associated with scales such as the MPQ Stress Reaction, Alienation and Aggression, and is positively correlated with Negative Affect. This personality factor is not correlated with Positive Affect. The third personality factor, Constraint, is associated with scales that measure Control versus Impulsiveness, and Harm Avoidance versus Danger Seeking. It is uncorrelated with state measures of Positive Affect and Negative Affect. According to Tellegen (1985), these personality traits showed consistent correlations with other well known instruments such as the 16-PF (Cattell, Eber & Tatsuoka, 1970) and the Eysenck Personality Questionnaire (EPQ) (Eysenck & Eysenck, 1975). For example, Tellegen indicated that Positive Emotionality, Negative Emotionality and Constraint factor scores are substantially correlated in a convergent-discriminant pattern with Eysenck's EPQ Extraversion/Introversion, Neuroticism, and (reversed) Psychoticism scales respectively (see Tellegen, 1982, 1985).

Based on relative sensitivity to rewards and punishments, Gray (1973) attempted to align the BAS and BIS emotional systems with Eysenck's Extraversion (E) and Neuroticism (N) factors. Gray interpreted Extraversion/Introversion as a dimension of greater sensitivity to signals of reward versus greater sensitivity to signals of punishment. Neuroticism was construed as greater sensitivity to signals of both reward and punishment. Gray (1973) showed that his two dimensions could be obtained from the 45 degree rotation of Eysenck's E and N factors. Tellegen (1985) suggested that if Gray interpreted his own dimensions as a 45 degree rotation of Eysenck's, then it is reasonable to treat Positive Affect and Negative Affect as the state dimensions corresponding to his reward-signal sensitivity (BAS) and punishment-signal sensitivity (BIS) trait dimensions. By supporting the association between Eysenck's E and N factors with the BAS and BIS systems, Gray provided a future link between his emotion systems and Tellegen's Positive Emotionality and Negative Emotionality. In fact, Tellegen (1985) concludes that Gray's reward and punishment-signal sensitivity are the constructs that correspond best to his self-descriptive trait factors of Positive Emotionality and Negative Emotionality (respectively). From their review of the emotion literature, Larsen and Ketelaar (1991) concluded that *"It is thus consistent with Gray's theory to hypothesise that positive affect and negative affect are the state manifestations of reward-signal sensitivity and punishment-signal sensitivity, respectively. When exposed to signals of reward, one experiences positive affect, and when exposed to signals of punishment, one experiences negative affect"* (p.133).

Gray's two emotional systems were earlier adopted by Fowles (1980) in his explanation of the dissociation between two autonomic measures, HR and SCL. Fowles (1980) postulated that HR reflected activation of the BAS while electrodermal activity (EDA) reflected the activation of the BIS. This was largely based on empirical studies showing increases in electrodermal activity during punishment/frustrative non-reward and HR increases during reward (see Chapter 2 discussion). While his proposal is

strongly tied to the study of motivation and incentive effects, Fowles' hypothesis holds certain implications for the study of emotion, in particular heart rate and skin conductance responses accompanying positive and negative type emotions.

Given the close link between NA and PA with the BIS and BAS, it would seem reasonable to adopt Fowles' hypothesis for the fractionation of HR and SCL as a function of NA and PA type emotions. However, as discussed in Chapter 2, Fowles did not support this approach and questioned the linkage between BIS/NA and BAS/PA (Fowles, 1982, 1987, 1988). Noting a stronger behavioral component in Positive Emotionality, Fowles acknowledged "some hope" for an association between the BAS and Positive Emotionality, and therefore Positive Affect. In his more recent publications, Fowles (1992, 1993) drew parallels between Gray's BIS and Barlow's (1988) (preparatory) anxiety. By linking Barlow's "anxious apprehension" to Gray's BIS, Fowles (1992), perhaps inadvertently, provided a link between the BIS and negative affect. While it may not have been what he intended, Fowles' hypothesis presents a theoretical platform from which to investigate HR and SC activity as a function of positive and negative emotions.

The second main concern underlying the study of the psychophysiology of emotion is the elicitation and reliable measurement of genuine pure emotional states. Researchers point to the difficulties associated with the laboratory environment (Ney & Gale, 1988; Wagner, 1989) and subject expectations and inhibitions (Ekman et al., 1983; Lewis et al., 1984) that may impinge on their emotional experiences in the laboratory. Research studies monitoring affective states during participation in challenging activities in real-life settings have provided confirmation of the elicitation of strong and genuine transitory emotional states that are readily observed by the experimenter (Nettleton & Dickinson, 1989). The availability of improved scientific monitoring equipment has now raised the possibility of monitoring the physiological

changes that accompany these more naturally evoked emotional states.

The successful use of ambulatory monitoring equipment has been demonstrated in a number of studies found in the psychophysiological literature (see Chapter 3). These studies largely have involved monitoring cardiovascular measures at pre-determined moments during challenging activities such as parachuting (e.g., Reid et al, 1971) and the Ropes Course (Lewis et al., 1984); and other activities such as presenting a speech to classmates (Matthews et al., 1986). Other studies have monitored cardiac activity during moments of stress or panic experienced during normal daily routines (e.g., Taylor et al., 1986; 1987). As demonstrated in Study 1 of this thesis, equipment limitations determine one's ability to monitor continuously and with laboratory standard levels of precision. In the following study, a Heartrate and Galvanic skin response Monitor (HGM1: Barry, Moroney, Orlebeke & de Vries, 1991) was used to continuously monitor, collect and store heart rate and skin conductance data.

In summary, the availability of a more technologically advanced monitoring device presented the opportunity to monitor and analyse patterns of heart rate and skin conductance level activity in relation to positive and negative emotions elicited naturally on the Ropes Course. In the absence of any other well-established psychophysiological explanation for the fractionation of HR and SCL, Fowles' hypothesis provides a base from which to examine the behavior of these two measures during a challenging activity involving both behavioral and emotional responses.

In light of Fowles' hypothesis, it was predicted that the Ropes Course elements identified with significantly high levels of PA (dominant BAS activation) would show significantly higher HR levels compared to those elements reporting significantly low levels of PA related emotions. Likewise it was expected that the Ropes Course elements reporting significantly high levels of NA related emotions (dominant BIS activation)

would also record significantly higher SC levels compared to the elements reporting low levels of PA type emotions.

6.2 STUDY 2

6.2.1 Introduction

This investigation began with a small study to confirm that significant changes in the HR and SCL measures were elicited with participation on the Ropes Course activity, and that fractionation between these two measures did occur. Using a portable monitoring device, a physiological profile of a small group of Ropes Course participants was recorded. The physiological measures of HR and SCL were examined for variability over the Ropes Course, and whether such variability was similar in the two measures.

6.2.2 Method

Subjects

Six children (3 boys and 3 girls), aged between 10 and 12 years and from different schools, were monitored on the Ropes Course while participating in their annual school outdoor education programme held at the Broken Bay Sport and Recreation Centre. Each child was randomly selected from a group of volunteers within a Ropes Course lesson. All subjects provided parental and school consent regarding their involvement in the study. The subjects were of average weight and height for that particular class.

Apparatus

SCL and HR were recorded using a portable heart rate and galvanic skin response monitoring device, HGM1 (Barry, Moroney, Orlebeke & de Vries, 1991). This

portable recording device allows digital field recording of SCL and HR with laboratory levels of precision due to its high sampling rate (10 Hz) and resolution (HR derived from interbeat intervals measured with 1 ms resolution and skin conductance measured with 0.025 μ S resolution). The size of the HGM1 is similar to that of a portable "walkman" cassette player (12.0 cm X 6.5 cm X 3.5 cm).

To record HR, pre-jelled disposable cardiac electrodes were placed on the subject's chest with one electrode at mid-sternum, and another on the lower ribs towards the subject's left side. Electrodermal activity was recorded from Ag/AgCl electrodes with contact limited by adhesive disks (area 0.7 cm²). An electrode paste of 0.05 molar NaCl in an inert viscous ointment base was used as the electrolyte. Electrodes were placed on the hypomalleolar area on the medial side of the plantar surface of the left foot, as recommended by Edelberg (1967), since (for safety reasons) the palmar sites were deemed inappropriate for recording while the subject was on the Ropes Course. Leads attached to the electrodes were plugged into the portable HGM1, carried in a small pack around the subject's waist.

Procedure

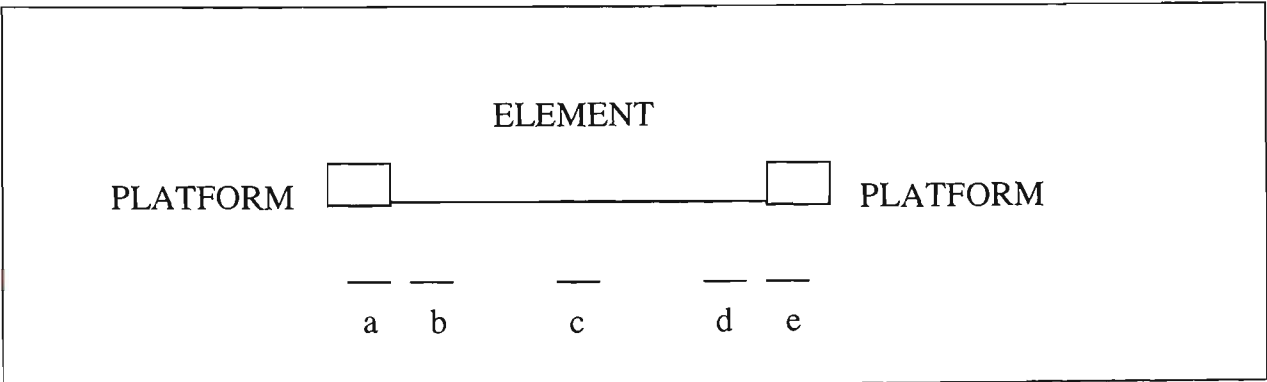
After an introductory talk, and while the children were adjusting their safety equipment (harness and helmet), a subject was randomly selected from the group of volunteers. The rest of the class was advised of the subject's participation in the research. This precaution was taken to reduce interference from other children while the subject was being monitored on the Ropes Course. The class (including the subject) was then taken to view the Ropes Course and given instructions regarding the rules and proper use of the elements of the Ropes Course. Each element was also briefly described in terms of its nature, history and possible usage.

Once the children were instructed to line up at the beginning of the Ropes

Course the subject and a friend¹ were taken to a room nearby where the experimental hardware was stored. Electrodes were placed on the foot and chest, as detailed previously, and a padded carry-pack was adjusted around the waist of the subject to carry the HGM1. An Apple IIe computer was initialised and used to set up the portable HGM1 for data collection. A stop-watch was synchronised with the computer clock to allow later identification of appropriate data epochs. The subject was then free to participate in the rest of the normal lesson procedure.

Cardiac and electrodermal measures were collected from five pre-determined epochs along each element of the Ropes Course: the 4 s before (a) and after each element (e), and the first 4 s (b), middle 4 s (c) and last 4 s (d) on each element (see Figure 6.1). The midpoint measurement was not calculated for the Flying Fox, as this element took only approximately 10 s to complete and thus most of the data were already being considered. Mean SCL and HR values were calculated for each of the 4 s periods.

Figure 6.1 Schematic diagram showing the Ropes Course element epoch (a-e) location for data collection and analysis. Each epoch represents 4 seconds.



¹ A buddy-system (participant and friend) is used during the Ropes Course activity for safety reasons, as well as to encourage cooperation between children. For reassurance of the subject during the study, the child's "buddy" was always present throughout the data collection.

6.2.3 Results

Twenty-nine HR and SCL means were obtained for each child. The raw data are in Appendix 3 while the HR and SC data profiles for three representative subjects are presented in Figure 6.2. A Pearson correlation coefficient of HR with SCL was obtained for each subject using the SPSSX CORRELATION procedure. Table 6.1 shows that 4 of the 6 subjects had a significant correlation between HR and SCL. However, as the coefficient of determination indicates, less than 50 % of the total variance was shared by the SCL and HR data of any subject. Figure 6.2 clearly illustrates the variability of HR and SCL measures obtained over the 29 epochs for three representative subjects as well as different patterns between the subjects. For example, Subject 1 showed a marked decrease in SCL across the last three epochs of the Postmans Walk (E4), while HR remained relatively stable for this same period. This subject’s response pattern is different to Subject 6 which showed a marked increase in both the SCL and HR measures across the same three epochs.

Table 6.1 Correlations between HR and SCL values over 29 epochs for individual subjects on the Ropes Course. Subjects are ordered by increasing correlation coefficients

Subject	Age	Sex	Correlation Coefficient	Significance	Coefficient of determination
1	12	m	.045	.408	.002
2	11	f	.218	.128	.047
3	11	m	.443	.008	.196
4	11	f	.478	.004	.228
5	10	m	.527	.002	.277
6	10	f	.704	.001	.495

Figure 6.2. Electrodermal and cardiac levels of three representative subjects, shown in order of increasing correlation between the measures. Mean data are shown from each measurement epoch over the elements.

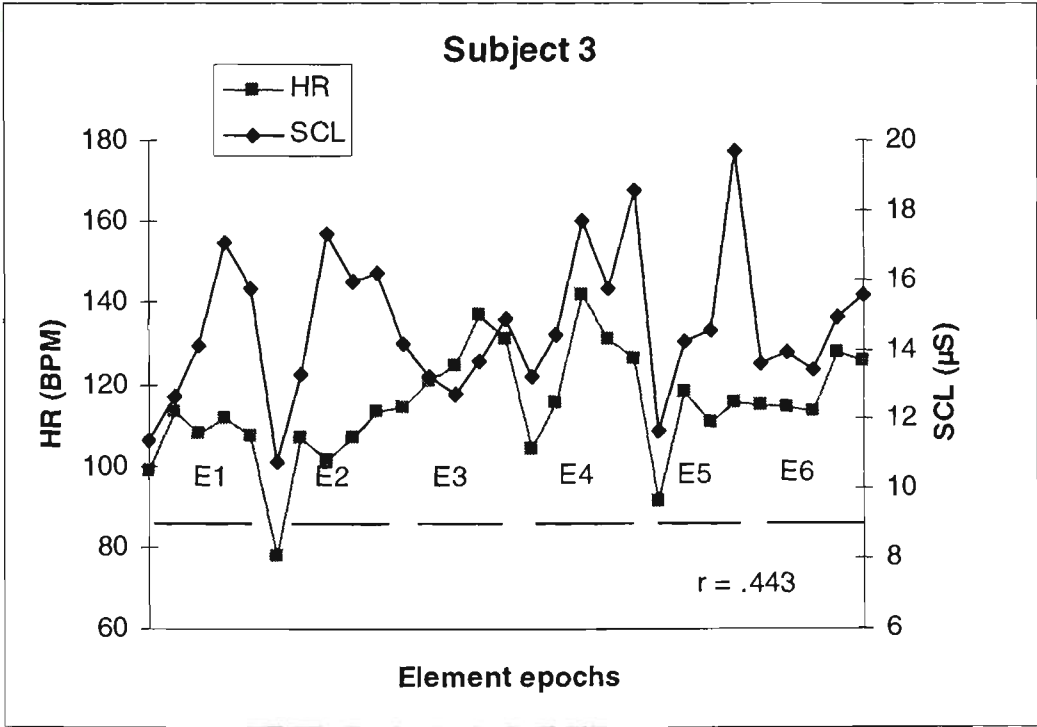
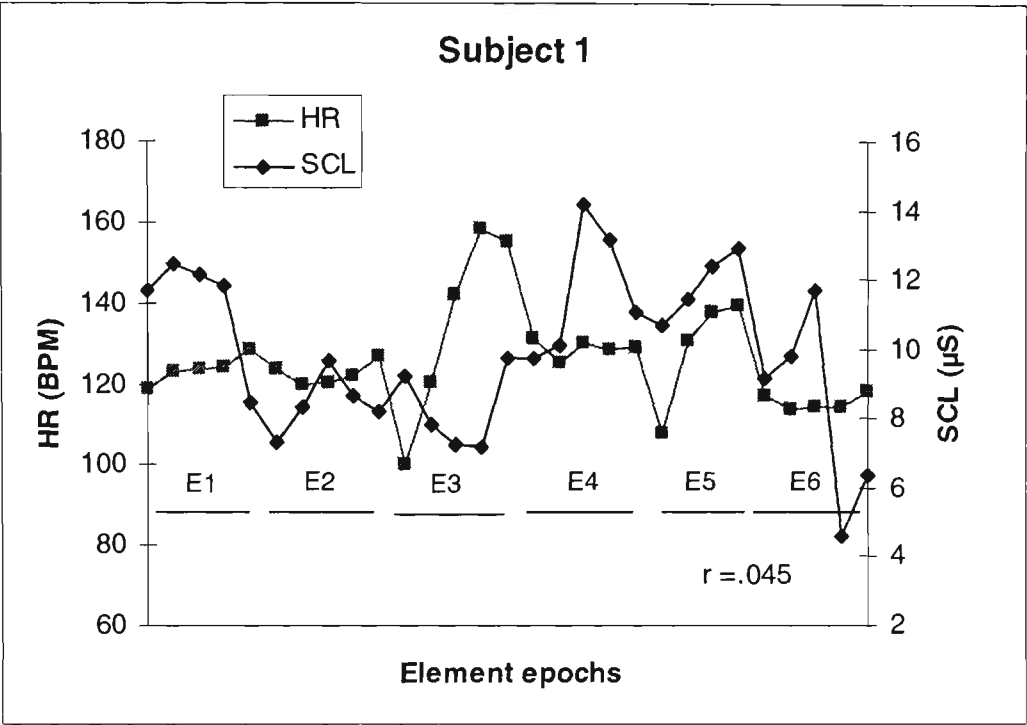
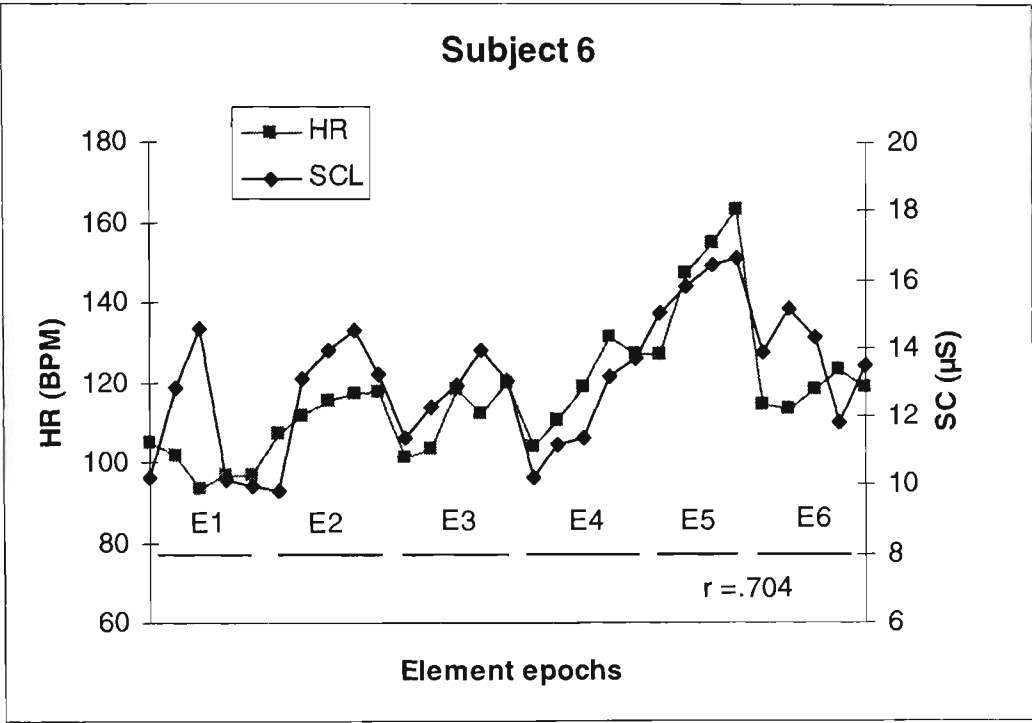


Figure 6.2 cont'd



6.2.4 Discussion

Figure 6.2 indicates the independence and substantial variation between HR and SCL measures over the Ropes Course elements. Subject 6 ($r=.704$, $p<.001$) and Subject 1 ($r=.045$, $p=.41$) recorded the highest and lowest levels of association between these two autonomic measures, respectively. Although the results presented in Table 6.1 indicate that the correlation between HR and SCL was significant for some subjects, the proportion of shared variance was always less than 0.50. As illustrated in Figure 6.2, there are no obvious consistent patterns of autonomic activity for these representative subjects over the Ropes Course. However, there are substantial HR and SCL changes occurring within each subject, reflecting the individual child's experience on the Ropes Course. For example, Subject 1 showed HR increases for the middle elements of the Ropes Course (E3 and E4) while peak SCL increases were found towards the later half of the Course (E4 and E5). These data support the fractionation of arousal measures

noted by the Laceys. They are also compatible with research examined by Lacey (1967), who reported that a shared variance of more than 50 % between these measures was not usually obtained, even under favourable conditions.

This study carried out on the Ropes Course demonstrated the ability of the HGM1 monitor to record useful data “in situ” with laboratory levels of precision. Compared to Study 1, the use of the ambulatory monitor ensured that data were collected with minimum intrusion and subject–researcher interaction was reduced during the Ropes Course attempt. Analyses on the data for the six subjects indicated that substantial autonomic variability occurred during this activity. These data support the suitability of the Ropes Course as a vehicle for a more detailed investigation of the interplay of psychological and physiological factors in determining various aspects of autonomic arousal.

6.3 STUDY 3

6.3.1 Introduction

In the following study, a range of emotions elicited on the six elements of the Ropes Course were examined for links with HR and SCL activity. The emotions experienced on the Ropes Course were monitored using five descriptors: challenge (C), hard (H), worry (W), fun (F) and excitement (E). Selection of the five emotional descriptors was based on results from pilot studies, which indicated that these emotion concepts were frequently expressed and clearly understood by Ropes Course participants. We linked the emotions associated with the descriptors challenge, hard (used as a synonym for "difficult") and worry to NA, while emotions associated with the descriptors fun and excitement were linked to PA. In terms of differences in these

reported emotional descriptors, variation in either NA or PA was identified for each element of the Ropes Course.

The use of the three descriptors challenge, hard and worry to reflect activation of the BIS during the Ropes Course activity is consistent with Gray's description of the BIS (see Chapter 2) and Barlow's (1988) "anxious apprehension" which Fowles (1992) later equated to the BIS. According to Barlow (1988, see also Barlow & Cerny, 1988) the types of negative emotions experienced during "anxious apprehension" would include those emotions experienced when dealing with everyday stressors, challenges or difficult situations that do not pose an immediate life-threat. Barlow (1988) uses the terms negative affect, worry and high arousal to describe his "anxious apprehension". In comparison, the two descriptors fun and excitement reflect the array of emotions typically experienced during situations combining "approach" behaviors and positive affect that are linked to the activation of the BAS (Fowles, 1980, 1992, 1993).

In light of Fowles' explanation for the fractionation of HR and SCL, the physiological data obtained from the Ropes Course elements were examined in relation to the PA and NA descriptor groupings. It was expected that the elements linked to significant differences in subject emotion descriptors identified with either PA or NA would show significant differences in (respectively) cardiac or electrodermal activity. In other words, elements eliciting significantly high or low levels of emotions fun and excitement would show significant differences in the heart rate measure. Similarly skin conductance activity would discriminate between elements significantly different on levels of the descriptors challenge, hard and worry.

6.3.2 Method

Subjects

Twenty children (11 boys and 9 girls) aged between 10 and 12 years, from various New South Wales state schools, were monitored on the Ropes Course while participating in their annual school camp at the Broken Bay Sport and Recreation Centre. All provided informed parental consent prior to participation. The children were randomly selected from a group of volunteers within each Ropes Course lesson over a seven week period.

Apparatus and procedure

Psychological measures. An Element Ratings Questionnaire was used to measure the positive and negative emotions elicited by each element of the Ropes Course. Subjects rated each of the elements, using seven point scales, on the descriptors challenge, hard, worry, fun, and excitement (see Appendix 4). These five descriptors encompassed most of the emotions expressed by Ropes Course child participants during pilot studies. Pilot studies also indicated that the descriptors were well understood by children aged 10-12 years. The descriptors were later grouped into the following: fun/excitement (PA), and challenge/hardness/worry (NA), and taken to reflect activity of the BAS and BIS respectively. The raw data from this Element Ratings Questionnaire are presented in Appendix 5.

Physiological measures. HR and SCL data were obtained using the apparatus described in Study 2. The raw data and statistical outcomes are presented in Appendix 6 and Appendix 7 respectively.

The procedure for Study 3 was similar to that of Study 2, except that subjects were required to complete the Ropes Course three times in immediate succession in

order to increase the reliability of the data base. The element evaluation questionnaires were administered approximately 5-10 minutes after the Ropes Course was completed for the third time. Subjects were first informed about this questionnaire at the time of administration. This was done to alleviate further concern for the subject and to provide as “normal” a Ropes Course experience as possible.

6.3.3 Results

Psychological measures

Table 6.2 shows the mean rating on each of the descriptors elicited by each element. As indicated in Table 6.2, the highest ratings for the fun and excitement descriptors were recorded on the fifth element of the Ropes Course, the Flying Fox (F: 5.65, E: 5.65). The highest ratings for the negative descriptors challenge, hard and worry were recorded on the Postman's Walk (C: 4.15, H: 3.90, W: 3.50) followed closely by the previous element, the Spiders Web (C: 3.70, H: 3.35, W: 2.75). These findings in the FE and CHW descriptor ratings are illustrated in Figure 6.3a and Figure 6.3b. Overall the ratings data supported the descriptor grouping of fun and excitement, and challenge, hard and worry. For each descriptor, repeated-measures analysis of variance was used to compare the rating obtained by each element with the mean rating over all six elements.

Fun and Excitement

The Flying Fox was the only element to score significantly higher than the average for the fun and excitement descriptors ($F=46.38$, $p<0.001$ and $F=84.77$, $p<0.001$, respectively). In regard to significantly low levels for the fun and excitement descriptors, it was found that the Bridge ($F=6.76$, $p<0.05$ and $F=31.85$, $p<0.001$ respectively) and Exit Ladder ($F=17.29$, $p<0.001$ and $F=15.07$, $p<0.001$ respectively) were each rated significantly lower compared to the average of all six elements. While

the Tyre Walk also recorded significantly low levels for the fun ($F=6.76$, $p<.05$) and excitement ($F=10.88$, $p<.01$) descriptors, the mean ratings for these two descriptors were not as significantly low as those obtained on the first and last elements of the Ropes Course. In summary, it was found that the fifth element (E5) of the Ropes course activity significantly differed the most from the first (E1) and last (E6) elements in eliciting (respectively) significantly higher and lower PA related emotions. In turn, this can be linked to the dominant activation of the BAS during the flying fox element compared to the first and last elements of the Ropes Course.

Challenge, Hard and Worry

For the descriptor challenge, it was found that the Spiders Web ($F=17.26$, $p<0.001$), and Postman's Walk ($F=29.73$, $p<0.001$) were rated significantly higher than the mean, while the Bridge ($F=65.54$, $p<0.001$), and Tyre Walk ($F=22.68$, $p<0.001$), were rated significantly lower (that is, less challenging) than the average of the six elements. Similarly, for the descriptor hard, it was found that the Spiders Web ($F=34.12$, $p<0.001$) and Postman's Walk ($F=44.79$, $p<0.001$) were rated significantly higher and the Bridge ($F=51.53$, $p<0.001$) and Tyre Walk ($F=18.30$, $p<0.001$) were rated significantly lower compared to the Ropes Course average. For the descriptor worry, it was found that a similar element group pattern prevailed: the Spiders Web ($F=11.81$, $p<0.003$) and Postman's Walk ($F=34.69$, $p<0.001$) were rated significantly higher than the average, while the Bridge ($F=56.52$, $p<0.001$) and Tyre Walk ($F=16.41$, $p<0.001$) were rated significantly lower. In summary, the third (E3) and fourth (E4) elements differed from the first (E1) and second (E2) elements in eliciting (respectively) significantly higher and lower levels of emotions associated with NA, thus indicating the activation strength of the BIS at different stages along the Ropes Course.

Table 6.2 Element descriptor ratings for the six elements of the Ropes Course (n=20).

ELEMENT	Descriptor									
	Challenge		Hard		Worry		Fun		Excitement	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Bridge (E1)	1.20 ^d	1.01	1.10 ^d	0.85	0.85 ^d	0.81	3.25 ^f	1.65	2.35 ^d	1.39
Tyre Walk (E2)	2.05 ^d	1.23	1.80 ^d	0.89	1.60 ^d	1.19	3.55 ^f	1.47	2.85 ^e	1.63
Spiders Web (E3)	3.70 ^a	1.26	3.35 ^a	1.14	2.75 ^e	1.58	4.10	1.62	4.05	1.39
Postmans W. (E4)	4.15 ^a	1.09	3.90 ^a	1.02	3.50 ^d	1.39	4.25	1.71	4.10	1.77
Flying Fox (E5)	3.40	1.46	2.40	1.63	2.40	2.11	5.65 ^a	0.74	5.65 ^a	0.59
Exit Ladder (E6)	2.90	1.41	2.15	1.27	2.15	1.69	3.00 ^d	1.41	2.60 ^d	1.54

KEY

- | | |
|------------------------------------|-----------------------------------|
| a significantly high at .001 level | d significantly low at .001 level |
| b significantly high at .01 level | e significantly low at .01 level |
| c significantly high at .05 level | f significantly low at .05 level |

Figure 6.3a Fun and excitement ratings for the six Ropes Course elements.

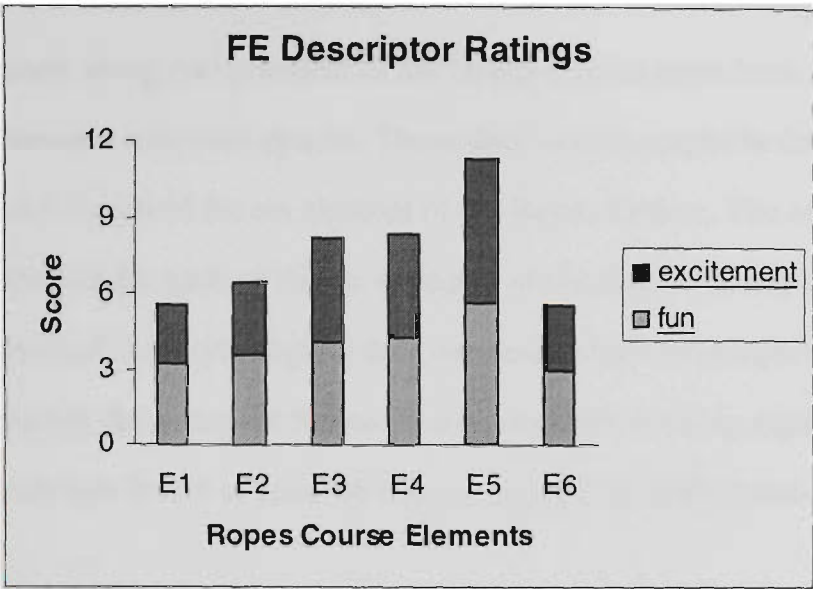
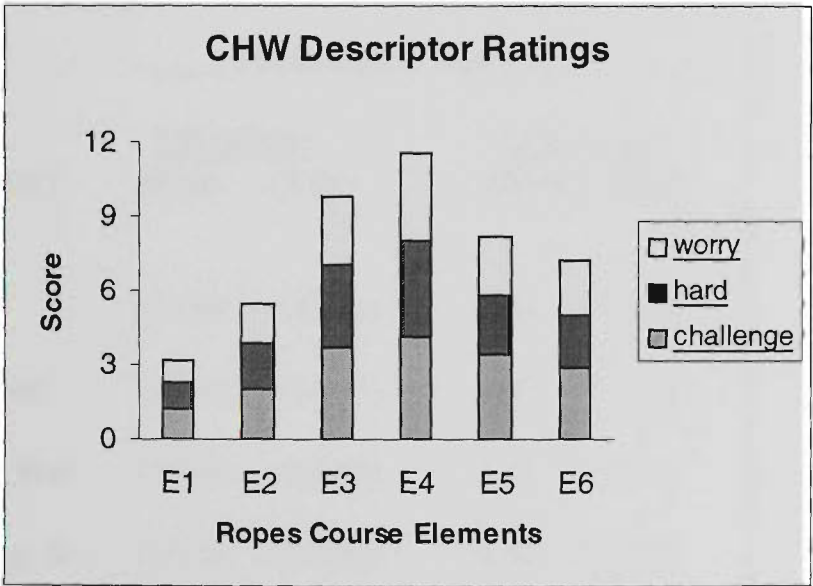


Figure 6.3b Challenge, hard and worry ratings for the six Ropes Course elements.



Physiological measures

In a similar fashion to Study 2, five 4 second epoch averages were calculated for each measure along each element of the Ropes Course apart from the Flying Fox (E5) which generated only four epochs. These data were averaged to form a mean HR and SCL value for each of the six element of the Ropes Course. The average HR and SC Levels obtained for each of the six elements of the Ropes Course are presented in Table 6.3. Analysis of the physiological data were carried out to compare average HR and SCL levels between the groups of Ropes Course elements evoking significantly high or significantly low levels of positive (FE) or negative (CHW) emotions.

Table 6.3 HR and SCL means and S.D.s (in brackets) for the six elements of the Ropes Course.

ELEMENT	____Physiological Measures____			
	<u>HR (BPM)</u>		<u>SCL (µS)</u>	
	Mean	(S.D.)	Mean	(S.D.)
Bridge	123.89	(13.86)	8.44	(3.65)
Tyre Walk	121.38	(14.05)	8.47	(3.52)
Spiders Web	132.06	(12.67)	8.31	(3.47)
Postmans W.	130.46	(15.95)	8.31	(3.57)
Flying Fox	129.33	(16.62)	10.34	(3.95)
Exit Ladder	123.39	(13.81)	9.21	(3.96)

Fun and Excitement

Figure 6.4 (a,b) indicate the physiological measures recorded for those elements rated significantly high (E5) or low (E1 and E6) for the fun and excitement descriptors, and thus linked to differences in PA. It was found that HR on the Flying Fox (129.33 BPM) was not significantly different ($F < 1$) from the HR mean recorded for the Bridge and Exit Ladder (123.64 BPM). However, SCLs were significantly higher on the Flying Fox (10.34 μ S) than on the Bridge and Exit Ladder (mean 8.82 μ S), $F = 26.59$, $p < 0.001$.

Challenge, Hard and Worry

Figure 6.5 (a,b) shows mean HR and SCL values for the elements eliciting significantly higher (E3 and E4) and lower (E1 and E2) levels of NA. Separate repeated-measures ANOVAs were used to test for differences in HR and SCL as a function of these elements. The mean heart rate for the Spiders Web and Postmans Walk (131.26 BPM) was significantly higher than that recorded for the Bridge and Tyre Walk (122.64 BPM), $F = 54.71$, $p < 0.001$. The mean SCL for the Spiders Web and the Postmans walk (8.31 μ S) was lower than that recorded for the Bridge and Tyre Walk (8.46 μ S) but this difference between the two groups did not reach statistical significance ($F < 1$).

Figure 6.4a Mean HR levels for elements representing **high FE** and **low FE**

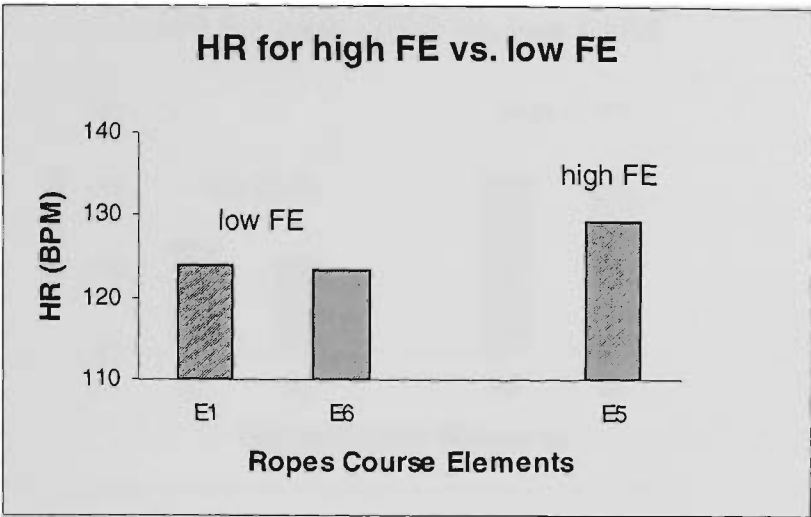


Figure 6.4b Mean SC levels for elements representing **high FE** and **low FE**

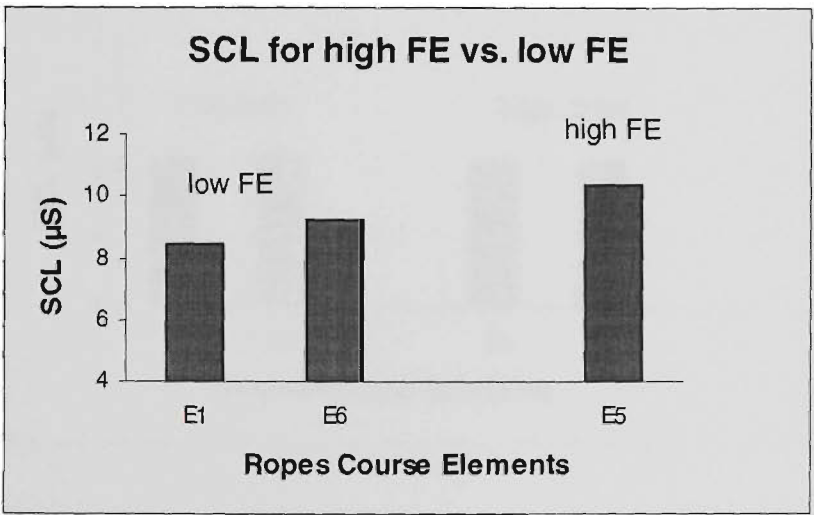


Figure 6.5a Mean HR levels for elements representing **high CHW** and **low CHW**

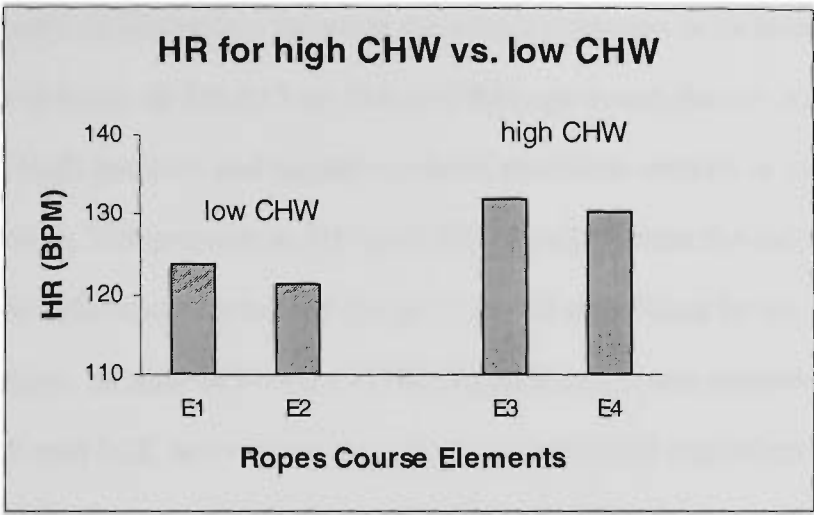
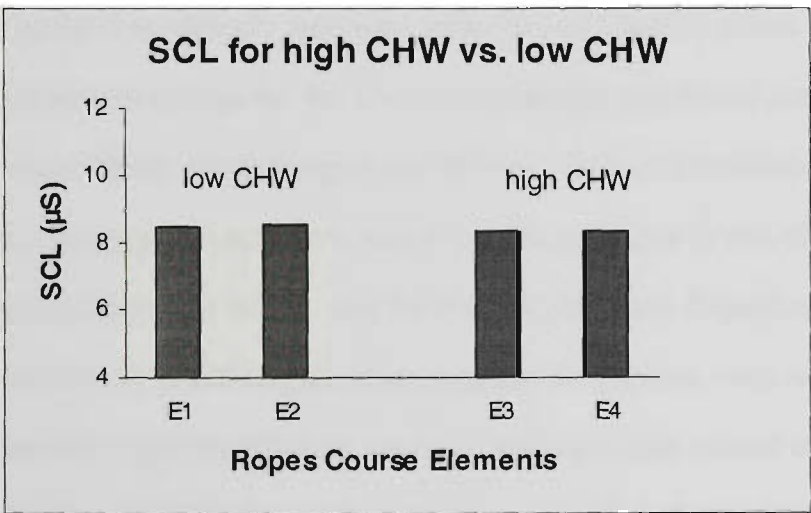


Figure 6.5b Mean SC levels for elements representing **high CHW** and **low CHW**



6.3.4 Discussion

Using a "real-life" situation, Study 2 and Study 3 explored HR and SCL activity in the context of a variety of negative and positive emotions. Compared to Study 1, the use of the HGM1 enabled HR and SC levels to be continuously monitored along each of

the six elements of the Ropes Course, and stored for later analyses. The results from Study 2 confirmed that significant changes in the HR and SCL measures occurred and analysis indicated fractionation between these two measures at different stages of the Ropes Course activity. In Study 3 an Element Ratings questionnaire was used to record differences in both positive and negative related emotions evoked at various stages of the Ropes Course. The patterns of HR and SCL activity across the individual elements were tested for differences reflecting the presence of significant levels of negative or positive emotions. In light of Fowles' (1980) hypothesis, it was expected that the patterns of HR and SCL activity would reflect the dominant activation of the BAS and the BIS, respectively, and therefore would be linked to the presence of positive and negative emotions, respectively.

The descriptor group challenge, hard and worry was used to identify emotions that were considered to reflect dominant negative affect. The descriptors fun and excitement were used to identify emotions reflective of positive affect. From the analysis of the element ratings for the five descriptors, it was found that the Spiders Web and Postmans Walk elicited significantly high levels of emotions identified by the challenge, hard and worry descriptors, while significantly low levels of the same emotions were found for the Bridge and Tyre Walk elements. Significantly high levels of emotions associated with the fun and excitement descriptors were recorded for the Flying Fox element. Significantly low levels of these positive related emotions were found on the Bridge, Tyre Walk and Exit Ladder, with the lowest mean levels for both descriptors recorded for the Bridge and Exit Ladder. These analyses confirmed differential activation of the BIS and BAS systems, and identified groups of elements that evoked significantly high or significantly low levels of positive and negative emotions. That is, we were able to find two groupings of the elements which differentially elicited extremes of NA (Spider Web and Postmans Walk versus Bridge and Tyre Walk) and PA (Flying Fox versus Bridge and Exit Ladder) linked emotions.

Analysis of mean HR and SCL differences between these element groupings indicated that HR significantly discriminated between elements eliciting significantly different levels of challenge, hardness and worry related emotions, but SCL did not. It is interesting to note that the mean SCL for the Spiders Web and the Postman's Walk (8.31 μ S) was actually somewhat lower than that recorded for the Bridge and Tyre Walk (8.46 μ S), a difference in the opposite direction to that expected by our predictions based on Fowles' hypothesis. It was also found that SCL measures significantly discriminated between elements that elicited significantly different levels of fun and excitement related emotions, while HR did not. In other words, HR activity reflected differences in negative emotion, which in turn are associated with the activation of the BIS. Similarly, it was found that the SCL activity reflected the significant differences in positive emotion levels, and therefore could be linked to the activation of the BAS. These findings not only fail to support Fowles' hypothesis, but suggest the converse, that a relationship exists between the BAS and SCL, and between the BIS and HR.

In line with Gray's description of the BIS and BAS, the negative emotions associated with the descriptors challenge, hard, and worry were expected to reflect differential involvement of the BIS, while the relatively positive emotions associated with the descriptors fun and excitement were expected to be reflective of BAS involvement. While there was no attempt to monitor the presence of Gray's third system, the flight/fight system, during the Ropes Course attempt, experimenter observations of the children on the Postmans Walk and Spiders Web are consistent with Gray's (1975) description of the BIS as a "stop, look and listen" response. In general, the participants displayed overt signs of worry and anxiety during the more challenging elements, but this contrasts to a sense of fear or panic which is associated with the fight/flight system (Gray, 1975; Barlow, 1988). It is conceded however, that, due to the continuous nature of stimulation experienced by the child on the Ropes Course, it is probable that involvement of the three emotional systems occurred with considerable overlap, and this

would have varied between subjects. However, for the purpose of this study, emotions as described by the five descriptors were taken to reflect the dominant presence of either NA or PA related emotions for each element.

This investigation, conducted outdoors at a Sport and Recreation Camp, highlights the value of research conducted in real-life situations using laboratory precision equipment. Emotional states of the subjects were not manipulated by the experimenter, but instead occurred as a natural response to a challenging and exciting event. The emotions and associated physiological changes monitored over the Ropes Course provide strong evidence that, under "real-life" conditions, HR is linked to negative emotions, while SCL is linked to positive emotions. While these findings are consistent with some laboratory studies investigating the psychophysiology of emotion (e.g., Haney & Euse, 1976) the need for more specific and tailored research studying the fractionation of autonomic arousal measures under both natural and laboratory-manipulated conditions is warranted.

There is a possible concern as to the contribution of movement/activity effects in each of the physiological measures in this study. Unlike common laboratory explorations of emotions, the subjects were required to physically participate in an activity. This movement contribution was not considered to be extensive, in that subjects progressed at less than a slow walking pace, and were often much slower. There was also some physical effort required by the subjects to maintain their balance. The effort required on each of the elements was roughly equivalent, except for the Flying Fox. Interestingly, the Flying Fox recorded some of the highest HR and SCL means, although subjects were required to simply sit in a harness. The largest heart rate responses were obtained on the Postmans Walk. This element was the most slowly traversed and required less vigorous body movement compared to the earlier elements. The movement contribution question does not undermine the strength and lack of

ambiguity of the findings, but a parallel estimate of subject movement should be sought in future studies to clarify its contribution to these data.

As discussed earlier in Chapter 3, there is an extensive literature that examines the physiological changes accompanying emotional states, and HR and SCL measures have long been used as reliable indicators of sympathetic arousal. However, apart from Fowles' hypothesis, the literature has yet to provide an adequate or convincing explanation for the fractionation of autonomic arousal measures related to our emotional experience. From this study it is evident that predictions arising from Fowles' hypothesis do not provide a satisfactory explanation for the fractionation of these measures. Instead the data from Study 3 suggest that HR reflects the engagement of Gray's Behavioural Inhibition System, while SCL reflects involvement of the Behavioural Activation System. These findings in the HR measure are consistent with other laboratory (e.g., Haney & Euse, 1976; Sinha, Lovallo & Parsons, 1992) and field (e.g., Matthews, Manuck & Saab, 1986) studies demonstrating elevated HR levels accompanying negative emotions such as worry and anxiety. Compared to the lack of consistent findings in the SCL measure in the emotion literature, the SCL measure in this study clearly differentiated between the high and low levels of positive emotions only, indicating its sensitivity to the BAS.

CHAPTER 7

Psychophysiological Changes during the Ropes Course: Implications for Self Esteem

7.1 GENERAL INTRODUCTION

The Ropes Course activity presents the participant with a series of psychological challenges in a physical outdoor environment. As discussed in Chapter 4, Outdoor Educators believe that successful participation in challenging activities such as the Ropes Course may lead to positive personal and social changes for the participant. This is due to the re-evaluation of one's capabilities and subsequently oneself that occurs with successful completion of challenging activities. A positive evaluation of one's performance leads to an increase in self esteem (see Bandura, 1977). According to the Outdoor Education literature (Chapter 4 review), this outcome rests on the premise that the activity or the task in question presents the participant with a suitable level of challenge (O'Brian, 1989).

While it is easy to monitor successful completion of outdoor activities it is more difficult to assess the level of challenge experienced by individual subjects. Results from the previous study suggested that participants on the Broken Bay Ropes Course did experience varying and significant levels of challenge across the Ropes Course and that the level of challenge was linked to negative subject emotions identified by the descriptors challenge, hard and worry. Results from the previous study also showed that the descriptors fun and excitement were suitable indicators for the presence of positive emotions experienced by Ropes Course participants. Analyses of the physiological data from Study 3 suggested that HR and SCL activity were linked to negative and positive emotions respectively.

This chapter describes two studies that were conducted to explore self esteem and its related psychophysiological changes in primary school children involved in a five day Outdoor Education program at the Broken Bay Sport and Recreation Centre. In the first study, Study 4, the Coopersmith Self Esteem Inventory (SEI, Coopersmith, 1981) was administered at the beginning and at the end of the five day program to monitor changes in self esteem for 70 children. This SEI provided information regarding the changes in Total Self Esteem, as well as changes in the General SE, Social SE, Home SE and School SE subscales. In Study 5, using the same questionnaire, General SE changes were monitored for a second group of child subjects over the five day program. The subjects in this study were divided into two groups according to whether they increased (Group 1), decreased or showed no change (Group 2) in General SE after participation in the Outdoor Education program. Their psychophysiological changes recorded on the individual elements of the Ropes Course activity were examined for differences that reflected group changes in General Self Esteem.

There are no known studies exploring the relationship between self esteem changes and autonomic activity in either the Psychophysiology or Outdoor Education literature. Based on the description of self esteem (Coopersmith, 1975), personal experiences of challenging activities as documented in the Outdoor Education literature (e.g., Mortlock, 1984; see also Chapter 4 review) and information provided in Study 3, it was proposed that subjects recording an increase in General Self Esteem would find the Ropes Course challenging, and would describe their emotional experience on the Ropes Course as positive overall. In comparison, subjects recording a decrease in General Self Esteem would experience more negative emotions during the Ropes Course activity. In light of the Study 3 findings, it was anticipated that the different emotions experienced on the Ropes Course for the two subject groups would be reflected in differential HR and SCL activity.

Study 5 used an upgraded version of the HGM1 (AMS03) which, in addition to the HR and SCL measures, monitored motility (movement) during the Ropes Course activity. AMS03 uses arbitrary units to measure motility, with higher levels reflecting relatively more movement. In response to concerns regarding the contribution of movement to the HR and SCL findings described in the previous chapter, the analyses carried out in Study 3 were repeated on the data from Study 5 for the same element comparisons, and the motility scores were also tested for differences across the same element groupings used in the HR and SCL analyses. The same analyses were repeated on the HR and SCL data with motility as the covariate.

In summary, as well as continuing this thesis' investigation of the psychophysiology of emotion, the following two studies attempt to illustrate the type and wealth of information gained from conducting psychophysiological research in the area of Outdoor Education using ambulatory monitoring. While a number of studies have identified self esteem changes due to participation in Outdoor Education programs, the following study attempts to identify psychophysiological changes that differentiate between participants who increase in self esteem and those who do not. This information could be invaluable to practitioners in Outdoor Education and others interested in the psychological processes underlying self esteem changes.

7.2 STUDY 4

7.2.1 Introduction

As discussed in Chapter 4, one underlying theme for the participation of school children in Outdoor Education programs and activities is that participation will lead to an increase in self esteem (SE). Coopersmith (1975) described self esteem as "*...one of the attitudes and beliefs that a person brings with him/her when he/she faces the world.*

It includes his/her beliefs as to whether he/she can expect success or failure, and whether he/she will become more capable as a result of his/her experiences. In psychological terms, self-esteem provides a mental set preparing the person to respond according to expectations of success, acceptance, and personal strength" (Coopersmith, 1975, p.95)

In Outdoor Education, activities are designed to instigate the re-evaluation of one's attitudes and beliefs by encouraging subjects to participate in challenging activities that would not normally be undertaken. For example, the "Initiatives Activity" relies on problem solving and group co-operation to overcome seemingly impossible tasks, while the Ropes Course activity is largely based on "perceived risk". In a supportive environment, these challenging activities are designed to cause the participant to re-evaluate their own capabilities in a more positive light after having faced and successfully completed what was previously viewed as a daunting or risky task. All subjects participating on the Ropes Course activity in the following study successfully completed the activity. However, it should also be recognised that any re-evaluation of their capabilities rests not only on the successful completion of the activity, but also on their own evaluation of their performance and the level of challenge experienced during the activity.

This change in belief concerning one's abilities can be transferred to other educational or physical settings (Coopersmith, 1991), and the importance of self esteem in these other learning areas has been demonstrated. For example, a number of studies (e.g., Bledsoe, 1964; Bodwin & Bruck, 1962) have shown that children with high self esteem perform better in their school work than children with lower levels of self esteem. In other words, children who feel better about their abilities to perform and who expect to do well actually perform better in school. Outdoor Education programs attempt to foster success that may lead to an increase in self esteem that, along with

attitude changes, is transferable to other areas of the school curriculum.

The Self Esteem Inventory (SEI) School Form (Coopersmith, 1991; see Appendix 8) was used to monitor self esteem changes in this study. The SEI was developed after an extensive study of self esteem in children (Coopersmith, 1967) and was designed to be used with school students aged 8-15. It consists of 58 items marked on a two point scale ("like me" or "unlike me"); 50 Self Esteem items and 8 items that constitute the Lie scale. The Lie scale is a measure of a student's "defensiveness or test-wiseness" (Coopersmith, 1991, p.2). The Self Esteem items can be divided into four sub-scales: General Self, Social Self-Peers, Home-Parents and School-Academic. According to Coopersmith (1991), "*the subscales allow for variances in perceptions of self esteem in different areas of experience*" (p.2). The high validity and reliability of the SEI has been supported by a number of studies (e.g., Kimball, 1972; Spatz & Johnston, 1973) and is documented by Coopersmith (1991).

This preliminary study was carried out to confirm the occurrence of subject changes in self esteem and to identify any procedural or methodological problems with the administration of the questionnaire during the hectic Broken Bay first and last day program schedule. The suitability of the SEI to detect the expected small changes in self esteem over the relatively short period of a week was also considered. In regard to self esteem changes, it was hypothesised that Self Esteem and the subscale General SE would increase due to participation in the Outdoor Education program offered at the Broken Bay centre.

A small number of articles in the Outdoor Education literature (e.g., Humberstone, 1990) have described gender differences in regard to participation levels and the related attitudes towards participation in adventure activities. Gender differences were not examined in Studies 1 to 3 due to the nature of these studies and the small

sample size. With a larger subject sample, gender differences were examined in the self esteem scores obtained in Study 4 to provide further information about the differential effects of Outdoor Education programs on boys and girls.

7.2.2 Method

96 volunteer primary students (44 boys, 52 girls) aged 10-12 years were administered the Coopersmith Self Esteem Inventory (SEI, 1981) on arrival and on completion of their five day residential outdoor education program at the Broken Bay Sport and Recreation Centre. Children were from a selection of schools located in Sydney and country NSW. Subjects participated in the study with parental and school consent. Analyses were carried out on data for 70 children (29 boys, 41 girls) who completed all the questions on the SEI and whose initial and final Lie subscale scores were less than 6.

7.2.3 Results

Table 7.1 shows the average Total SE score for the two subject groups (Group 1; 29 boys; Group 2: 41 girls) at the beginning (t1) and end (t2) of the five day Outdoor Education program conducted at the Broken Bay Sport and Recreation centre. The average General SE, Social SE, School SE, and Home SE subscale scores for the boys and girls are also presented in Table 7.1. The raw scores for the 70 subjects and statistical outcomes for this study are presented in Appendices 9 and 10.

Using a series of one-way ANOVAs over group, preliminary analyses were carried out to determine whether gender differences occurred at the initial measurement occasion. These analyses indicated that there were no significant gender differences for the initial Total SE score ($F(1,68)=.18, p=.67$), or for the General SE ($F(1,68)=.68,$

p=.41), Home SE (F(1,68)=.23, p=.64), Social SE (F(1,68)=.06, p= .80) or School SE (F(1,68)= .66, p=.42) subscales. The difference in the Lie scale at the first measurement occasion for the two groups was not significant (F(1,68)=1.25, p=.27).

Table 7.1 Study 4 Coopersmith Self Esteem Scores (n=70) for Group 1 (29 boys) and Group 2 (41 girls).

MEASURE	TIME		EFFECTS (F values)		
	t1 mean (S.D.)	t2 mean (S.D.)	Group	Time	G X T
Total SE					
Boys	36.97 (8.10)	38.31 (8.69)	0.17	7.51 **	0.00
Girls	36.19 (6.86)	37.58 (7.94)			
General					
Boys	19.17 (4.20)	19.65 (4.50)	0.26	5.32 *	0.88
Girls	18.34 (4.12)	19.49 (4.36)			
Social					
Boys	6.28 (1.99)	6.41 (1.86)	0.79	0.43	2.40
Girls	6.17 (1.46)	5.83 (1.66)			
Home					
Boys	6.41 (1.59)	6.76 (1.57)	0.19	8.63 **	0.03
Girls	6.22 (1.74)	6.61 (1.87)			
School					
Boys	5.10 (1.89)	5.48 (1.94)	0.45	1.97	0.20
Girls	5.46 (1.78)	5.66 (1.81)			
Lie					
Boys	2.41 (1.48)	2.07 (1.33)	3.70	0.61	1.95
Girls	2.83 (1.56)	2.93 (1.60)			

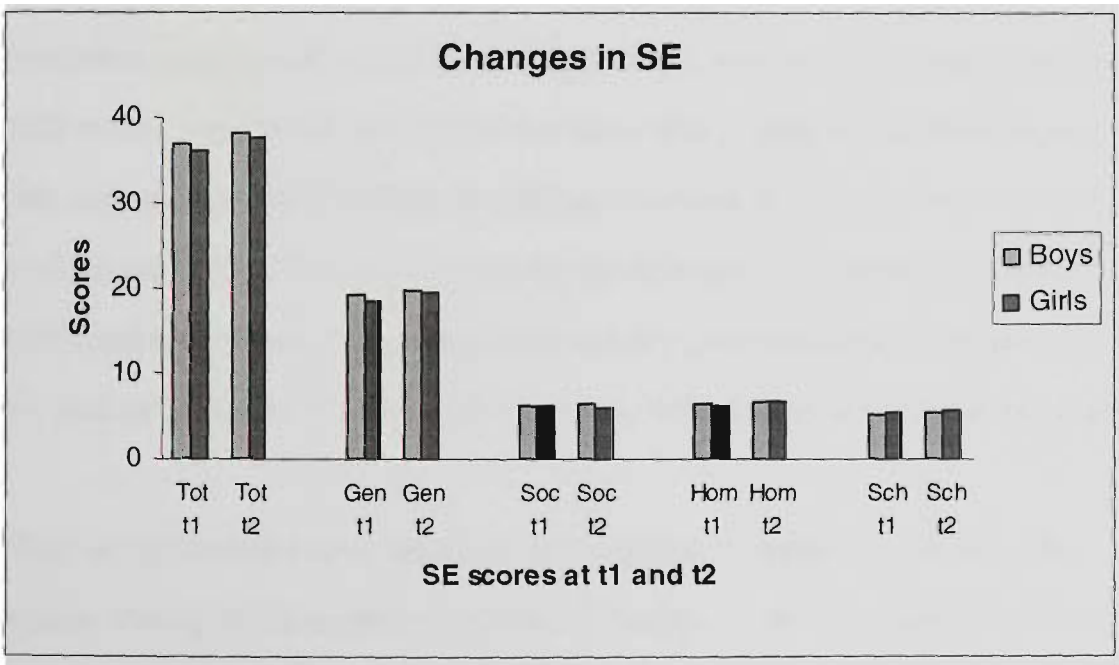
** significant at .01 level

* significant at .05 level

Changes in self esteem were analysed separately using a two-way ANOVA over time (t1 versus t2, representing the measures before and after the five day program) and

gender groups (g1 versus g2), with repeated measures on the time factor. These analyses showed that the increase in Total Self Esteem was significant ($F(1,68)=7.51, p<.01$), as were the increases obtained for General SE ($F(1,68)=5.32, p<.05$) and Home SE ($F(1,68)=8.63, p<.01$). There were no significant Group or Group X Time interactions indicating that the changes observed in the SE scores did not differ between boys and girls. The changes obtained in the Social SE and School SE subscales were not significant and there were no significant Group effects or Group X Time interactions for these two scores. There were no significant Group, Time or Group X Time effects obtained for the Lie subscale score. These findings in the Total Self Esteem and the SE subscale scores are illustrated in Figure 7.1.

Figure 7.1 Changes in Total SE, General SE, Social SE, Home SE and School SE scores.



7.2.4 Discussion

This preliminary study confirmed increased self esteem levels after participating in the five day Outdoor Education Program at the Broken Bay Sport and Recreation centre. Significant increases were found for Total SE, General SE and Home SE. These findings are consistent with other pen/paper studies (e.g. McIntyre, 1987; see also Humberstone, 1990) that have shown increased self esteem levels after participation in challenging adventure activities. There were no significant gender differences found in the initial Total SE score or for any of the initial subscale scores. There were no significant Group effects or Group X Time interactions found in the self esteem data indicating that there were no gender differences in self esteem or any of the self esteem subscales. In other words, the increases observed in the SE scores did not differ between the boys and girls.

From Coopersmith's (1991) definition of the subscales, it was suggested that the outdoor activities implemented at the Broken Bay Centre were more likely to affect the General SE scores. Also, it was anticipated that the whole experience of being away from home and mixing with other school children was more likely to influence Home SE, School SE and Social SE scores. Therefore, the General SE increase recorded in Study 4 reflected self esteem changes that occurred due to participation in programmed activities, such as the Ropes Course and Initiative Activities, over the five day program.

This study identified some problems associated with subject response to the questionnaire. During administration a number of students voiced their dislike of the two point answering system ('like me' or 'unlike me'). This factor accounted for a large number of questionnaires not filled out completely, and that were subsequently eliminated from the data sample. However, analyses in Study 4 showed that with a relatively large subject sample the Coopersmith SEI was able to ascertain changes in

self esteem in children visiting the Broken Bay Centre.

7.3 STUDY 5

7.3.1 Introduction

Similar to many studies conducted in Outdoor Education, this preliminary study did not provide information concerning the psychological and physiological changes or processes that take place during these activities and, more specifically, the psychophysiological changes that are associated with changes in self esteem. As discussed in Chapter 4, the use of both questionnaires and physiological monitoring can provide a more detailed picture of the psychophysiological changes, and in particular the emotional changes, that take place during challenging outdoor activities. Also compared to self-report measures, some autonomic measures (e.g., HR and SCL) may prove to be more sensitive to the psychological processes underlying the emotional changes noted during these sorts of activities.

The following study was designed to further investigate the psychophysiological changes of Ropes Course participants, and specifically whether these changes differed for groups of subjects who increased or decreased in self esteem. First however, to confirm the findings presented in Study 3, the initial set of analyses tested HR and SCL changes for linkages with the presence of significantly high or low levels of negative (challenge, hard and worry) (CHW) and positive (fun and excitement) (FE) emotions. The descriptor ratings on the six elements were analysed to identify those elements eliciting significantly high or significantly low levels of challenge, hard, worry, fun and excitement compared to the element average. From the previous study, it was expected that the Flying Fox would rate significantly high for the FE descriptor group compared to the Ropes Course average, while the Bridge and Exit Ladder would rate significantly

low for this positive emotion descriptor group. It was also expected that the Postmans Walk and Spiders Web would rate significantly high, and the Bridge and Exit Ladder significantly low for the CHW descriptor group. The selected elements representing the high and low levels for the FE and CHW descriptors were grouped and tested for HR and SCL change differences.

The updated HGM1 (AMS03) used in this study monitored and stored motility (MOT) data. To address some of the concerns raised in Study 3 regarding the contribution of movement to HR and SCL activity monitored across the Ropes Course, differences in motility across the same element groups used in the HR and SCL analyses were examined. In addition, the ANOVAs carried out on the HR and SCL data were repeated with average motility levels as a covariate. As discussed in Chapter 6, it was anticipated that motility would have some influence on changes in the HR and SCL measures, but this influence was not expected to over-ride the physiological changes resulting from the effects of emotion.

The second set of analyses in Study 5 explored the psychophysiological changes of Ropes Course participants in relation to group changes in General Self Esteem. In this study Subjects were monitored for General SE changes using a modified Coopersmith SEI administered prior to and on completion of the five day camp. The General SE scores were used to divide the subjects into two groups for the current study: Group 1 included subjects who increased in General SE and Group 2 included subjects who decreased or showed no change in General SE. With the inclusion of subjects who showed no change in self esteem in Group 2 these two groups were not considered extreme groups, and a reduction in group differences was expected. The descriptor ratings data and the physiological data (HR, SCL and MOT) gathered during the Ropes course attempt were tested for differences that reflected group change in self esteem.

Based on some methodological issues identified in Study 4, the use of the Coopersmith SEI in Study 5 was slightly modified to support easier administration of this questionnaire and to reduce the number of incomplete responses in the smaller subject sample. The two point answering system was changed to a four point answering system with subjects instructed to tick one of the following: “false”, “mostly false”, “mostly true” or “true”. This modified SEI was received more favourably by children during pilot studies following Study 4, and resulted in fewer questions and vocal objection during its administration. It was anticipated that, compared to the two point scale, the four point score could be more sensitive to self esteem changes over the relatively brief period of five days

Ratings of the Ropes Course elements for the descriptors challenge, hard, worry and fun and excitement were averaged and tested for group differences across the Ropes Course and for the individual elements. In regard to analyses of the physiological data, the HR, SC and MOT levels were averaged across the entire Ropes Course (i.e., the 29 epochs) and tested for group differences. Further analyses explored group differences in the HR and SCL response across the epochs for each element. These data were tested for group differences in the linear, quadratic and cubic trends across each element. This approach contrasts with that adopted in Study 1 where the use of only two measurement occasions provided limited information regarding the cardiovascular response and changes in state anxiety experienced during the Ropes Course activity for the two subject groups. It also contrasts with Study 3 where analyses simply compared HR and SC average levels between the groups of elements identified with high levels of positive or negative emotions.

While this study was largely exploratory, based on the Outdoor Education and self esteem literature (see Chapter 4) it was anticipated that group differences in the types of emotions experienced would occur on the more challenging elements of the

Ropes Course. This would be reflected in both the descriptor ratings and physiological responses monitored during the Ropes Course attempt.

7.2.3 Method

Subjects

Thirty-six children (18 boys and 18 girls) aged between 10 and 12 years participating in their annual outdoor education school camp were randomly selected to participate in this study. The children were monitored for General Self Esteem changes over the five day program held at the Broken Bay Sport and Recreation centre. The subjects were also monitored for psychophysiological changes during the Ropes Course activity. All volunteer subjects were informed as to the nature of the study and provided parental consent prior to participation in the study. A total of 4 subjects were eliminated from the data sample due to high lie scale scores ($L > 6$) on the Self Esteem Inventory or incomplete physiological data sets. Analyses were carried out on the data of the remaining subjects (18 girls and 14 boys).

Apparatus

Psychological measures.

To monitor General Self Esteem changes, subjects were administered the modified (four point scale instead of a two point scale) Self Esteem Inventory (SEI; Coopersmith, 1991) at the beginning and at the end of the five day program. As for Study 3, an Element Ratings Questionnaire (see Appendix 4) was administered at the end of the Ropes Course activity and used to assess the level of positive and negative emotion experienced across the individual elements. This questionnaire required subjects to rate the Ropes Course elements on a seven point scale for the descriptors challenge, hard, worry, fun, and excitement. These descriptors were adopted from Study 3, which suggested that they were associated with either the positive or negative

emotions experienced by Ropes Course child participants. Similar to that Study, the descriptors were grouped into the following: fun/excitement (FE) and challenge/hard/worry (CHW) and were taken to reflect positive affect (PA) and negative affect (NA) respectively.

Physiological measures.

HR, SCL and motility (MOT) levels were obtained using a portable data logger (Ambulatory Monitoring System, AMS03). This device was updated from the one used in the previous study (HGM1) to incorporate motility measures (A subject printout from the AMS03 device is provided in Appendix 11). All methods relating to the use of the AMS were consistent with those adopted in Study 2 and Study 3. Four second averages were calculated from five epochs located at the same positions along the individual elements as described for Study 2 (see Figure 6.1).

Procedure

Subjects were administered the modified Coopersmith Self Esteem Inventory (SEI; Coopersmith, 1991) on their arrival at the Broken Bay Sport and Recreation Centre. During the five day Outdoor Education program, the subjects were monitored for psychophysiological changes during their "normal" Ropes Course activity. This half day activity usually occurred on the third or fourth day of the five day program. Compared to Study 3, subject data were collected from one attempt of the Ropes Course only, thus maintaining the usual Ropes Course lesson procedure implemented at the Broken Bay Centre. On completion of the five day program, subjects were administered a second modified SEI to determine their change in General SE.

7.3.3 Results

The first set of analyses carried out on the subject data aimed to confirm some of the findings from Study 3. Elements identified with significantly high levels of positive

or negative emotions were grouped and tested for differences in average HR and SCL levels. Motility differences between the same element groupings were also tested. The effects of motility on the reported HR and SCL changes were examined further with a second series of Analyses of Covariance performed on the HR and SCL averages with motility as the covariate.

In the second set of analyses, the relationship between group changes in General SE and the psychophysiological changes experienced on the Ropes Course was explored. Subject General Self Esteem scores obtained at the beginning and end of the five day Outdoor Education program were used to group the subjects into two groups. Group 1 included subjects who increased in General SE while Group 2 included subjects who decreased or showed no change in General SE. Element evaluations were explored for significant differences between the two subject groups for the FE and CHW descriptors averaged across the Ropes Course and for each of the six elements. HR, SCL and motility levels were also examined for group differences across the entire Ropes Course and for the individual elements. All of the raw data and statistical outcomes for Study 5 are presented in Appendices 12, 13 and 14.

ANALYSES SET 1

Ratings Data

Table 7.2 shows the Ropes Course element ratings for the five descriptors challenge, hard, worry, fun and excitement. A repeated measure analysis on the element ratings was used to identify the elements eliciting significantly high or low levels of challenge, hard, worry, fun and excitement. Compared to the experiment average, significantly high levels of fun (5.31) and excitement (5.12) were found for the Flying Fox element while significantly low levels of fun and excitement were recorded on the Bridge (F: 3.62, E: 2.97) and Exit Ladder (F: 3.91, E: 3.79). Compared to the

experiment average, the Spiders Web (C: 3.47, H: 3.00, W: 2.84) and Postmans Walk (C: 4.12, H: 3.56, W:3.47) recorded the highest levels for the challenge (C), hard (H) and worry (W) descriptors. The Bridge (C: 1.31, H: 0.72, W: 0.78) and the Exit Ladder (C: 1.56, H: 0.91, W: 1.23) recorded significantly low levels for these three descriptors compared to the Ropes Course average. These findings are indicated in Table 7.2. Mean FE and CHW descriptor rating scores for each of the Ropes Course elements are illustrated in Figure 7.2a and Figure 7.2b respectively.

Table 7.2 Element descriptor ratings for the six elements of the Ropes Course and analysis outcomes.

ELEMENT	Descriptor									
	Challenge		Hard		Worry		Fun		Excitement	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Bridge	1.31 d	1.03	0.72 d	0.77	0.78 d	1.24	3.62	1.83	2.97 d	1.49
Tyre Walk	2.68	1.38	1.87	1.10	2.28	1.73	4.00	1.16	3.53	1.29
Spiders Web	3.47 a	1.65	3.00 a	1.78	2.84 a	1.61	3.69	1.55	4.22	1.34
Postmans W	4.12 a	1.48	3.56 a	1.81	3.47 a	1.95	4.03	1.53	4.19	1.55
Flying Fox	3.06	2.24	1.84	2.13	1.97	2.15	5.31 a	1.57	5.12 a	1.54
Exit Ladder	1.56 d	1.32	0.91 d	1.23	1.09 d	1.23	2.81 d	1.82	2.69 d	1.84

KEY

- a score significantly high at .001 level
b score significantly high at .01 level
c score significantly high at .05 level
- d score significantly low at .001 level
e score significantly low at .01 level
f score significantly low at .05 level

Figure 7.2a Fun and excitement ratings for the six Ropes Course elements.

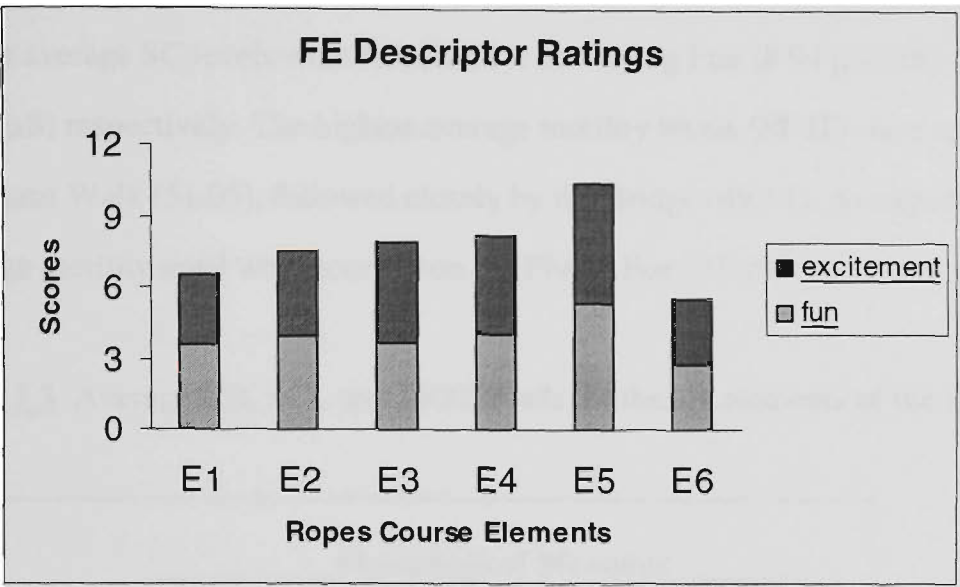
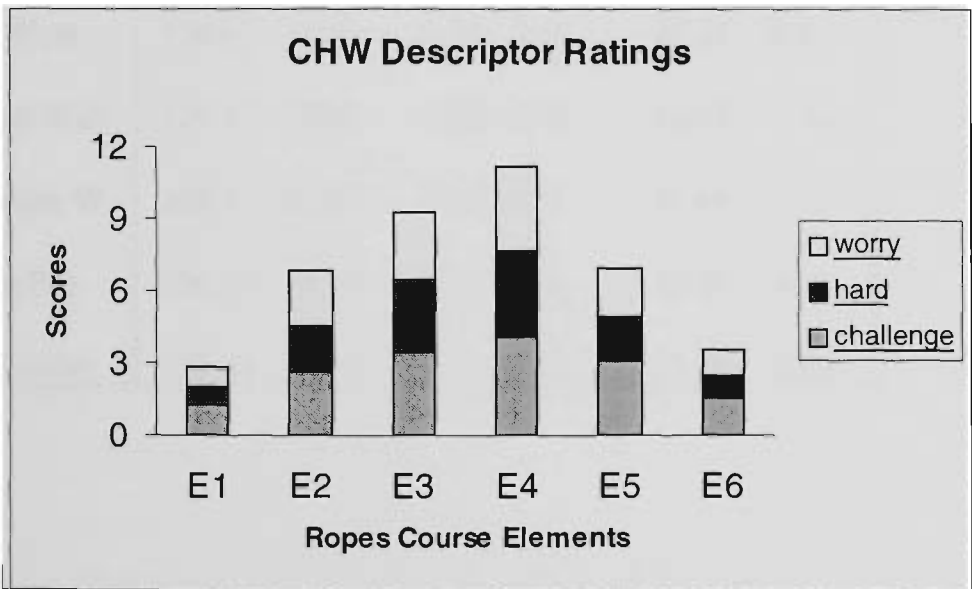


Figure 7.2b Challenge, hard and worry ratings for the six Ropes Course elements



Physiological data

Table 7.3 shows the average HR, SCL and MOT levels obtained for the six elements of the Ropes Course. The Spiders Web recorded the highest average HR levels

(129.90 BPM) while the Tyre walk (120.61 BPM) recorded the lowest average HR levels closely followed by the first element, the Bridge (120.97 BPM). The highest and lowest average SC levels were recorded for the Flying Fox (8.94 μ S) and the Bridge (6.60 μ S) respectively. The highest average motility levels (MOT) were recorded on the Postmans Walk (51.05), followed closely by the Bridge (49.11). As expected, the lowest average motility level was recorded on the Flying Fox (31.99).

Table 7.3 Average HR, SCL and MOT levels for the six elements of the Ropes Course.

ELEMENT	Physiological Measures					
	HR (BPM)		SCL (μ S)		MOT	
					(arbitrary units)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Bridge	120.97	16.96	6.60	2.27	49.11	12.99
Tyre Walk	120.61	12.89	6.74	2.58	45.23	11.91
Spiders Web	129.90	14.06	7.54	3.40	43.65	9.24
Postmans W.	128.57	14.47	7.87	3.36	51.05	11.27
Flying Fox	126.07	15.85	8.94	4.11	31.99	15.29
Exit Ladder	122.19	10.90	8.14	3.64	37.28	7.08

The Ropes Course elements eliciting significantly high or low levels of FE and CHW linked emotions were examined for differences in the HR and SC measures. A one way ANOVA confirmed a significant difference in HR between the Spiders Web + Postmans Walk (mean=129.23 BPM) (**high CHW**) and Bridge + Exit Ladder (mean =121.58 BPM) (**low CHW**) element groups; $F(1,31)=28.76, p<.000$. There was no significant difference recorded in the SCL measure for the same element groups

(Spiders Web + Postmans Walk, mean=7.71 μ S; Bridge + Exit Ladder, mean=7.37 μ S); $F(1,31)=2.02$, $p=.17$. In regard to the FE descriptors, the SCL measure was significantly higher for the Flying Fox (mean=8.94 μ S) (**high FE**) compared to the Bridge and Exit Ladder (mean=7.37 μ S) (**low FE**), $F(1,31)=18.69$, $p<.000$. The HR measure was also significantly different for this element grouping, with higher HR levels on the Flying Fox (mean=126.07 BPM) (**high FE**) compared to the Bridge and Exit Ladder (mean=121.58 BPM) (**low FE**), $F(1,31)=6.20$, $p<.05$. While this difference in HR between the **high FE** and **low FE** element groups was significant, the difference was not as great as that observed between the **high CHW** and **low CHW** element groups. These findings for the element groups representing the high and low FE and CHW descriptors are illustrated in Figures 7.3 a & b and Figures 7.4 a & b respectively.

Motility Effects

To examine the possible contribution of movement to the above findings in the HR and SC response, the average motility levels were examined for differences between the same element groups representing high and low levels of FE and CHW. Comparison of the average motility scores between the **high FE** (mean =31.99) and **low FE** (mean = 43.19) element groups was significant, with the highest motility score found for the **low FE** grouping ($F(1,31)=26.96$, $p<.001$). In other words, the difference in the motility level for the **high FE** and **low FE** element groups was in the opposite direction to that observed in both the SCL and HR measures. A significant difference in motility was observed between the **high CHW** (mean = 47.35) and **low CHW** (mean = 43.19) element groups ($F(1,31)=8.46$, $p<.01$), although the difference did not reach the same level of significance as that obtained in the HR data for the same element group comparison. The mean motility levels for these element group comparisons are illustrated in Figure 7.3c and Figure 7.4c.

Figure 7.3 a-c Means of cardiac (a), electrodermal (b) and motility (c) levels on elements representing **high FE** and **low FE**

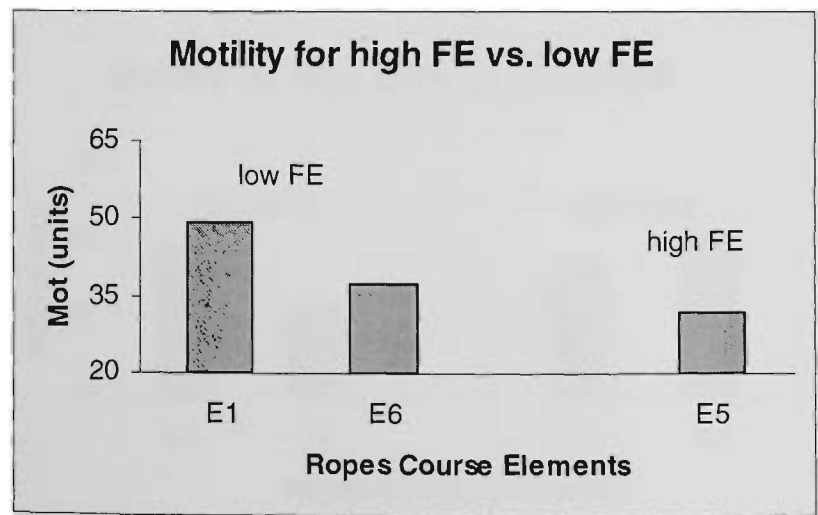
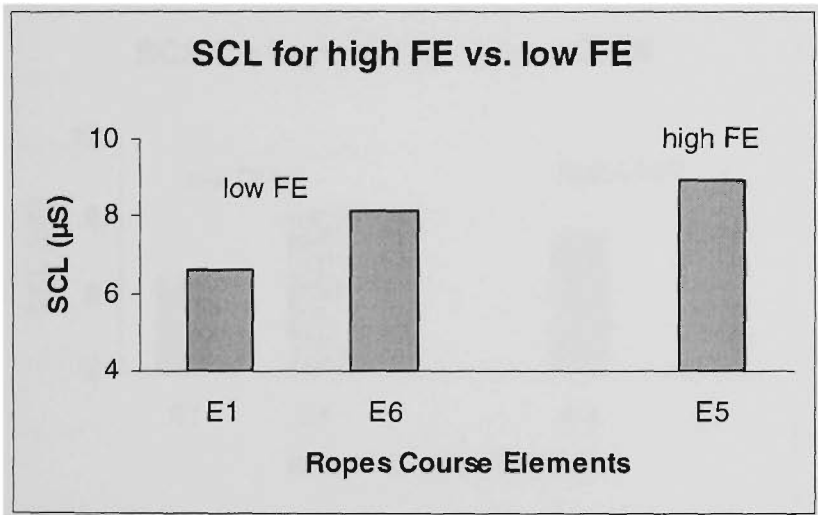
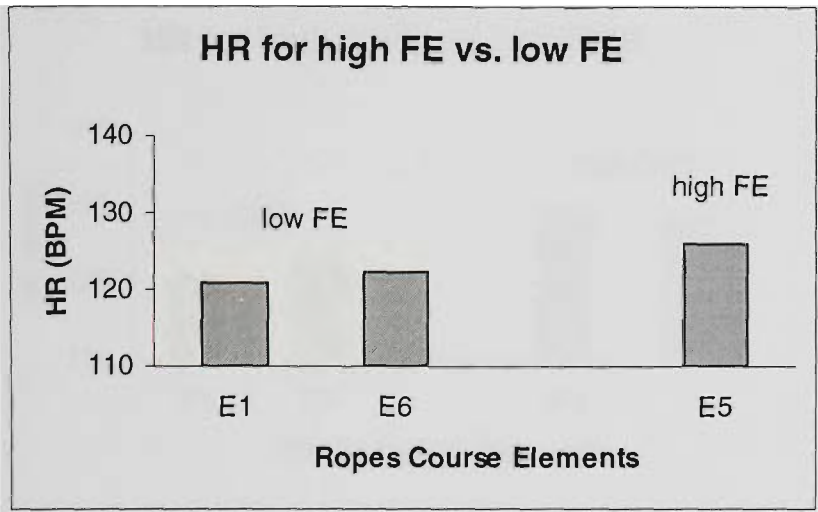
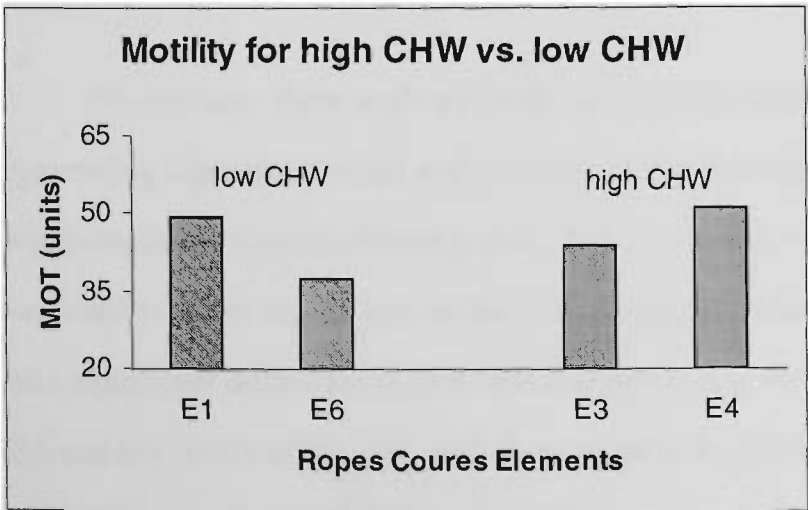
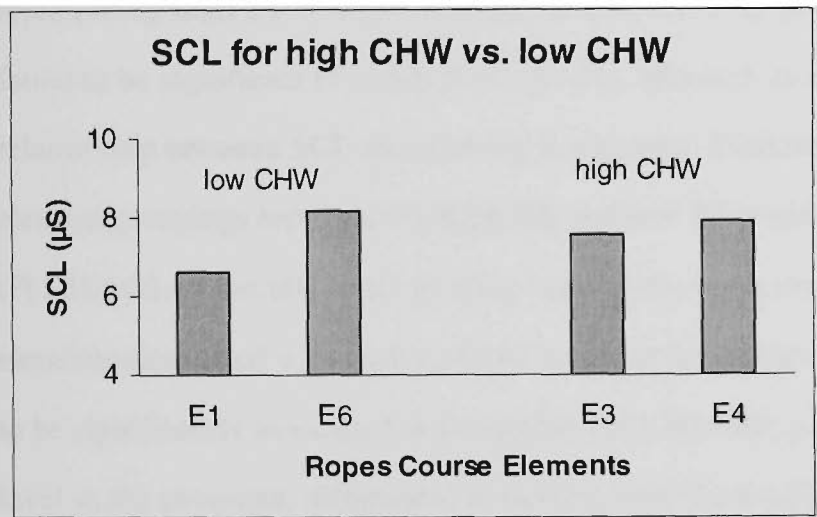
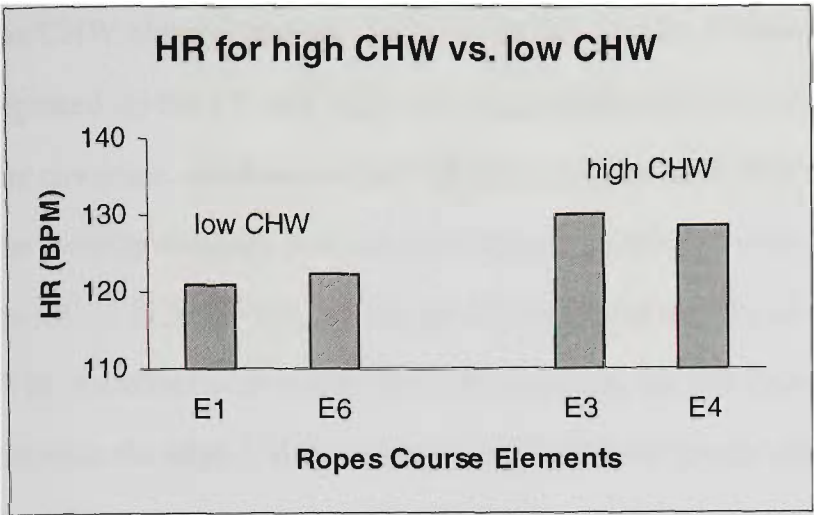


Figure 7.4a-c Means of cardiac (a), electrodermal (b) and motility (c) levels on elements representing **high CHW** and **low CHW**



The above analyses indicated that motility did vary across the element groups and that movement may have influenced the significant finding in the HR measure for the CHW element groups. To examine this finding further, the same comparisons were repeated on the HR and SCL data using Analyses of Covariance with motility level as the covariate. Analyses of the HR difference for the CHW element groups showed that the motility measure was not significantly associated with the overall HR ($F(1,30)=.01$, $p=.94$) or SCL ($F(1,30)=1.03$, $p=.32$) measures for this set of element comparisons. With the effect of motility taken into account, the HR measure still significantly differed between the **high CHW** and **low CHW** element groups ($F(1,30)=21.53$, $p<.001$) while the SCL measure did not ($F(1,30)=2.99$, $p=.09$). In regard to the element groups representing **high FE** and **low FE**, the effect of motility on the mean SCL measure was found to be significant ($F(1,30)=9.66$, $p<.01$), although as noted above, an inverse relationship between SCL and motility is apparent. Differences in SCL between the element groupings representing **high FE** and **low FE** remained significant ($F(1,30)=32.45$, $p<.001$) with motility level as the covariate. HR activity for the elements associated with high and low levels of the positive descriptors was not found to be significantly associated with motility ($F(1,30)=.89$, $p=.35$), and, using the motility level as the covariate, differences in the HR level for the Flying Fox versus the Bridge + Exit Ladder remained significant ($F(1,30)=6.05$, $p<.05$).

In summary, these analyses on the average HR and SC levels for element groups representing significantly high and low levels of positive and negative emotions were largely consistent with the findings described in Study 3. A significant difference in HR was found between the groups of elements associated with high and low levels of CHW, and a significant difference in SCL was found between the elements associated with high and low levels of FE. These findings in the HR and SCL measures were supported in the Covariance analyses with motility as the covariate. One finding in the HR data was not consistent with the results found in Study 3. A significant difference in HR was

obtained here between the Flying Fox (**high FE**) and the Bridge + Exit Ladder (**low FE**), which remained in the Covariance analysis using motility as the covariate. These results suggest that motility did not affect the emotion related physical response patterning across the elements. Some possible explanations for this discrepant finding in the HR measure are addressed in the Discussion section below.

ANALYSES SET 2

In the second set of analyses the element descriptor ratings and the physiological changes monitored along the six Ropes Course elements were examined for differences as a function of group change in General Self Esteem. Differences in the HR and SCL response across the epoch averages for each of the six elements were examined for group differences. Variations in motility along the individual elements were also tested for group differences.

Self esteem changes

Table 7.4 shows the General Self Esteem scores for the 14 boys and 18 girls obtained using the modified SEI questionnaire administered at the beginning (t1) and end (t2) of the five day program. Analysis of the General SE scores showed an initial General SE score of 74.41 which increased to 76.87 at the completion of the program. Two one-way ANOVAs conducted on the General SE and Lie scores at t1 confirmed that there were no gender differences in either of these two scores at the first measurement occasion (General SE: $F(1,30)=.007$, $p=.94$; Lie scale: $F(1,30)=.09$, $p=.77$). A two-way repeated-measure ANOVA was used to test the General SE scores for significant time (t1 versus t2) and gender (boys versus girls) effects. This analyses showed that the increase was not significant ($F(1,30)=2.55$, $p=.120$) and that there was no significant gender effect ($F(1,30)=.14$, $p=.71$) or interaction between gender and time

($F(1,31)=1.31, p=.261$). The increase in the Lie scale over time was found to be significant ($F(1,30)=7.08, p<.05$), however as indicated in Table 7.4, the average Lie scale score remained lower than 4 for both the boys and girls. The changes in General Self Esteem and the Lie Scale for the boys versus the girls are illustrated in Figure 7.5a and Figure 7.5b.

Table 7.4 Study 5 General SE scores and analyses outcomes for gender effects.

	TIME		Effects (F values)		
	t1	t2	Group (G)	Time (T)	G X T
General SE					
Boys	74.57	75.21	.14	2.55	1.31
Girls	74.28	78.17			
LIE Scale					
Boys	2.64	3.57	.35	7.08 *	0.19
Girls	2.50	3.17			

* significant at .05 level

Figure 7.5a General SE changes for the boys (n=14) and girls (n=18) on the modified Coopersmith SEI

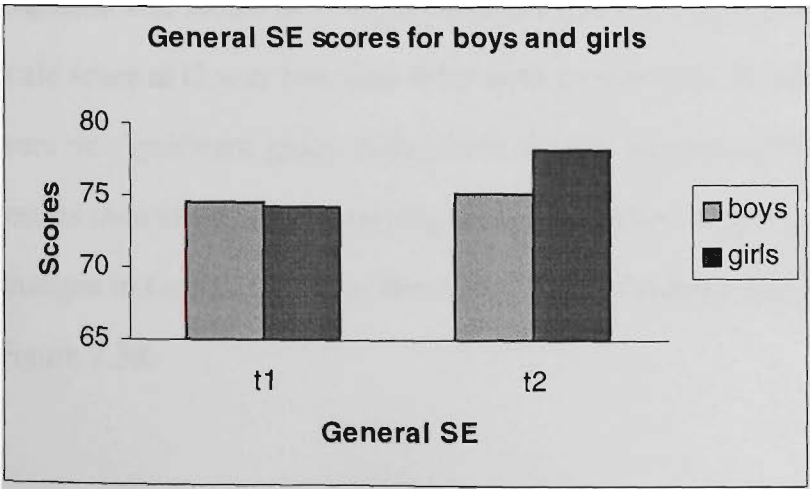
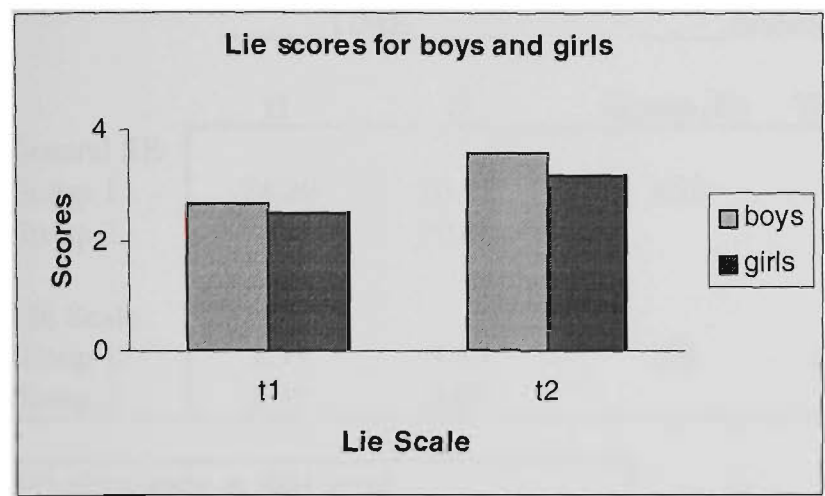


Figure 7.5b Lie Scale changes for the boys (n=14) and girls (n=18) on the modified Coopersmith SEI



Subjects were divided into 2 groups according to whether they increased (Group 1) or decreased or showed no change (Group 2) in General SE over the program. A one-way ANOVA confirmed that Group 1 (n=20) and Group 2 (n=12) did not significantly differ in the initial General SE ($F(1, 30) = .023, p = .88$) or Lie scale $F(1,30) = 1.40, p = .24$) scores. A two-way repeated-measures ANOVA examined changes in General SE for the two groups. Due to subject group manipulation, a significant group X time interaction was recorded for the General SE scores, ($F(1,30) = 29.20, p < .001$). The increase in the Lie scale was found to be significant ($F(1,30) = 5.28, p < .05$), although the average lie scale score at t2 was less than 4 for both groups and, as indicated in Table 7.5, there were no significant group differences for this increase ($F(1,30) = 1.42, p = .24$). These results indicate that the grouping strategy resulted in groups which showed different changes in General SE over the camp. These findings are illustrated in Figure 7.5c and Figure 7.5d.

Table 7.5 Study 5 General SE scores for Group 1 (increased in General SE) and Group 2 (decreased in General SE) (Group 1, n=20; Group 2, n=12).

	TIME		Effects (F values)		
	t1	t2	Group (G)	Time (T)	G X T
General SE					
Group 1	74.20	80.95	.023	.245	29.20 ***
Group 2	74.75	70.08			
LIE Scale					
Group 1	2.35	3.40	.19	5.28 *	1.42
Group 2	2.92	3.25			

*** significant at .001 level
* significant at .05 level

Figure 7.5c General SE changes for Group 1 (n=20) and Group 2 (n=12) on the modified Coopersmith SEI

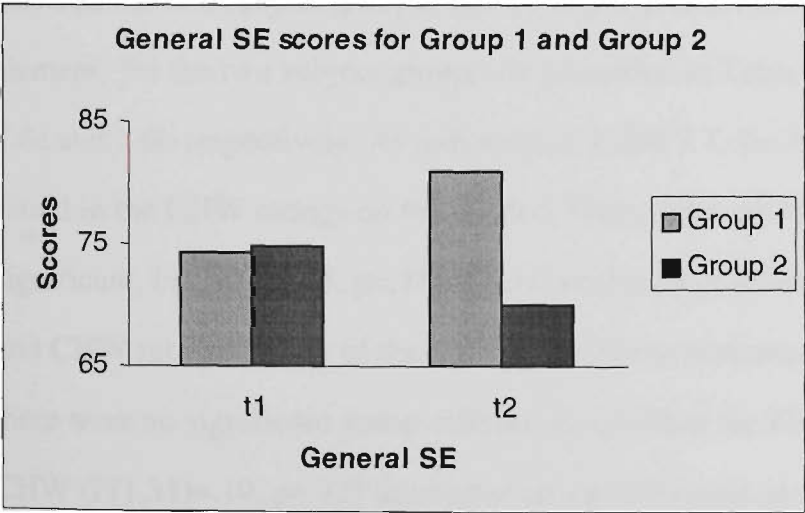
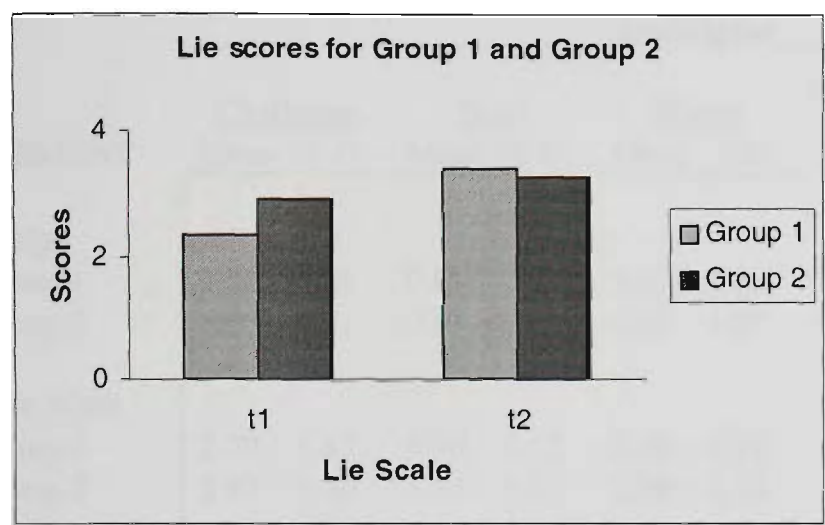


Figure 7.5d Lie scale changes for Group 1 (n=20) and Group 2 (n=12) on the modified Coopersmith SEI



Element Descriptor Ratings

Table 7.6 shows the average descriptor ratings for the six element of the Ropes Course calculated for Group 1 and Group 2. The average fun + excitement and challenge + hard + worry descriptor ratings were calculated for the six elements and tested for significant differences on the individual elements and across the Ropes Course between the two subject groups. The average FE and CHW descriptor ratings on the six elements for the two subject groups are presented in Table 7.7, and illustrated in Figure 7.6a and 7.6b respectively. As indicated in Table 7.7, the largest group difference was found in the CHW ratings on the Spiders Web, although this difference was not significant, $F(1,30)=1.45, p=.24$). There were no significant group differences in the FE and CHW ratings on any of the six Ropes Course elements. Analyses also found that there were no significant group differences in either the FE ($F(1,31)=0.452, p=.51$) or CHW ($F(1,31)=.10, p=.75$) descriptor ratings averaged across the Ropes Course attempt.

Table 7.6 Study 5 Element descriptor ratings for Group 1 (n=20) and Group 2 (n=12).

ELEMENT	<u>Descriptor</u>									
	<u>Challenge</u>		<u>Hard</u>		<u>Worry</u>		<u>Fun</u>		<u>Excitement</u>	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Bridge										
Group 1	1.35	0.93	0.65	0.81	0.85	1.35	3.40	1.85	3.00	1.59
Group 2	1.25	1.21	0.83	0.21	0.67	1.07	4.00	1.80	2.92	1.38
Tyre Walk										
Group 1	2.70	1.45	1.90	1.12	2.40	1.93	3.85	1.34	3.50	1.23
Group 2	2.67	1.30	1.83	1.12	2.08	1.38	4.25	0.75	3.58	1.44
SpidersWeb										
Group 1	3.15	1.90	2.90	1.92	2.60	1.70	3.80	1.64	4.00	1.30
Group 2	4.00	0.95	3.17	1.58	3.25	1.42	3.50	1.44	4.58	1.38
Postmans W.										
Group 1	3.95	1.35	3.55	1.57	3.20	1.96	3.90	1.62	3.95	1.76
Group 2	4.42	1.68	3.58	2.23	3.92	1.93	4.25	1.42	4.58	1.08
Flying Fox										
Group 1	3.60	2.06	2.05	2.11	2.05	2.01	5.25	1.52	5.10	1.62
Group 2	2.17	2.33	1.50	2.19	1.83	2.44	5.42	1.73	5.17	1.45
Exit Ladder										
Group 1	1.30	1.26	0.95	1.36	1.10	1.07	2.70	1.95	2.85	2.01
Group 2	2.00	1.34	0.83	1.03	1.08	1.50	3.00	1.65	2.42	1.56

Figure 7.6a FE descriptor ratings for Group 1 versus Group 2

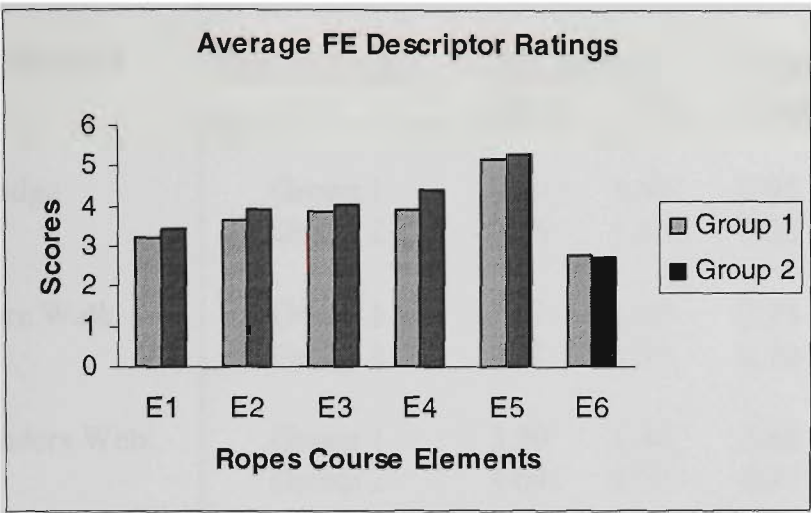


Figure 7.6b CHW descriptor ratings for Group 1 versus Group 2

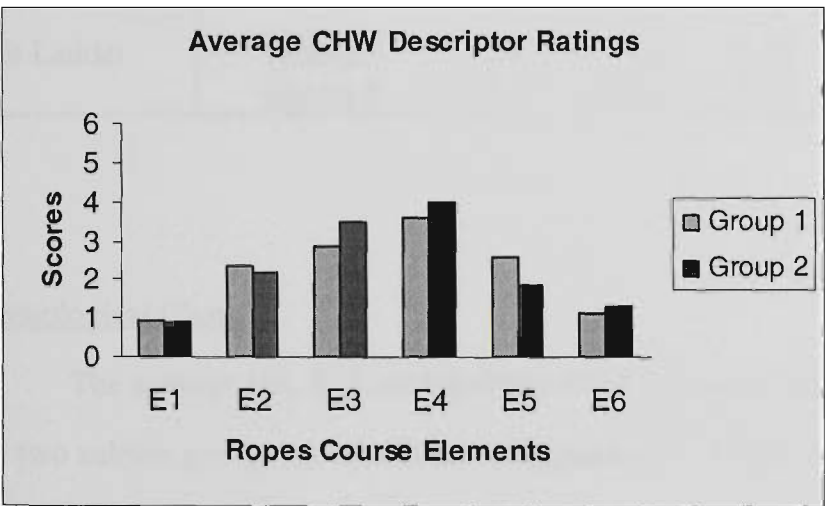


Table 7.7 Study 5 FE and CHW ratings on the six Ropes Course elements for Group 1 and Group 2.

ELEMENT	Subject Group	<u>FE ratings</u>		<u>CHW ratings</u>	
		mean	S.D.	mean	S.D.
Bridge	Group 1	3.20	1.54	0.95	0.85
	Group 2	3.46	1.30	0.92	0.78
Tyre Walk	Group 1	3.67	1.00	2.33	1.30
	Group 2	3.92	0.95	2.19	1.03
Spiders Web	Group 1	3.90	1.40	2.88	1.48
	Group 2	4.04	1.12	3.47	1.06
Postmans Walk	Group 1	3.92	1.47	3.57	1.22
	Group 2	4.41	0.95	3.97	1.65
Flying Fox	Group 1	5.17	1.42	2.57	1.68
	Group 2	5.29	1.56	1.83	2.05
Exit Ladder	Group 1	2.77	1.87	1.12	0.99
	Group 2	2.71	1.50	1.31	1.09

Physiological Changes

The average HR, SCL and motility (MOT) scores recorded on the 29 epochs for the two subject groups are tabulated in Appendix 13. While there were no significant group differences in the HR, SCL or MOT levels measured at the first epoch, this was taken as a baseline value by subtracting the value of the first epoch on the whole Ropes Course from each data point separately for each subject. Figures 7.7 a-c thus show the physiological changes (HR, SCL and MOT) relative to the beginning of the Ropes Course for the two subject groups.

Initial analyses of the physiological data tested average HR, SC and MOT responses across the entire Ropes Course attempt for group differences. A one-way ANOVA performed on the average HR data showed that the two subject groups did not

significantly differ in the average HR levels experienced across the Ropes Course ($F(1,31)=.08, p=.778$). The same analyses also confirmed that there were no significant differences between the two subject groups in the average SCL ($F(1,31)=.14, p=.713$) or the motility ($F(1,31)= 1.54, p=.224$) changes measured across the Ropes Course.

Figure 7.7a Study 5 HR changes across the Ropes Course for Group 1 and Group 2

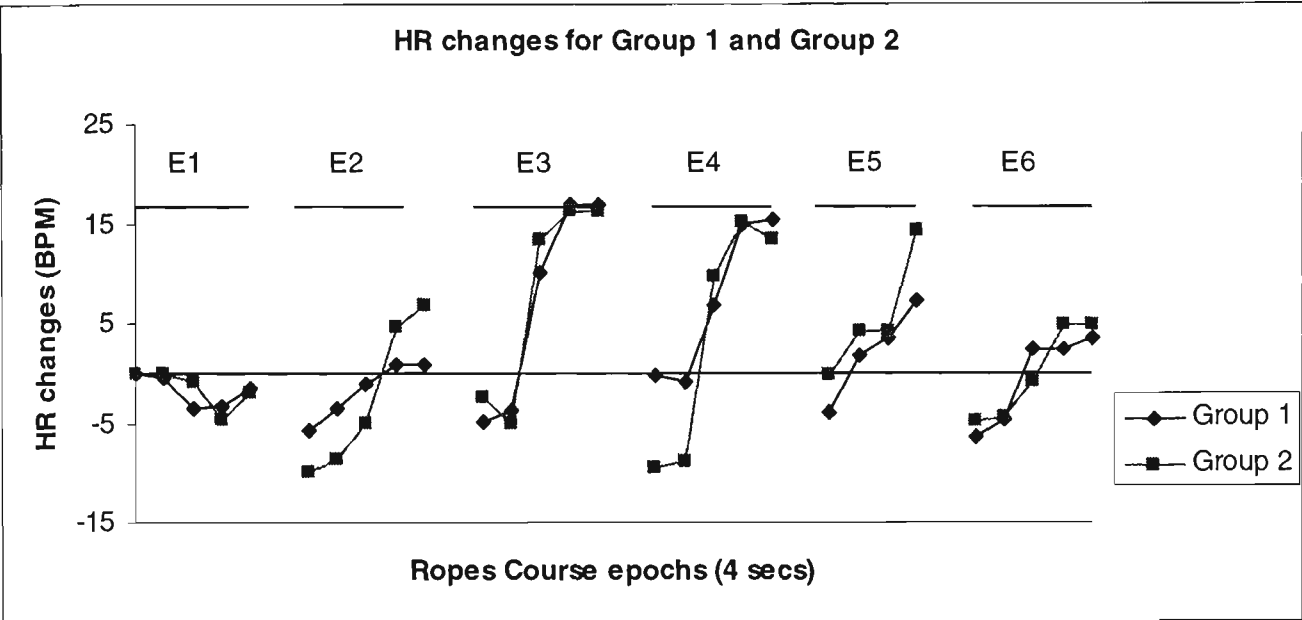


Figure 7.7b Study 5 SCL changes across the Ropes Course for Group 1 and Group 2

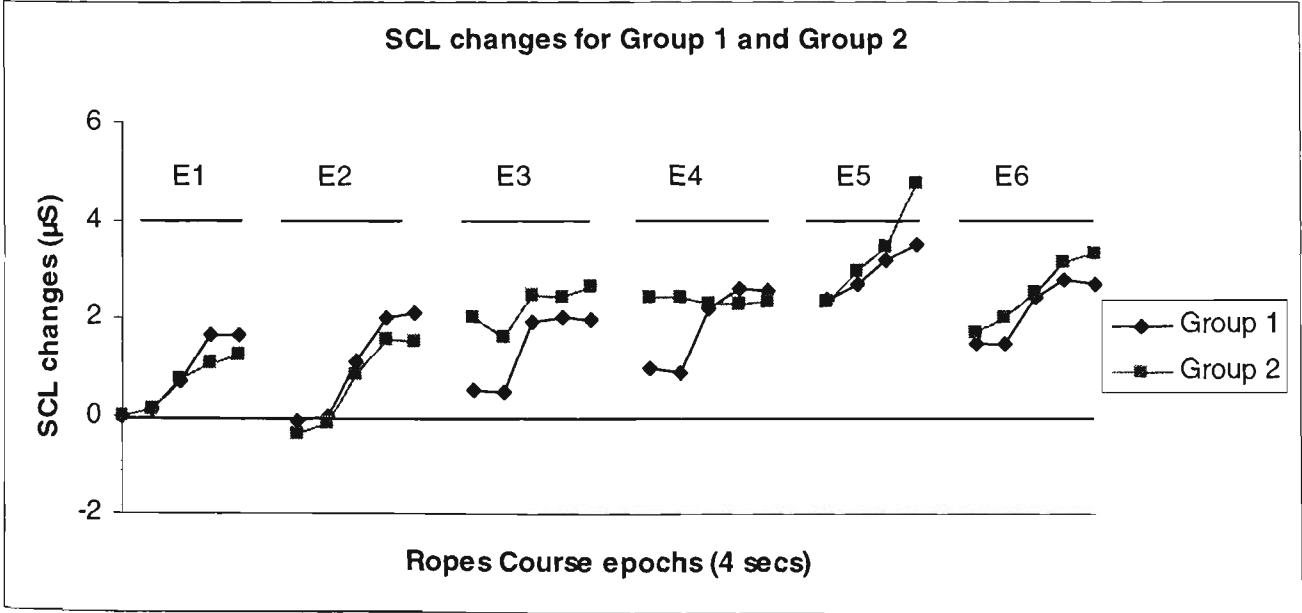
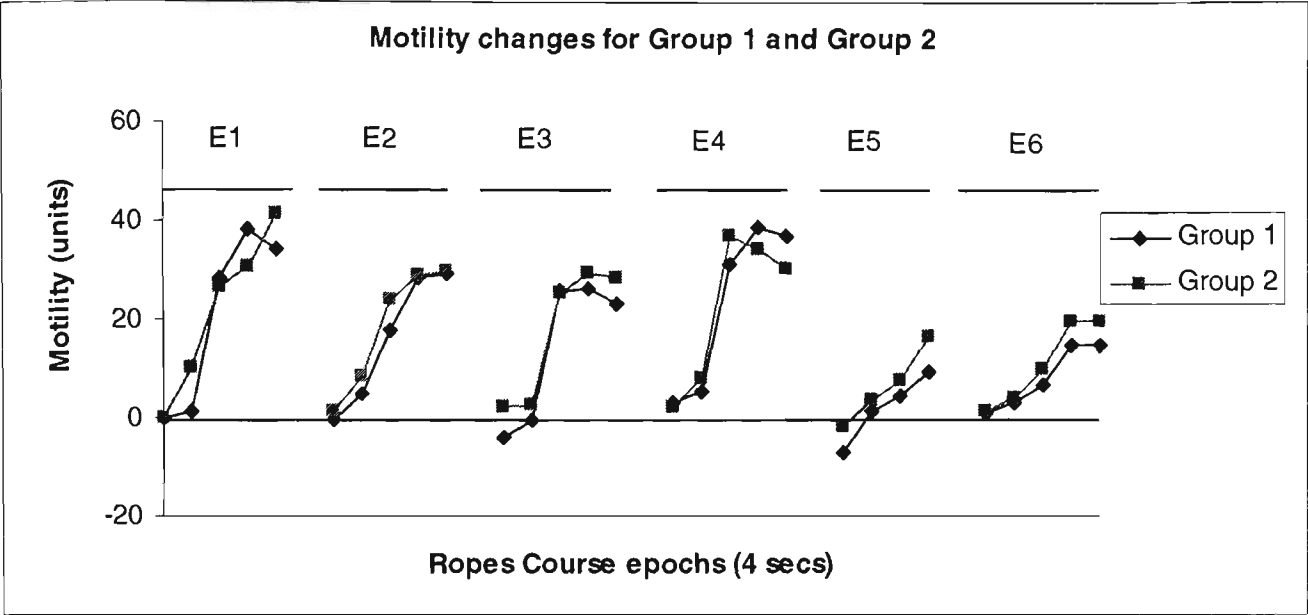


Figure 7.7c Study 5 MOT changes across the Ropes Course for Group 1 and Group 2



The zeroing procedure described above was repeated for each element relative to its first epoch. This enabled comparison between the two subject groups in terms of average deviations from a separate baseline for each of the six elements. Figure 7.8 a-c thus shows the relative physiological responses on each element of the Ropes Course. Separate repeated-measures analyses tested the physiological response in terms of the linear, quadratic and cubic trends across the epochs within each of the six Ropes Course elements for group differences.

Figure 7.8a Study 5 Relative HR changes across the six Ropes Course elements for Group 1 and Group 2

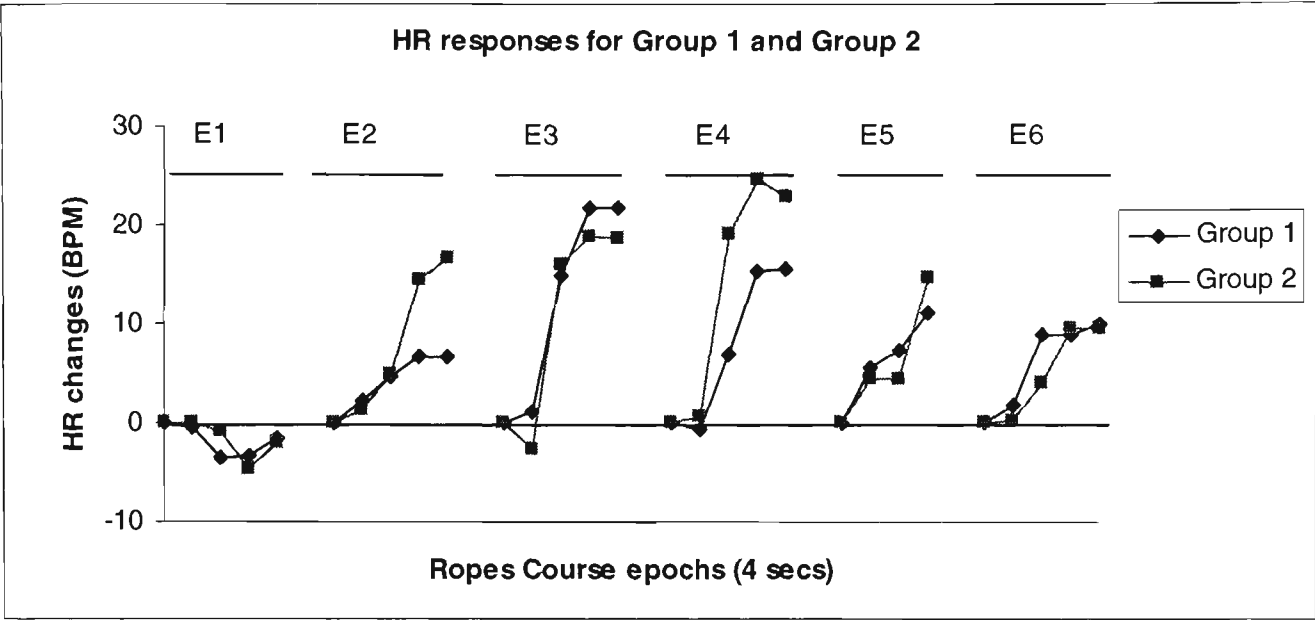


Figure 7.8b Study 5 Relative SCL changes across the six Ropes Course elements for Group 1 and Group 2

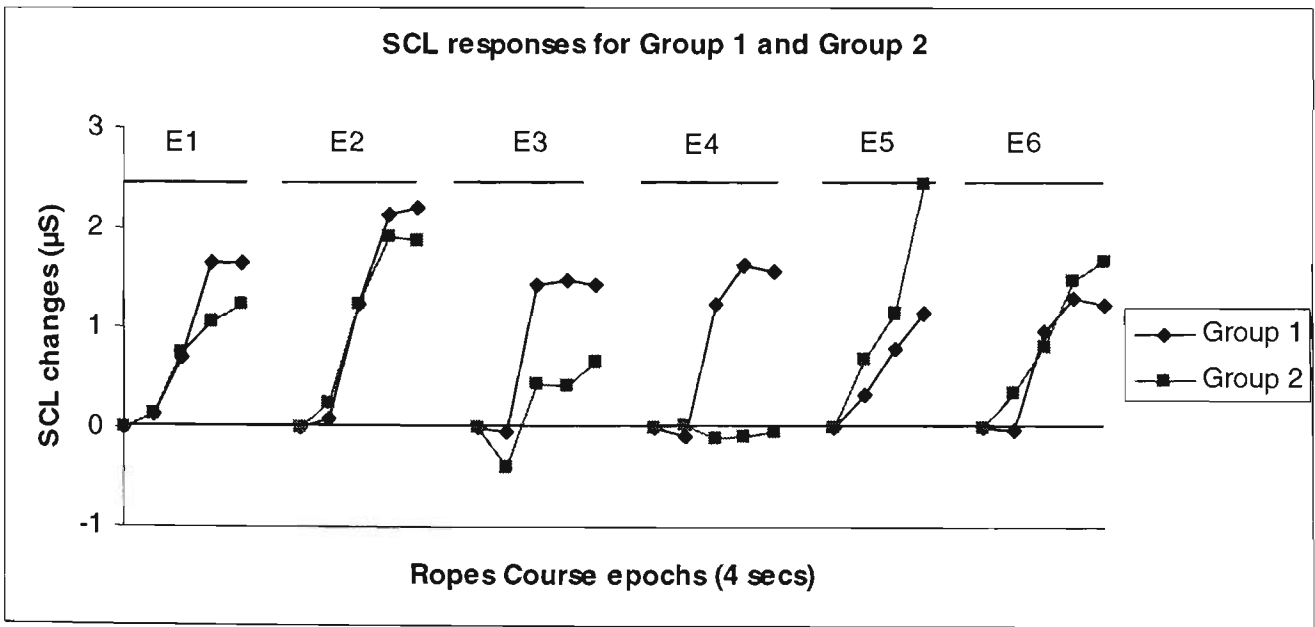
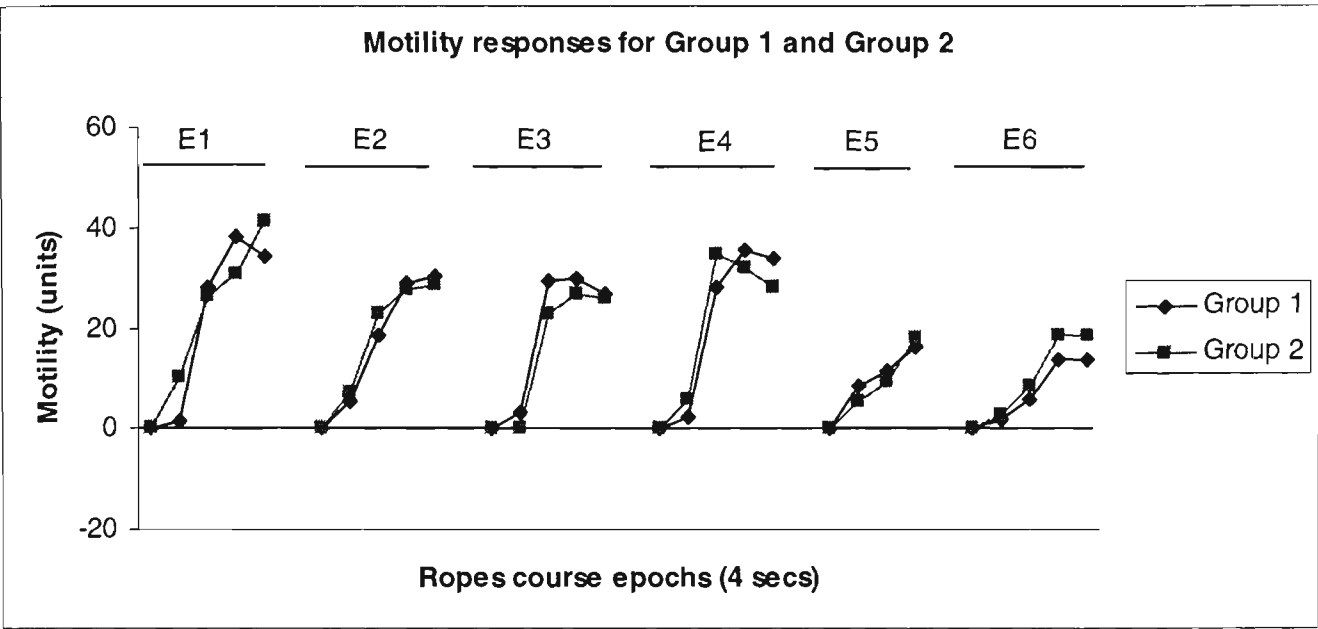


Figure 7.8c Study 5 Relative MOT changes across the six Ropes Course elements for Group 1 and Group 2



Heart rate

Figure 7.8a shows the average relative HR changes for Group 1 and Group 2 across the six elements of the Ropes Course, with the first epoch of each element representing a baseline value of zero. HR decreased across the first element of the Ropes Course (E1, epochs a-e) for both subject groups, resulting in a HR level approximately 5 BPM below the baseline at epoch (E1, d). HR levels increased for both groups on the Tyre Walk, and as illustrated, the HR increase for Group 2 was greater than Group 1, reaching approximately 15 BPM above the baseline. A similar pattern of HR increases was obtained for the two subject groups on the Spiders Web (E3) while the HR increase for Group 2 on the Postmans Walk was substantially greater than Group 1. Similar patterns of HR increases were obtained on the Flying Fox and Exit Ladder for the two subject groups.

Analyses carried out on the HR response for the individual elements confirmed significant group differences for two elements. On the Tyre Walk (E2) the linear

response component for Group 2 was significantly greater than that obtained for Group 1 ($F(1,30)=7.66$, $p<.01$). This difference in the HR response approached significance in the quadratic trend also ($F(1,30)=3.70$, $p=.06$). For the Postmans Walk (E4) a significant group difference was found in the quadratic trend in the HR response ($F(1,30)=4.67$, $p<.05$) and in the mean response ($F(1,30)=5.27$, $p<.05$). These findings confirm the group differences on the Tyre Walk (E2) and Postmans Walk (E4) illustrated in Figure 7.8a.

Skin Conductance Level

Figure 7.8b shows the relative SCL response recorded on each of the six element epochs, with the first epoch of each element representing a baseline value of zero. The pattern of SCL increases recorded on the first and second elements, the Bridge (E1) and Tyre Walk (E2) were similar for both groups, although Group 1 recorded slightly greater SCL increases towards the end of the first two elements. Larger group differences in the SCL response on the Spiders Web (E3) are apparent in Figure 7.8b, with Group 1 showing a strong SCL increase between the second (E3, epoch b) and third (E3, epoch c) epochs, before plateauing. SCLs on the Postmans Walk (E4) remained close to baseline level for Group 2 while Group 1 showed a strong SCL increase after the second epoch on this element. A similar pattern of SCL increases for the two subject groups were found for the Flying Fox (E5) and Exit ladder (E6) elements, although Group 2 recorded a faster SCL increase than Group 1 on the Flying Fox.

Analyses examining these group differences in the SCL response across the individual elements found strong group differences for two elements, the Spiders Web and Postmans Walk. As mentioned above, the SCL response for Group 1 on the Spiders Web (E3) showed a marked increase between epochs b and c, after which SCL remained relatively stable. In contrast, the SCL response measured for Group 2 showed a less dramatic increase between epoch's b and c compared to Group 1. This difference was

apparent in the quadratic response component that approached significance ($F(1,30)=3.74, p=.063$) and in the overall mean response ($F(1,30)=4.58, p<.05$). The Postmans Walk (E4) element showed significant group differences for the SCL response in the linear ($F(1,30)=5.61, p<.05$) and cubic trends ($F(1,30)=6.79, p<.05$). There was also a group difference in the overall mean response ($F(1,30)=5.25, p<.05$). As mentioned above, the SCL for Group 2 remained fairly stable on this element while Group 1 showed a substantial SCL increase from epoch b to epoch d along this element.

Table 7.8 Study 5 Group effects on HR, SCL and MOT responses across the six elements of the Ropes Course.

ELEMENT	HR RESPONSE		SCL RESPONSE		MOT RESPONSE	
	Mean/Trend	F(1,30)	Mean/Trend	F(1,30)	Mean/Trend	F(1,30)
Bridge		n.s.		n.s.		n.s.
Tyre Walk	linear	7.66 *		n.s.		n.s.
	quad.	3.70 #				
Spiders Web		n.s.	mean	4.58 *		n.s.
			quad.	3.74 #		
Postmans Walk	mean	5.27 *	mean	5.25 *		n.s.
	quad.	4.67 *	linear	5.61 *		
			cubic	6.79 *		
Flying Fox		n.s.		n.s.		n.s.
Exit ladder		n.s.		n.s.		n.s.

* significant at .05 level
approached significance

Motility

Variation in motility across the individual elements for the two subject groups is illustrated in Figure 7.8c. Each element recorded motility increases across the epochs, and these patterns of SCL increases were similar for both groups. Analyses on these data (see Table 7.8) did not show any significant group differences in motility levels on any of the Ropes Course elements.

7.3.4 Discussion

While a number of studies have shown that subjects increase in self esteem after participation in Outdoor Education activities, there is little research evidence of the types of psychological or physiological changes that take place during these activities. There are no known studies reported in the literature that attempt to examine the psychophysiological changes that differentiate groups of subjects who increase or decrease in self esteem. Extending on the first two studies conducted on the Ropes Course, the aim of the present study was to provide further insight into the emotional and physiological changes that take place during challenging activities, and to examine their relationship, if any, with General Self Esteem changes. In Study 4, the Coopersmith self esteem Inventory (SEI) was used to confirm self esteem increases, in particular General SE increases, in school aged children participating in a five day Outdoor Education program. In this Study, psychophysiological changes were monitored for a second group of subjects during their participation on one activity, the Ropes Course.

In the light of some concerns raised in Study 3, initial analyses of the data from Study 5 re-examined HR and SCL activity as a function of positive and negative emotion. Similarly to Study 3, elements associated with significantly high and low levels of positive and negative emotions were tested for differences in the HR and SCL

measures. The same comparisons were also made on the motility levels to monitor the contribution of movement. In the second set of analyses, the subjects were divided into two groups according to whether they increased or decreased in General Self Esteem. The psychophysiological changes monitored on the Ropes Course were tested for group differences in the descriptor ratings (FE and CHW) and the HR, SCL and Motility measures averaged across the entire Ropes Course. Group differences in the physiological response across the element epochs were also tested for each element.

Analyses of the Element Descriptor Ratings data indicated that, compared to each descriptor average, the Flying Fox element rated significantly high while the Bridge and Exit Ladder scored significantly low for the fun and excitement descriptors. The Postmans Walk and Spiders Web rated significantly high for the challenge, hard and worry descriptors, with the Bridge and Exit Ladder showing significantly low levels for this same descriptor group. These results for the element ratings are consistent with those obtained in Study 3, except in the case of the Exit Ladder which was identified as lower in CHW than the Tyre Walk. This slight difference may be due to the fact that subjects attempted the Ropes Course once in the current study before rating the elements on the five descriptors, rather than the three times in Study 3.

Physiological changes and emotion

To confirm the findings in Study 3, the HR and SCL data gathered from the present study were tested for linkages with negative and positive emotions respectively. HR and SCL were tested for significant differences between the Ropes Course elements representing the high and low FE and CHW descriptor groups. Consistent with the results found in Study 3, HR levels were significantly higher for the **high CHW** group compared to the **low CHW** group, while the SCL measure did not significantly differ between these two groups. On the other hand the SCL measure was significantly high for the **high FE** group compared to the **low FE** group. These data replicated the findings

in Study 3 for the same element groups. However, the mean HR level for the **high FE** group was significantly higher than that obtained on the elements representing the **low FE** group. This difference was not as large as that obtained between the high and low CHW groups, but this significant finding was not consistent with Study 3 findings in the HR measure.

Concerns relating to the influence of movement in the HR and SCL data were raised in Study 3. Analyses of the motility levels for the same element comparisons in Study 5 found a smaller but significant motility level difference between the element groups representing **high CHW** and **low CHW**, with highest motility recorded on the high CHW group. A significant difference in motility was also found for the **high FE** and **low FE** elements. However, this difference in motility was in the opposite direction to differences found in both the HR and SCL measures, with the lowest motility level recorded for the Flying Fox element. To control for the effect of movement on the physiological measures, the analyses on the HR and SCL data were repeated with motility as a covariate. These analyses showed that motility was not strongly associated with HR in the element comparisons representing high and low CHW, and the difference observed in HR for the CHW element groups remained significant. Only the association between motility and SCL for the elements representing **high FE** and **low FE** was significant, but as already mentioned, this difference in motility was in the opposite direction, and it did not contribute to the significant emotional effect in the SCL measure in the FE group. The analyses using motility as the covariate eliminated the possibility of motility being responsible for the significant HR difference found in the **high FE** and **low FE** groups of elements.

While the significant HR difference between the elements representing the positive emotions was not consistent with Study 3, it should be noted that the HR means obtained for the elements representing FE are comparable. The average HR levels

obtained in Study 3 and Study 5 for the Flying Fox element (**high FE**) were 129.33 BPM and 126.07 BPM respectively. Likewise, the mean HR levels for the **low FE** element groups in Study 3 and Study 5 were 122.64 BPM and 121.58 BPM respectively. In the light of the relatively low motility levels recorded on the Flying Fox, one possible explanation for this finding is that the difference in HR found between the high and low FE elements actually reflected level differences in the challenge, hard and worry ratings, rather than fun and excitement. As indicated in Table 7.2, the Flying Fox element in this study rated higher on each of these three descriptors than the Bridge and Exit ladder. While significant, the difference in HR levels between the **high FE** and **low FE** elements was less than that recorded between the **high CHW** and **low CHW** elements, and this is consistent with the larger differences in the challenge, hard and worry ratings found for the high and low CHW elements.

Given the relatively low motility levels, a second possibility is that HR activity on the Flying Fox element was influenced by both positive and negative emotions. That is, the HR levels reflected the cumulative effects of the moderate level of negative emotion and high level of positive emotion experienced on this element, as measured by ratings on the fun, excitement, challenge, hard, and worry descriptors. This would be consistent with other research studies in the psychophysiology literature that have demonstrated elevated HR activity accompanying both positive and negative emotion (e.g., Levenson, Ekman & Friesen, 1990; De Jong Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993).

In summary, these data largely support the findings from Study 3 and suggest that HR and SCL activity are associated with strong levels of negative and positive emotions respectively, although some other possibilities contributing to the behaviour of the HR measure are suggested. Analyses conducted on the data in Study 5 showed that motility did contribute to some variation in the HR measure, but this factor did not over-

ride the effect of negative emotion on this measure during the Ropes Course attempt.

Physiological changes and self esteem

The second part of the study examined the psychophysiological changes experienced by children participating on the Ropes Course as a function of General Self Esteem changes. A modified SEI (Coopersmith, 1981) was administered at the beginning and end of the five day Outdoor Education program conducted at the Broken Bay Sport and Recreation centre. The results from the preliminary study (Study 4) involving 70 children confirmed that child participants in the program increased in Total Self Esteem. A significant increase was also obtained for the General SE and Home SE subscales. Further analyses indicated that there were no gender effects in any of the self esteem scores.

In the main study a second subject sample was split according to whether they increased (Group 1) or decreased or showed no change (Group 2) in General Self Esteem, and examined for differences in the psychophysiological changes experienced during their Ropes Course attempt. In this exploratory study, the Element Descriptor Ratings and the physiological changes (HR, SCL) monitored on the Ropes Course were tested for differences between the two subject groups. The HR and SCL recorded across each of the six elements of the Ropes Course were also tested for differences between the two groups. It was anticipated that the two groups would have experienced different emotions across the Ropes Course, particularly during the more challenging elements, and that this would be reflected in the accompanying physiological activity.

Compared to Group 1, Group 2 subjects recorded slightly higher average ratings for the descriptors challenge, worry, fun and excitement across the six elements of the Ropes Course. This difference in the FE and CHW descriptor ratings for the two groups were not significant when tested on the Ropes Course average or for the individual

elements. Follow-up analyses on the ratings data explored group differences across the element clusters (FE and CHW) and in each individual score, but failed to find any significant group differences. These findings in the ratings data suggested that the two groups found the Ropes Course to be equally challenging, with similar levels of negative and positive emotions reported. The physiological changes monitored during the Ropes Course activity presented a different picture. Analyses comparing the average HR and SCL changes across the Ropes Course attempt failed to find significant differences between the two groups. However, as indicated in the group HR and SCL profiles during the Ropes Course attempt (see Figures 7.8a and 7.8b), there were clearly some strong differences between the two groups on some elements.

Analyses of the HR and SCL response (epochs a-e) for the two groups across the six elements showed some group differences, particularly on the more challenging elements, the Spiders Web and the Postmans Walk. Analyses of the HR response on the Tyre Walk showed that the linear increase for Group 2 was significantly greater than that obtained for Group 1. The HR response difference in the quadratic trends in the two groups also approached significance on this element. On the Postmans Walk a significant group difference was obtained in the mean level and quadratic trend in HR, with larger HR increases observed for Group 2. Group differences in SCL activity were also recorded for this element. SCL for Group 2 remained stable while Group 1 showed a marked SCL increase over the first three epochs. Analyses showed that this group difference in the SCL response was significant for both the linear and cubic trends over epochs, and in the mean level response. A larger increase in SCL, apparent in the quadratic trend over epochs was obtained for Group 1 on the Spiders Web, and this Group difference approached significance. A significant group difference in mean SCL was found on the Spiders Web.

In summary, significant group differences in the HR response were found on the

Tyre Walk (linear and quadratic response components) and Postmans Walk (quadratic response component and mean response level). Group differences were found in the SCL response on the Postmans Walk (linear and cubic response components and mean response level). A group difference in the SCL response (the quadratic response component approached significance and the mean response level reached significance) for the Spiders Web element was also apparent. No significant group differences were found in the motility response across the six Ropes Course elements.

According to the ratings data, the Spiders Web and Postmans Walk elements were rated significantly high in challenge, hard and worry compared to the Ropes Course average. There were no group differences found in the ratings data for the Spiders Web and Postmans Walk, however, the analyses on the physiological data suggested group differences that were not reflected in the ratings data. Compared to Group 1, Group 2 showed larger HR responses and smaller SCL responses for these two elements. Based on Study 3 and Study 5 findings, one interpretation of these physiological data is that, during the more challenging stages of the Ropes Course, Group 2 experienced stronger negative emotion (relatively more BIS) than Group 1, while at the same time Group 1 experienced stronger positive emotion (relatively more BAS).

These findings in the physiological data are consistent with studies described in the Outdoor Education (see Chapter 4) and Social Psychology literature (Mannell & Kleiber, 1997) that suggest that positive emotions and increased self esteem result from successful participation on challenging activities. On the Ropes Course it was anticipated that subjects reporting an increase in General Self Esteem would find the Ropes Course attempt to be a more positive experience, and while this was not reflected in the self-report measures, it was suggested by the accompanying physiological response patterns.

The ratings data did not differentiate between the two subject groups, with Group 2 recording only slightly higher ratings for both negative and positive descriptors. One possible explanation for the discrepancy between the ratings data and physiological measures is that perhaps the physiological measures are more sensitive, and provide a more objective measure of BIS and BAS activity. Another possible explanation is that the findings in the ratings data reflected problems typically associated with the use of self report measures such as social expectations (Wagner, 1989; see also study by Lewis, Ray, Wilkinson, & Ricketts, 1984). It should also be noted that the ratings scores were recorded after the Ropes Course attempt, and this contrasts with the physiological data, which were gathered “in situ”.

While the HR and SCL data showed group differences in response patterning, there were no significant group differences recorded in the average motility level across the Ropes Course or for the motility levels recorded across the epochs for the individual. Given that the subject groups experienced similar motility levels, this finding provided further evidence of differential HR and SCL activity on the Ropes Course not linked to movement. This finding also provides strong evidence that differences in HR and SCL activity are able to reflect emotional changes in the presence of moderate activity. This is consistent with the study by Schwartz, Weinberger and Singer (1981), who demonstrated fractionation of the cardiovascular measures under exercise and imagery conditions as a function of emotion.

One concern faced in the current study was the use of the SEI to monitor changes in General Self Esteem as related to participation on the Ropes Course activity. In Study 5, subjects were monitored for General SE changes over a five day period. It was assumed that the psychophysiological changes experienced on the Ropes Course by the two subject groups typified their experience on other challenging activities conducted during the program. While the Ropes Course activity forms a major

component of the five day program, it is apparent that other events may have contributed to changes in General Self Esteem. It is therefore recognised that the use of the SEI in Study 5 would have been more appropriate if this questionnaire was administered immediately before and after the Ropes Course attempt. Coopersmith (1991) noted that affective traits such as self esteem are prone to sudden and significant changes over short periods of times. While the stability of the SEI has been confirmed in a study using pre test-post test comparison over a six month period (Drummond, McIntire & Ryan, 1977), problems associated with the use of this questionnaire over shorter periods of time (e.g., 4-5 hours) have not been considered.

7.4 GENERAL SUMMARY OF THE FIELD STUDIES

This thesis examination of the psychophysiology of emotion began with four field studies involving "in situ" monitoring of children participating in a challenging activity, the Ropes Course. The first study on this challenging activity was conducted to determine if strong emotional changes were experienced by the child participants (n=24), and whether these changes were reflected in the accompanying autonomic physiological activity. In Study 1, a sphygmomanometer was used to monitor HR, SBP and DBP levels at two measurement occasions; on the platform prior to the first element, and at platform 4, between the Postmans Walk and Flying Fox. The Spielberger (1970) STAI was administered on the same two occasions to obtain changes in state anxiety, and these were used to group subjects according to whether they increased or decreased in state anxiety. Analyses of the cardiovascular changes indicated that only the SBP changes reflected changes in state anxiety. Heart rate showed a significant increase for both groups while the DBP measure remained fairly stable for both groups. These findings in the cardiovascular responses indicated the suitability of the Ropes Course activity as a suitable vehicle to conduct more detailed research exploring the psychophysiology of emotion.

The following three studies on the Ropes Course together explored HR and SCL activity as a function of emotion. In the preliminary study, Study 2, an ambulatory monitor (HGM1) was used to measure HR and SC levels along the Ropes Course activity for six subjects. Tests of correlation across 29 epochs within each subject showed that fractionation of the HR and SCL measures occurred at some stages of the Ropes Course. In Study 3 these different patterns of HR and SCL activity were investigated as a function of positive or negative emotion experienced on the different elements of the Ropes Course. Fowles (1980) proposed that HR and SCL activity were (respectively) linked to the dominant activation of the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS). In turn, the emotion literature (e.g., Tellegen, 1985; Larsen & Ketelaar, 1991) associated the BAS and the BIS with positive affect (PA) and negative affect (NA) respectively. Based on Fowles' hypothesis, and in the absence of other theories providing an explanation for the behaviour of these two measures as a function of emotion, linkages of HR with PA and SCL with NA were proposed.

Subjects in Study 3 (n=20) were monitored for HR and SCL changes along the Ropes Course activity over three consecutive attempts. The physiological measures were averaged for five four second epochs along the elements and an average level was calculated for each element. An Element Ratings Questionnaire administered on completion of the activity recorded ratings for five descriptors: fun, excitement, challenge, hard and worry, for each of the six elements. The descriptors fun and excitement were grouped and taken to reflect positive emotion (FE), while the descriptors challenge, hard and worry were grouped and taken to represent negative emotion (CHW) experienced on the Ropes Course. Analyses of the ratings data for these descriptor groups found that, compared to the average across the six elements, high levels of fun and excitement were found for the Flying Fox, and low levels of the same descriptors were found for the Bridge and Exit Ladder. High levels of challenge, hard

and worry related emotions were recorded on the Spiders Web and Postmans Walk, with low levels of negative emotion found for the Bridge and Tyre Walk. The HR and SC levels for these groups of elements were averaged and tested for significant differences as a function of high versus low CHW and high versus low FE. A significant difference was found in HR levels between **high CHW** and **low CHW** elements. SCL did not differ between these groups of elements. The SCL measure did significantly differ between the elements representing **high FE** and **low FE**, while the HR measure did not. Contrary to expectations based on Fowles' hypothesis, these data suggested linkages of HR with NA and SCL with PA. That is, the HR measure reflected differences in high and low levels of negative emotions while the SCL measure reflected differences in levels of positive emotion.

Extending on Study 3, the next aim of this thesis was to provide further insight into the emotional and physiological changes that take place during challenging activities, and to examine their relationship, if any, with self esteem changes. In a preliminary study, Study 4, the Coopersmith Self Esteem Inventory was administered at the beginning and end of the five day Outdoor Education Program implemented at the Broken Bay Sport and Recreation Centre. Analyses of the Total Self Esteem scores and the subscale scores for this questionnaire, from 70 subjects, confirmed increases in Total Self esteem, General Self Esteem and Home Self Esteem. In Study 5, a modified Coopersmith SEI questionnaire was used to monitor General Self Esteem changes for 32 subjects. These data were then used to split the subjects into two groups according to whether they increased (Group 1), decreased or showed no change (Group 2) in General SE.

Using an upgraded ambulatory monitor, the AMS03, the subjects in Study 5 were monitored for psychophysiological changes during one attempt on the Rope Course activity. Initial analyses of the data aimed to confirm the main findings from

Study 3. These analyses confirmed significant differences in HR, but not SCL, for the elements representing **high CHW** and **low CHW**. Also, a significant difference in SCL was found between the elements representing **high FE** and **low FE**. Not consistent with Study 3 findings, was a significant difference in HR obtained between the **high FE** and **low FE** clusters. It was suggested that high HR levels obtained between the FE element groupings reflected the differences in CHW ratings averaged for the representative elements. That is, compared to the Bridge and Exit Ladder (**low FE**) the Flying Fox element (**high FE**) showed higher levels of challenge, hard and worry and this resulted in higher HR levels for this element. These results were largely consistent with those from Study 3, although further research examining HR and SCL changes accompanying positive and negative emotions was recommended.

Variation in motility levels across the individual elements was evident and subsequent analyses indicated that this variation did influence some of the findings in the HR measure. The difference in motility levels for the **high CHW** and **low CHW** elements was significant. Analyses of HR with motility level as a covariate for the CHW elements showed that the difference in HR between the high and low CHW elements remained significant. These findings indicated that while motility did influence HR activity, it did not over-ride the HR difference obtained between the **high CHW** and **low CHW** elements. A significant difference in motility was also obtained for the **high FE** and **low FE** elements, with higher motility levels associated with the lower HR and SCL levels recorded on the elements representing **low FE**. Analyses with motility as the covariate indicated a significant association between motility and SCL for the FE element comparison, but this relationship was in the opposite direction, and the difference in SCL for the elements representing high and low FE remained significant. These data suggest that movement played no significant part in the different physiological response patterns associated with different emotions in these field studies.

As mentioned previously, a modified SEI General Self Esteem subscale score was used in the second part of Study 5 to group the subjects according to whether they increased (Group 1, $n=20$) or decreased (Group 2, $n=12$) in General SE over the five day program. It was anticipated that the two groups would experience different emotions on the more challenging elements of the Ropes Course, and that this would be reflected in the accompanying physiological activity. Analyses of the FE and CHW ratings failed to find significant group differences. However, group differences were found for the HR and SCL measures across the more challenging elements located in the middle of the Ropes Course activity. Compared to Group 1, Group 2 recorded significantly larger HR increases over time on the Tyre Walk and Postmans Walk apparent in the linear and quadratic response components respectively. Also, a significant group difference was found for the HR mean response level for the Postmans Walk. Group 1 showed larger SCL increases on the Spiders Web, and this difference approached significance in the quadratic response component, and reached significance in the mean response level. On the Postmans Walk, the SCL increase over time in both the linear and cubic response components was found to be significantly greater for Group 1 than Group 2, as was the mean response level. Analysis of the Ropes Course average motility levels and the changes in motility across the individual elements did not show any group differences.

From the results described in Study 3 and the first part of Study 5, it was suggested that the HR and SCL measures in reflected the effects of higher levels of negative emotion and lower levels of positive emotion experienced by Group 2 in Study 5 on the specified elements. This in turn suggested that the subject group reporting an increase in self esteem (Group 1) experienced more positive emotion (dominant BAS activation) during the more challenging elements of the Ropes Course. These results in the physiological data support the notion that successful participation in a challenging activity results in positive emotion and an increase in self esteem (see Chapter 4). To date, this theory has not been supported by physiological measures, or measures

collected during the activity itself.

Together these three studies carried out on the Broken Bay Ropes Course provided confirmation of strong emotional changes that were accompanied by significant physiological changes. The investigation of HR and SCL activity as a function of emotion experienced during a "real-life" activity was tested in light of Fowles' (1980) hypothesis. Contrary to expectations based on Fowles' hypothesis, the results from Study 3 and Study 5 suggested that during challenging activities, HR and SCL changes reflect the presence of significant levels of negative and positive emotions respectively. However, some findings in Study 5, particularly in the HR measure, suggest that this finding needs further research investigation. The lack of consistent findings in this area is apparent in other related studies reported in the psychophysiological literature. As discussed in Chapter 3, there is still considerable doubt as to the relationship between the changes in HR and SCL and emotion elicited under laboratory conditions. A number of recent laboratory studies have suggested linkages of HR with negative emotions (Sinha, Lovallo & Parsons, 1992) and SCL with arousal (Vrana, 1993).

To conclude, the use of the Ropes Course activity served two purposes. Firstly, the Ropes Course activity was found to elicit strong levels of positive and negative emotions that could be studied for their accompanying physiological changes. Secondly, the Ropes Course activity proved to be a suitable activity from which to demonstrate the applicability and benefits of psychophysiological research activity in Outdoor Education and other related areas. Results in Study 3 and Study 5 convincingly showed associations of HR with negative emotion and SCL with positive emotion. Study 5 also indicated that while motility did contribute to some changes in the physiological measures, this factor did not over-ride the effects of emotion on the HR and SCL response during the Ropes Course attempt.

Each of the Ropes Course studies illustrated the benefits of using both psychological and physiological measures to monitor emotional changes experienced during challenging adventure activities. For example, Study 5 analyses showed that, during the more challenging elements of the Ropes Course, group differences in the physiological responses occurred that were not reflected in the ratings data, but which were linked to group changes in self esteem. These studies on the Ropes Course presented some important findings in regard to positive and negative emotion and the accompanying physiological activity, which in turn provided a greater understanding of the emotional and self esteem changes experienced by Ropes Course participants.

CHAPTER 8

HR and SCL Changes Accompanying Positive and Negative Emotions Evoked Through Imagery

8.1 STUDY 6

8.1.1 Introduction

The results from the studies carried out on the Ropes Course provided some interesting findings in regard to physiological changes accompanying different types of emotions elicited under "real-life" situations. The use of the Ratings questionnaires confirmed that strong positive and negative emotions were experienced on the Ropes Course, and that this range of emotions could be linked to the different patterns of HR and SCL activity monitored across the six Ropes Course elements. Laboratory based research in the psychophysiology of emotion has also identified different patterns of HR and SCL activity, but to date this research has failed to provide a convincing explanation for the behavior of these two measures accompanying different emotional states. Extending the emotion studies conducted on the Ropes Course, this Chapter introduces the first of two laboratory studies using adult subjects engaged in imagery trials to evoke different emotional states. In the light of the results from Studies 3 and 5, HR and SCL activity monitored during the imagery sessions was tested for differences reflecting the presence of either positive or negative emotions.

The data from Study 3 were tested in light of Fowles' (1980) hypothesis concerning the fractionation of two autonomic measures, heart rate (HR) and skin conductance level (SCL), as a function of two activation systems, the Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS). As discussed in

Chapter 2, Fowles' research provided a suitable theoretical base from which to investigate the fractionation of HR and SCL as a function of positive and negative emotions. Contrary to predictions based on Fowles' hypothesis, analysis of the HR and SCL changes recorded across the elements of the Ropes Course in Study 3 indicated that the HR measure discriminated between high and low levels of negative emotions, while conversely, the SCL measure reflected differences between high and low levels of positive emotions. Analysis of the physiological data in Study 5 largely supported this association between HR and the negative emotions and between SCL and the positive emotions.

The findings from Study 3 were not altogether unexpected as increased heart rate levels accompanying negative type emotions but not positive type emotions have been reported previously in studies involving imagery (Haney & Euse, 1976; Roberts & Weerts, 1982). In addition, increases in skin conductance levels have been observed while imagining exciting thoughts (Wegner, Shortt, Blake & Page, 1990). However, other laboratory studies exploring heart rate and skin conductance responses accompanying positive and negative emotions have not proved as conclusive (see Chapter 3 for review). In the laboratory environment, more recent studies have attempted to elicit intense emotions using other methods, such as the presentation of slides and film sequences (Hubert & de Jong-Meyer, 1990; Lang, Greenwald, Bradley & Hamm, 1993) and facial expression techniques (Levenson, Ekman & Friesen, 1990), although the majority of studies continue to employ imagery (Sinha, Lovallo & Parsons, 1992; Vrana, 1993; De Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993). The findings from these later studies suggest that HR may reflect differences in valence, while the SCL response is somewhat ambiguous across emotions, and at best may simply reflect arousal levels (Lang, Greenwald, Bradley & Hamm, 1993; Johnsen, Thayer & Hugdahl, 1995). As anticipated by Wagner (1989), the study of the psychophysiology of emotion now rests on the exploration of physiological changes

accompanying groups of similar emotions that differ in regard to valence (positive versus negative) and level (high versus low).

While the findings from the emotion studies involving the Ropes Course were convincing, two concerns emerged in these “outdoor” studies. The first concern was related to the contribution of movement to the physiological changes recorded on the Ropes Course. The results from Study 5 showed that movement did indeed contribute to some changes in the HR data, although as discussed in Study 3 and Study 5, this was not as great an influence on HR activity as that attributed to the presence of strong negative emotions. The effect of movement was not apparent in the SCL data. Using imagery to manipulate the level and type of valence experienced in the laboratory, the influence of movement on HR activity can be eliminated.

The second concern raised in Studies 3 and 5 relates to the use of five descriptors to detect and categorise the presence of positive and negative emotions experienced during the Ropes Course attempt. In Study 3 the Descriptor Ratings Questionnaire was designed to detect relative differences in positive and negative emotion levels for the individual elements of the Ropes Course. However, the contribution of other emotions present on each element needs to be considered. For example, in Studies 3 and 5, the Flying Fox element was identified with significantly high levels of fun and excitement. This element also showed moderate levels of challenge, hard and worry that could have influenced the physiological response (most likely HR) on this element. This finding not only highlights the importance of monitoring other emotions present but also the need to determine the overall affective state. Another finding in Study 5 also drew attention to the use of self-report descriptor ratings and their ability to accurately monitor all emotions experienced. In the second part of the Study, the two groups recorded significantly different patterns of HR and SCL activity on some elements (the Tyre Walk and Postmans Walk in the case of HR;

the Spiders Web and Postmans Walk for SCL) of the Ropes Course even though there were no significant differences found in the Element Ratings Questionnaire on any of the five descriptors for these specific elements. While this finding may reflect problems associated with the use of self-report Likert scales of emotion (e.g., see review in Levenson, 1988; also similar study by Lewis, Ray, Wilkinson & Ricketts, 1984) factors such as the presence of other emotions that may have contributed to group differences need to be considered. The exploration of the nature of the five descriptors used by the Ropes Course participants was limited due to time constraints and the use of child subjects. Further clarification of the positive or negative nature of the five descriptors, along with a more sensitive means of quantifying the emotions present during the experiment can be achieved using a standardised questionnaire that attempts to monitor the overall level of affect rather than the presence of discrete emotions.

With consideration to both the findings from the studies on the Ropes Course and the methodological developments in laboratory studies outlined in Chapter 3, the following laboratory experiment attempted to investigate HR and SCL changes to different emotions evoked by imagery. The same five descriptors of challenge (C), hard (H), worry (W), fun (F) and excitement (E) were used to direct adult subjects to imagine situations that evoked different levels of these positive and negative related emotions. Similarly to their usage in the previous study, these five descriptors were explored in a simple questionnaire to determine those imagery sessions best representative of positive and negative emotional experiences. This approach rests on the premise that the FE and CHW descriptor groupings reflect positive and negative affect respectively.

The five descriptors were originally selected for use in Study 3 as they represented an array of emotions frequently experienced and verbally expressed by Ropes Course child participants. The ratings data from the previous study showed that the descriptors challenge, hard and worry versus fun and excitement used in the context

of a challenging activity reflected a negative and positive emotional experience respectively. In the emotion literature (see review in Watson and Tellegen, 1985) the descriptor (or "emotion term") excitement has consistently been associated with high pole Positive Affect (PA) (Zevon & Tellegen, 1982; Lebo & Nesselroade, 1978; Russell & Ridgeway, 1983) while the descriptor worry is categorised as high pole Negative Affect (NA) (e.g. Hendrick & Lilly, 1970; Watson, Clark, & Tellegen, 1984). While the term fun does not feature in the literature review of "emotion terms" by Watson and Tellegen (1985), the related descriptors of joy, happy and pleasant are associated with both high pole PA (Watson, Clark and Tellegen, 1984) and low pole NA (Zevon and Tellegen, 1982).

The descriptors hard and challenge also do not feature in Watson and Tellegen's 1985 summary of positive and negative affect factors and have not been referred to as fundamental emotions or "moods" in the emotion literature (e.g., Fridja, 1986; Russell, 1980; Watson, 1988; Ekman, Levenson & Friesen, 1983). However, it would be reasonable to claim that these descriptors are associated with situations (e.g., the Ropes Course activity or sitting an exam) that typically also involve different levels of negative emotions such as worry and anxiety. This is consistent with the ratings data gathered in Study 3 that indicated that hard, challenge and worry were strongly associated, and that together these three descriptors were useful indicators of the presence of negative emotions experienced during certain stages of the Ropes Course activity.

Under imagery conditions the content of the imagery situation is not readily detected and the nature and/or meaning of the descriptors in relation to the imagined situation may be appraised differently (see Smith, 1989; Wagner, 1989; Hubert & de Jong-Meyer, 1990). This holds particular relevance for the descriptor challenge, which has been associated with both positive and negative types of emotions, depending on the situation experienced (Fridja, 1986). For the present study, a standardised questionnaire,

the Positive and Negative Affect Schedule (PANAS) (Watson, Clark & Tellegen, 1988) (see Appendix 15) was used alongside the Ratings Questionnaire to monitor the levels of positive and negative affect experienced during each imagery session. The use of the PANAS questionnaire also served to validate the positive or negative valence characteristics of each of the five descriptors challenge, hard, worry, fun and excitement as applied to this study.

The PANAS is a relatively brief scale used to determine levels of both positive and negative affect. The validation and reliability of this scale is described in Watson, Clark and Tellegen (1988). They report acceptably high alpha reliabilities for both intercorrelations and internal consistencies for both Positive Affect (PA) (.86-.90) and Negative Affect (NA) (.84-.87). According to the authors, this questionnaire also exhibits a significantly high level of stability in a range of time frames, including the "moment" ratings. Normative data obtained from college students showed that the PA is often scored higher than NA, and this relationship holds true regardless of the time frame.

The PANAS questionnaire emerged from the study of emotion and mood terms (Russell, 1980; Watson & Tellegen, 1985) and while it continues to be used in other emotion studies reported in the recent psychology literature (e.g., Boutcher, McAuley & Courneya, 1997), there is no known record of it, or a similar questionnaire, being used in psychophysiological investigations of emotion. As discussed in the Chapter 3 literature review, the sole use of ratings to monitor the presence and nature of emotions remains prominent in psychophysiological studies examining emotion, even though the preference for standardised questionnaires to determine affective state is promoted in the emotion literature (Levenson, 1988; Tellegen, 1989).

The following laboratory study used imagery to elicit emotional responses in the

subjects. It has been shown reliably that imagining emotional scenes results in facial muscle and visceral changes and can be regarded as a suitable procedure to examine the effects of emotion on the physiological responses (de Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993). In a review of their research findings, Rimé, Philippot and Cisamolo (1990) also suggested that the imagery of meaningful situations, that is situations of personal relevance, are more potent in the elicitation of strong and genuine emotions. Compared to other psychophysiological studies of emotion, Vrana (1993; 1994) recorded unusually high HR levels during the disgust imagery. He attributed the enhanced cardiac activity observed in his 1993 study to the use of meaningful “relived” imagery.

A number of studies have utilised imagery to elicit emotions for both short (e.g., Vrana, 1993, 8 seconds) and longer periods of say 30 seconds (e.g., Ekman et al, 1983; de Jong-Meyer et al., 1993) or 1 minute duration (e.g., Haney & Euse, 1976). While mixed success is described in the literature for both short and prolonged imagery periods, it appears more meaningful to monitor physiological changes accompanying emotions experienced over longer periods compared to the shorter periods used in some imagery studies (e.g., Vrana, 1993) and studies involving picture presentation (e.g., Greenwald et al., 1989).

In the following experiment subjects imagined situations that were personally meaningful and which they felt would evoke emotional states associated with each of the five descriptors. In an attempt to control and gauge the intensity of the emotions concerned, subjects were instructed to imagine both high and low levels for each of the descriptors, and each imagery session was monitored using the descriptor ratings and PANAS questionnaires.

HR and SCL measures were collected throughout the 10 one minute imagery

sessions. These data were averaged across 13 consecutive 5 second epochs (E0 to E12). The baseline epoch (E0) represents the five second period prior to imagery participation. The first epoch (E1) represents the first 5 seconds of the imagery period and so forth. Imagery session ratings of the five descriptors, as well as the PANAS scores, were used to select appropriate imagery sessions for physiological data comparison and analysis. The descriptor ratings for each imagery session were used to select the imagery sessions representing four clusters of **high FE**, **low FE**, **high CHW** and **low CHW**. The PANAS data were used to provide a pictorial representation of the 10 imagery sessions in an “affective space” defined by the PA and NA dimensions. Thus, the PA and NA scores provided another source from which to select imagery session clusters (**high PA**, **low PA**, **high NA** and **low NA**) for analysis of the physiological correlates of emotion.

Based on the literature, it was expected that imagery involving high levels of emotion would result in enhanced physiological responses. In the light of the findings of the previous study, it was hypothesised that the HR and SCL changes would separately discriminate between high and low levels of the imagery sessions representing negative (CHW and NA) and positive (FE and PA) emotions respectively. Initial analyses of the HR and SCL data for the imagery session clusters **high FE**, **low FE**, **high CHW** and **low CHW** tested for time (epoch 0 to epoch 12), level (high versus low) and valence (positive versus negative) effects. A second set of analyses explored level (high versus low) differences in SC and HR changes separately for each of the valence (CHW and FE) groups. These two sets of analyses were repeated to examine the same effects in the HR and SCL data for the **high PA**, **low PA**, **high NA** and **low NA** clusters (Analyses Set 3 and Analyses Set 4).

8.1.2 Method

Subjects

Fifty undergraduate students (39 female, 11 male), aged 20-50 years volunteered to participate in the study to fulfil a course requirement in a psychophysiology subject at the University of Wollongong. Each student gave informed consent prior to his or her participation in the study.

Apparatus

HR and SCL were recorded using a portable Heart Rate and Galvanic Skin Response Monitor, HGM1 (Barry, Moroney, Orlebeke & de Vries, 1991) as used in Study 3. While this experiment was conducted in the laboratory, this device allowed subjects to be seated in relative privacy out of sight of the experimenter and computer equipment.

To record heart rate, pre-jelled disposable cardiac electrodes were placed on the subject's chest with one electrode at mid-sternum, and another on the lower ribs towards the subject's left side. Electrodermal activity was recorded from Ag/AgCl electrodes with contact limited by adhesive disks (area 0.7cm^2). An electrode paste of 0.05 molar NaCl in an inert viscous ointment base was used as the electrolyte. Electrodes were placed on the volar surfaces of the distal phalanges of the second and third digits of the non-preferred hand.

An instructional booklet contained instructions for each of the 10 imagery sessions on separate pages. The imagery sessions covered a high and low level for each of the following descriptors: challenge, hard, worry, fun and excitement. An example of the imagery session instruction was: *"Close your eyes and imagine yourself in a situation that you would describe as involving a high level of worry"*. The order of the

imagery sessions in the booklet was randomised for each subject to eliminate sequence effects. Each imagery session was followed by a PANAS questionnaire (Watson, Clark & Tellegen, 1988) and a brief Ratings questionnaire. The PANAS questionnaire required subjects to use 20 "emotion" words using a five point scale to indicate how they felt during each imagery session. Also on a five point scale, the Ratings questionnaire instructed subjects to rate the "imagined situation" on each of the five descriptors: challenge, hard, worry, fun and excitement.

Procedure

On arrival at the laboratory in pairs, subjects were seated and fitted with the EKG and SC electrodes. After connection to the HGM1 and initialisation with the computer the first subject was seated at a separate table with their back to the second subject. The second subject was then connected to another HGM1 unit and initialised with the same computer. This subject's HGM1 device remained connected to the computer to allow the experimenter to view a clock that was synchronised with both the HGM1 devices. A screen prevented both subjects from viewing the monitor display and the experimenter during the experiment.

Both subjects were presented with the experimental booklet and instructed to turn pages only when requested. The subjects read a brief description of the experiment before being requested to turn to the next page. To gain familiarity with the PANAS questionnaire and to provide some baseline information, subjects filled out a PANAS questionnaire ("initial PANAS") on how they currently felt. Subjects were then asked if they understood the PANAS questionnaire and the experimental procedure. Subjects were also informed that the descriptor hard was to be considered in terms of the concept of "difficulty". Subjects were reminded that they were to attend to the imagery instruction until instructed to turn to the next page. After a brief quiet period subjects were instructed to turn to the first imagery session instruction page. The imagery session

was terminated after 1 minute and the subjects were requested to turn to the following page containing the PANAS and ratings questionnaire. Subjects were allowed 90 seconds to complete these questionnaires. This procedure was repeated for the 10 imagery sessions. At the completion of the experiment subjects filled out another PANAS questionnaire (“final PANAS”) detailing how they felt at that time.

8.1.3 Results

Three sets of data: imagery Ratings data, PANAS data and the physiological data (HR and SCL) were obtained. The Ratings and PANAS raw data are listed in Appendix 16 while the HR and SCL data and statistical outcomes from this study are presented in Appendices 17 and 18. The PANAS scores were analysed using planned contrasts to confirm that the imagery was successful in eliciting changes in subject affective states and that these states were distributed over the affective space defined by the PA and NA axes. The data gathered from the ratings of the individual imagery sessions and the PANAS scores were used to determine the imagery session clusters for the physiological data comparisons. Using two different approaches, the skin conductance and heart rate measure responses were examined for differences between the four clusters; **high FE**, **low FE**, **high CHW** and **low CHW**, in regard to time (epoch 0 to epoch 12), level (high versus low) and valence (positive versus negative) factors. These same factors were tested again on a second set of imagery session clusters: **high PA**, **low PA**, **high NA** and **low NA** formed from the imagery session PANAS scores.

While normative data on gender differences in imagery indicate substantial variation in gender and age in regard to imagery vividness (White, Ashton & Brown, 1977), no gender or age analyses were performed in this study. It was not the intent of this thesis to examine gender or age differences in imagery vividness or the accompanying physiological activity, but rather to explore physiological changes that

reflect valence and level variation in emotion as reported by the subjects. In addition, due to the small number of male and mature-aged psychology students these variables were not adequately represented in the subject sample.

Ratings Data

With the aid of the five descriptors, subject ratings were used to monitor the presence and intensity of emotions elicited during the imagery sessions. Table 8.1 shows the mean rating and standard deviations for each of the descriptors: challenge (C), hard (H), worry (W), fun (F) and excitement (E) recorded for the 10 imagery sessions. An experiment average for each descriptor was calculated from the rating scores across the 10 imagery sessions. This experiment average was then used for comparative analysis with each imagery session to determine which imagery sessions elicited significantly high or significantly low levels of each of challenge, hard, worry, fun and excitement (see Table 8.1). For example, compared to the experiment average, the imagery session "high hard" showed (among other things) significantly high levels for the descriptor challenge, and significantly low levels for the descriptor excitement. Similar to Study 3, these data were used to select the imagery sessions representing the four clusters: **high FE**, **low FE**, **high CHW** and **low CHW** as described below. Figure 8.1a and Figure 8.1b shows the FE and CHW descriptor ratings, respectively, for the 10 imagery sessions (The high level sessions are abbreviated in upper case; for example, CH represents the "high challenge" imagery session).

Fun and excitement

It was found that, compared to the experiment average, significantly high levels of fun and excitement related emotions were elicited during the "high fun" and "high excitement" imagery sessions. Compared to the experiment average, four imagery sessions recorded significantly low levels of both fun and excitement, "high hard", "high worry", "low worry" and "low fun".

Table 8.1 Imagery Session Descriptor Ratings: Ratings on the five descriptors for each imagery session

IMAGERY SESSION	Descriptor									
	Challenge		Hard		Worry		Fun		Excitement	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
High Challenge	4.26 ^a	0.99	3.80 ^a	1.12	3.24 ^a	1.33	2.56	1.42	3.12	1.49
High Hard	3.86 ^a	0.88	4.06 ^a	1.19	3.46 ^a	1.05	1.74 ^d	1.10	1.94 ^d	1.22
High Worry	3.30 ^b	1.36	3.44 ^a	1.37	4.34 ^a	0.94	1.10 ^d	0.30	1.48 ^d	0.89
High Fun	2.20 ^e	1.23	1.68 ^d	1.06	1.48 ^d	0.76	4.46 ^a	0.74	4.24 ^a	0.85
High Excitement	3.10	1.46	2.18	1.42	1.90 ^e	0.91	4.18 ^a	0.94	4.40 ^a	0.86
Low Challenge	2.34 ^e	1.12	2.08 ^e	1.10	1.48 ^d	0.68	2.52	1.18	2.16 ^e	1.11
Low Hard	2.24 ^d	1.89	1.78 ^d	1.04	1.66 ^d	1.02	2.24	1.24	2.12 ^e	1.10
Low Worry	2.22 ^d	1.13	1.84 ^d	0.93	2.10	1.20	2.06 ^e	1.28	1.84 ^d	1.13
Low Fun	2.26 ^e	1.18	1.82 ^d	0.98	1.68 ^d	1.06	2.10 ^e	1.18	1.84 ^d	1.00
Low Excitement	1.94 ^d	1.20	1.74 ^d	1.03	1.46 ^d	0.76	2.34	1.30	2.26	1.32

KEY	
^a significantly high at .001 level	^d significantly low at .001 level
^b significantly high at .01 level	^e significantly low at .01 level
^c significantly high at .05 level	^f significantly low at .05 level

Figure 8.1a Fun (F) and excitement (E) descriptor ratings for the 10 high (abbreviated in upper case) and low level imagery sessions

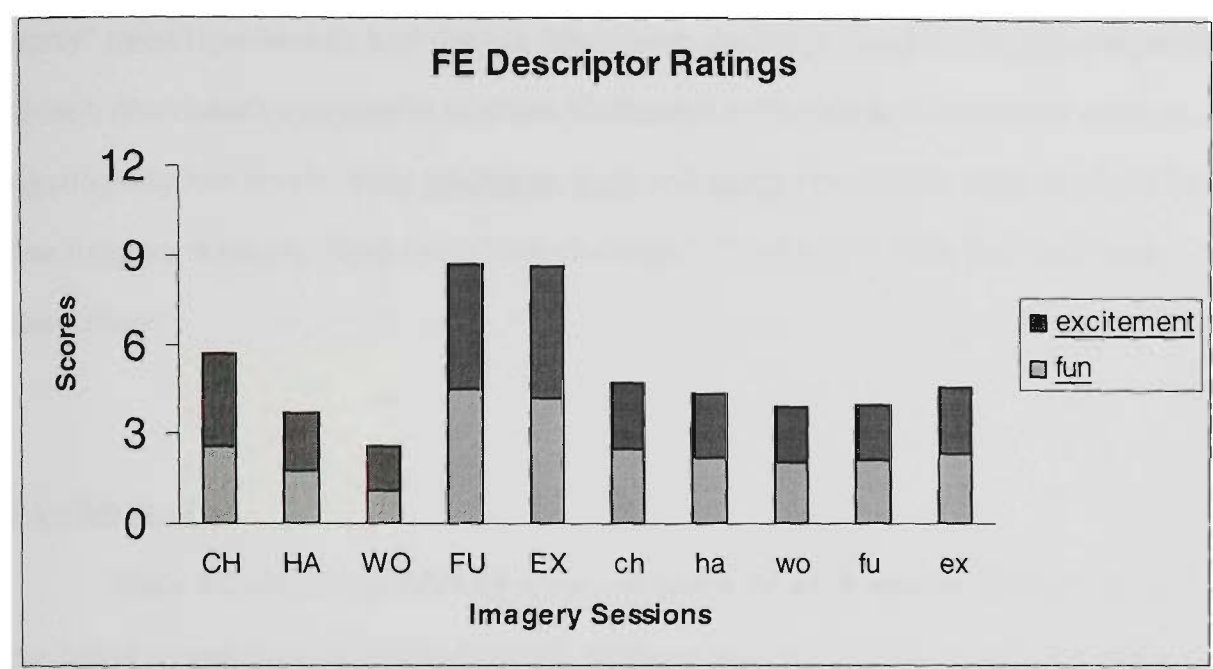
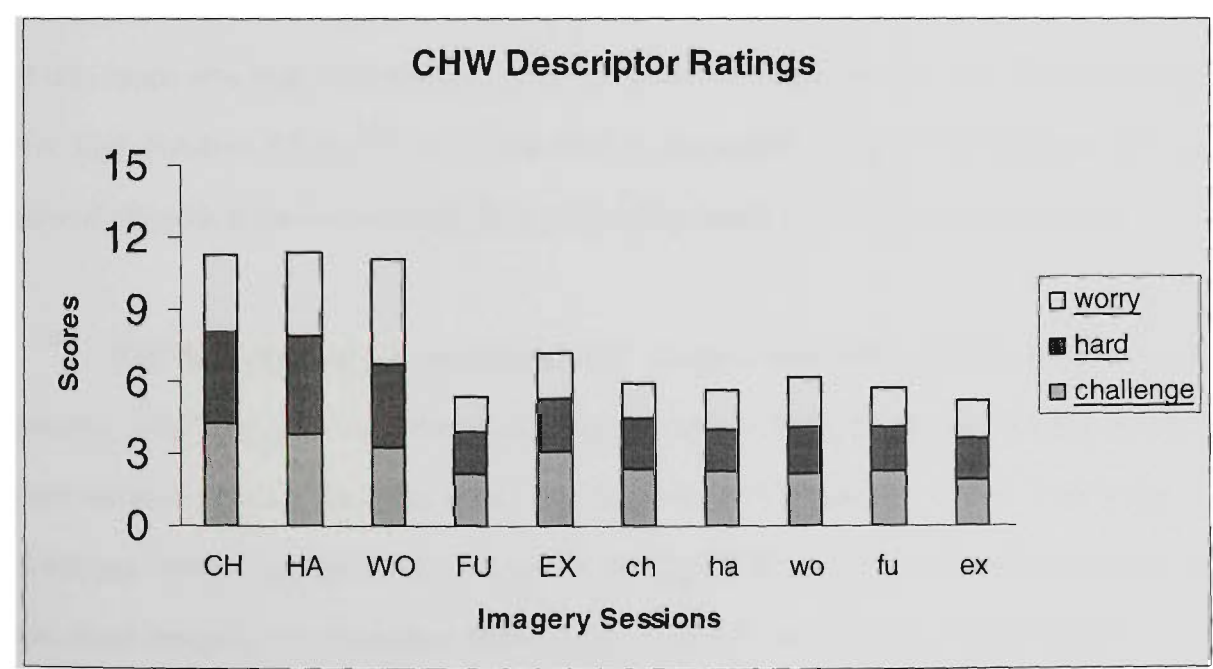


Figure 8.1b Challenge (C), hard (H) and worry (W) descriptor ratings for the 10 high (abbreviated in upper case) and low level imagery sessions



Challenge, hard and worry

It was found that the imagery sessions "high challenge", "high hard" and "high worry" rated significantly high for the descriptors challenge, hard and worry compared to each descriptor's experiment average. Compared to the relevant descriptor average, significantly low levels of the challenge, hard and worry descriptors were obtained for five imagery sessions, "high fun", "low challenge", "low hard", "low fun" and "low excitement".

PANAS DATA

Table 8.2 shows the PANAS scores obtained for each imagery session as well as the initial (*i*) and final (*f*) PANAS scores obtained prior to, and on completion of the experiment. Figure 8.2 shows these PANAS scores plotted in a two dimensional "affective space". The PA score is presented on the y-axis while the NA score is presented on the x-axis. The (x,y) centre point co-ordinates (9.07, 16.77) were calculated from the average NA and PA scores for the 10 imagery sessions. A division of this space into high/low quadrants for PA and NA (high PA/low NA, high PA/high NA, high NA/low PA and low PA/low NA) is illustrated in Figure 8.2 and provides a natural classification for the grouping of imagery sessions for later comparison.

The "high fun" and "high excitement" imagery sessions evoked high levels of positive affect (PA) and relatively low negative affect (NA). High NA/low PA levels were obtained during the "high hard" and "high worry" imagery sessions. The "high challenge" imagery session was located in the high PA/high NA quadrant. A cluster of low-level imagery sessions were found in the low PA/low NA region as were the affective states of the subjects at the initial (*i*) and final (*f*) baselines.

First, the PA and NA scores for the imagery sessions were compared to a mean

baseline PA and NA score to confirm that significant levels of positive or negative affect were experienced during the imagery sessions. Inter-imagery-session comparisons of the PA and NA scores were carried out to confirm affect differences between imagery sessions representing the four clusters of **high PA, low PA, high NA** and **low NA** (see Figure 8.2). Comparison of the HR and SCL data was carried out on these four clusters (**high PA, low PA, high NA** and **low NA**) to examine valence and level effects. These analyses of the physiological data are described in the Physiological Results section.

Figure 8.2 PA and NA scores for the 10 imagery sessions plotted in the experiment “affective space”. High level imagery sessions are abbreviated in upper case lettering.

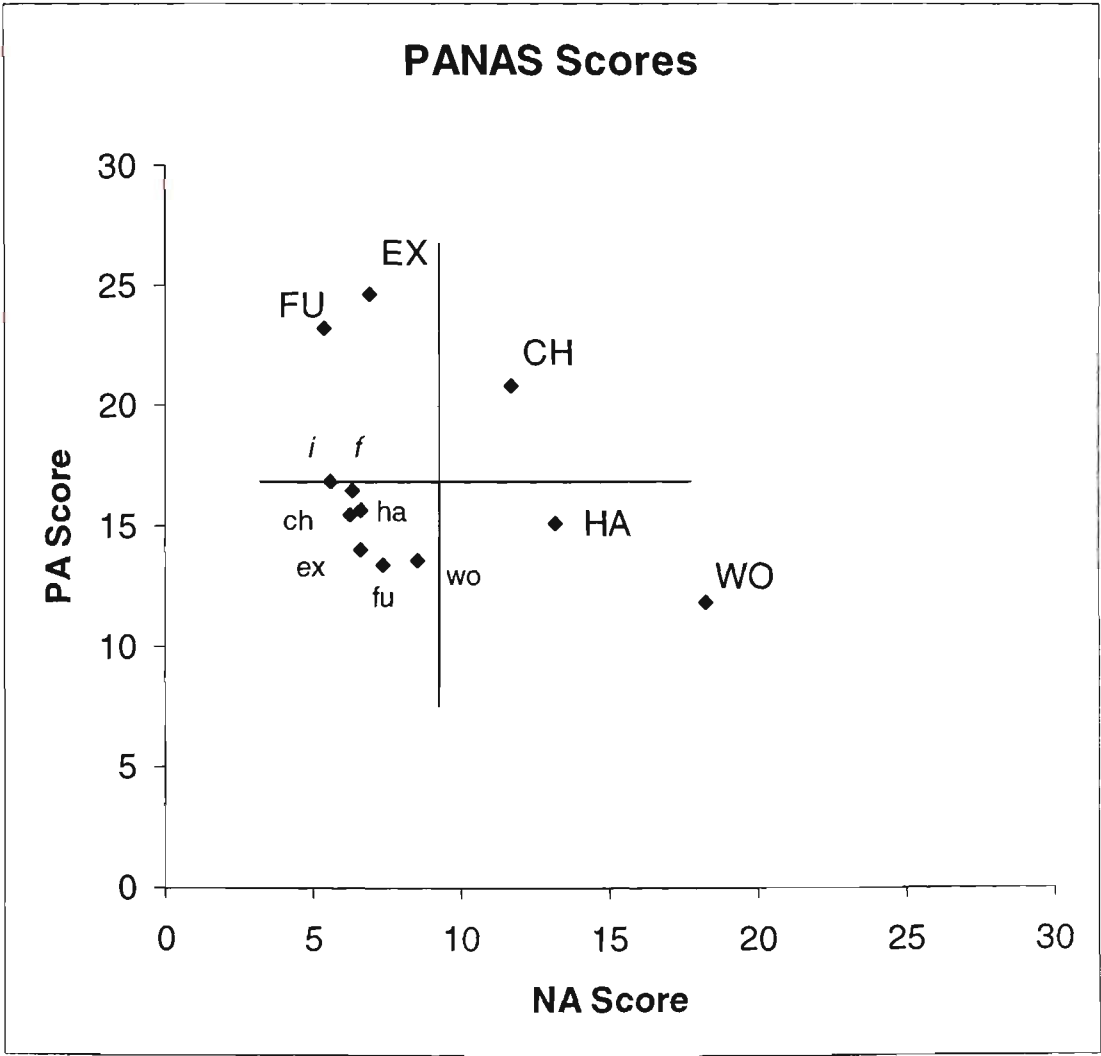


Table 8.2 Imagery Session PANAS Scores

IMAGERY SESSION	PA SCORE		NA SCORE	
	MEAN	S.D.	MEAN	S.D.
High Challenge (CH)	20.82	6.35	11.67	5.42
High Hard (HA)	15.07	5.89	13.16	5.65
High Worry (WO)	11.86	4.37	18.26	5.95
High Fun (FU)	23.21	4.74	5.36	2.61
High Excitement (EX)	24.61	4.70	6.94	2.91
Low Challenge (ch)	15.50	6.35	6.26	2.11
Low Hard (ha)	15.67	5.80	6.62	3.96
Low Worry (wo)	13.58	5.67	8.53	4.17
Low Fun (fu)	13.40	5.38	7.33	4.02
Low Excitement (ex)	13.96	6.60	6.6	3.44
Initial (i)	16.83	3.81	5.62	1.06
Final (f)	16.44	4.20	6.34	3.20

Baseline data

A planned comparison confirmed that the initial and final PA scores were not significantly different ($F(1,49)=0.84, p=.36$). Similarly, the initial and final NA scores were not significantly different ($F(1,49)=2.68, p=.11$). The initial and final scores were thus averaged to form mean baseline PA and NA scores. These baseline scores were taken to reflect the subject at a resting or "neutral" state.

The success of the imagery task, that is the ability of the imagery sessions to elicit different emotional states, was confirmed by examining affective state differences (PA and NA scores) between the imagery sessions and the baseline score. As mentioned above, the PANAS scores from the high level imagery sessions indicated that the five descriptors were located in three different quadrants: fun and excitement; challenge; hard and worry. This grouping of the five descriptors was used as a guide for the preliminary analysis of the PA and NA scores compared to the baseline for each of the 10 imagery sessions.

Fun and Excitement

PA : The average of the "high fun" and "high excitement" PA scores was significantly higher than the baseline PA score ($F(1,49)=143.21, p<.001$) confirming that these two imagery sessions were identified with enhanced positive affect relative to the baseline state. The "high excitement" imagery session scored significantly higher than "high fun" in PA ($F(1,49)=9.03, p<.01$). The average of the "low fun" and "low excitement" imagery sessions scored significantly lower in PA than the baseline score ($F(1,49)=12.97, p<.001$). These two low level imagery sessions were not significantly different in regard to their PA levels ($F(1,49)=0.67, p=.42$).

NA: The mean "high fun" and "high excitement" average NA score was not significantly different from the baseline score, ($F(1,49)=0.16, p=.69$). However, these

two sessions were found to differ significantly in this measure, ($F(1,49)=12.92$, $p<.001$) with the "high excitement" session recording higher NA levels. The "low fun" and "low excitement" imagery sessions showed a somewhat higher mean NA score than the baseline ($F(1,49)=4.21$, $p<.05$). The NA scores for these two sessions were not significantly different ($F(1,49)=1.74$, $p=.19$).

Hard and Worry

PA: The average of the "high hard" and "high worry" imagery sessions scored significantly lower in PA than the baseline ($F(1,49)=23.20$, $p<.001$). A planned comparison revealed that "high hard" and "high worry" differed significantly in PA ($F(1,49)=19.77$, $p<.001$). The average PA score for the "low hard" and "low worry" imagery sessions was significantly lower ($F(1,49)=8.76$, $p<.01$) than that obtained for the baseline. These two imagery sessions also recorded significantly different levels in PA ($F(1,49)=4.59$, $p<.05$).

NA: The "high hard" and "high worry" imagery sessions were found to be significantly higher in NA than the baseline ($F(1,49)=220.39$, $p<.001$). Compared to "high hard", the "high worry" imagery session showed significantly higher levels of NA ($F(1,49)=36.22$, $p<.001$). The average "low worry" and "low hard" NA score was found to be higher than the baseline measure ($F(1,49)=12.29$, $p<.001$). A significant difference in NA scores for these two imagery sessions was also found ($F(1,49)=8.19$, $p<.01$), with the "low worry" recording higher NA levels.

Challenge

As illustrated in Figure 8.2, "high challenge" alone was located in the high PA/high NA quadrant. As "high challenge" did not show any obvious similarities with the other imagery sessions, it, along with "low challenge", was analysed separately for differences in PA and NA scores compared to the baseline scores.

PA: The "high challenge" imagery session scored significantly higher in PA ($F(1,49)=22.15, p<.001$) than the baseline score. The "low challenge" imagery session did not significantly differ in PA from the baseline ($F(1,49)=1.55, p=.22$).

NA: In regard to the NA score, the "high challenge" imagery session was found to be significantly higher ($F(1,49)=64.35, p<.001$) than the baseline score. The "low challenge" imagery session was not significantly different from the NA baseline ($F(1,49)=.63, p=.43$).

In summary, "high challenge" scored significantly high for both PA and NA measures while "low challenge" did not significantly differ on either of these measures compared to the baseline scores.

The above analyses involving the PA and NA scores confirmed that the 10 imagery sessions elicited significantly different and varied levels of positive and negative emotions. Division of the imagery sessions into the four quadrants based on the PA and NA scores enabled the imagery sessions to be grouped into the four clusters: **high PA**, **low PA**, **high NA** and **low NA** for later analysis of the physiological data. The imagery sessions of "high challenge", "high fun" and "high excitement" were found to represent the **high PA** cluster while the "high challenge", "high hard" and "high worry" imagery sessions were taken to represent the **high NA** cluster. All of the low level imagery sessions along with "high hard" and "high worry" were averaged to form the **low PA** cluster. The "high fun" and "high excitement" imagery sessions were averaged along with the five low level imagery sessions to form the **low NA** cluster.

PHYSIOLOGICAL DATA

HR and SC levels were averaged over five second intervals for each one minute imagery period, resulting in a total of 12 epochs. The first epoch (E1) represents the average level for the first five seconds of the imagery period, and so forth. The five second epoch average immediately prior to each imagery session was used as a baseline value for that imagery session. This baseline value (E0) was used to adjust each set of the imagery session physiological data to zero at time $t=0$ thus allowing heart rate and skin conductance changes to be examined across the 10 imagery sessions in terms of deviations from baseline.

For the first two analyses, the ratings data were used to select imagery sessions representing the four clusters: **high FE, low FE, high CHW** and **low CHW**. The HR and SCL data from the selected imagery sessions were averaged to represent the change in HR and SCL over time for each of these four clusters. As stated, initial analyses simply examined these four clusters for time (E0 to E12), valence (negative and positive) and level (high versus low) effects in HR and SCL. In the second set of analyses, the physiological measures were tested for significant differences between the high and low levels separately for each valence. This analysis is comparable to that used in Study 3 and Study 5 which used the five descriptors grouped in a similar fashion to select Ropes Course elements for physiological data comparisons.

These two analyses on the physiological data were repeated for a second set of imagery session clusters: **high PA, low PA, high NA** and **low NA**, which were based on the PANAS scores (see Figure 8.2), rather than the ratings data. The physiological data from these four clusters were averaged and tested for significant differences in the time (E0 to E12), level (high versus low) and valence (PA versus NA) factors (Analyses Set 3). Differences between the high and low levels were tested separately for the PA and

NA clusters in Analyses Set 4.

Using a repeated measure design, the four sets of analyses were carried out on the data recorded over the total imagery period (E0 to E12). Separate analyses were performed on the epochs representing different components across the imagery period for each of the physiological measures. As illustrated in Figure 8.3a, HR changes averaged for the four CHW and FE clusters increased across the first 20 seconds, reaching a peak at epoch 4. HR decelerated for the remainder of the imagery period, resulting in HR levels below baseline at epoch 12. This pattern of physiological activity shows similarities with other studies employing prolonged imagery (Haney & Euse, 1976). It is likely that the first component of the physiological response reflects both the cognitive and emotion aspects of the task, for example the selection of an appropriate image and factors relating to affective judgement such as subject interest. Studies involving picture presentation (e.g., Lang, Greenwald, Bradley & Hamm, 1993) have shown associations between subject interest and physiological responses monitored over relatively shorter periods of say 10 seconds. The second component of the physiological response typically found in prolonged imagery is most likely associated with emotional effect as well as the cognitive elaboration of the image. In order to examine the physiological changes reflecting the effect of emotion in both the first and second response components, changes in HR and SCL (see Figure 8.3e) were examined using the epochs representing a response increase (HR: epoch 0 to epoch 4; SCL, epoch 0 to epoch 5) and a response decrease (HR, epoch 4 to epoch 12; SCL, epoch 5 to epoch 12).

ANALYSES SET 1

Level (High versus Low) and Valence (FE versus CHW) Effects.

As outlined above, the imagery session ratings data were used to select the imagery sessions representing the four clusters: **high FE, low FE, high CHW** and **low**

CHW. A three-way ANOVA was used to test each of the physiological measure changes (HR and SCL) for differences between these clusters in regard to time, valence and level effects. The time effects were examined in linear, quadratic and cubic trends only. All of the statistical outcomes are presented in Table 8.3.

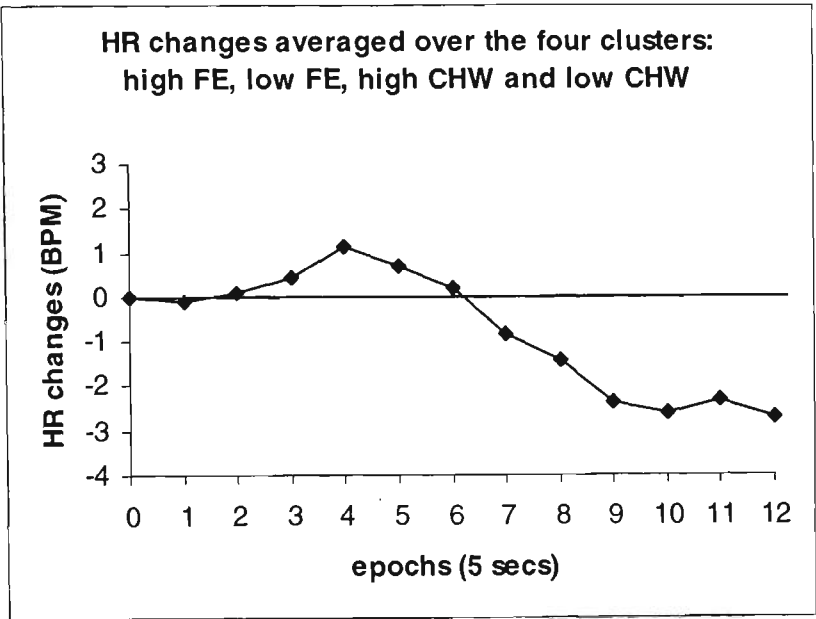
Heart Rate Changes

TIME

Figure 8.3a illustrates the average HR changes for the four clusters. After a slight initial deceleration, HR activity accelerated to a peak at epoch 4. This was followed by a marked deceleration which appears to plateau at epochs 10-12. At epoch 4, the average peak changes in HR were 1.12 BPM, while the largest decreases were obtained at the last epoch (epoch 12) which recorded an average of 2.74 BPM below the baseline level. Analyses were carried out on the HR data gathered across the entire imagery period and for the epochs representing a HR increase (epoch 0 to epoch 4) and the subsequent HR decrease (epoch 4 to epoch 12). Analysis of the entire imagery period for the four clusters showed a significant time effect in each of the linear ($F(1,49)=57.10$ $p<.001$), quadratic ($F(1,49)=16.67$, $p<.001$) and cubic ($F(1,49)=9.20$, $p<.01$) trends over time.

An analysis of the HR increase observed during the first 20 seconds of imagery (epoch 0 to epoch 4) indicated a linear trend that approached significance ($F(1,49)=3.83$, $p=.056$). The HR decrease from epoch 4 to epoch 12 showed a significant linear trend ($F(1,49)=45.53$, $p<.001$). Together these findings suggest that the marked deceleration in HR observed over the entire imagery session was stronger than the initial HR acceleration found in the earlier stages of the HR response. In summary, these data confirm the significance of the HR response averaged over the four clusters, particularly the large HR deceleration that occurred for a substantial part of the imagery period.

Figure 8.3a HR changes averaged over the four clusters; **high FE, low FE, high CHW and low CHW**



LEVEL

Figure 8.3b shows the mean HR changes for the high (**high CHW + high FE**) and low (**low CHW + low FE**) level clusters. Initially, the high level clusters recorded a greater acceleration peaking at epoch 4, after which the high and low level clusters showed a parallel deceleration pattern. Mean HR levels for the high level clusters were found to be significantly greater than the low level clusters ($F(1,49)=4.32, p<.05$). This level difference between the high and low clusters was not found to be significant between epochs 0 and epoch 4, but was significant between epochs 4 and 12, ($F(1,49)=5.35, p<.05$).

Table 8.3 Statistical Outcomes for Analyses Set 1

EFFECTS	Imagery Epochs	HR changes		SCL changes	
		Trend	F(1,49)	Trend	F(1,49)
Time	E0 to E12	linear	57.10 ***	linear	16.06 ***
		quad.	16.67 ***	quad.	50.18 ***
		cubic	9.20 **	cubic	7.44 **
	Increase	linear	3.83 #	linear	22.11 ***
	Decrease	linear	45.33 ***	linear	61.30 ***
				cubic	4.73 *
Level	E0 to E12		4.32 *		n.s.
	Increase		n.s.		n.s.
	Decrease		5.35 *		n.s.
Valence	E0 to E12		n.s.		n.s.
	Increase		n.s.		n.s.
	Decrease		n.s.		n.s.
Level X Time	E0 to E12	linear	4.53 *	quad.	4.18 *
	Increase	linear	3.56 #		n.s.
	Decrease		n.s.		n.s.
Valence X Time	E0 to E12		n.s.		n.s.
	Increase		n.s.		n.s.
	Decrease		n.s.		n.s.
Level X Valence	E0 to e12		n.s.		n.s.
	Increase		n.s.		n.s.
	Decrease		n.s.		n.s.
Level X Valence X Time	E0 to E12	linear	6.66 *		n.s.
	Increase		n.s.		n.s.
	Decrease	linear	5.63 *	linear	3.36 #

Key

*** significant at .001 level

** significant at .01 level

* significant at .05 level

approached significance

LEVEL X TIME

Analyses of the whole imagery period showed a significant level X linear time interaction ($F(1,49)=4.53, p<.05$), while a level X linear time ($F(1,49)=3.56, p=.06$) result approached significance during the first 20 seconds of imagery. There were no differences in the linear trend over time for the second segment of the imagery session. These data suggest that the high level clusters produced greater acceleration in HR during the first 20 seconds of imagery and that this difference remained for the rest of the session, underlying the main level effects noted above.

VALENCE

Figure 8.3c shows that the mean HR changes for the FE (**high FE + low FE**) and CHW (**high CHW + low CHW**) clusters were similar across the whole imagery period.

Figure 8.3b HR changes averaged for the high (**high FE + high CHW**) and low (**low FE + low CHW**) clusters

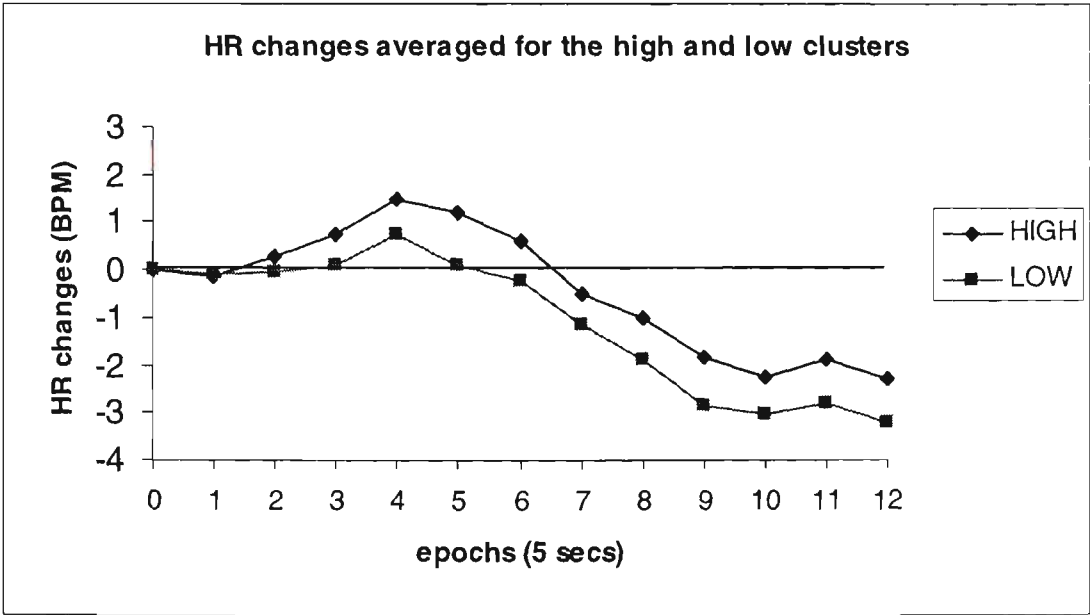
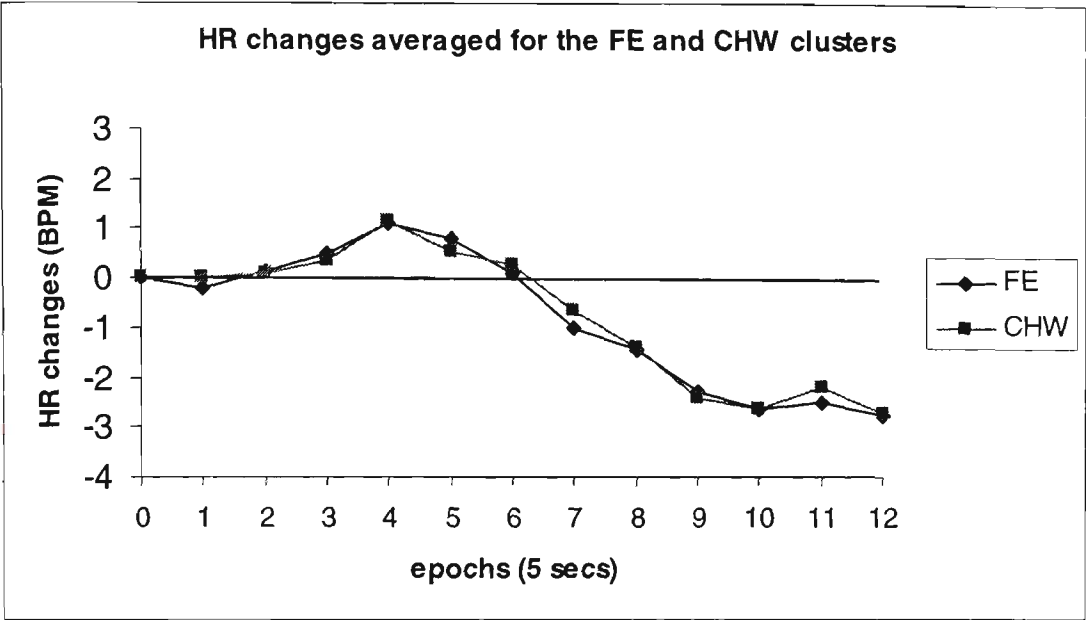


Figure 8.3c HR changes averaged for the FE (high FE + low FE) and CHW (high CHW + low CHW) clusters



Data analyses confirmed that there were no differences between these two valence clusters over the entire imagery period or for the HR response across epochs 0 to 4, and epochs 4 to 12.

VALENCE X TIME

As noted in Table 8.3, there were no significant valence X time interactions in the HR response for the CHW and FE valence clusters.

LEVEL X VALENCE

There were no significant level X valence effects recorded for the four clusters in the HR measure.

LEVEL X VALENCE X TIME

Figure 8.3d shows the pattern of HR changes for the four clusters of **high FE**,

low FE, high CHW and **low CHW**. During the deceleration phase, that is from epoch 4 to epoch 12, there were clear differences between the high and low levels, and this differed for each valence condition. Analyses of the whole imagery period showed a significant three-way level X valence X linear time ($F(1,49)=6.66, p<.05$) interaction. A significant level X valence X linear time interaction ($F(1,49)=5.63, p<.05$) was also found between epoch 4 and epoch 12. The **high FE** and **low CHW** clusters showed greater HR deceleration than the **low FE** and **high CHW** clusters. This is illustrated in Figure 8.3d i).

In summary, during the first 20 seconds of the imagery period, HR acceleration was greater for the high level clusters, and this initial acceleration resulted in the larger average HR levels recorded for the high level imagery clusters across the entire imagery period. During the last 40 seconds of the imagery period (epoch 4 to epoch 12), variation in the deceleration between the four clusters occurred. This led to higher and lower HR levels in **high CHW** and **low CHW** respectively, with intermediate levels for the other two clusters.

Figure 8.3d HR changes for the **high FE**, **low FE**, **high CHW** and **low CHW** clusters.

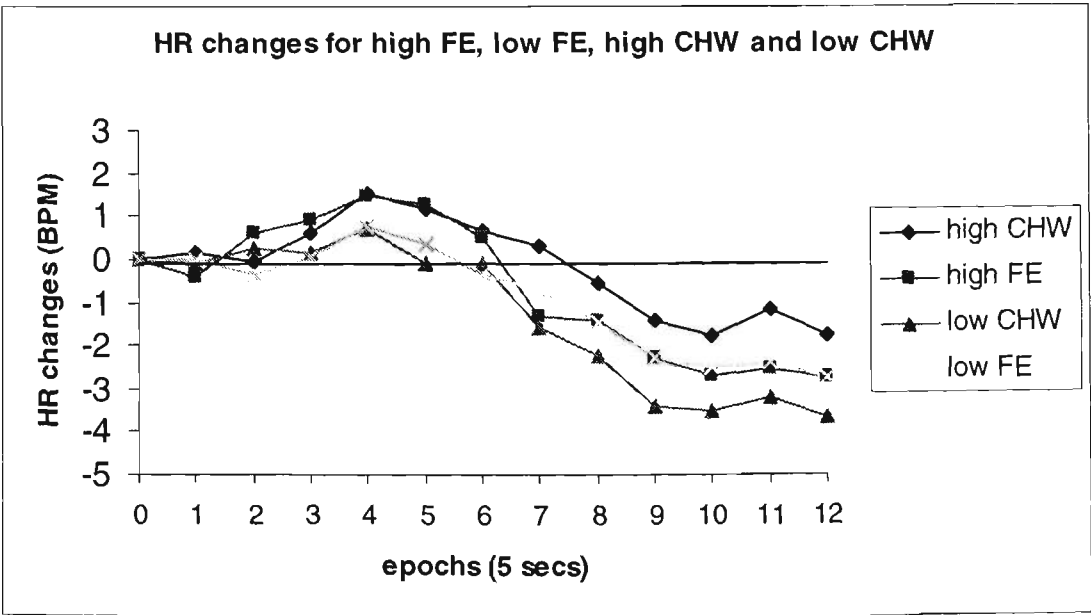
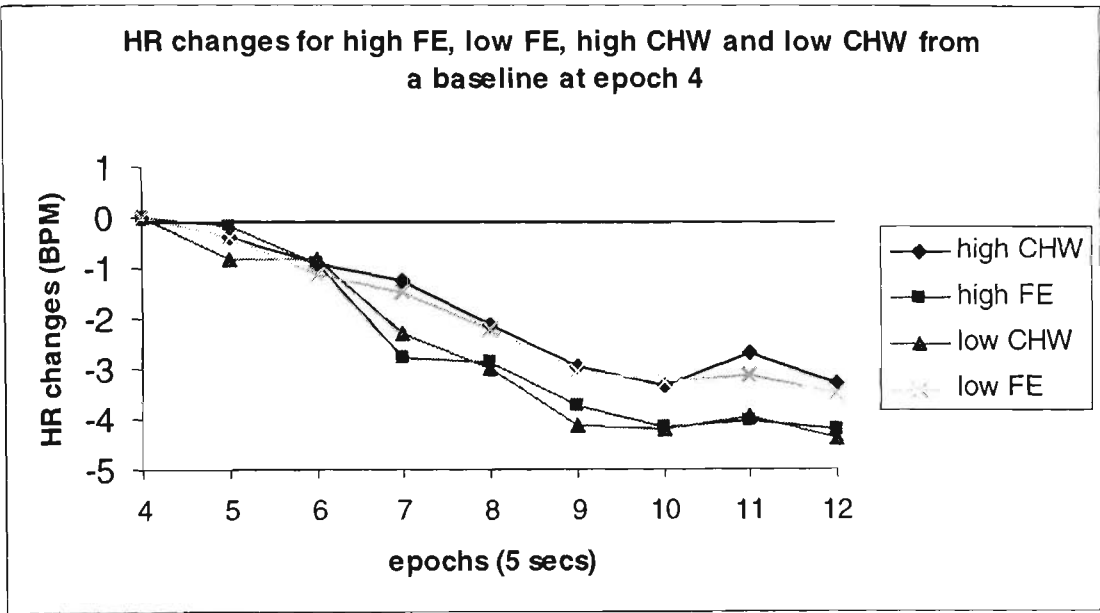


Figure 8.3d i) HR changes for the **high FE**, **low FE**, **high CHW** and **low CHW** clusters from a baseline at epoch 4

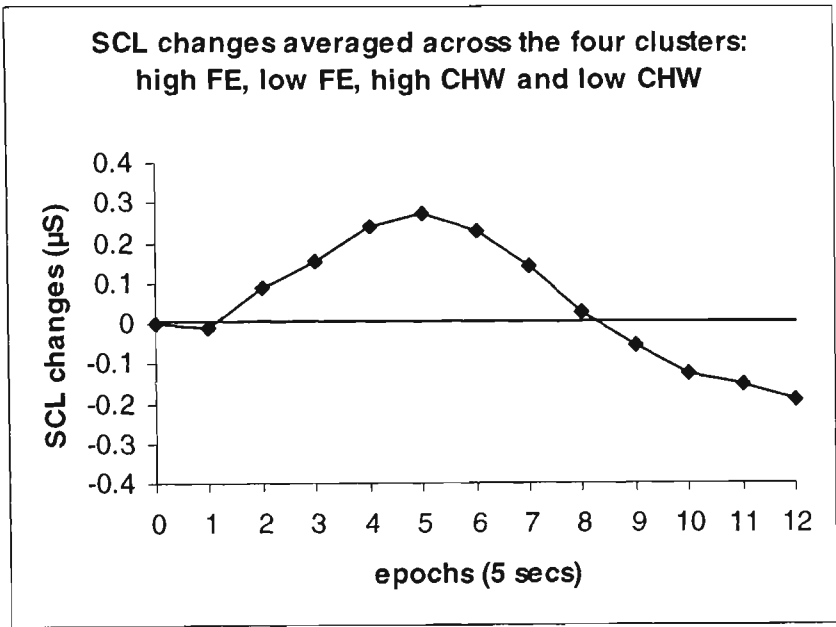


Skin Conductance Level Changes

TIME

Figure 8.3e illustrates the average changes in SCL from the pre-imagery baseline for the four clusters as a function of time. After a very small initial decrease, changes in the SCL measure showed a substantial increase peaking at epoch 5 (0.27 μ S). This peak was followed by a marked linear decrease until the end of the imagery period (epoch 12) finishing at 0.19 μ S below the baseline value. The SCL peak occurred one epoch later than that recorded for the HR measure. Due to exocrine gland innervation, the latency of the electrodermal system is approximately 2 seconds longer than the cardiac response, and it is thus reasonable to expect the SCL peak to occur later than the HR peak.

Figure 8.3e SCL changes averaged over the four clusters; **high FE, low FE, high CHW and low CHW**



Analysis of the SCL response tested for differences as a function of the time, level and valence factors across the entire imagery period and during the SCL increase (epoch 0 to epoch 5) and decrease (epoch 5 to epoch 12). All of the statistical outcomes for these analyses are presented in Table 8.3.

This response for SCL was reflected in a significant time effect over the entire imagery session in each of the linear ($F(1,49)=16.06, p<.01$), quadratic ($F(1,49)=50.18, p<.001$) and cubic ($F(1,49)=7.44, p<.01$) trends. The SCL linear increase between epochs 0 and 5 was found to be significant ($F(1,49)=22.11, p<.001$), as was the linear decrease ($F(1,49)=61.30, p<.001$) recorded between epochs 5 and 12. A smaller but significant cubic trend ($F(1,49)=4.73, p<.05$) was found in the SC data between epochs 5 and 12. These results confirm a significant SCL response for the four clusters across the entire imagery period, particularly a significant SCL increase from epoch 0 to epoch 5 and a decrease from epoch 5 to epoch 12.

LEVEL

Figure 8.3f shows the average SCL changes for the high (**high CHW + high FE**) versus low (**low CHW + low FE**) level clusters. SCL changes for these clusters showed a similar linear increase between epochs 1 and 4 of the imagery period. The high level clusters recorded a larger SCL peak increase ($0.31\mu\text{S}$) at epoch 5 compared to the low level clusters ($0.23\mu\text{S}$). The SCL response during the last 35 seconds of the imagery period for both clusters showed a similar decline in SCL over time (see Figure 8.3f *i*). The difference in mean SCL between the high and low level clusters was not significant across the entire imagery period or for the periods of imagery between epochs 0 and 5 and epochs 5 and 12.

LEVEL X TIME

A significant level X quadratic time interaction ($F(1,49)=4.18, p<.05$) was obtained over the whole imagery period, confirming that SCL for these high and low level clusters differed over the course of the imagery period. As illustrated in Figure 8.3f, SCL between epoch 4 and 6 was noticeably different for the high and low clusters, with a slightly larger peak SCL increase recorded for the high clusters. However, as illustrated in Figure 8.3f *i*), both the high and low clusters showed similar SCL decreases during the second component of the SCL response.

Figure 8.3f SCL changes averaged for the high (**high FE + high CHW**) and low (**low FE + low CHW**) clusters

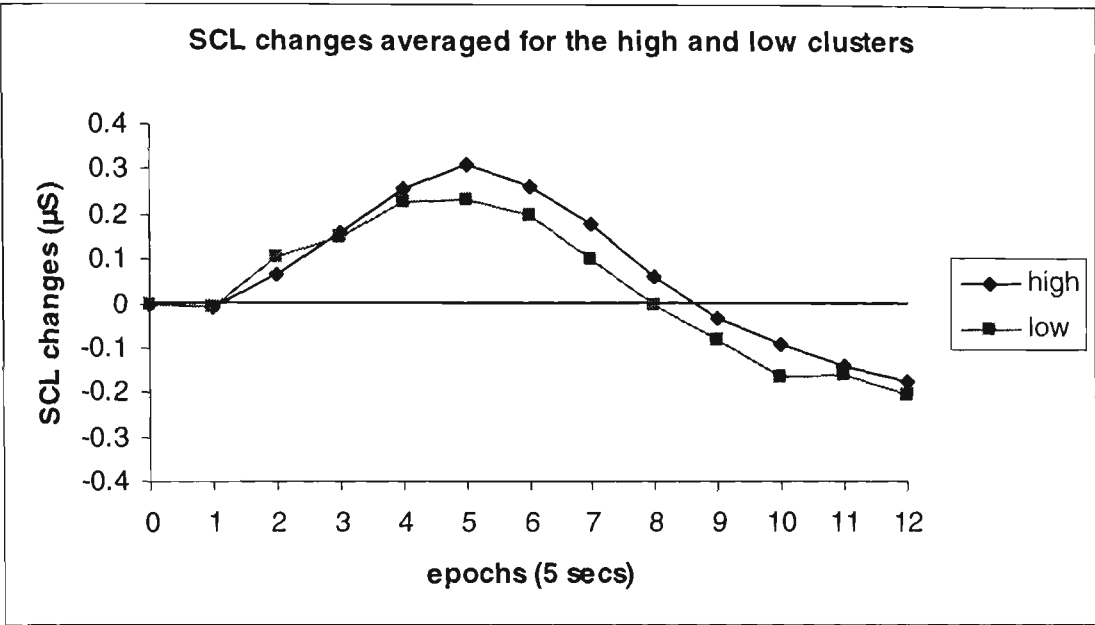
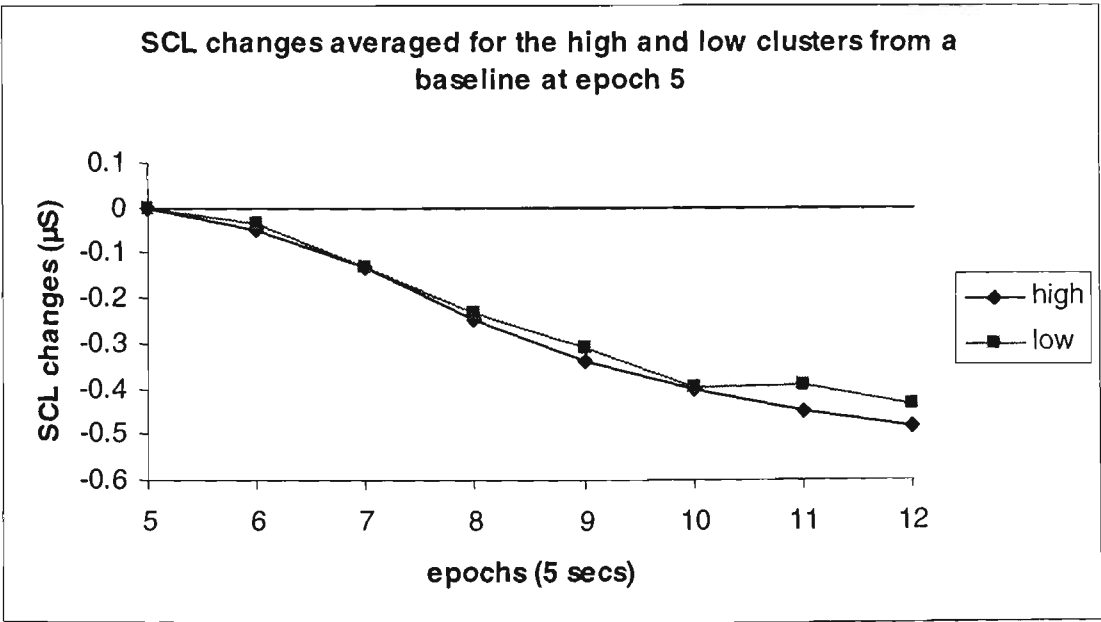


Figure 8.3f i) SCL changes averaged for the high (**high FE + high CHW**) and low (**low FE + low CHW**) clusters from a baseline at epoch 5.



VALENCE

Figure 8.3g shows that the mean SCL changes for the FE and CHW clusters were similar across the whole imagery period. There were no significant valence effects (CHW versus FE) found in the SCL measure.

OTHER INTERACTIONS

Figure 8.3h shows the SCL response curve for the four clusters across the entire imagery period. Apart from the significant level X quadratic time interaction discussed earlier, there were no significant interactions in regard to time, level and valence effects, although a level X valence X linear time interaction approached significance ($F(1,49)=3.36, p=.073$) in the second part of the response. Figure 8.3h i) suggests that this was due to the faster decline of **high FE** relative to the other three clusters.

Together these findings suggest that while there was a marked SCL response over the imagery period, this physiological measure was only able to clearly differentiate between the high and low level clusters in regard to their quadratic response pattern across the entire imagery period.

Figure 8.3g SCL changes averaged for the FE (**high FE + low FE**) and CHW (**high CHW + low CHW**) clusters

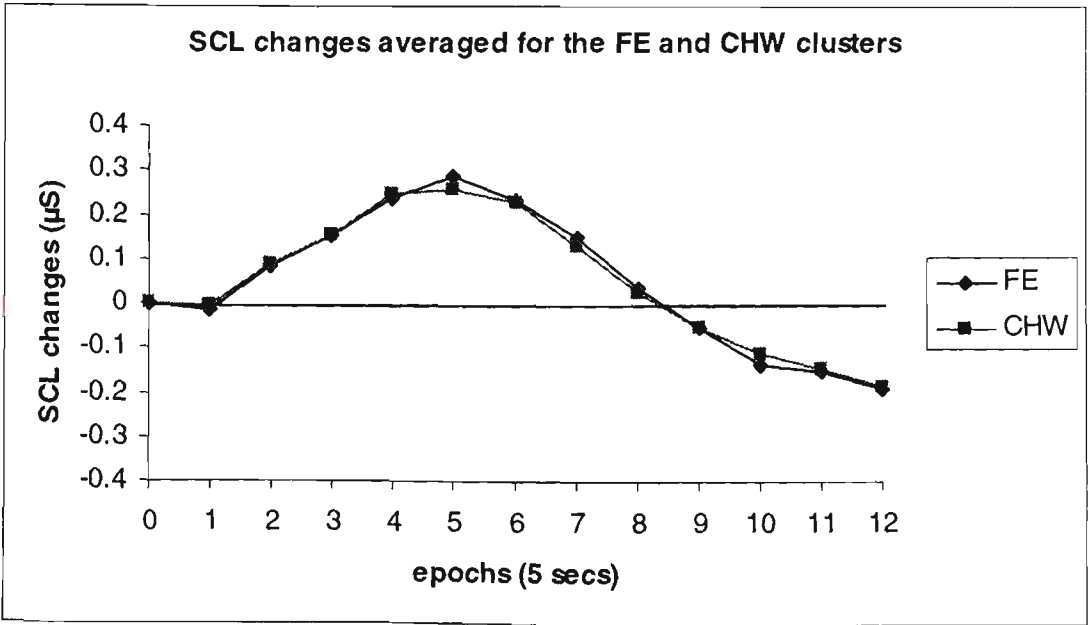


Figure 8.3h SCL changes for the **high FE, low FE, high CHW and low CHW** clusters.

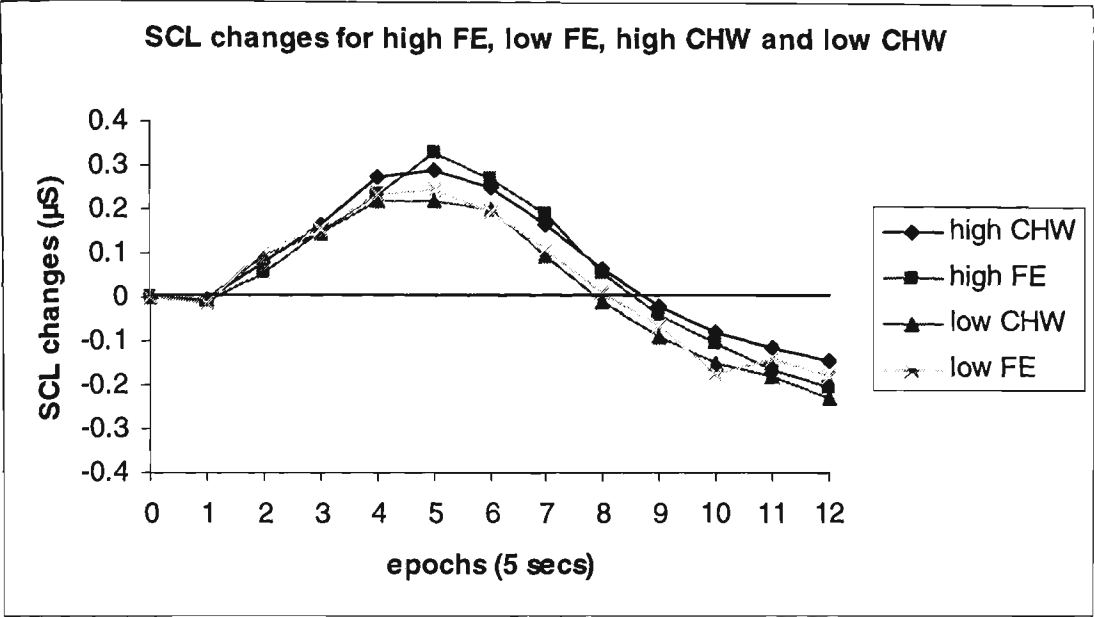
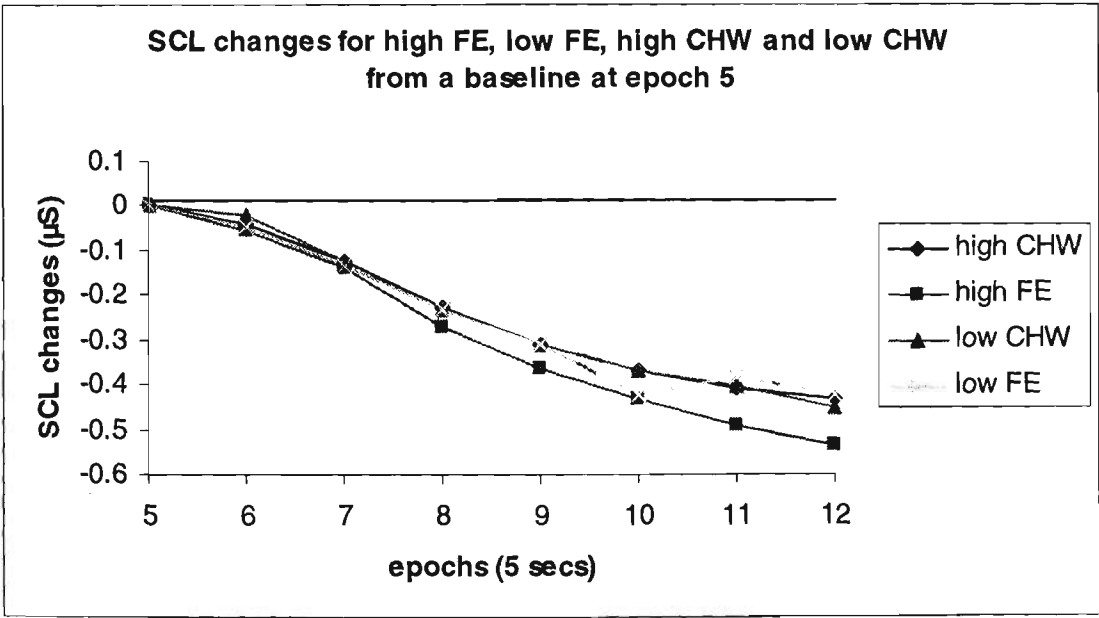


Figure 8.3h i) SCL changes for the **high FE, low FE, high CHW and low CHW** clusters from a baseline at epoch 5



ANALYSES SET 2

Differences between the High and Low levels for each of the FE and CHW clusters

The results from Analyses Set 1 suggested that the changes in HR were greater for the high level clusters compared to the low level clusters, and this effect seemed stronger in the CHW clusters compared to the FE clusters. Changes in SCL did not reveal significant differences between the four clusters for the main level and valence effects. However, a significant level X quadratic time interaction in SCL over the whole session, and a level X valence X linear time interaction that approached significance in the second part of the response, warranted closer examination of each valence condition.

Using the same imagery session clusters, Analyses Set 2 examined differences in HR and SCL changes between high and low levels separately for each of the FE and CHW clusters. That is, differences in the HR and SCL response between the **high FE** and **low FE** clusters were examined, and likewise between the **high CHW** and **low CHW** clusters. Two-way ANOVAs were carried out on these data to determine time and level effects. All of the statistical outcomes for this second set of analyses are presented in Table 8.4.

Heart Rate Changes

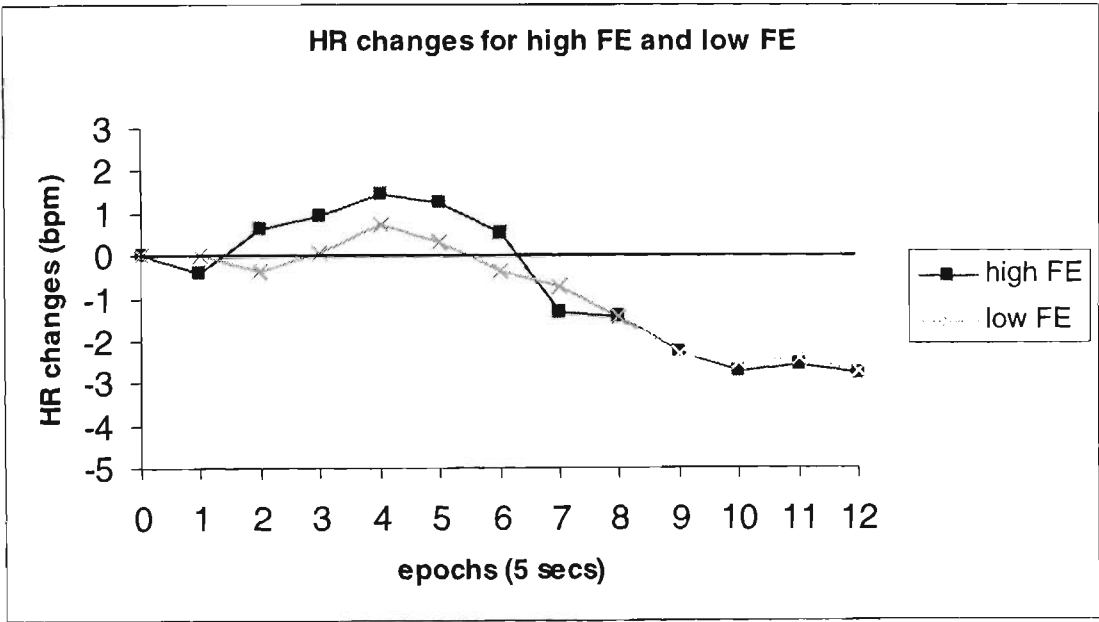
FE Clusters

TIME

Figure 8.4a shows the pattern of HR activity recorded for the **high FE** and **low FE** clusters. After a slight deceleration, the **high FE** cluster recorded a larger HR acceleration compared to the **low FE** cluster, and this reached a peak at epoch 4. This was followed by a marked HR deceleration for both clusters with the **high FE** cluster

showing greater deceleration, particularly between epoch 5 and epoch 7. This resulted in similar HR changes for both the **high FE** and **low FE** clusters for the last five epochs of the imagery period.

Figure 8.4a HR changes for the **high FE** and **low FE** clusters



A significant time effect was observed in the linear ($F(1,49)=42.20, p<.001$), quadratic ($F(1,49)=14.41, p<.001$), and cubic ($F(1,49)=8.32, p<.01$) trends for the imagery sessions representing the **high FE** and **low FE** clusters. These data supported the patterns of HR acceleration and deceleration described. Analysis of the HR increase between epoch 0 and 4 showed a linear effect that approached significance ($F(1,49)=3.22, p=.08$). The HR decrease obtained from epoch 4 to epoch 12 showed a significant linear time effect, $F(1,49)=37.88, p<.001$. This confirmed that the deceleration response during the second half of the imagery period was significant for these two clusters.

Table 8.4 Statistical Outcomes for Analyses Set 2

EFFECTS		Imagery Epochs	HR changes Trend F(1,49)		SCL changes Trend F(1,49)	
FE	Time	E0 to E12	linear	42.19 ***	linear	13.34 ***
			quad.	14.40 ***	quad.	39.36 ***
			cubic	8.32 **	cubic	6.43 *
		Increase	linear	3.22 #	linear	17.44 ***
		Decrease	linear	37.88 ***	linear	55.37 ***
					cubic	4.43 *
	Level	E0 to E12		n.s.		n.s.
		Increase		n.s.		n.s.
		Decrease		n.s.		n.s.
	Level X Time	E0 to E12		n.s.		n.s.
		Increase		n.s.		n.s.
		Decrease		n.s.	linear	5.48 *
CHW	Time	E0 to E12	linear	64.18 ***	linear	17.60 ***
			quad.	16.00 ***	quad.	62.88 ***
			cubic	8.59 **	cubic	7.52 *
		Increase	linear	3.63 #	linear	25.93 ***
		Decrease	linear	49.10 ***	linear	66.26 ***
					cubic	4.31 *
	Level	E0 to E12		n.s.		n.s.
		Increase		n.s.		n.s.
		Decrease	linear	3.64 #		n.s.
	Level X Time	E0 to E12	linear	9.75 **		n.s.
		Increase		n.s.		n.s.
		Decrease	linear	4.27 *		n.s.

Key
*** significant at .001 level
** significant at .01 level
* significant at .05 level
approached significance

LEVEL

Statistical analysis showed that there were no significant differences in HR as a function of level when tested over the entire imagery period or for the periods of imagery between epochs 0 to 4 and epochs 4 to 12.

LEVEL X TIME

There were no significant level X time interactions found for these data suggesting that the pattern of HR activity did not significantly differ between the **high FE** and **low FE** clusters during the course of the imagery period, or for the response increase and decrease also investigated. That is, the responses shown in Figure 8.4a do not differ statistically as a function of level of FE.

CHW Clusters

The patterns of HR acceleration and deceleration for the **high CHW** and **low CHW** clusters are shown in Figure 8.4b. The **high CHW** cluster showed some fluctuations across the first two epochs. This was followed by HR acceleration that peaked at epoch 4, after which a strong deceleration was recorded for the **high CHW** cluster until plateauing at epoch 10. A HR change of 1.78 BPM below the baseline level for the **high CHW** cluster was recorded at epoch 12. The **low CHW** cluster recorded similar patterns of HR acceleration and deceleration as the **high CHW** cluster across the imagery period.

HR acceleration for the **low CHW** cluster was less than the **high CHW** cluster during the first stages of the imagery period (epoch 0 to epoch 4). HR deceleration for the **low CHW** cluster was greater than the **high CHW** cluster during the second half of the imagery period (as illustrated in Figure 8.4b *i*), with HR levels reaching 3.66 BPM below the baseline level at epoch 12 for the **low CHW** cluster.

TIME

This pattern of HR acceleration followed by HR deceleration was reflected in significant time effects in each of the linear ($F(1,49)=64.18, p<.001$), quadratic ($F(1,49)=16.01, p<.001$) and cubic ($F(1,49)=8.59, p<.01$) trends examined for the CHW clusters across all epochs. Analysis of the HR increase (epoch 0 to epoch 4) showed a linear trend that approached significance ($F(1,49)=3.63, p=.06$). Analysis of the HR decrease observed between epoch 4 and epoch 12 confirmed a significant time effect for the linear trend, ($F(1,49)=49.10, p<.001$) thus supporting the strong HR deceleration described for the CHW clusters.

Figure 8.4b HR changes for the **high CHW** and **low CHW** clusters

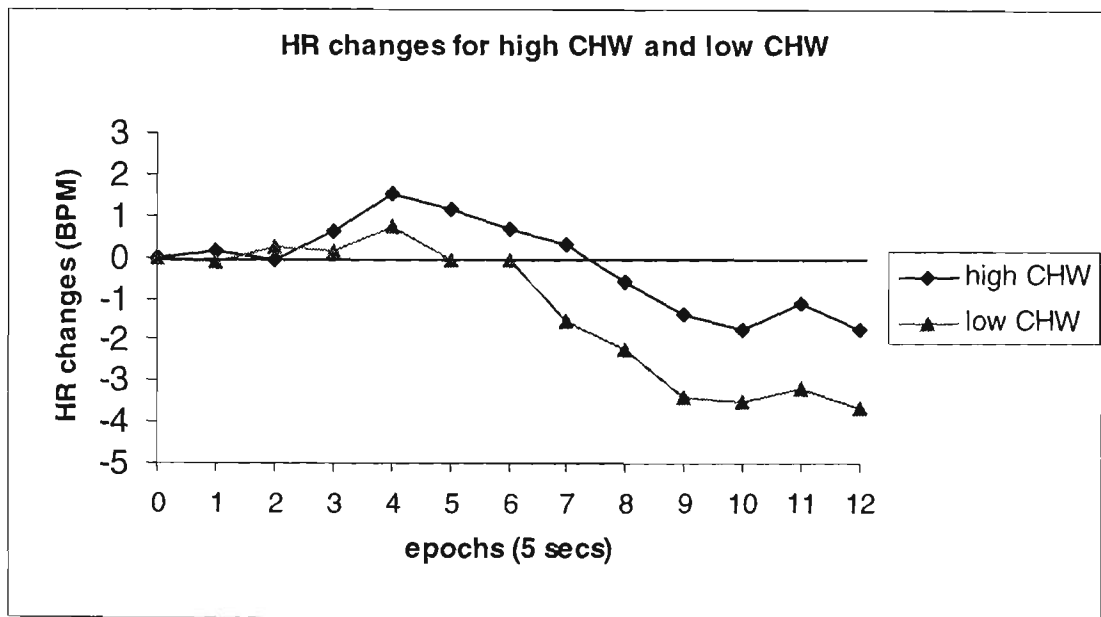
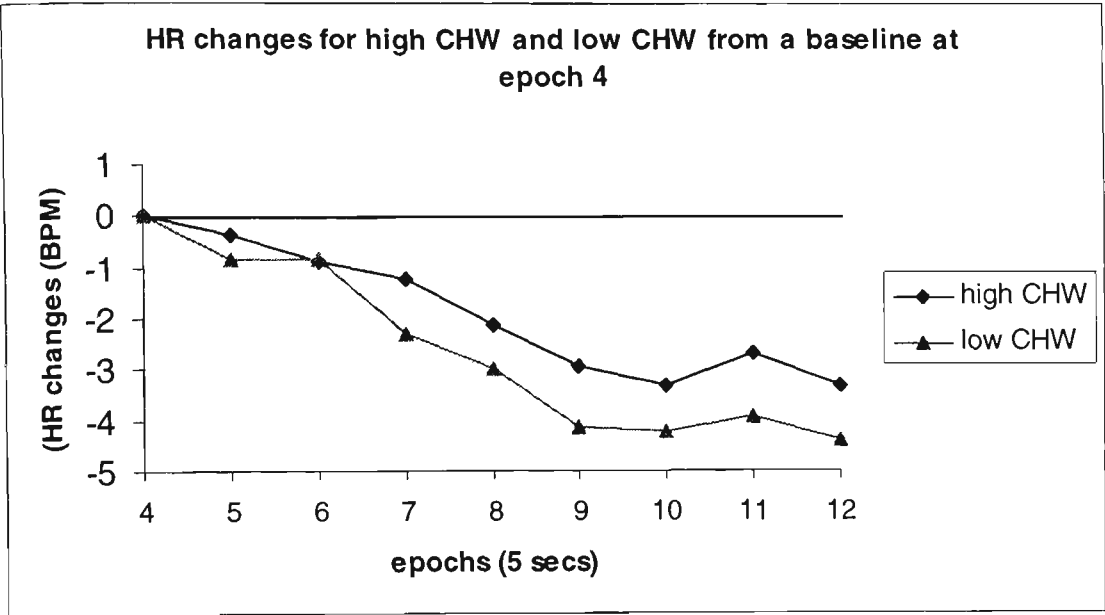


Figure 8.4b i) HR changes for the **high CHW** and **low CHW** clusters from a baseline at epoch 4



LEVEL

The difference in average HR between the **high CHW** and **low CHW** clusters was not found to be significant when tested across the entire imagery period. Separate analyses on the average HR data found a level effect between epoch 4 and 12 that approached significance ($F(1,49)=3.64$ $p<.06$). This confirmed that the **high CHW** cluster showed a higher average HR level during the last 35 seconds of imagery.

LEVEL X TIME

A significant level X linear time interaction ($F(1,49)=9.75$, $p<.01$) suggested that the relationship between these two clusters altered during the course of the imagery period. Analysis of the HR response between epoch 4 and epoch 12 showed a significant level X linear time interaction ($F(1,9)=4.27$, $p<.05$). The **low CHW** cluster recorded a larger overall linear deceleration across the imagery period (see Figure 8.4b i), probably contributing to the observed level difference.

In summary, these data confirmed greater HR acceleration for the **high CHW** cluster compared to the **low CHW** cluster, resulting in a higher mean HR. This HR level difference between the CHW clusters approached significance during the second stage of the imagery period.

Skin Conductance Level Changes

FE Clusters

The SCL response for the **high FE** and **low FE** clusters is illustrated in Figure 8.4c. After a slight decrease, SCL showed a linear increase, peaking at epoch 5 for both the FE clusters, with the **high FE** cluster recording larger SCL increases. From epoch 5 until the end of the imagery period, the SCL response for both clusters showed a marked decrease, with the **high FE** recording slightly greater SCL decreases from epoch 5 to reach a similar level to the **low FE** cluster at epoch 12.

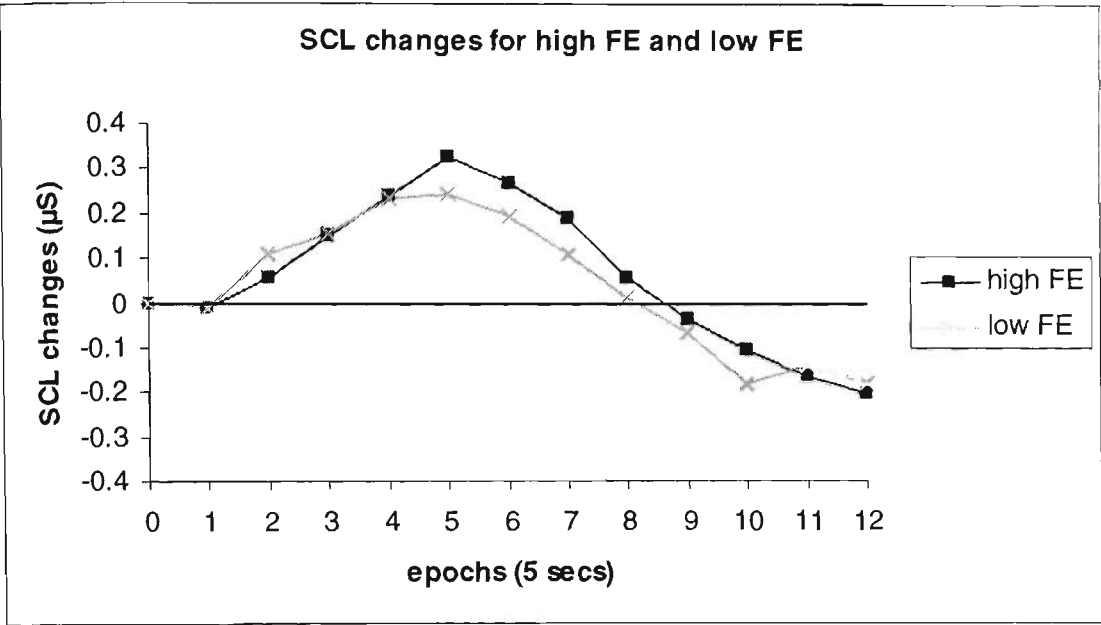
TIME

The SCL response for the FE clusters proved significant in each of the linear ($F(1,49)=13.34, p<.001$), quadratic ($F(1,49)=39.36, p<.001$) and cubic ($F(1,49)=6.43, p<.05$) trends examined across the 12 epochs of imagery. Analysis of the imagery session parts showed that significant time effects occurred for both the SC increase (linear trend, $F(1,49)=17.44, p<.001$) and the SCL decrease (linear, $F(1,49)=55.37, p<.001$; and cubic trends, $F(1,49)=4.43, p<.04$) as described above.

LEVEL

The mean SCL was not significantly different for the **high FE** and **low FE** clusters. This result was confirmed in the SCL data across epochs 0 to 5 and epochs 5 to 12.

Figure 8.4c SCL changes for the **high FE** and **low FE** clusters



LEVEL X TIME

A significant level X linear time interaction was found in the SCL data between epochs 5 and 12 of the imagery period, ($F(1,49)=5.47, p<.05$). This indicated linear trend differences between the **high FE** and **low FE** clusters over the second component of the SCL response, with a steeper decrease obtained for the **high FE** cluster. As indicated in Figure 8.4c, the decrease in SCL for the **high FE** cluster was slightly larger, reading to a similar level to the **low FE** cluster late in the imagery period observed.

CHW Clusters

TIME

There was a significant time effect in the SCL data for the CHW clusters in each of the linear ($F(1,49)=17.60, p<.000$), quadratic ($F(1,49)=62.88, p<.001$) and cubic ($F(1,49)=7.52, p=.01$) trends examined. A significant linear ($F(1,49)=25.93, p<.001$) time effect was found across epochs 0 to 5, while strong linear ($F(1,49)=66.26, p<.001$)

and cubic time effects ($F(1,49)=4.31, p<.05$) were found in the last eight epochs of imagery.

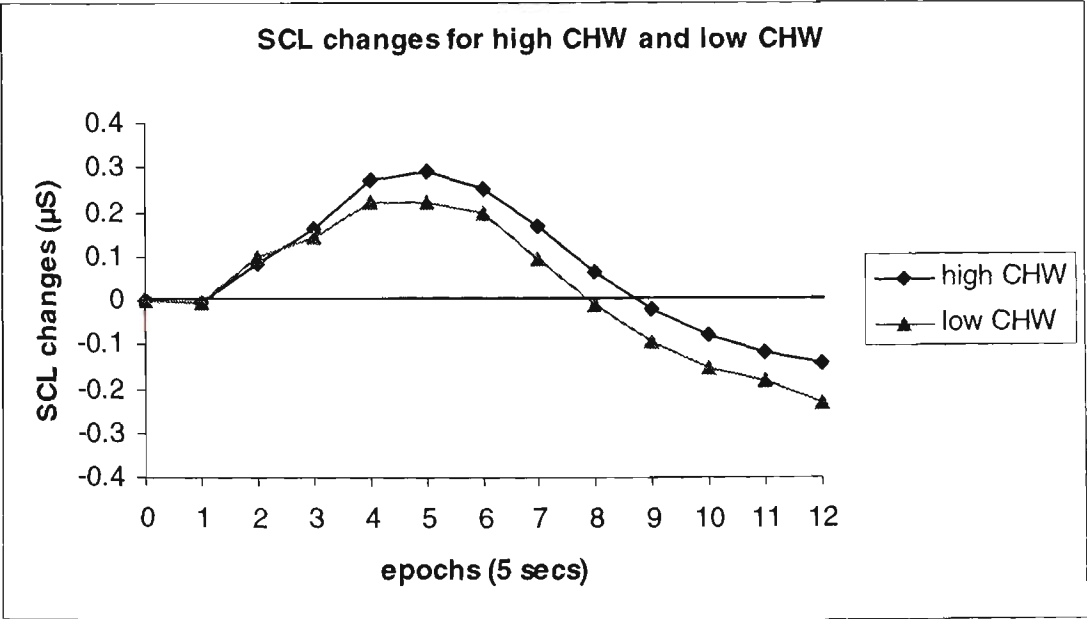
LEVEL

Mean SCLs were greater for the **high CHW** compared to the **low CHW** clusters (see Figure 8.4d), although this difference was not significant when tested over the whole imagery period, or for the SCL increase and decrease.

LEVEL X TIME

There were no significant time X level interactions found for the **high CHW** and **low CHW** clusters across any of the imagery periods tested. These findings suggest that the SCL measure was not sensitive to differences in the level of negative emotions elicited under the imagery conditions employed in Study 6.

Figure 8.4d SCL changes for the **high CHW** and **low CHW** clusters



Result Summary for FE and CHW clusters

In summary, the first set of analyses (Analyses Set 1) conducted on these four clusters showed significant HR differences as a function of level. The high level clusters produced greater HR acceleration across the entire imagery period. There were no significant valence effects although a significant three way interaction indicated that variation of HR in the four clusters did occur during the second stage of the imagery period. A second analyses (Analyses Set 2) on the HR response for the FE and CHW clusters separately showed that significant differences were obtained in the CHW clusters only. Significant level X linear time interactions were found across the entire imagery period and for epoch 4 to epoch 12 in the CHW clusters. The stronger HR acceleration for the **high CHW** cluster resulted in a higher mean HR than for the **low CHW** cluster, and this level difference approached significance during the second stage of the imagery period.

Analyses Set 1 indicated that SCL was not as sensitive to the level effect as HR in the same four clusters. However, a significant level X quadratic time result obtained across the entire imagery period, and a level X valence X linear time interaction that approached significance during the second part of the imagery sessions in SCL warranted further investigation. Analyses Set 2 showed that there were no significant differences in SCL for the CHW clusters. A significant level X linear time interaction was recorded for the second part of the imagery period in the FE clusters only. This result supported the stronger SCL decrease (from a higher peak) noted in the **high FE** cluster during the second part of the imagery period.

To conclude, these results across the four clusters indicated HR differences that significantly reflected the effect of level in the negative (CHW) clusters. There were no significant level effects in HR for the FE clusters. SCL differences were recorded in the positive clusters only, with a significant level X linear time interaction recorded in the

FE clusters during the second stage of the imagery period. While the **high FE** cluster produced greater SCL increases during the first stage of the imagery period this did not result in a significant average SCL difference between the two clusters.

ANALYSIS SET 3

Level (High versus Low) and Valence (PA versus NA) Effects.

The third set of analyses for this study explored changes in HR and SCL as a function of positive and negative affect. Figure 8.2 shows the 10 imagery sessions plotted on an "affective space" with the NA and PA scores of each individual imagery session corresponding to the x and y co-ordinates respectively. The experiment affective space is defined by the PA (y axis) and NA (x axis) dimensions which are centred on the experiment average PA and NA scores. The use of this affective space provided an alternative method of imagery session selection to the one used for the ratings data, as well as providing a selection process that considered the overall affective state experienced during each imagery session. In other words, imagery session selection was influenced by both the level of the target emotion and the level of any secondary or opposing emotions elicited in the same imagery session. The PA and NA scores were used instead of the descriptor ratings to select the imagery sessions representing four new clusters: **high PA**, **low PA**, **high NA** and **low NA**.

The imagery sessions of "high excitement", "high fun" and "high challenge" represented **high PA**, while the imagery sessions "high hard", "high worry" and "high challenge" represented **high NA** states. The **low PA** cluster is represented by the average of all the low level imagery sessions plus the "high worry" and "high hard" imagery sessions. **Low NA** is represented by the average of all the low level imagery sessions and the "high fun" and "high excitement" imagery sessions.

These clusters differed from the four clusters, **high FE**, **low FE**, **high CHW** and **low CHW** used in the first two sets of analyses. While the **high CHW** and **high NA** clusters are the same, the **high PA** cluster included the "high challenge" imagery session which is not found in the **high FE** cluster. Compared to the **low FE** cluster, the **low PA** cluster included three additional imagery sessions: "low challenge", "low excitement", and "low hard". The **low NA** cluster also included additional imagery sessions ("low worry", "high excitement") not found in the **low CHW** cluster.

The first set of statistical analyses carried out on the changes in the HR and SCL measures for these four PA and NA clusters were similar to that carried out in Analyses Set 1. Three-way ANOVAs were used to test the physiological responses for differences between the clusters in regard to time (E1 to E12), valence (PA versus NA) and level (high versus low) effects. These analyses were repeated on the data representing the two components of the physiological response across the entire imagery period (HR, epoch 0 to epoch 4 and epoch 4 to epoch 12; SCL, epoch 0 to epoch 5 and epoch 5 to epoch 12). The statistical outcomes from these analyses are presented in Table 8.5.

Heart Rate Changes

Figure 8.5a shows the HR changes averaged over the four imagery session clusters: **high PA**, **low PA**, **high NA** and **low NA**. With slightly higher average HR levels, the pattern of HR changes for these four clusters is similar to that observed for the four clusters **high FE**, **low FE**, **high CHW** and **low CHW** (see Figure 8.3a) as described in Analyses Set 1. After the first epoch, HR accelerated to a peak at epoch 4, reaching an average of 1.27 BPM above the baseline. The average HR response for the four clusters then showed a strong deceleration that finished approximately 2.5 BPM

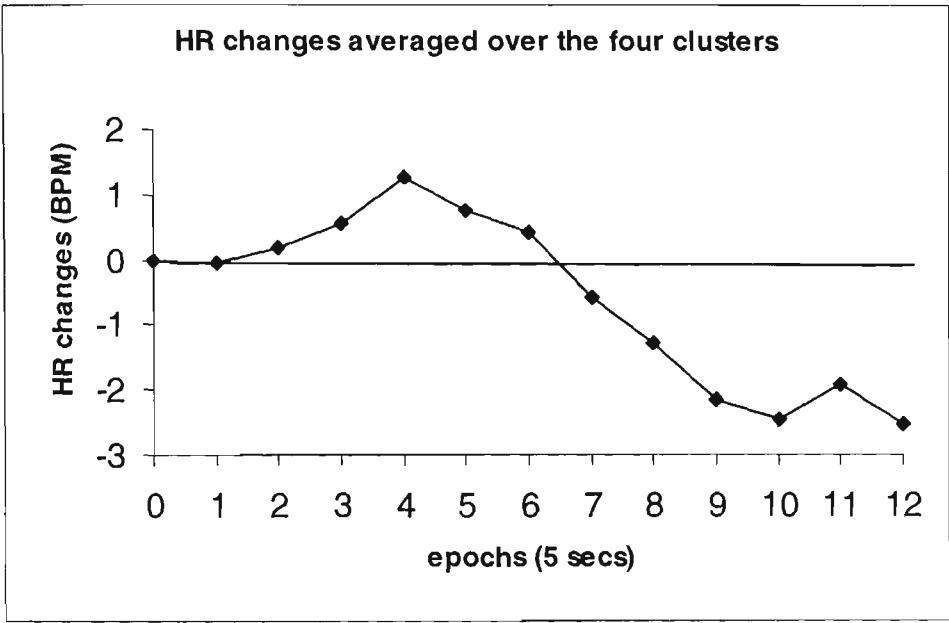
Table 8.5 Statistical Outcomes for Analyses Set 3

EFFECTS	Imagery Epochs	HR changes Trend F(1,49)		SCL changes Trend F(1,49)	
Time	E0 to E12	linear	49.77 ***	linear	13.52 ***
		quad.	19.45 ***	quad.	49.89 ***
		cubic	9.96 **	cubic	6.58 **
	Increase	linear	5.41 *	linear	22.04 ***
	Decrease	linear	45.81 ***	linear cubic	61.90 *** 5.14 *
Level	E0 to E12		4.60 *		n.s.
	Increase		n.s.		n.s.
	Decrease		5.71 *		n.s.
Valence	E0 to E12		n.s.		n.s.
	Increase		n.s.		n.s.
	Decrease		n.s.		n.s.
Level X Time	E0 to E12	linear	8.91 **	quad.	3.41 #
	Increase	linear	3.66 #		n.s.
	Decrease		n.s.		n.s.
Valence X Time	E0 to E12	linear	3.69 #		n.s.
	Increase		n.s.	quad.	3.63 #
	Decrease	linear	3.95 #		n.s.
Level X Valence	E0 to e12		n.s.		n.s.
	Increase		n.s.		n.s.
	Decrease		n.s.		n.s.
Level X Valence X Time	E0 to E12	linear	3.67 #		n.s.
	Increase		n.s.		n.s.
	Decrease	linear	3.93 #		n.s.

Key
*** significant at .001 level
** significant at .01 level
* significant at .05 level
approached significance

below the baseline at epoch 10. This was followed by some fluctuation around a plateau. HR levels remained higher than the baseline level during the first half of the imagery period (E2-E6), and fell well below the baseline level during the second half of the imagery period.

Figure 8.5a HR changes averaged over the four clusters; **high PA, low PA, high NA** and **low NA**.



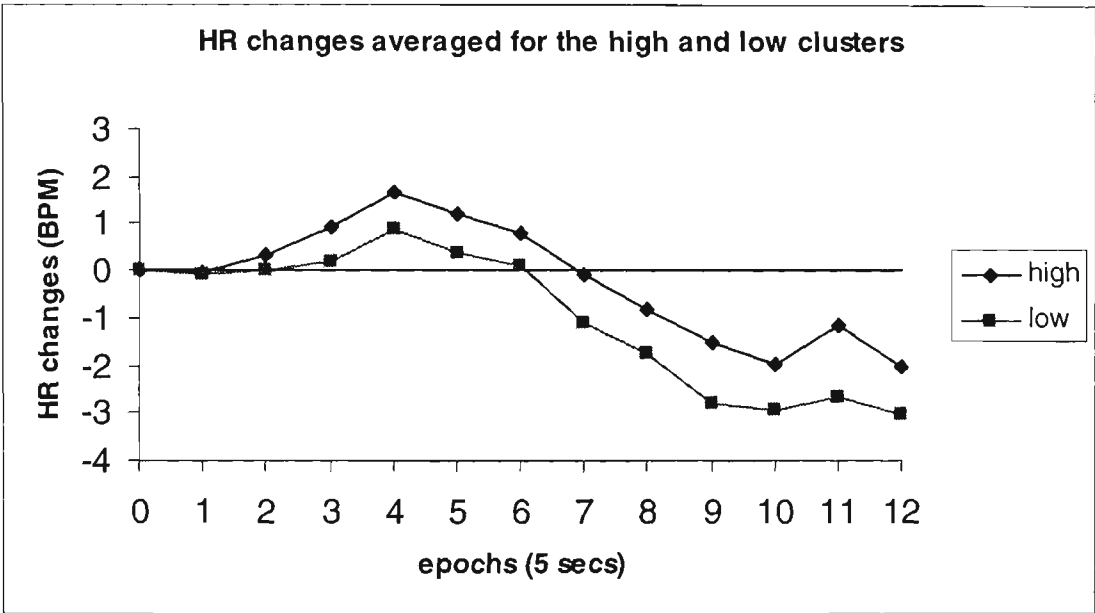
TIME

Analysis of the entire imagery period found significant time effects in each of the linear ($F(1,49)=49.77, p<.001$), quadratic ($F(1,49)=19.45, p<.001$) and cubic ($F(1,49)=9.96, p<.01$) trends examined. The HR acceleration (epoch 0 to epoch 4) observed in the first half of the imagery period was significant in the linear trend over time ($F(1,49)=5.41, p<.05$). Analysis of the HR deceleration component (epoch 4 to epoch 10) also found a significant linear trend ($F(1,49)=45.81, p<.001$).

LEVEL

Average HR levels recorded for the high level clusters were found to be higher than those recorded for the low level clusters ($F(1,49)=4.60, p<.05$) when measured across the entire imagery period. HR level differences were also obtained between epoch 4 and epoch 12 ($F(1,49)=5.71, p<.05$). These findings are apparent in Figure 8.5b with the high level clusters recording a greater HR acceleration followed by a slightly smaller HR deceleration.

Figure 8.5b HR changes averaged for the high (**high PA + high NA**) and low (**low PA + low NA**) clusters



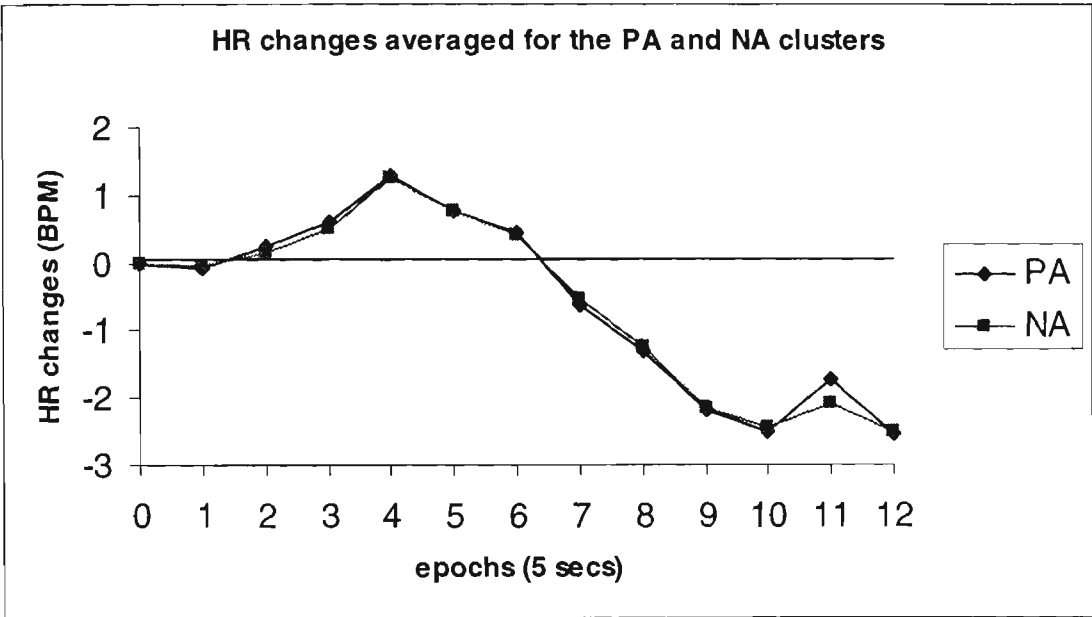
LEVEL X TIME

The differences in the acceleration and deceleration phases of the HR measure described above are reflected in a significant level X linear time interaction found over the entire imagery period, ($F(1,49)=8.91, p<.01$). This same effect in the linear trend across epochs 0 to 4 approached significance ($F(1,49)=3.67, p<.06$). These findings confirm the different patterns of HR activity between the high and low level clusters across the imagery period described above and underlie the main effect for level.

VALENCE

As indicated in Figure 8.5c, changes in HR levels for the negative valence clusters (i.e., **high NA** and **low NA**) were similar to that observed for the positive valence clusters (i.e., **high PA** and **low PA**). This was confirmed in the data analyses carried out over the entire imagery period and across epochs 0 to 4 and 4 to 12, which failed to find any significant differences between these cluster groupings.

Figure 8.5c HR changes averaged for the PA (**high PA + low PA**) and NA (**high NA + low NA**) clusters



VALENCE X TIME

A valence X linear time interaction approached significance ($F(1,49)=3.69$, $p<.06$) across the entire imagery period. This same interaction approached significant levels for the HR data tested between epoch 4 and epoch 12 ($F(1,49)=3.95$, $p=.05$). These reflect the slight differences in the pattern of HR activity for the two valence clusters across the imagery period, with the change in HR for NA dropping slightly faster than for PA.

OTHER INTERACTIONS

As recorded in Table 8.3, a level X valence X linear time interaction approached significance ($F(1,49)=3.67, p=.06$) in the HR measure over the 12 epochs for the four clusters **high PA**, **low PA**, **high NA** and **low NA**. This same interaction also approached significant levels ($F(1,49)=3.93, p=.05$) for the HR data between epoch 4 and epoch 12. As illustrated in Figure 8.5d and Figure 8.5d i), during the second component of the HR response the **high NA** cluster showed the least HR deceleration, the **low NA** cluster showed the most deceleration while the HR decelerations recorded for the **high PA** and **low PA** clusters were similar. In other words, differences in HR deceleration were greatest between the NA clusters. This result in the HR data is similar to the four clusters examined in Analyses Set 1

Figure 8.5d HR changes for the **high PA**, **low PA**, **high NA** and **low NA** clusters.

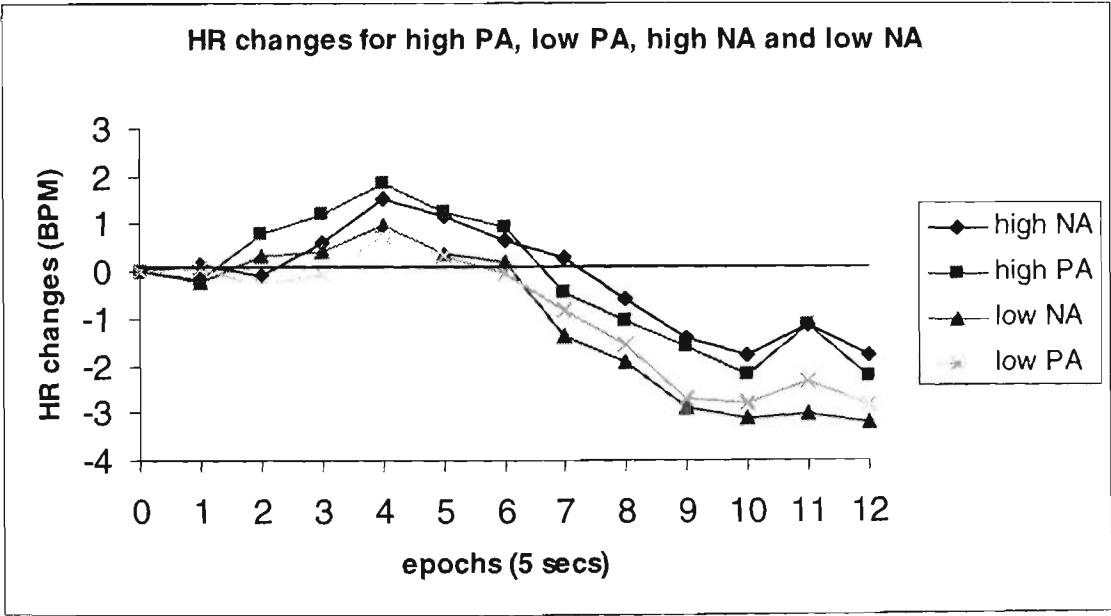
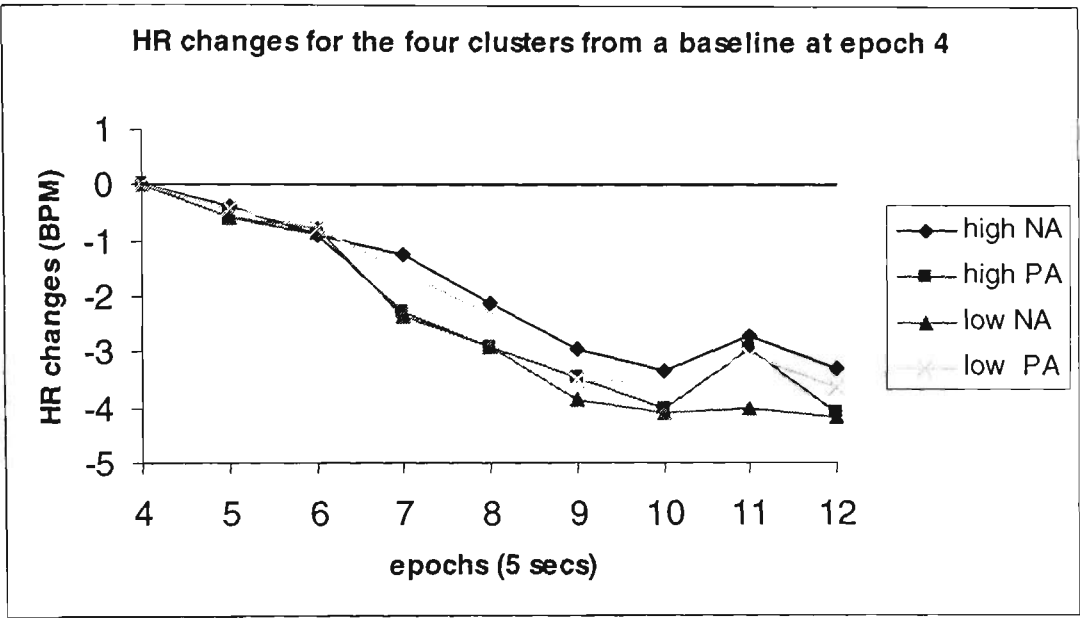


Figure 8.5d i) HR changes for the **high PA, low PA, high NA** and **low NA** clusters from a baseline at epoch 4



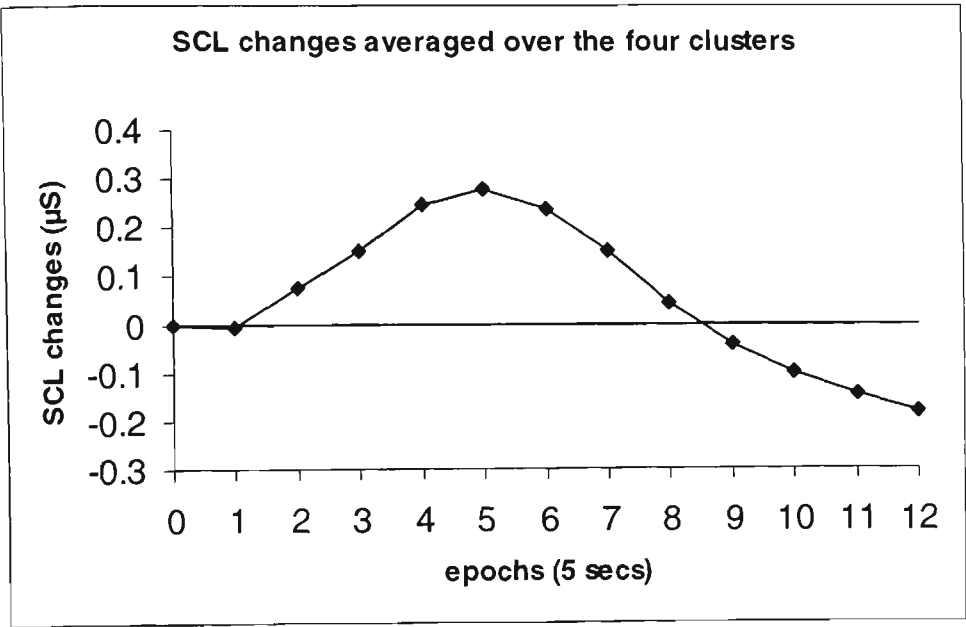
Skin Conductance Changes

Figure 8.5e illustrates the average SCL response for the four clusters over the one minute imagery period (E0-E12). Similar to the SCL changes observed in the first set of analyses (see Figure 8.3e), the SCL changes showed an increasing linear trend, reaching 0.28 μ S above the baseline at epoch 5. Thereafter, SCL showed a marked decrease that fell below the baseline after epoch 8 and finished 0.18 μ S below the baseline at epoch 12.

TIME

A significant time effect was obtained in SCL over the entire imagery session in each of the linear ($F(1,49)=13.52, p<.001$), quadratic ($F(1,49)=49.89, p<.001$) and cubic ($F(1,49)=6.58, p<.05$) trends examined. Analysis of the SCL increase between epochs 0 and 5 showed a significant linear ($F(1,49)=22.04, p<.001$) trend, while the SCL decrease observed from epoch 5 to epoch 12 showed significant linear ($F(1,49)=61.90, p<.001$) and cubic ($F(1,49)=5.14, p<.05$) trends. These findings confirmed the pattern of SCL activity described above.

Figure 8.5e SCL changes averaged over the four clusters; **high PA, low PA, high NA** and **low NA**



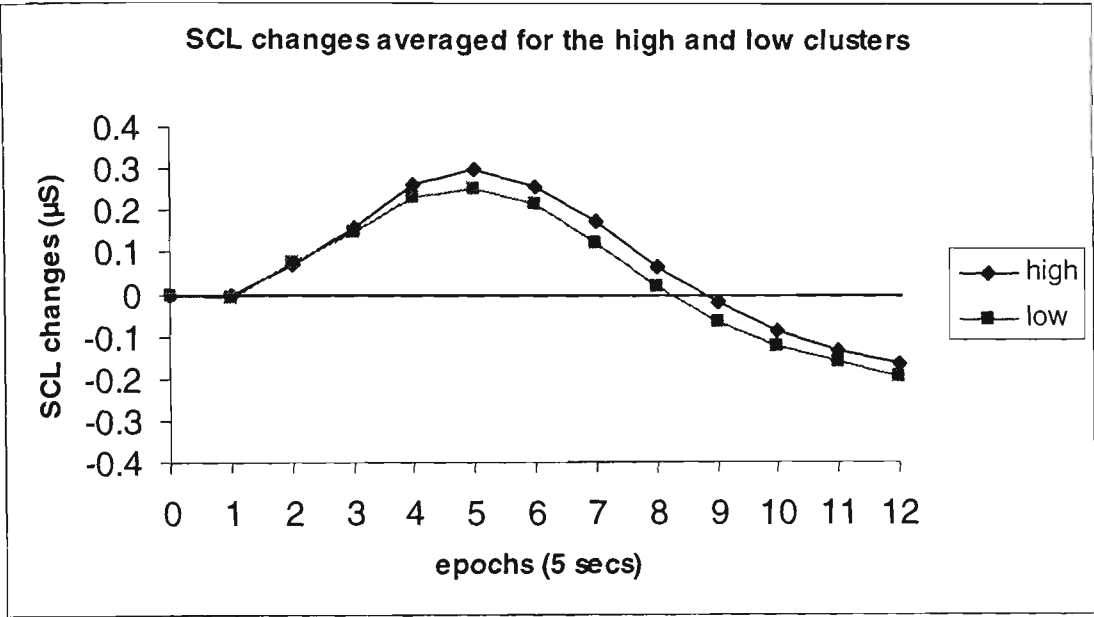
LEVEL

Figure 8.5f shows the average SCL changes for the high level (**high PA** and **high NA**) clusters versus the low level (**low PA** and **low NA**) clusters. Prior to epoch 4, these two clusters recorded a similar increase in SCL. At the peak of the SCL response, epoch 5, the high level clusters recorded larger increases in SCL and this level difference was sustained until the end of the imagery period. However, the difference in mean SCL over the epochs between the high and low level clusters was not found to be significant for any of the periods of imagery tested.

LEVEL X TIME

The difference in SCL between the high and low level clusters over the imagery period approached significance in the quadratic trend ($F(1,49)=3.41, p=.07$). The differences in the linear increase at the beginning of the imagery period and the linear decrease during the second half of the imagery period did not reach statistical significance. These findings suggest that the pattern of SCL activity over the entire course of the imagery period was somewhat sensitive to level differences in the clusters.

Figure 8.5f SCL changes averaged for the high (**high PA + high NA**) and low (**low PA + low NA**) clusters



OTHER INTERACTIONS

As illustrated in Figure 8.5g, SCL did not significantly differ for the PA and NA clusters, although a quadratic time X valence interaction did approach significance ($F(1,49)=3.63, p=.06$) for the SCL data between epochs 0 and 5. This finding reflects differences in the PA and NA clusters between epochs 1 and 3, with the NA clusters recording a slightly stronger SCL increase during the early stages of imagery.

The SCL response for each of the four PA and NA clusters is illustrated in Figure 8.5h. There is a suggestion in the data that the response difference between **high PA** and **low PA** is greater than that between **high NA** and **low NA**. However, there were no significant level X valence or time X level X valence interactions in the SCL data tested across the entire imagery period or across the epochs representing the SC increase and decrease described above. Together, these findings suggest that the SCL response across the imagery period did not significantly differ between the two valence conditions, regardless of the imagery period examined.

In summary, these findings in SCL for the PA and NA clusters reflected those obtained in Analyses Set 1 for the FE and CHW clusters. While a marked SCL change occurred across the imagery period, unlike HR this measure did not show differential sensitivity to level and valence differences in the four clusters.

Figure 8.5g SCL changes averaged for the PA (high PA + low PA) and NA (high NA + low NA) clusters

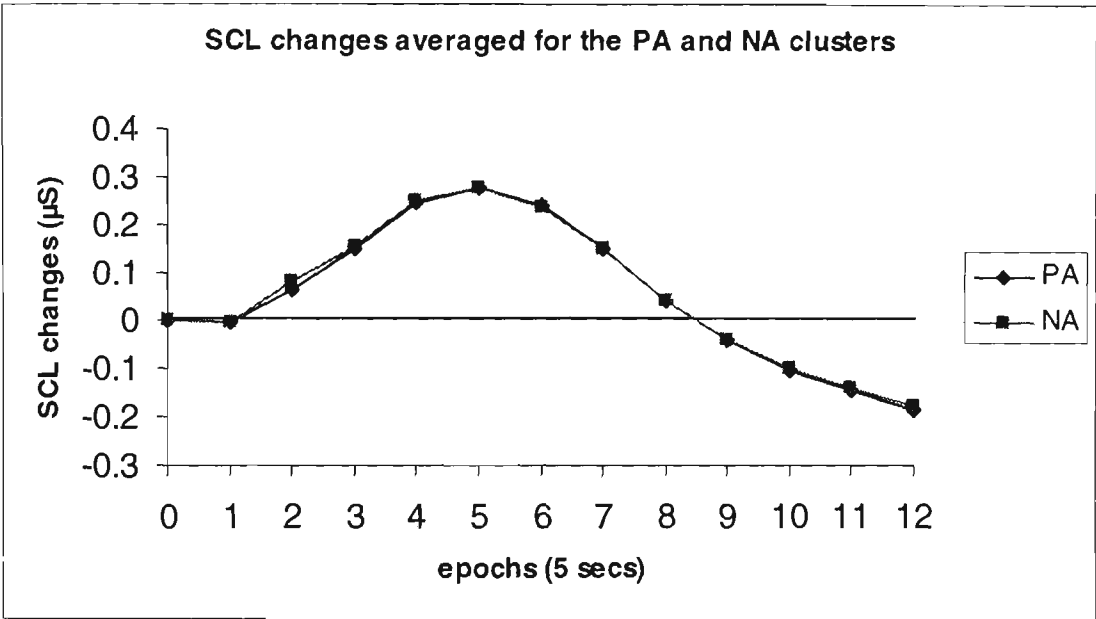
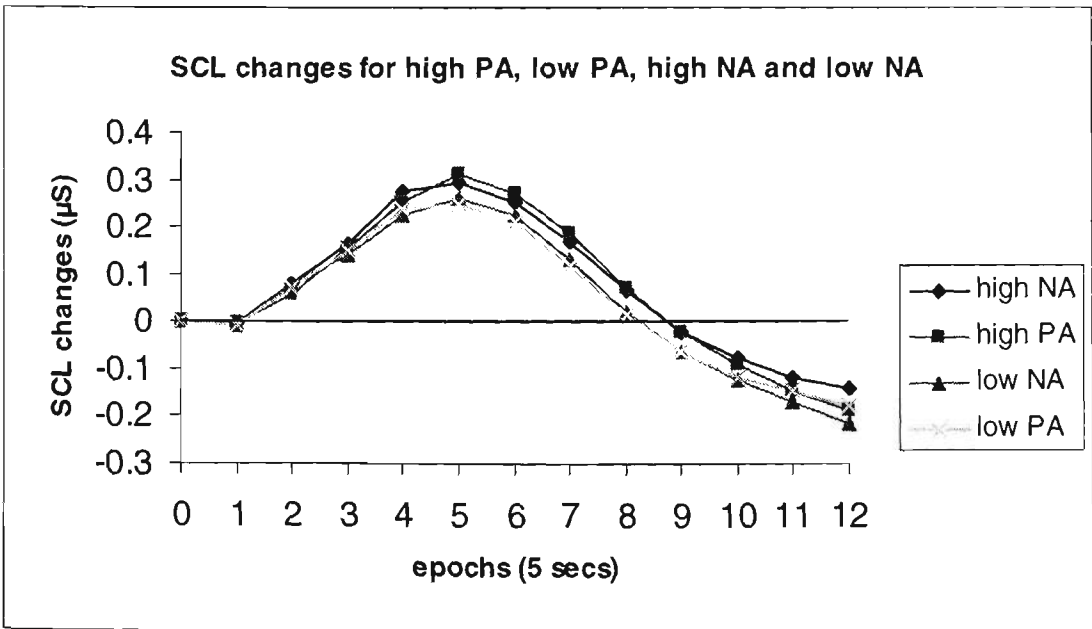


Figure 8.5h SCL changes for the high PA, low PA, high NA and low NA clusters.



ANALYSIS SET 4

Differences between High and Low levels for each of the NA and PA groups

The results from Analyses Set 3 confirmed significant patterns of HR and SCL activity across the imagery session for the four clusters **high NA**, **low NA**, **high PA** and **low PA**. Analysis examining the effect of level (high versus low) showed that the HR measure was able to discriminate between the high and low levels of affect, and this effect was somewhat different for the PA and NA clusters across the imagery period. The SCL measure showed a level X quadratic time interaction across the imagery period that approached significance. There were no other significant effects in the patterns of HR and SCL activity for the four clusters.

Similar to Analyses Set 2, this final set of analyses explored differences in HR and SCL activity between the high and low level clusters separately for each of the valence conditions (PA and NA). This analysis was designed to complement the analyses carried out so far on the four clusters and to provide more information regarding the effect of level within each valence. All of the statistical outcomes for Analyses Set 4 are presented in Table 8.6.

Heart Rate Changes

PA Clusters

The average HR changes for the **high PA** and **low PA** clusters are illustrated in Figure 8.6a. After a slight decrease, HR showed a marked acceleration for the **high PA** cluster that peaked at epoch 4. This compares to the **low PA** cluster which showed HR deceleration at epoch 2 followed by a relatively smaller HR acceleration between epochs 2 and 4. Both the **high PA** and **low PA** clusters showed a marked deceleration

Table 8.6 Statistical Outcomes for Analyses Set 4

EFFECTS		Imagery Period Epochs	HR changes		SCL changes	
			Trend F(1,49)		Trend F(1,49)	
PA	Time	E0 to E12	linear	49.95 ***	linear	13.59 ***
			quad.	20.74 ***	quad.	47.75 ***
			cubic	10.80 **	cubic	6.36 **
		Increase	linear	5.78 *	linear	21.20 ***
		Decrease	linear	46.21 ***	linear	61.53 ***
					cubic	5.21 *
	Level	E0 to E12		n.s.		n.s.
		Increase		n.s.		n.s.
		Decrease		n.s.		n.s.
	Time X level	E0 to E12		n.s.		n.s.
		Increase	linear	3.83 #		n.s.
		Decrease		n.s.	linear	4.24 *
NA	Time	E0 to E12	linear	49.12 ***	linear	13.36 ***
			quad.	18.07 ***	quad.	51.94 ***
			cubic	9.09 **	cubic	6.76 *
		Increase	linear	4.98 *	linear	22.77 ***
		Decrease	linear	45.20 ***	linear	62.11 ***
					cubic	5.02 *
	Level	E0 to E12		n.s.		n.s.
		Increase		n.s.		n.s.
		Decrease		n.s.		n.s.
	Time X level	E0 to E12	linear	8.52 **		n.s.
		Increase		n.s.		n.s.
		Decrease	linear	4.12 *		n.s.

Key

*** significant at .001 level

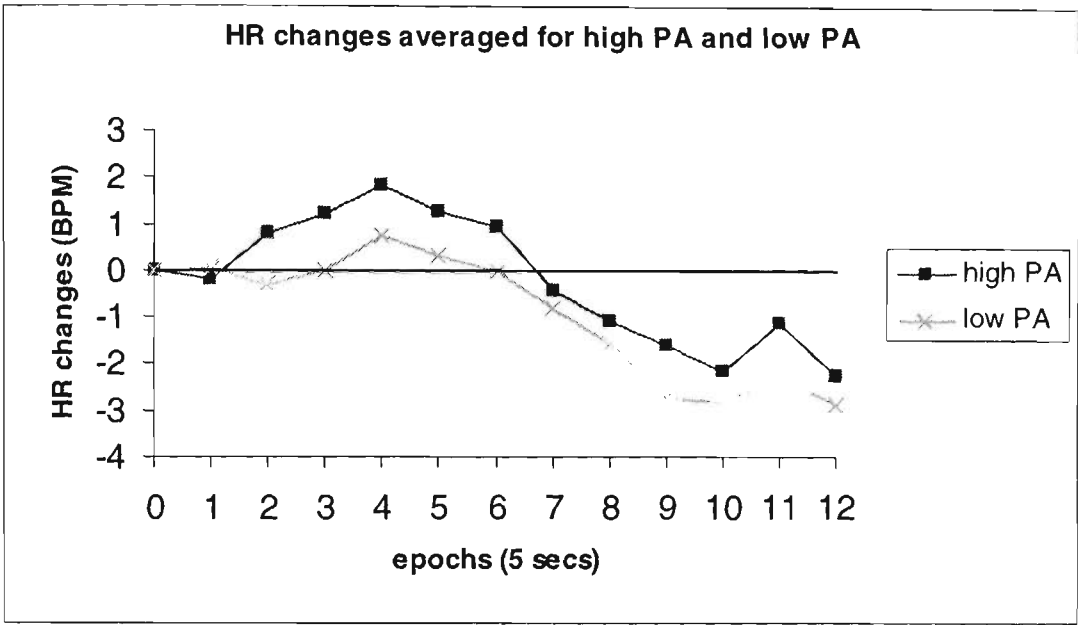
** significant at .01 level

* significant at .05 level

approached significance

for the remainder of the imagery period, plateauing across the last three epochs of the imagery period.

Figure 8.6a HR changes for the **high PA** and **low PA** clusters



TIME

A significant time effect in each of the linear ($F(1,49)=49.95, p<.001$), quadratic ($F(1,49)=20.74, p<.001$) and cubic ($F(1,49)=10.80, p<.001$) trends was found in the HR data gathered across the imagery period. Analysis of the HR data between epoch 0 and epoch 4 found a significant linear trend over time ($F(1,49)=5.78, p<.05$). The marked HR deceleration between epoch 4 and epoch 12 resulted in a significant linear ($F(1,49)=46.21, p<.001$) trend for the last 40 second period of imagery.

LEVEL

Figure 8.6a shows that compared to the **low PA** cluster, the **high PA** cluster recorded slightly larger HR increases across the imagery period. This difference in HR

was not found to be significant across the imagery period or for the first (epoch 0 to epoch 4) and second (epoch 4 to epoch 12) response components.

LEVEL X TIME

Compared to the **low PA** cluster, the **high PA** cluster recorded larger HR increases across the imagery period, particularly between epochs 2 and 6. Analysis indicated that the different patterns of HR acceleration and deceleration for the **high PA** and **low PA** clusters were not significantly different, although between epochs 0 and 4 a level X linear time interaction approached significance ($F(1,49)=3.83$, $p=.06$).

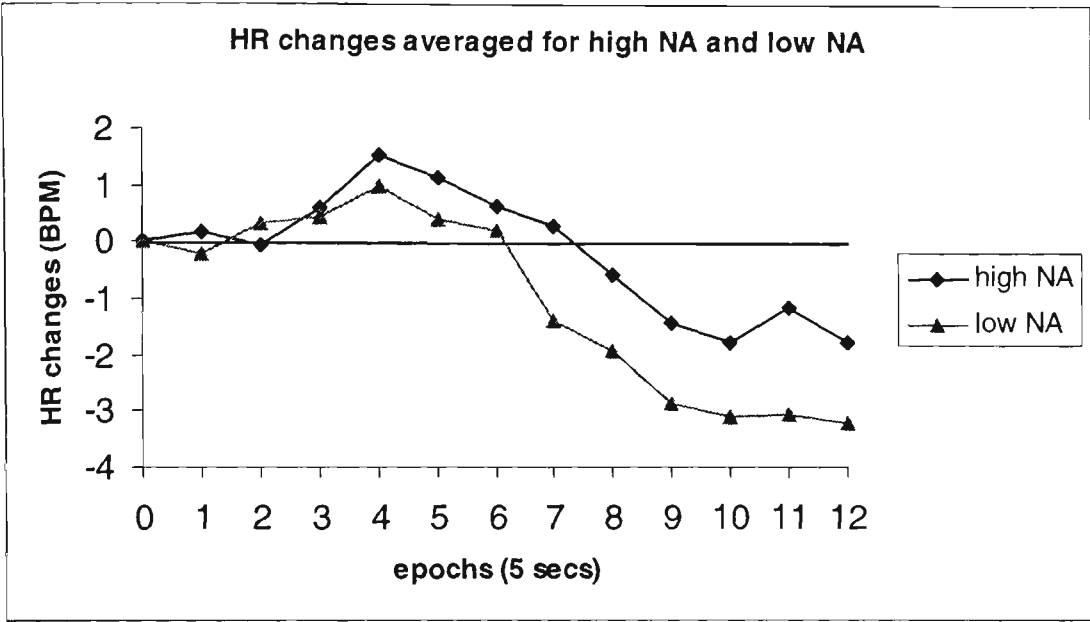
NA Clusters

Figure 8.6b shows the average HR changes for the **high NA** and **low NA** clusters. Initially, both clusters showed HR acceleration that peaked at epoch 4 with the **high NA** cluster recording the larger peak HR increase. After epoch 4, both the **high NA** and the **low NA** clusters showed HR deceleration with HR levels recorded below the baseline after epoch 6 or 7. The HR deceleration for the **high NA** cluster was not as great as for the **low NA** cluster, and both clusters plateaued after epoch 10. The **low NA** cluster showed the lowest HR decrease, recording 3.21 BPM below the baseline at epoch 12.

TIME

A significant time effect was found in the HR data for each of the linear ($F(1,49)=49.11$, $p<.001$), quadratic ($F(1,49)=18.07$, $p<.001$) and cubic ($F(1,49)=9.09$, $p<.01$) trends examined. A significant linear trend over time ($F(1,49)=4.98$, $p<.05$) was found between epoch 0 and epoch 4. A significant linear trend ($F(1,49)=45.20$, $p<.001$) was also found between epochs 4 and 12 in the HR data, thus confirming the marked HR deceleration illustrated in Figure 8.6b.

Figure 8.6b HR changes for the **high NA** and **low NA** clusters



LEVEL

Figure 8.6b indicates that increases in HR for the **high NA** cluster were greater than the **low NA** cluster, particularly during the second half of the imagery period. However, as indicated in Table 8.6, there were no significant affect level differences in HR when tested over the entire imagery period or for the two main components of the HR response.

LEVEL X TIME

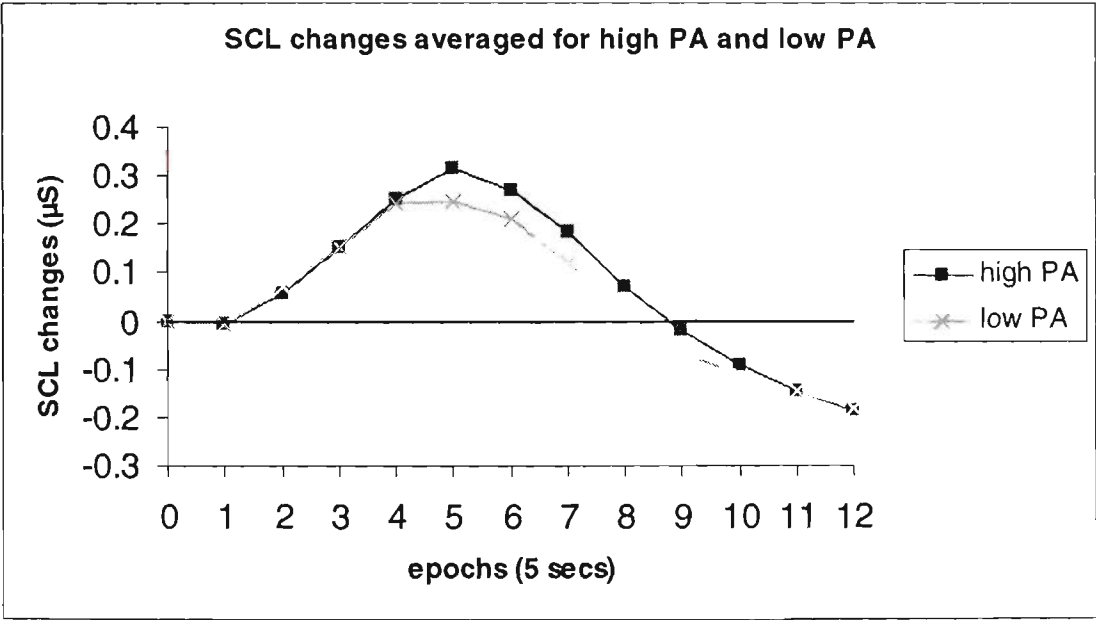
A significant linear time X level interaction effect was observed for the NA clusters ($F(1,49)=8.52, p<.01$) across the entire imagery period. This same interaction was also found to be significant ($F(1,49)=4.12, p<.05$) between epochs 4 and 12 in the linear trend. As illustrated in Figure 8.6b this finding reflects the greater overall HR deceleration recorded for the **low NA** cluster compared to the **high NA** cluster over the course of the imagery period, and this cluster difference is also apparent during the later stages of the imagery period. That is, over the imagery period, **high NA** imagery developed higher HR levels than **low NA** imagery.

Skin Conductance Level Changes

PA Clusters

The average SCL changes for the **high PA** and **low PA** clusters are illustrated in Figure 8.6c. Initially, SCL changes for both the **high PA** and **low PA** clusters increased linearly, peaking at epoch 4 or 5, with the **high PA** cluster recording a slightly larger SCL increase. After epoch 5, both clusters showed a SCL decrease, with the **high PA** cluster recording slightly larger SC decreases to reach a similar level to the **low PA** cluster.

Figure 8.6c SCL changes for the **high PA** and **low PA** clusters



TIME

Statistical analyses confirmed that the changes for the PA clusters were significant in each of the linear ($F(1,49)=13.59$, $p<.001$), quadratic ($F(1,49)=47.75$, $p<.001$) and cubic ($F(1,49)=6.36$, $p<.05$) trends. A significant linear trend was found between epoch 0 and epoch 5 ($F(1,49)=21.20$, $p<.001$) as well as a linear trend

($F(1,49)=61.53$, $p<.001$) and a cubic trend ($F(1,49)=5.21$, $p<.05$) between epoch 5 and epoch 12, thus confirming a significant SCL linear increase and decrease during the imagery period.

LEVEL

As shown in Figure 8.6c, the SCL increases from the baseline were larger for the **high PA** cluster than the **low PA** cluster between epoch 4 and epoch 10. The resulting level differences were not found to be significant in the SC response tested across the total imagery period or for the two main response components (epoch 0 to 5 and epoch 5 to 12).

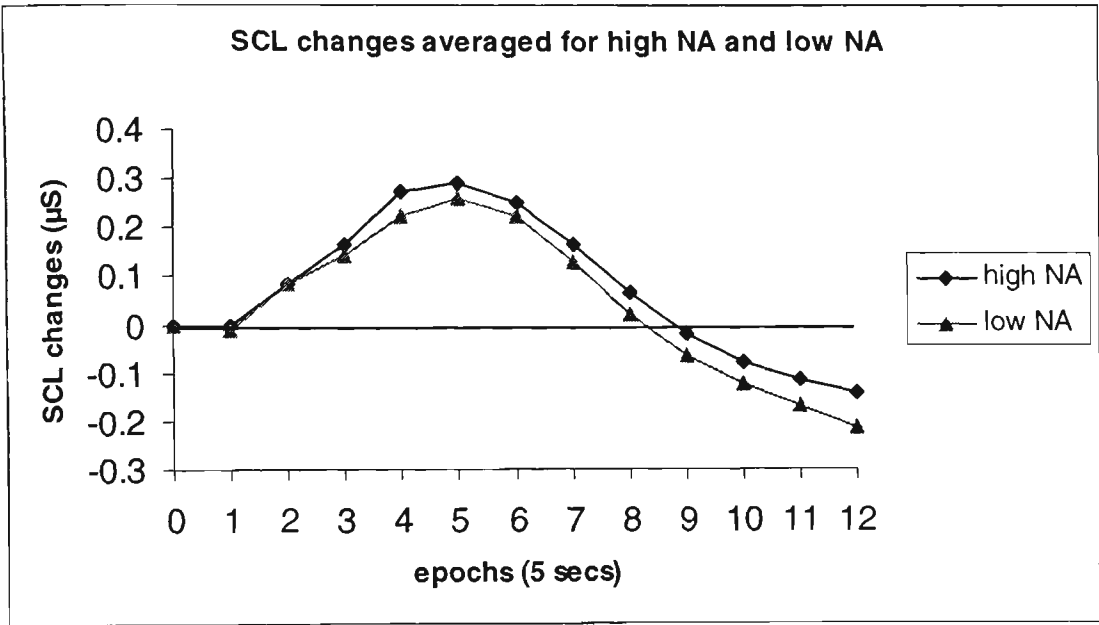
LEVEL X TIME

A significant level X linear time interaction ($F(1,49)=4.23$, $p=.05$) was found for the imagery period between epoch 5 and epoch 12 for the PA clusters. This suggests that the difference apparent at epoch 5 (i.e., SC increase greater for the **high PA** cluster), which disappeared by epoch 11, was significant despite the lack of a significant difference in the linear trend in its development phase. This provides some evidence of a significantly larger response with **high PA** imagery compared to **low PA** imagery.

NA Clusters

Similar to the PA clusters, changes in SCL for the **high NA** and **low NA** clusters increased to a peak at epoch 5 followed by a decrease for the remainder of the imagery session. The changes in SCL for the two NA clusters fell below the baseline after epoch 8. The SCL levels for the **high NA** cluster were greater than those obtained for the **low NA** cluster after epoch 4, and this difference showed little subsequent variation, with both clusters recording similar SCL decreases during the second half of the imagery period. The SCL changes for the NA clusters are illustrated in Figure 8.6d.

Figure 8.6d SCL changes for the **high NA** and **low NA** clusters



TIME

Statistical analyses confirmed the significant time effect for SCL over all epochs in each of the linear ($F(1,49)=13.36, p<.001$), quadratic ($F(1,49)=51.93, p<.001$) and cubic ($F(1,49)=6.76, p<.05$) trends. Testing across the first 5 epochs of the imagery period showed a significant linear trend ($F(1,49)=22.77, p<.001$). Significant time effects were found in SCL from epoch 5 to epoch 12 in the linear ($F(1,49)=62.11, p<.001$) and cubic ($F(1,49)=5.02, p<.05$) trends. These analyses confirmed the presence of a significant SCL response across the imagery period, with a strong linear increase followed by a strong linear decrease about the peak at epoch 5.

LEVEL

While the SCL changes for the **high NA** cluster were larger than the **low NA** cluster for a large portion of the imagery session, the resulting level difference did not reach significance.

LEVEL X TIME

No differences in the SCL response shape between the **high NA** and **low NA** clusters were found to be significant across the entire imagery period, or for the epochs representing the SC increase and decrease described earlier.

Result Summary for the PA and NA clusters

The results in HR and SCL for the PA and NA clusters largely mirrored those obtained in the FE and CHW clusters. Similar to Analyses Set 1, the results described in Analyses Set 3 confirmed that HR activity reflected affect level differences across the four clusters. Analyses Set 4 showed that HR significantly differed between the high and low levels of negative emotions with significant level X time interactions obtained in the NA clusters only.

The SCL response was not as convincing, although, as expected, higher SCLs were found for the **high PA** cluster compared with the **low PA** cluster. While no significant level differences were obtained in SCL in Analyses Set 4, a significant level X time interaction in the second part of the imagery period confirmed that the high PA cluster produced larger SCL increases during the developmental phase. There were no significant effects in the SCL data for the negative clusters.

8.1.4 Discussion

This study examined the fractionation of autonomic measures (SC and HR levels) as a function of positive and negative emotions elicited in a laboratory setting using imagery. Directed by the descriptors challenge, hard, worry, fun and excitement, subjects were instructed to imagine 10 different situations that resulted in the elicitation of high and low levels of positive and negative emotions. The data gathered from the ratings of the five descriptors and the PANAS questionnaire administered at the end of

each imagery session were used to determine which imagery sessions elicited high or low levels of positive (FE or PA) or negative (CHW or NA) emotions. A number of comparisons were performed on the physiological data to examine level (high versus low) and valence (positive versus negative) effects.

Ratings Data

The descriptors challenge, hard, worry, fun and excitement were used to direct subjects to imagine situations that elicited positive and negative emotions. These five descriptors were adopted from the previous experiment where they represented an array of emotions experienced by Ropes Course participants. For the present study, the five descriptors were used in the Ratings Questionnaire to a) monitor the contribution of each of these descriptors to each imagery session and b) to select and cluster the imagery sessions representing significantly high or significantly low levels of negative (CHW) and positive (FE) emotions.

Analyses of the ratings data for the five descriptors confirmed that, compared to the experiment average, the imagery sessions "high challenge", "high hard" and "high worry" scored significantly higher for the CHW descriptor cluster, while the "high fun" and "high excitement" imagery sessions scored significantly higher for the FE cluster. That is, the ratings of the five descriptors for the high level imagery sessions in this study supported the negative (CHW) and positive (FE) clustering adopted from Study 3. Compared to the experiment average the five imagery sessions of "high fun", "low challenge", "low hard", "low fun" and "low excitement" showed significantly lower levels of challenge, hard and worry while the four imagery sessions of "high hard", "high worry", "low worry" and "low fun" scored significantly lower for the FE descriptor group. The physiological data from the imagery sessions representing the four clusters, **high FE**, **low FE**, **high CHW** and **low CHW**, were separately averaged and examined for level and valence effects.

PANAS data

The PANAS questionnaire monitored subject affective states at the beginning and on completion of the experiment and during each of the 10 imagery sessions. Compared with the ratings data, the PANAS scores provided a more standardised measure of the level of positive and negative affect experienced during the imagery sessions. The PANAS questionnaire also provided more information regarding the valence characteristics of each of the five descriptors used in the present study and in Studies 3 and 5. As illustrated in Figure 8.2, subjects in Study 6 experienced an array of emotional states that scored in the four quadrants of the affective space defined by the PA and NA axes centred on the imagery sessions' average PA and NA score. The affective state of the subjects on arrival at the laboratory (*initial*) and on completion (*final*) of the experiment scored relatively low for the PA and NA measures. These two sets of PA and NA scores were not significantly different and were subsequently averaged to form baseline PA and NA scores reflecting subjects in a "neutral" affective state. The lack of significant differences between the PANAS scores taken from these two measuring times suggested that emotional states experienced during the imagery sessions were transitory in nature. That is, on completion of the experiment, subjects returned to an affective state similar to that measured at the beginning of the experiment.

In regard to the emotions elicited during the high level imagery sessions, the "high fun", "high excitement" and "high challenge" sessions scored high in PA, while the "high challenge", "high hard" and "high worry" imagery sessions exhibited high levels of NA. Planned comparisons between the imagery session PA and NA scores and the baseline score confirmed that the imagery sessions "high fun" and "high excitement" were significantly high in PA, but not NA, compared to the baseline. Similarly, analyses confirmed that the "high hard" and "high worry" sessions scored significantly high in NA and significantly low in PA than the baseline score. The "high challenge" imagery

session scored significantly high for both the PA and NA scores compared to the baseline. Inter-imagery session comparisons confirmed that the "high excitement" imagery session scored higher for PA and NA compared to "high fun", while the "high worry" imagery session showed higher NA and lower PA levels than "high hard".

As illustrated in Figure 8.2, the low level imagery sessions clustered in the low PA/low NA affective space quadrant. There were some significant differences between these imagery sessions and the baseline PA and NA scores, suggesting that the low level imagery sessions did elicit emotional states that were different from the baseline state. The average PA score for the "low fun" and "low excitement" imagery sessions was significantly lower than that observed during the baseline measure, while the NA score was significantly higher. The average PA score for the "low hard" and "low worry" imagery sessions was found to be lower than the baseline PA score, while the NA score was higher compared to the baseline. As shown in Figure 8.2, the "low hard" and "low worry" imagery sessions differed significantly in both the PA and NA scores. This suggests that these two imagery sessions involved different emotional states, or that similar emotional states were experienced at different intensities. The "low challenge" imagery session PA and NA scores were not significantly different from the baseline scores.

The analyses of the PANAS data confirmed that the high level imagery sessions elicited emotional states that were significantly different from the "neutral" or baseline affective state of the subject, and that these emotional states were significantly different from each other. The low level imagery sessions were not as widely distributed in the same affective space and some sessions were not significantly different from the baseline or other low level imagery sessions in regard to NA and PA levels. This information raises some concerns in regard to the effectiveness of the low level imagery sessions in eliciting different emotional states, and whether such emotional states were

likely to produce different physiological response patterns.

The PANAS data provided information concerning the affective characteristic of each of the five descriptors in relation to the current experiment context. For example, as illustrated in Figure 8.2, subjects identified the fun and excitement descriptors with high PA while the descriptors hard and worry were identified with high NA. Contrary to the Ropes course participants (Study 3 and Study 5), the participants in this study indicated that the descriptor challenge was not solely identified with NA, but was also associated with PA. This indicated that the imagery situation imagined for the descriptor challenge was not similar to the situation experienced and appraised by the Ropes Course participants.

The findings from the PANAS data not only provided information concerning the nature of the descriptors used in the experiment, but also highlighted the need to accurately monitor all emotions experienced during the experiment. This point is illustrated with the PA and NA scores for the "low fun" and "low excitement" imagery sessions. As anticipated, the average PA score for these two imagery sessions was lower in PA than the baseline. However, compared to the baseline, a higher average NA score was obtained for these two imagery sessions. This suggested that while low levels of positive emotions were experienced during these imagery sessions, relatively high levels of negative emotions were also present.

In summary, the findings from the PANAS data supported the use of each of the five descriptors to elicit a wide variety of positive and negative emotional states, particularly in the high pole PA and NA regions. The NA and PA scores gathered from each of the 10 imagery sessions were used to plot the imagery sessions in an "affective space", thus providing a pictorial representation of the affective states experienced during the imagery sessions. The PA and NA scores confirmed the valence nature of

each of the imagery sessions and these scores were used to select the imagery sessions representing the four clusters, **high PA**, **low PA**, **high NA** and **low NA**. These four clusters included slightly different imagery sessions to those representing **high FE**, **low FE**, **high CHW** and **low CHW** clusters. The **high NA** and **high CHW** clusters included the same three imagery sessions, however, compared to **high FE**, the **high PA** cluster also included the "high challenge" imagery session. The **low PA** cluster included three imagery sessions: "low challenge", "low hard" and "low excitement" additional to those found in the **low FE** cluster. The **low NA** cluster also included imagery sessions: "low worry" and "high excitement" additional to the **low CHW** cluster. Similar to the clusters selected from the Ratings data, these four new clusters based on PA and NA scores were used to explore valence and level effects in the physiological data.

Physiological Data

Initial analyses of the physiological data explored time, level and valence effects for the four clusters **high FE**, **low FE**, **high CHW** and **low CHW**. Significant changes in HR and SCL for the selected imagery session clusters occurred over the imagery period. HR showed an average increase of 1.12 BPM after 20 seconds (epoch 4) of imagery, followed by a linear decrease for the remaining imagery period. HR fell below baseline levels for the last 30 seconds of the imagery period. SCL showed a peak increase of 0.27 S after 25 seconds (epoch 5) of imagery before showing a linear decrease that resulted in SC levels below the baseline for the last 20 seconds of the imagery period. This physiological response pattern is consistent with previous research (Jones & Johnson, 1980; Cuthbert & Lang, 1989; Sinha, Lovallo & Parsons, 1992) that showed physiological changes accompanying imagery. These findings are also consistent with the results of Haney and Euse (1976) who demonstrated peak HR and SC levels between 20 and 30 seconds after imagery onset. Analysis of the data for the main time effect confirmed significant linear, quadratic and cubic trends in both measures. Separate analyses were carried out across the epochs representing the first

(HR, epoch 0 to epoch 4: SC, epoch 0 to epoch 5) and second (HR: epoch 4 to epoch 12; SC: epoch 5 to epoch 12) components in both measures. These analyses confirmed a significant linear increase (peaking at epoch 4 for the HR measure and epoch 5 for the SCL measure) followed by a significant linear decrease in both the physiological measures.

Further testing on the FE and CHW clusters showed that increases in HR were greater for the high level clusters compared to the low level clusters, and that these differences were significant when tested over the entire imagery period ($F(1,49)=4.32$, $p<.05$) and between epochs 4 and 12 ($F(1,49)=5.35$, $p<.05$). A significant level X linear time interaction ($F(1,49)=4.53$, $p<.05$) obtained across the imagery period in the HR data confirmed different patterns of HR acceleration and deceleration for the high and low level clusters. The high level clusters recorded higher HR levels during the first component (epoch 0 to epoch 5) of the HR response, while similar levels of HR changes during the second component (epoch 4 and epoch 12) were obtained for the high and low clusters. There were no differences in average HR between the positive and negative clusters, although significant level X valence X linear time interactions found across the entire imagery period ($F(1,49)=6.66$, $p<.05$) and from epoch 4 to epoch 12 ($F(1,49)=5.63$, $p<.05$) suggested that level differences between the four clusters varied according to the valence condition. As illustrated in Figure 8.3d, the **high CHW** and **low CHW** clusters recorded the highest and lowest HR levels respectively, with intermediate levels for the two FE clusters. This resulted in a greater HR difference between the two negative clusters compared with the difference observed between the two positive clusters.

Mean changes in SCL recorded for the high level imagery session clusters were found to be slightly greater than for the low level session clusters, but the resulting SCL level difference was not significant. A quadratic trend over time X level interaction for

the SCL data across the entire imagery period was significant ($F(1,49)=4.18, p<.05$) suggesting that the total SCL response across the imagery period was sensitive to level differences. The high level clusters did produce greater SCL increases between epochs 3 to 5, and this difference in SCLs between the high and low level clusters was sustained for the remainder of the imagery period. There were no differences in average SCL between the positive and negative valence clusters. A level X valence X linear time interaction approached significance in the second component of the SCL response ($F(1,49)=3.36, p<.073$) suggesting that level differences in SCL were slightly influenced by the valence factor during the second part of the imagery period. In summary, results from the first analyses on the FE and CHW clusters showed that changes in both HR and SCL were elicited during the imagery sessions and the response patterns for both these measures were sensitive to cluster level differences. Only the HR measure showed a significant average level difference between the high and low level clusters, with analyses indicating that these affect level differences were greater for the negative clusters.

The second set of analyses on the same clusters were carried out to clarify the results of the first analysis, that is, to test further the level effect observed in the HR data and to explore the level X time and level X valence X time interactions in the HR and SCL response. Based on the experiment hypothesis, it was anticipated that further examination of these interactions would confirm SCL and HR level responses that reflected affect level differences in the positive and negative emotions respectively. Differences in the HR and SC responses between the high and low level clusters were examined separately for each valence group. On the basis of the results from Study 3, it was hypothesised that the **high CHW** and **low CHW** clusters would differ significantly in HR activity, but not for SC activity. Likewise, the imagery session clusters of **high FE** and **low FE** were expected to differ significantly in regard to the SC response, but not HR. The results from this Analyses Set 2 showed that the average HR levels were

higher for the **high CHW** cluster compared to the **low CHW** cluster, and this level difference approached significance during the last 40 seconds of imagery (i.e., epochs 4 to 12) ($F(1,49)=3.64$, $p=.06$). A significant level X linear trend over time also confirmed the different HR response for the two CHW clusters, with the high CHW cluster recording greater HR acceleration across the entire imagery period ($F(1,49)=9.75$, $p<.01$) and for the second response component (epoch 4 to epoch 12) ($F(1,49)=4.27$, $p<.05$). In other words, the level difference observed between the high and low CHW clusters developed over time. There were no significant level effects or time X level interactions in the HR data for the **high FE** and **low FE** clusters.

As predicted, there were no significant differences in SCL between the **high CHW** and **low CHW** clusters. The average SCL for the **high FE** and **low FE** clusters did not significantly differ, but a significant level X linear time interaction was found for these clusters for the SC decrease between epoch 5 and epoch 12 ($F(1,49)=5.48$, $p<.023$). During the developmental phase, the **high FE** cluster produced greater SCL increases than the **low FE** cluster, and during the recovery phase, the **high FE** cluster showed a greater SC decrease that resulted in similar SCLs towards the end of the imagery period. While the significant level X linear interaction obtained between epoch 5 and epoch 12 showed a SCL pattern in the opposite direction to that expected, it may also be interpreted as evidence of SCL sensitivity to the level effect in positive emotions during the early period of imagery.

The lack of a strong level difference in the SCL data suggests that compared to HR, SCL shows limited differential responsiveness under imagery conditions. This finding in the SCL measure in Study 6 can also be compared to the field studies (Study 3 and Study 5) where large SCL differences were obtained in the elements representing **high FE** and **low FE**. In summary, the results from the first two analyses sets carried out on the FE and CHW clusters provided some support for the experiment hypothesis. HR

activity reflected level differences in the negative clusters only. SCL showed some sensitivity to level differences in the positive emotions only.

The two analyses described so far were repeated on a second set of imagery session clusters that were selected using the PA and NA scores obtained from the PANAS questionnaire. The PA and NA scores were used to plot each imagery session on an "affective space" that was defined by PA and NA axes with the centre co-ordinates calculated from the experiment average PA and NA scores. As evident in Figure 8.2, this pictorial representation of the imagery sessions showed natural clusters in each of the high and low PA and NA quadrants. Therefore, in contrast to the Descriptor Ratings Questionnaire, the PANAS data provide a more standardised and sensitive method from which to differentiate the imagery sessions on the basis of valence and level. The "high challenge", "high fun" and "high excitement" imagery sessions were averaged to form the **high PA** cluster. The "high hard" and "high worry" imagery sessions plus the five low level imagery sessions were averaged to form the **low PA** cluster. The "high hard", "high worry" and "high challenge" imagery sessions were averaged to form the **high NA** cluster. The "high excitement", "high fun" and all the low level imagery sessions were grouped to represent **low NA**. As described earlier, this second set of clusters differed from the set of clusters selected using the Ratings scores, and the use of the PANAS data ensured that the contribution of opposing emotions (not necessarily able to be identified by the five descriptors) to each imagery session was monitored. HR and SCL changes were examined for differences between these clusters for the valence (PA versus NA) and level (high versus low) factors.

A three-way ANOVA carried out on the physiological data for these PA and NA clusters revealed similar findings in the average HR and SCL response to that obtained in the FE and CHW clusters, but with one exception. Compared to the FE and CHW clusters, the linear increase observed in the HR data across epochs 0 to 4 reached

significance in the PA and NA clusters. In regard to the main level and valence effects, the analyses showed that HR levels were significantly higher for the high level clusters than the low level clusters when measured across the imagery period ($F(1,49)=4.60$, $p<.05$) and during the last 40 seconds ($F(1,49)=5.71$, $p<.05$) of imagery. In addition, a significant level X linear trend over time interaction was found across the entire imagery period ($F(1,49)=8.91$, $p<.01$), which confirmed the stronger HR acceleration followed by a weaker HR deceleration pattern observed for the high level clusters across the one minute imagery period. The average SCL difference between the high and low level clusters was not significant, however a level X quadratic trend over time interaction across the entire imagery period approached significance, with the high level clusters recording greater SC increases between epochs 3 and 6. This resulted in relatively higher SCLs for the remainder of the imagery period. There were no significant average level differences between the four clusters for the valence factor in either the HR or the SCL data, however significant valence X time ($F(1,49)=3.69$, $p<.06$) and valence X level X time ($F(1,49)=3.67$, $p<.06$) interactions in the linear trend were obtained in the HR data across the entire imagery period. These same interactions approached significance (valence X time ($F(1,49)=3.95$, $p<.06$); valence X level X time ($F(1,49)=3.93$, $p<.06$)) in the linear trend over time during the second component of the HR response. These interactions suggest that the difference in HR between the NA clusters was increasing somewhat faster across the imagery period than the difference observed between the PA clusters.

A second set of analyses carried out on the PA and NA clusters explored level effects separately for each of the valence conditions to confirm affect level differences in the HR and SCL measures. These analyses showed a significant level X linear trend over time interaction ($F(1,49)=4.12$, $p<.05$) in the HR data across the entire imagery period for the **high NA** and **low NA** clusters. As noted in the Results section, this finding indicated that the **high NA** cluster produced larger HR changes than the **low NA**

cluster during the first component of the HR response. In the second component, differences between the two clusters increased, with the **low NA** cluster showing greater HR deceleration towards the end of the imagery period. Together, these led to the higher HR levels in **high NA** compared with **low NA**. A weak linear time X level interaction approached significance in the HR data between the **high PA** and **low PA** clusters during the first 20 seconds of imagery. Perhaps this relatively weak finding in the HR measure reflected subject judgement factors, such as interest, for the two clusters.

Analysis of the SCL response for the NA clusters did not show any significant level or level X time interactions. A significant linear time X level interaction ($F(1,49)=4.24, p<.05$) was found for the second component of the SCL response (i.e., epoch 5 to epoch 12) in the **high PA** and **low PA** clusters. This finding reflected the greater SCL decrease recorded for the **high PA** cluster during the last stages of the imagery period. This finding also suggested that the SCL increases observed for the **high PA** cluster during the developmental stages of the imagery period were greater than those obtained for the **low PA** cluster, and indicate SCL sensitivity to affect level differences in the PA clusters only

The results from Analysis Set 1 and Analysis Set 3 involving the two sets of imagery session clusters provided evidence of significant HR and SCL activity across the imagery period, with a significant increase and decrease in both measures recorded (respectively) before and after the peak at 20 (HR) and 25 (SCL) seconds into the imagery period. The results indicated that HR was able to discriminate between the high and low level clusters, particularly during the last 40 seconds of the imagery period. The average SCL changes were not as sensitive to the level factor, however a significant level X quadratic time interaction found in Analyses Set 1 indicated some sensitivity to the level effect for this measure. Significant interactions obtained in HR and SCL also indicated that level differences observed in these measures were influenced by the

valence factor.

Analyses Set 2 and Analyses Set 4 confirmed that level differences were obtained in the negative (CHW and NA) clusters for HR. A level effect for the CHW clusters approached significance, while strong time X level interactions were noted for both the CHW and NA clusters across the entire imagery period and between epochs 4 to 12. A weaker time X level interaction was reported in the HR data for the PA clusters (Analyses Set 4), but this interaction did not reach significance and it occurred in the earlier stages of imagery, that is between epochs 0 and 4. SCL did not show significant level differences for either the positive (FE and PA) or negative (CHW and NA) clusters. A significant level X linear trend over time interaction was found for SCL in the PA clusters between epochs 5 and 12 only. This finding confirmed a stronger SCL increase and a more marked SCL decrease during the second response component for the **high PA** cluster relative to the **low PA** cluster. These findings in HR support the main hypothesis: that HR activity reflects level differences in the negative (CHW and NA) clusters only. The SCL measure was not as responsive to the level factor, but SCL response sensitivity to level differences was evident in the positive (FE and PA) clusters only.

While the results in the HR data largely support the main hypothesis, during these analyses a major concern emerged relating to the imagery sessions selected to represent the **low FE** cluster. The **low FE** cluster incorporated two imagery sessions "high hard" and "high worry", which, while recording a low rating for the fun and excitement descriptors, also rated significantly high for the challenge, hard and worry descriptors. Based on our results from the first and third analyses, along with previous research illustrating high HR levels accompanying negative emotions (e.g., Haney & Euse, 1976; Levenson, Ekman & Friesen, 1990), we can reasonably suggest that these two imagery sessions would have contributed higher average HR levels to this cluster

based on their high level and negative valence characteristics. In other words, the presence of other high level secondary emotions in the **low FE** cluster may have clouded or possibly contaminated the HR findings for the **high FE** and **low FE** clusters. The influence of secondary emotions may also have contributed to the poor result in the SCL measure for the positive clusters. Problems associated with the presence of secondary emotions also occurred with other clusters. For example, the **low PA** cluster also included the "high hard" and "high worry" sessions, but the effect of these two imagery sessions was probably weakened with the inclusion of five low level sessions in this cluster. The effects of secondary emotions, that is emotions present beside the target emotion, have been identified in past research studies (Ekman et al, 1983) employing descriptor ratings.

Average SCL differences were not obtained in any of the clusters tested in this Study, and it is therefore suggested that under the current imagery conditions, the SCL measure was not as responsive to imagery manipulation as the HR measure. That is, the SCL response may have simply reflected subject involvement in the imagery task or level of subject interest, and therefore failed to differentiate between the imagery clusters for either the valence or level factors. Previously, SCL has been linked with arousal, particularly during studies involving picture presentation (e.g., Lang, Greenwald, Bradley & Hamm, 1993). Other studies involving imagery (e.g., de Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993; see also Carroll, Marzillier & Merian, 1982) have failed to reliably produce SCL changes.

One important observation from this study is that differences in the HR level as a function of the level of emotion were larger towards the end of the imagery period (see Figure 8.3b and Figure 8.5b). This suggests that the physiological changes accompanying emotions should be investigated over longer time frames of say 30 seconds or more, compared to some of the shorter imagery time periods described in the

literature (e.g., Vrana, 1993). This would particularly apply to novice imagers, who (as these data and those of Haney & Euse, 1976, suggest), take some time to establish clear physiological patterns, with peak levels recorded some 20 seconds after imagery onset. Certainly, comparisons between these studies and other psychophysiological studies using only brief periods of imagery (e.g., Vrana, 1993) or picture presentation (e.g., Lang, Greenwald, Bradley & Hamm, 1993) to evoke emotion should be treated with caution. One other benefit of engaging in longer periods of imagery is that the effects of emotion may be stronger with a prolonged emotional experience. Subjects were also encouraged to imagine situations that evoked emotions comparable to "real-life" emotional experiences.

Two major concerns emerged during the analyses for this study. The first and more obvious concern is whether the use of imagery can elicit target emotional states that are comparable in nature and intensity to emotions experienced under real-life conditions. From their research involving a number of studies, Rimé, Philippot and Cisamolo (1990) concluded that distinctive patterns of peripheral changes are more likely to result during intense emotions rather than the more moderate emotions elicited in the laboratory. The PANAS data showed that the imagery did elicit significant changes in emotional states compared to subjects' baseline or neutral level, particularly for the high level imagery sessions. In addition, the differences in the level of emotions were reflected in the HR measure, where it was found that the high level imagery sessions did result in larger HR changes compared to the low imagery sessions. However, whether the emotions were comparable in intensity to those experienced by the Ropes Course participants can not be measured. It should be noted that the changes in physiological levels (for both the SCL and HR measures) of the Ropes Course participants were considerably larger. This may be due to the use of child subjects who were generally more emotionally and verbally expressive (e.g., smiling, laughing) and seemingly less emotionally inhibited during the Ropes Course activity.

Psychophysiology studies have also shown that compared to adults, children show higher average HR levels and produce larger HR responses (e.g., Garwood, Engel & Capriotti, 1982). It is also likely that some movement effect may have contributed to the larger HR response in the field studies.

The second concern relating to Study 6 was demonstrated in the ratings data analyses, where the presence of secondary emotions was identified. As mentioned, secondary emotions are emotions present alongside the target or primary emotion. The valence or other characteristics (e.g., intensity) of these secondary emotions may differ from the target emotion, and they are likely to contribute to the resultant physiological patterns recorded. Aware of this concern, Ekman and his colleagues (Ekman, Levenson & Friesen, 1983) eliminated subject data that showed unacceptable high levels of other emotions besides those targeted. Ekman and his colleagues used descriptors to detect the presence of other emotions. The success of this method may be questioned as it would seem that an exhaustive range of descriptors would have been required to accurately monitor the presence of all other emotions in this study. Another consideration is that this method does not determine the arousal and valence contribution of the secondary emotions to the overall emotional experience. For the present experiment, the use of the PANAS questionnaire provided a more simple and effective method of monitoring the resulting affective state of the subject, including the contribution, if any, of secondary emotions during the imagery sessions. Rather than "pinpointing" the presence of all discrete emotions, the physiological data patterns were examined in relation to the dominant presence of either positive or negative affect. The PANAS data also provided a more accurate picture of subjects' affective state prior to, and after, participation in the experiment.

To continue the investigation of psychophysiological changes accompanying negative and positive emotions, studies need to address the problems associated with

emotion elicitation and secondary emotions. For example, in regard to our hypothesis concerning changes in SCL and HR reflecting levels of (respectively) positive and negative emotions, it would be ideal to elicit emotions that are located at the extreme ends of the PA and NA scales. Increasing the differences in valence and intensity level between clusters of emotions would increase the probability of obtaining more clearly defined and different physiological patterns. In addition, emotions that differ in either PA or NA, while remaining essentially stable for the other valence, need to be used. In other words, we need to explore HR and SCL changes between groups of emotions that differ significantly in PA, but not NA, and vice versa. Thus, in recognising the likely presence of secondary emotions, their contribution to the resulting emotional experience would be taken into consideration.

Typical of other studies investigating the psychophysiology of emotion, this study raised as many questions or concerns as it answered. However, with the use of the PANAS questionnaire, it is one of the first attempts to integrate a current theoretical approach to the psychology of emotion (Russell, 1980; Watson & Tellegen, 1985) with psychophysiological research trends exploring discrete emotions (e.g., Ekman, Levenson & Friesen, 1983; Sinha, Lovallo and Parsons, 1992). The findings from this study, along with other concurrent research developments (e.g., Witvliet & Vrana, 1995), suggest that further investigation of the physiological activity accompanying emotions should focus on both valence and arousal characteristics. The PANAS questionnaire provided an opportunity to explore the psychophysiology of emotion along this line as it provides a quantitative measure of the level of positive affect and negative affect experienced. As applied in the next study, the PA and NA scores can be used to monitor the presence of secondary emotions, and computations on the PA and NA scores can be used to provide arousal and valence scores for each imagery session.

CHAPTER 9

HR and SCL changes accompanying high pole NA and PA emotions evoked through imagery

9.1 STUDY 7a

9.1.1 Introduction

Extending on the previous study, the following study examined HR and SCL changes accompanying 10 different high-pole and low-pole PA and NA emotions elicited in the laboratory using imagery methodology. In addition to the five descriptors of challenge, hard, worry, fun, and excitement, used in the previous study, a further five: anxious, calm, drowsy, enthusiasm and distress were adopted in this study to evoke a wider range of positive and negative emotions during imagery. The additional five descriptors were selected from the emotion literature, which identified them with the extreme ends of either the Negative Affect (NA) or Positive Affect (PA) dimensions (Watson & Tellegen, 1985). It seemed likely that these emotions would be accompanied by distinctive patterns of autonomic activity (Rimé et al., 1990). This is evident in the literature with the demonstration of autonomic activity accompanying strong and clearly identifiable emotions such as fear, anger and anxiety (e.g., Ax, 1953; Schwartz, Weinberger & Singer, 1981; Sinha, Lovallo & Parsons, 1992).

According to Watson and his colleagues (e.g., Watson, Clark & Tellegen, 1988), high energy, concentration and pleasurable engagement reflect a state of high positive affect whereas sadness and lethargy reflect a state of low positive affect. Mood states such as anger, disgust, guilt and fear reflect negative affect, with calmness and serenity characterising low negative affect. Thus, according to the emotion literature (e.g.,

Russell, 1980; Watson et al., 1988), the description of emotional states should encompass both arousal and valence characteristics. Based on the above definition of PA and NA, and other information found in the emotion literature (e.g., Russell, 1980; Fridja, 1986; Wagner, 1989), it was expected that the "enthusiasm" imagery session would show similar PA and NA levels to the "fun" and "excitement" imagery sessions, while the imagery sessions of "anxiety" and "distress" would elicit similar types of emotions experienced during the "hard" and "worry" imagery sessions. The remaining two imagery sessions of "drowsy" and "calm" were selected as they represented emotions associated with extreme low levels of PA and NA respectively (Watson & Tellegen, 1985). It was expected that the selection of these two imagery sessions would eliminate the cluster effect observed for the five low level imagery sessions in the previous study.

The results from Study 6, and others recently published in the emotion literature, suggested other possible explanations for the pattern of changes in HR and SCL accompanying positive and negative emotions. Study 6 indicated that HR activity was responsive to the imagery manipulations, with significant differences for the level factor, particularly in the negative clusters. There were no significant differences in HR for the valence (positive versus negative) factor. Contrary to these findings, studies by Ekman, Levenson and Friesen (1983), Schwartz, Weinberger and Singer (1982) and Sinha, Lovallo and Parsons (1992) suggested that HR increases reflected valence effects. However, other studies have not supported these findings. For example Stemmler (1989) found that HR failed to differ between the emotions of fear and anger and between sad and joyful imagery. De Jong-Meyer et al. (1993) reported non-differential findings for HR and SC measures during sad and joyful emotional imagery, and similar increases in HR have been observed for positive emotions such as happiness, compared to negative emotions (Levenson, Ekman & Friesen, 1990).

Compared to the studies involving imagery, research involving the presentation of pictures (e.g., Cuthbert, Bradley & Lang, 1990; Lang, Greenwald, Bradley & Hamm, 1993) has proved more fruitful, particularly for SC activity. Lang and his colleagues (e.g., Lang et al., 1993) found that the electrodermal activity varied according to the subjects' arousal rating, independently of whether pleasant or unpleasant pictures were viewed. However, as discussed in the previous Chapter, monitoring physiological indices during picture presentation has traditionally been conducted over short periods of (say) less than 10 seconds. The effects of emotion on the physiological measures over longer periods using picture methodology has not been investigated. One other concern with using picture presentation to study the physiological correlates of emotion is the social or experimental expectations underlying each picture. For example, a slide showing a birthday party may record a high score for the descriptor happiness, even though emotions related to happy may not have been experienced by the subject during the presentation of the slide. In other words, the subject may simply report the expected emotions rather than focusing on emotions present. As discussed in the previous study, social and experimenter expectations can be minimised using imagery where subjects individually select the content of their imagery sessions.

Thus, despite the relatively negative findings in the previous study for the SCL response, the following study again employed imagery to evoke positive and negative emotions from which to study the patterns of accompanying HR and SCL changes. The original five descriptors of challenge, hard, worry, fun and excitement were again used to select the imagery sessions representing the four clusters: **high FE**, **low FE**, **high CHW**, and **low CHW**. Differences in HR and SCL changes were examined as a function of these four clusters for the valence and level factors. Based on our previous study findings, it was hypothesised that the high level imagery sessions would elicit enhanced physiological changes, while there would be no significant differences between the two valence (CHW and FE) clusters. A second set of analyses examined

differences in level (high versus low) separately for each valence group. It was hypothesised that the HR responses would differ significantly between the **high CHW** and **low CHW** clusters, while the SCL changes would not. It was also hypothesised that only the SCL changes would differentiate between the **high FE** and **low FE** clusters.

The first and second sets of analyses described so far for Study 7a are consistent with the analyses carried out on the FE and CHW clusters in Study 6. In contrast to Study 6, the third set of analyses in Study 7a explored HR and SCL changes for differences between imagery session clusters that differed significantly in PA but not NA, and for imagery session clusters that differed significantly in NA but not PA. By selecting descriptors identified in the literature as extremely high or low in either PA or NA, this analysis attempted to monitor and control the level of secondary emotions present which may influence the accompanying physiological patterns. The terms **high pole PA**, **low pole PA**, **high pole NA** and **low pole NA** were used to describe the four new clusters, selected using the PANAS data, that represented emotions identified with the extreme ends of the arousal and valence dimensions.

In line with the emotion literature, it was expected that the **high pole PA** cluster of "fun", "enthusiasm", "excitement" and "challenge" would yield higher PA levels but similar NA levels to the **low pole PA** "drowsy" imagery session. Likewise, it was expected that the **high pole NA** cluster of "anxious", "hard", "worry" and "distress" would record higher NA levels but similar PA levels to the **low pole NA** imagery session representative, "calm". Thus, the imagery session clusters used in Analyses Set 3 were pre-determined and the PANAS data were used to confirm that the respective clusters differed in either PA or NA while remaining stable for the opposing affect. In regard to the physiological changes, it was hypothesised that the imagery sessions significantly differing in PA but not NA would show significant differences in the SCL response, and imagery sessions significantly differing in NA, but not PA, would show

significant differences in the HR response.

As mentioned, the results from Study 6 raised concerns as to the effectiveness of imagery to elicit emotions of suitable intensity to explore the physiological changes that accompany them, particularly for the SCL measure. To enhance the effectiveness of imagery in the present study, subjects were instructed to imagine themselves physically involved in the imagined situation. Studies have shown that stronger emotional experiences have been reported and enhanced physiological responding obtained when subjects were "active" in the imagined situation (Lang et al., 1980; Sinha et al., 1992; de Jong-Meyer et al., 1993). The use of imagery, and physiological changes accompanying imagery of physical activities has received attention in areas relating to sport performance (Tremayne & Barry, 1990) and the study of elite sports people (e.g., Bakker & Kayser, 1994). These studies have suggested that imagining personal participation in a physical situation elicits a strong psychophysiological response similar to that experienced under "real-life" conditions. The five descriptors of challenge, hard, worry, fun and excitement were originally taken from a "real life" active task, the Ropes Course. It would therefore seem more appropriate if the five descriptors were used to direct subjects to imagine situations in which they were physically involved. In regard to the use of the five descriptors to monitor positive and negative emotions, this would support a closer similarity between the field and laboratory studies.

Other measures adopted in this experiment to enhance the effectiveness of the imagery methodology included a) testing subjects individually to minimise embarrassment and/or distraction, and b) providing extra time between the imagery sessions. Subjects were provided with an additional 30 seconds rest period between imagery sessions. This is consistent with the recommendation by Haney and Euse (1976) who advised a suitable rest period to allow subjects to return to pre-imagery session baseline levels. Also studies which have assessed subject imagery ability (e.g.,

Miller et al., 1987; Lang et al., 1993) have found clear differences in the psychophysiological measures between good and poor imagers. To provide data for some follow-up analyses (Study 7b), subjects in Study 7a were also ranked for imagery vividness using the shortened version of the Bett's Questionnaire Upon Mental Imagery (QMI) (Sheehan, 1967) (Appendix 19). Using this same questionnaire, a study by White, Ashton and Brown (1977) involving 2000 students indicated that the majority of good imagers may be women. As for the previous study, no gender analyses were performed on the data in Study 7a due to the gender imbalance in the subject sample and the experiment focus on physiological changes reflecting reported differences in emotion level and valence characteristics. It should be noted however, that the majority of subjects were female in Study 6 and Study 7, and analyses carried out in Study 7b were performed on the data for a subgroup of "good" imagers.

In summary, directed by a series of 10 descriptors, subjects imagined situations that elicited high levels of positive and negative emotions. HR and SCL changes were monitored and collected over 10 one minute imagery sessions. The physiological measures were examined for differences reflecting valence and level using a series of ANOVAs performed on two different sets of imagery session clusters: **high FE, low FE, high CHW, low CHW** and **high pole PA, low pole PA, high pole NA and low pole NA**. Consistent with the main hypothesis, it was expected that HR differences would reflect level differences in the negative clusters and SCL differences would reflect level differences in the positive clusters.

9.1.2 Method

Subjects

Fifty undergraduate students (36 female, 14 male), aged 20-50 years participated in the study to fulfil a course requirement in a psychophysiology subject at the

University of Wollongong. None of the subjects had participated in any of the previous studies described in this thesis and all gave informed consent.

Apparatus

The physiological measures were monitored using the same apparatus and monitoring procedure as that described for Study 6.

Similarly to Study 6, an instructional booklet contained instructions for each of the 10 imagery sessions on separate pages. Subjects were instructed to imagine 10 different situations that elicited positive or negative emotions related to the following descriptors: challenge, hard, worry, fun, excitement, anxious, distress, calm, drowsy and enthusiasm. An example of an imagery session instruction is: “*Close your eyes and imagine yourself physically involved in a situation that you would describe as involving a high level of WORRY*”. The order of the imagery sessions in the booklet was randomised for each subject to eliminate sequence effects. Each imagery session was followed by a PANAS questionnaire (Watson, Clark & Tellegen, 1988) and a brief Ratings questionnaire. As for Study 6, the two questionnaires provided ratings for the five descriptors challenge, hard, worry, fun, excitement, and PA and NA scores for each of the 10 imagery sessions. A final questionnaire, the Betts Questionnaire for Mental Imagery (QMI), (Sheehan, 1967) was also administered.

Procedure

The experimental procedure was essentially the same as that described for Study 6, although some minor differences should be noted. Subjects were tested in this study on an individual basis. Subjects were also allocated an additional 30 seconds between imagery sessions. This increased the inter-imagery session period to 90 seconds, allowing subjects ample time to finish the questionnaires and relax prior to the next imagery session. The Betts Questionnaire for Mental Imagery (Sheehan, 1967) was

administered on completion of the experiment.

9.1.3 Results

Four sets of data: the Ratings data, the PANAS data, the QMI score and the physiological data (SCL and HR) were obtained. The Ratings, PANAS and QMI scores are listed in Appendix 20. HR and SCL raw data and statistical outcomes for Study 7a are presented in Appendices 21 and 22 respectively.

The Ratings data for the 10 imagery sessions were analysed in the same manner as described in Study 6, and used to select the imagery sessions representing the four clusters: **high FE**, **low FE**, **high CHW** and **low CHW**. Thus, extending on the previous study, the first set of analyses carried out in this study tested differences in the HR and SCL response for the four clusters in regard to time (epoch 0 to epoch 12), level (high versus low) and valence (positive versus negative) factors. The differences between the high and low levels were also tested separately for each valence group in Analyses Set 2.

The PANAS scores were analysed using planned contrasts to confirm that the imagery was successful in eliciting changes in subject affective states and that these states were distributed over the affective space defined by the PA and NA axes. The PA and NA scores were also used to identify the valence nature of a second set of clusters for physiological data comparison in Analyses Set 3. The PA and NA scores were used to confirm differences in PA, but not NA, between the **high pole PA** ("enthusiasm", "excitement", "fun" and "challenge") and the **low pole PA** ("drowsy") imagery session clusters. Similarly, differences in PA and NA levels were also examined between the **high pole NA** ("anxious", "worry", "hard" and "distress") and the **low pole NA** ("calm") imagery session clusters to confirm differences in NA levels only. Compared to the

previous study, this procedure adopted in Study 7a attempted to control and lower the presence of secondary emotions for each cluster. The resulting four clusters: **high pole PA, low pole PA, high pole NA and low pole NA** were examined for HR and SCL response differences separately for each valence condition.

RATINGS DATA

Table 9.1 shows the mean rating and standard deviations for each of the descriptors: fun (F), excitement (E), challenge (C), hard (H) and worry (W), recorded for the 10 imagery sessions. An experiment average for each descriptor was calculated from the rating scores across the 10 imagery sessions and used for comparative analysis with each imagery session to determine which imagery sessions recorded significantly high or significantly low levels of fun, excitement, challenge, hard and worry.

The statistical outcomes for these analyses are presented in Table 9.1. Figure 9.1 (a and b) illustrates these findings for the FE and CHW descriptor groups separately. As for Study 6, these data were used to select the imagery sessions representing the four clusters: **high FE, low FE, high CHW and low CHW**.

Table 9.1 Imagery Session Descriptor Ratings: Ratings on the five descriptors for each imagery session

Imagery Session	Descriptor									
	Challenge		Hard		Worry		Fun		Excitement	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxious (A)	3.16 ^c	1.27	3.26 ^a	1.18	3.56 ^a	1.29	1.40 ^e	0.81	2.18 ^e	1.02
Hard (H)	3.84 ^a	1.06	4.06 ^a	0.89	2.92 ^a	1.14	1.56 ^d	0.93	2.00 ^d	1.11
Worry (W)	2.82	1.19	3.34 ^a	1.27	3.88 ^a	1.12	1.32 ^d	0.77	1.80 ^f	0.99
Distress (S)	2.80	1.36	3.40 ^a	1.33	3.84 ^a	1.17	1.20 ^d	0.61	1.64 ^f	1.12
Challenge (C)	4.08 ^a	0.97	3.26 ^a	1.01	2.34	0.98	2.46	1.20	3.16 ^a	1.18
Calm (M)	1.36 ^d	0.66	1.40 ^d	0.78	1.22 ^d	0.47	1.84 ^d	1.04	1.18 ^d	0.52
Drowsy (D)	1.66 ^d	0.89	1.38 ^d	0.64	1.04 ^d	0.20	2.90 ^b	1.18	1.64 ^d	1.03
Fun (F)	2.40 ^e	1.25	1.56 ^d	0.91	1.18 ^d	0.39	4.34 ^a	0.92	3.88 ^a	0.89
Excitement (E)	2.92	1.27	1.88 ^d	1.21	1.32 ^d	0.68	3.88 ^a	1.02	4.26 ^a	0.78
Enthusiasm (N)	3.20 ^c	1.31	2.00 ^d	1.11	1.32 ^d	0.59	3.78 ^a	0.95	4.00 ^a	0.86

KEY	
a significantly high at .001 level	d significantly low at .001 level
b significantly high at .01 level	e significantly low at .01 level
c significantly high at .05 level	f significantly low at .05 level

Fun and excitement

It was found that, compared to each descriptor experiment average, significantly high levels of fun and excitement related emotions were elicited during the "fun", "excitement" and "enthusiasm" imagery sessions. In comparison significantly low levels of fun and excitement related emotions were elicited in five imagery sessions; "anxious", "hard", "worry", "distress" and "drowsy".

Challenge, hard and worry

Compared to the relevant descriptor average, it was found that the "anxious" imagery session elicited significantly high levels for each of the descriptors challenge, hard and worry. The "hard" imagery session also elicited significantly high levels for each of the descriptors challenge, hard and worry. Three imagery sessions: "drowsy", "calm" and "fun" showed significantly lower levels for the same three descriptors compared to the respective descriptor average.

Figure 9.1a Fun (F) and excitement (E) descriptor ratings for the 10 imagery sessions

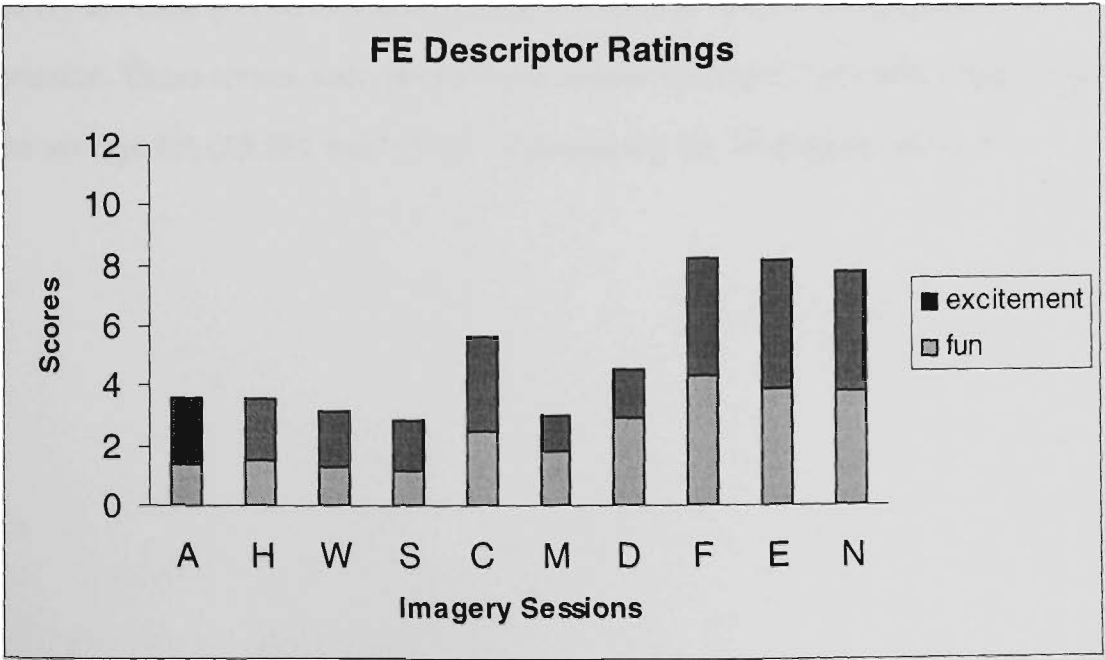
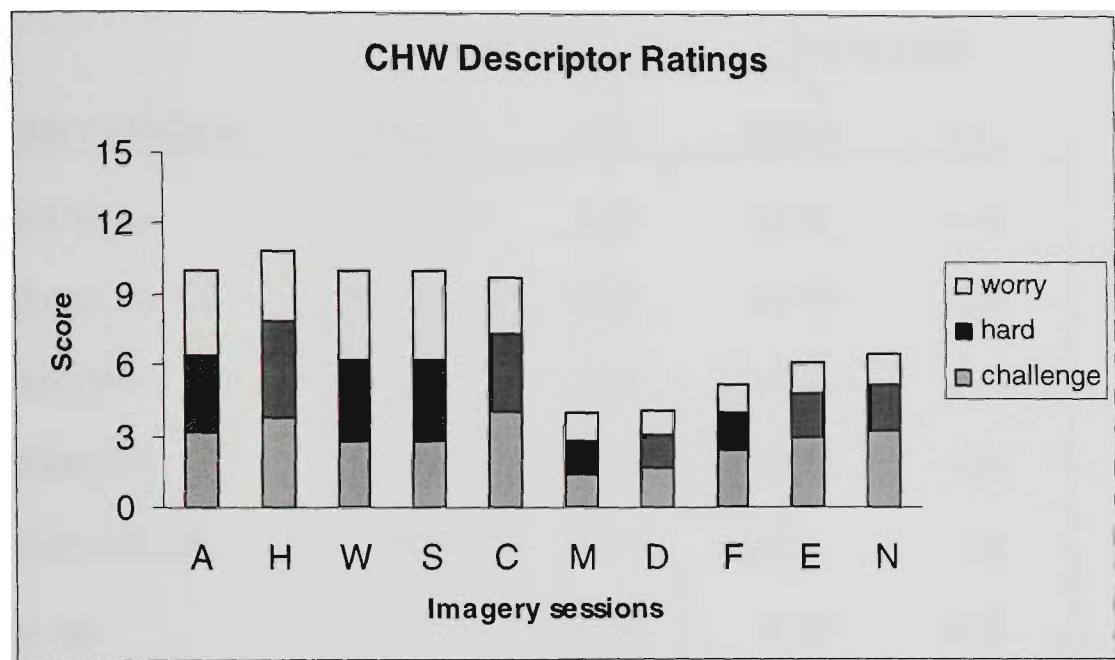


Figure 9.1b Challenge (C), hard (H) and worry (W) descriptor ratings for the 10 imagery sessions



PANAS DATA

Table 9.2 shows the mean PANAS score for each imagery session as well as the initial (*i*) and final (*f*) PANAS scores obtained prior to and on completion of the experiment. These scores were plotted on a two dimensional "affective space" centred on the average PA (15.88) and NA (9.77) scores for the 10 imagery sessions.

Table 9.2 Imagery Session PANAS Scores (n=50)

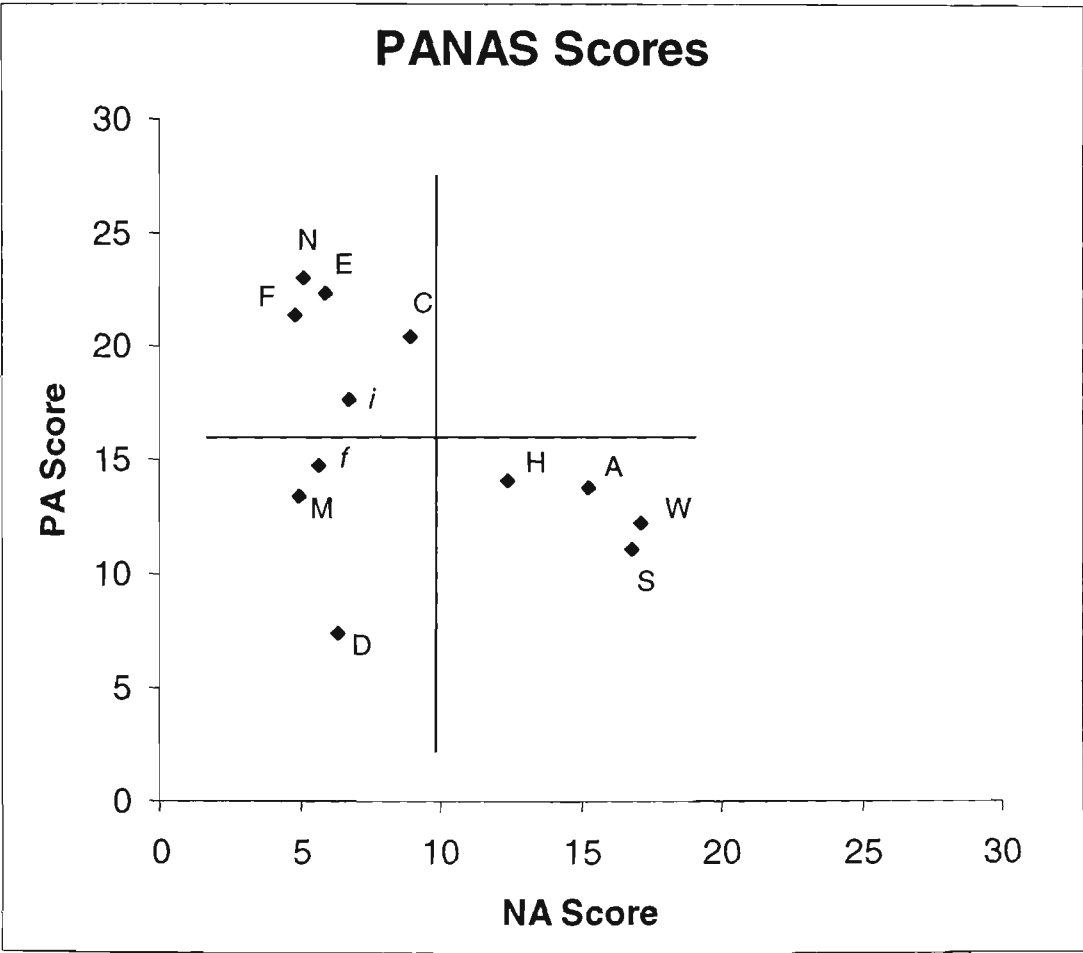
IMAGERY SESSION	PA SCORE		NA SCORE	
	MEAN	S.D.	MEAN	S.D.
ANXIOUS (A)	13.77	4.37	15.27	4.92
HARD (H)	14.06	4.87	12.39	4.95
WORRY (W)	12.24	4.65	17.16	4.14
DISTRESS (S)	11.07	4.39	16.86	4.78
CHALLENGE (C)	20.34	5.99	8.91	3.46
CALM (M)	13.39	5.71	4.94	0.93
DROWSY (D)	7.38	2.79	6.34	1.65
FUN (F)	21.33	5.22	4.78	1.42
EXCITEMENT (E)	22.32	5.08	5.88	2.47
ENTHUSIASM (N)	22.98	4.77	5.13	1.87
INITIAL (i)	17.59	4.64	6.71	2.97
FINAL (f)	14.73	4.36	5.68	1.92

As illustrated in Figure 9.2 the imagery sessions of "enthusiasm", "excitement" and "fun" formed a cluster in the high PA/low NA region of the affective space. The "challenge" imagery session is also located in the high PA region, but is situated to the right of the other imagery sessions located in the same quadrant. This is due to the relatively higher NA score for the "challenge" imagery session. There were no imagery sessions found in the high PA/high NA region. The imagery sessions of "anxious", "hard" "worry" and "distress" are located in the low PA/high NA quadrant, with the "worry" imagery session recording the highest NA score followed closely by "distress".

The "drowsy" and "calm" imagery sessions are both located in the low PA/low NA quadrant. Compared to the "calm" imagery session, the "drowsy" imagery session scored lower in PA.

Compared to the experiment average, subjects scored lower in NA and higher in PA prior to participation in the experiment (*i*). On completion of the experiment (*f*) subjects recorded lower PA and NA scores compared to those measured at the beginning of the experiment.

Figure 9.2 PA and NA scores for the 10 imagery sessions plotted in the experiment “affective space”.



The success of the imagery task, that is the ability of the imagery sessions to elicit different emotional states, was confirmed by examining affective state differences

between the imagery sessions and a mean baseline. Inter imagery session comparisons were also carried out to confirm that each imagery session elicited different types or levels of positive and negative emotions, and that these emotional states were located across a broad area of the experiment "affective space". Planned comparisons tested for differences in PA and NA between imagery sessions located closely together in the experiment affective space.

Baseline data

A planned comparison found that the initial and final baseline PA scores were significantly different ($F(1,49)=31.98, p<.001$). Similarly, the initial and final baseline NA scores were also found to be different ($F(1,40)=7.58, p<.01$). These findings suggest that on completion of the experiment, subjects were in an altered affective state to that measured at the beginning of the experiment. Consistent with the analyses adopted in Study 6, the initial and final PA and NA scores were averaged to provide a baseline score.

High PA/low NA: Fun, Excitement, Enthusiasm and Challenge

Compared to the baseline, the average PA and NA scores for the "fun", "excitement" and "enthusiasm" cluster were found to be significantly different (PA ($F(1,49)=124.95, p<.001$); NA ($F(1,49)=7.85, p<.01$)). Planned analyses confirmed that within this cluster, only the "enthusiasm" and "fun" imagery sessions were significantly different for PA ($F=7.64, p<.01$). In regard to NA, the "excitement" imagery session differed from both the "enthusiasm" ($F(1,49)=5.03, p<.05$) and "fun" ($F(1,49)=8.93, p<.01$) imagery sessions.

The "challenge" imagery session differed significantly in both the PA

($F(1,49)=25.92$, $p<.001$) and NA ($F(1,49)=22.34$, $p<.001$) scores compared to the mean baseline. Compared to the average of the "fun", "excitement" and "enthusiasm" cluster, the "challenge" imagery session was found to be significantly different in both PA ($F(1,49)=8.09$, $p<.01$) and NA ($F(1,49)=54.93$, $p<.001$). Analyses also showed that the "challenge" imagery session was not significantly different to the "fun" imagery session in PA ($F(1,49)=1.84$, $p=.181$).

Together these analyses showed differences in either NA or PA, or both, between the imagery sessions located in the high PA/low NA quadrant, and that this imagery session cluster represented affective states that were significantly different to the experiment baseline state.

High NA/low PA: Anxious, Hard, Worry and Distress

The average of the four imagery sessions "anxious", "hard", "worry" and "distress" was found to be significantly different from the baseline in PA ($F(1,49)=49.82$, $p<.001$) and NA ($F(1,49)=333.48$, $p<.001$). Planned comparisons showed that the "hard" imagery session was significantly different to the average of the "anxious", "worry" and "distress" imagery sessions ($F(1,49)=6.58$, $p<.05$) in PA. Further analyses showed that the "hard" imagery session was not significantly different from the "anxious" ($F(1,49)=.18$, $p=.677$) imagery session in PA. In addition, the PA scores for the "worry" and "distress" imagery sessions did not differ significantly ($F(1,49)=2.70$, $p<.107$).

Analyses of the NA scores for the four imagery sessions showed that the "hard" imagery session was significantly different from the average of the other three imagery sessions ($F(1,49)=52.38$, $p<.001$). This imagery session was also found to be different to its closest neighbour, the "anxious" imagery session ($F(1,49)=17.82$, $p<.001$). Only the

"worry" and "distress" imagery sessions were found to not differ significantly ($F(1,49)=.32, p=.573$) in NA within this high NA/low PA quadrant.

These analyses of the negative cluster of imagery sessions showed differences in either PA or NA for all but two imagery sessions: "worry" and "distress". This finding is illustrated in Figure 9.2, with these two imagery sessions located closely to each other in the experiment affective space. These analyses also showed that this cluster of imagery sessions represented affective states significantly different from the baseline affective state.

Low PA/low NA: Calm and Drowsy

Compared to the baseline, the "calm" imagery session was found to be significantly lower in PA ($F(1,49)=12.12, p<.001$) and NA ($F(1,49)=17.62, p<.001$) scores. The "drowsy" imagery session was found to be significantly lower in PA only ($F(1,49)= 242.16, p<.001$) compared to the baseline.

To summarise, analyses of the PA and NA scores for the 10 imagery sessions indicated that a) each of the 10 imagery sessions evoked affective states that were significantly different in either PA or NA or both from the baseline state and b) except for "worry" and "distress", each of the imagery sessions used in this study significantly differed from each other in either PA or NA or both. These findings provided justification for the inclusion of each imagery session in the study, and showed that, compared to Study 6, these 10 imagery sessions provided a larger experimental "affective space" in which to explore the accompanying physiological activity as a function of emotion.

PHYSIOLOGICAL DATA

Similarly to Study 6, HR and SC levels were averaged over five second intervals (epochs) for the one minute imagery period, resulting in a total of 12 epochs. A baseline value (5 second epoch prior to imagery) was used to adjust each of the imagery session's physiological data sets to zero at time $t=0$. This allowed HR and SCL responses to be examined across the 10 imagery sessions in terms of deviations from this pre-imagery baseline.

As for Study 6, the first two sets of analyses in Study 7a used the five descriptors of fun, excitement, challenge, hard and worry to identify imagery sessions eliciting significantly high or low levels of related positive or negative types of emotions. HR and SCL changes for the four clusters **high CHW**, **low CHW**, **high FE** and **low FE** were averaged. Analyses Set 1 examined these clusters over time (epoch 1 to epoch 12), valence (positive versus negative) and level (high versus low) effects for the HR and SCL changes. In the second set of analyses, the physiological measures were tested for significant differences between the high and low levels separately for each valence.

The imagery sessions representing the high pole PA and NA clusters were pre-determined. Compared to Study 6, the PA and NA scores were simply used to confirm differences in PA and not NA between the **high pole PA** and **low pole PA** clusters. Similarly, significant differences in NA but not PA were tested for the **high pole NA** and **low pole NA** clusters. HR and SCL changes were examined for differences between the **high pole PA** and **low pole PA** clusters, and between the **high pole NA** and **low pole NA** clusters separately in Analyses Set 3.

In each of these three analyses sets, the effects examined were tested on the physiological data gathered over the entire one minute imagery period and for the

imagery epochs representing a response increase and a response decrease. Significant time effects were examined in linear, quadratic and cubic trends only.

ANALYSES SET 1

Level (High versus Low) and Valence (Positive versus Negative) Effects.

Table 9.3 presents the statistical outcomes for Analyses Set 1 in the HR and SCL data.

Heart Rate Responses

Figure 9.3a illustrates the mean HR changes averaged for the four clusters of **high FE, low FE, high CHW and low CHW**. Initial HR activity showed a marked acceleration across the first three epochs. For the following four epochs (E3-E7), HR showed very slight decreases and increases, with the highest HR change peaking at approximately 3 BPM at the 7th epoch. After epoch 7, HR showed a deceleration which, in contrast to the HR response obtained in Study 6, did not fall below the baseline. The HR acceleration noted across the first 3 epochs following baseline was interpreted as the image response development phase. It was found to be greater than that obtained for the FE and CHW clusters in Study 6, reaching a substantially higher level at epoch 3.

TIME

Analysis of the entire imagery period for the four clusters showed a significant time effect, apparent in the quadratic trend only ($F(1,49)=40.84, p<.001$). Analysis of the HR increase (epoch 0 to epoch 3) showed it to be significant in both the linear ($F(1,49)=20.84, p<.001$) and quadratic ($F(1,49)=5.92, p<.05$) response components. The HR decrease noted between epoch 3 and epoch 12 was found to be significant ($F(1,49)=13.69, p<.001$) in the linear trend.

Table 9.3 Statistical Outcomes for Analyses Set 1

EFFECTS	Imagery Period	HR changes		SCL changes	
		Trend	F(1,49)	Trend	F(1,49)
Time	E0 to E12	Quad.	40.84 ***	quad.	70.10 ***
	Increase	linear quad.	20.84 *** 5.92 #	linear	42.97 ***
	Decrease	linear	13.69 ***	linear	47.56 ***
Level	E0 to E12		5.15 *		n.s.
	Increase		n.s.		n.s.
	Decrease		7.26 **		3.43 #
Valence	E0 to E12		5.54 *		n.s.
	Increase		n.s.		n.s.
	Decrease		8.94 **		n.s.
Level X Time	E0 to E12	linear	27.02 ***	linear	7.20 **
	Increase		n.s.	quad.	3.94 #
	Decrease		15.35 ***		n.s.
Valence X Time	E0 to E12	linear	22.52 ***	quad.	4.45 *
	Increase		n.s.		n.s.
	Decrease		4.73 *	linear	3.78 #
Level X Valence	E0 to e12		n.s.		n.s.
	Increase		n.s.		n.s.
	Decrease		n.s.		n.s.
Level X Valence X Time	E0 to E12	linear	4.06 *		n.s.
	Increase		n.s.		n.s.
	Decrease	cubic	8.57 *		n.s.

KEY

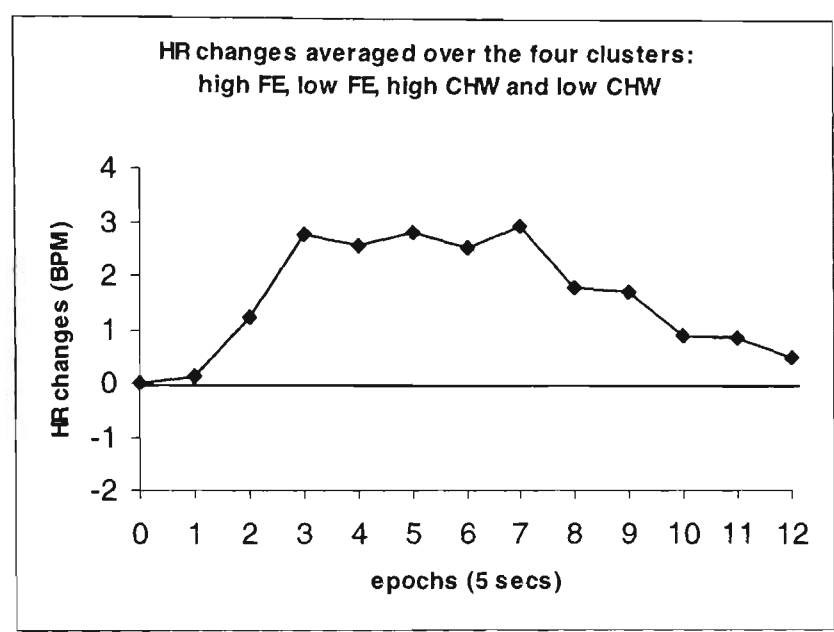
*** significant at .001 level

** significant at .01 level

* significant at .05 level

approached significance

Figure 9.3a HR changes averaged over the four clusters; **high FE, low FE, high CHW and low CHW**



LEVEL

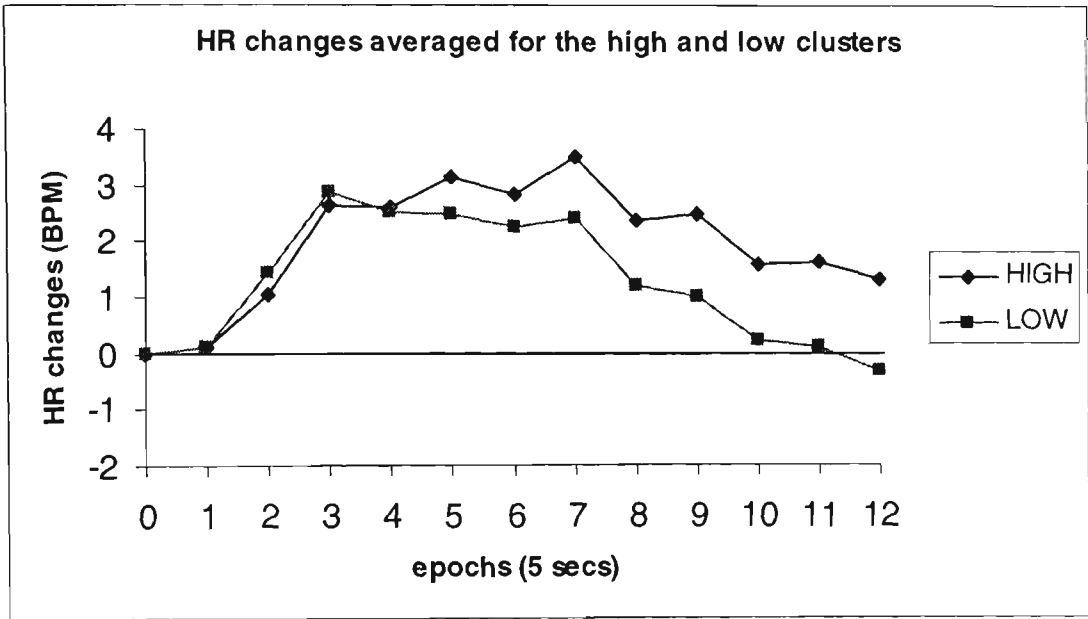
As illustrated in Figure 9.3b, compared to the low level clusters, the high level clusters recorded larger HR increases, particularly towards the second half of the imagery period. This resulted in an average level difference that was significant over the entire imagery period ($F(1,49)=5.15, p<.05$) and for the period of imagery between epoch 3 and epoch 12 ($F(1,49)=7.26, p<.01$).

LEVEL X TIME

A significant level X linear trend over time ($F(1,49) = 27.02, p<.001$) interaction confirmed that the relationship between the high and low level clusters increased over the whole imagery period. As shown in Figure 9.3b, the high and low level clusters showed similar HR acceleration for the first three epochs. The high level clusters continued HR acceleration until epoch 7 after which a steady deceleration was measured until the end of the imagery period. The low clusters showed HR deceleration from epoch 3 to epoch 12, resulting in lower HR levels compared to the high clusters. This

pattern of HR changes for the high and low clusters also resulted in a significant level X linear time ($F(1,49)=15.33$, $p<.001$) interaction between epoch 3 and epoch 12.

Figure 9.3b HR changes averaged for the high (**high FE + high CHW**) and low (**low FE + low CHW**) clusters



VALENCE

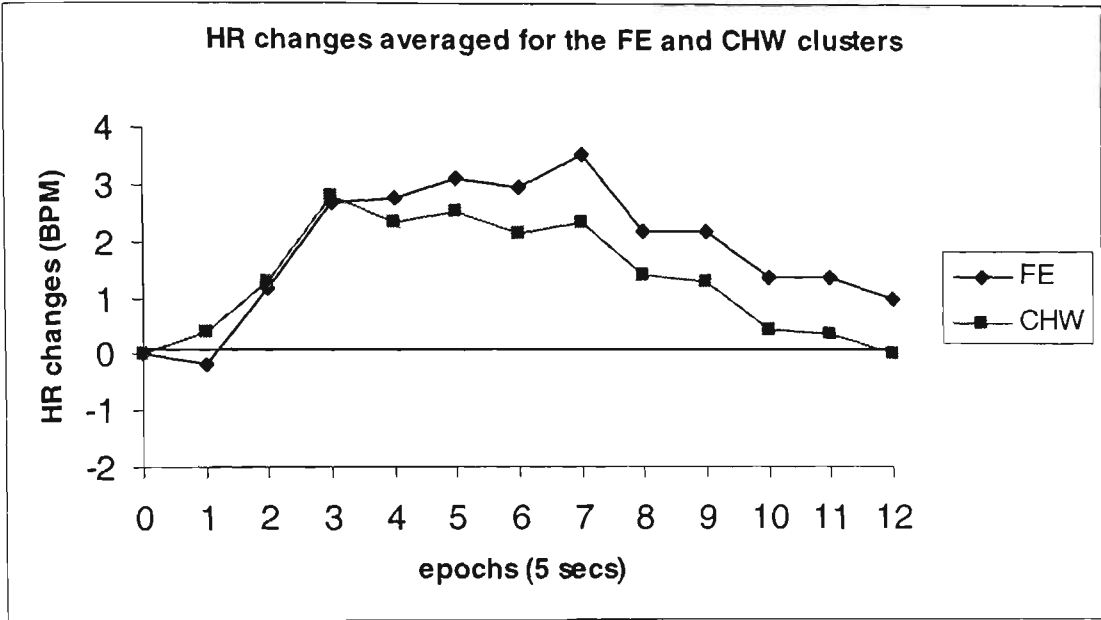
Figure 9.3c shows that the positive (FE) clusters produced larger average HR increases than the negative (CHW) clusters after the 3rd epoch. This resulted in an average level difference between the positive and negative clusters which was found to be significant across the whole imagery period ($F(1,49)=5.54$, $p<.05$), and for the period of imagery between epoch 3 and epoch 12, ($F(1,49)=8.94$, $p<.01$).

VALENCE X TIME

Significant valence X linear trend over time interactions were obtained over the entire imagery period ($F(1,49)=22.52$, $p<.001$) and from epochs 3 to 12 ($F(1,49)=4.73$, $p<.05$). These results reflected the pattern of HR activity for the FE and CHW clusters illustrated in Figure 9.3c. These developing differences after epoch 3 contributed to the

overall valence main effect noted above.

Figure 9.3c HR changes averaged for the FE (**high FE + low FE**) and CHW (**high CHW + low CHW**) clusters

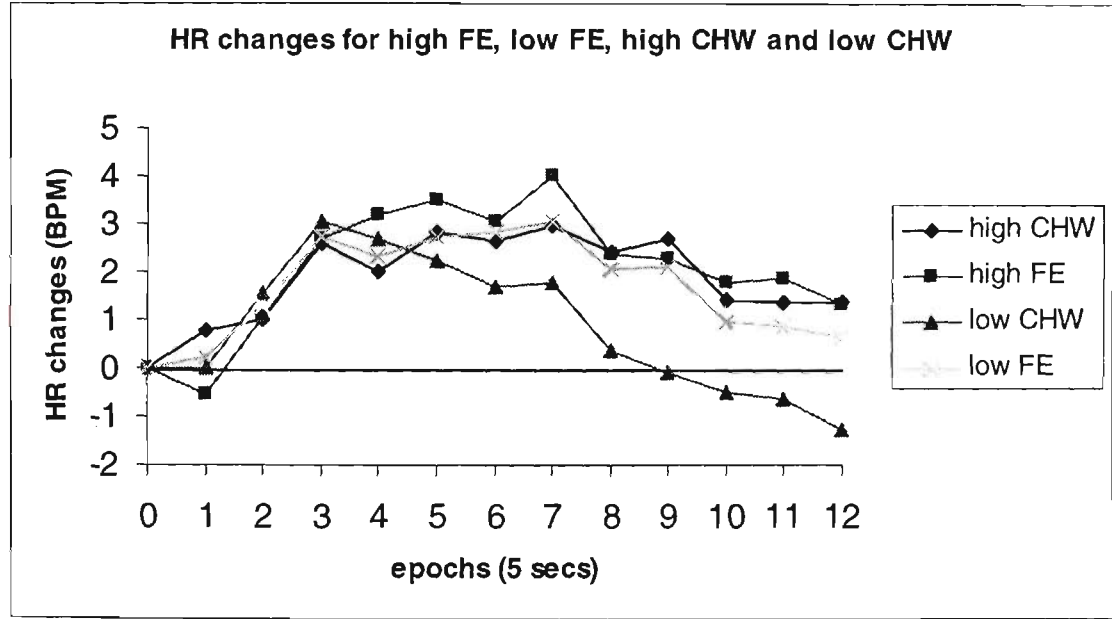


OTHER INTERACTIONS

A significant level X valence X linear trend over time interaction was obtained across the entire imagery period ($F(1,49)=4.06$, $p<.05$), and a significant level X valence X cubic time interaction ($F(1,49)=8.57$, $p<.05$) was found for the imagery period between epoch 3 and epoch 12. These findings suggest that the developing differences in HR increases between the high and low clusters differed as a function of valence. Figure 9.3d shows that prior to epoch 4, HR acceleration was similar for the four clusters. The **high FE** cluster sustained the highest HR levels between epoch 4 and epoch 8, after which this cluster showed similar HR levels to the **high CHW** cluster. The HR difference between the high and low levels in the CHW clusters was greater than the FE clusters, and this difference increased steadily during the second half of the imagery period. Of the four clusters, only the **low CHW** cluster recorded HR levels below the baseline value and this occurred during the final 20 seconds of imagery.

In summary, these analyses suggested that the imagery trials resulted in significant HR activity, and compared to Study 6, average increases in HR levels were greater, and were sustained longer over the course of the imagery period. The analyses for the main valence and level effects showed that average HR levels were greater for the high clusters versus the low clusters and for the FE clusters compared to the CHW clusters. However, as indicated in the interactions described above, the ability of the HR measure to discriminate between the high and low levels within each valence differed, with the largest differences observed between the **high CHW** and **low CHW** clusters during the second half of the imagery period. In other words, the HR response optimally reflected differences in negative emotions.

Figure 9.3d HR changes for the **high FE, low FE, high CHW** and **low CHW** clusters.

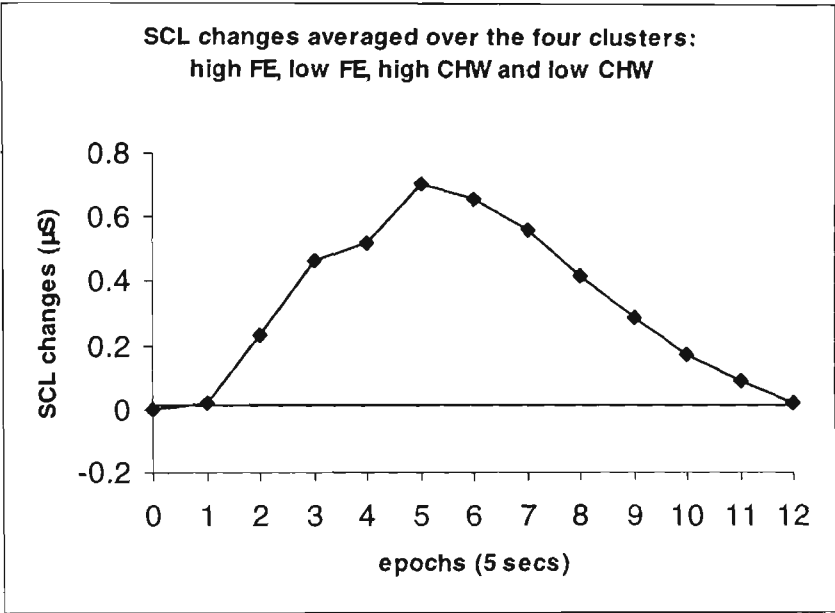


Skin Conductance Level Changes

Figure 9.3e illustrates the mean SCL response averaged over the four clusters as a function of time. SCL showed a linear increase that peaked at epoch 5 with a SCL increase of approximately $0.7\mu\text{S}$. SCL then decreased linearly for the remainder of the

imagery session to a level just above the baseline. The peak in SCL occurred at the same epoch (epoch 5) as found in Study 6 although, compared to this earlier Study, SCL remained higher than the baseline throughout the imagery period.

Figure 9.3e SCL changes averaged over the four clusters: **high FE, low FE, high CHW and low CHW**



TIME

A significant time effect was obtained over the entire imagery session in the quadratic trend ($F(1,49)=70.10, p<.001$). Analysis of the SCL increase described between epoch 0 and epoch 5 showed a significant linear increase ($F(1,49)=42.97, p<.001$). The SCL decrease observed between epoch 5 and epoch 12 was also found to be significant in the linear trend ($F(1,49)=47.56, p<.001$).

LEVEL

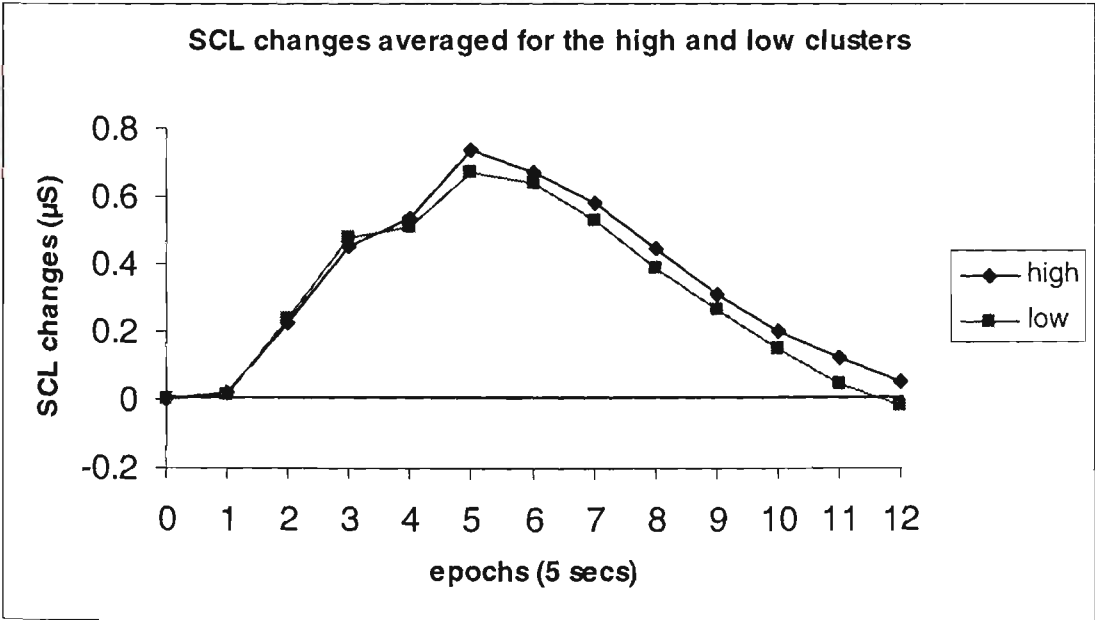
During the initial stages of imagery the low level clusters recorded a slightly greater SCL increase. The high level clusters showed larger increases in SCL for the imagery period between epoch 5 and epoch 12, that is during the response decrease.

There was no significant level difference found between the high and low level clusters, although the difference between the clusters over epoch 5 to epoch 12 approached significance ($F(1,49)=3.43, p=.070$).

LEVEL X TIME

A significant level X linear trend over time interaction ($F(1,49)=7.20, p<.01$) was found across the entire imagery period, confirming that the difference between the high and low level clusters increased over the course of the imagery session. From Figure 9.3f, it is evident that the high and low level clusters showed a similar increase in SCL prior to epoch 4 after which the high level clusters produced the larger increases in SCL. A level X quadratic trend over time interaction that approached significance ($F(1,49)=3.94, p=.053$) was found in the SCL increase (epoch 0 to epoch 5) for the high and low clusters. As illustrated in Figure 9.3f, this finding reflects the behavior of SCL described during the earlier stages of imagery, in particular at epochs 3 and 4.

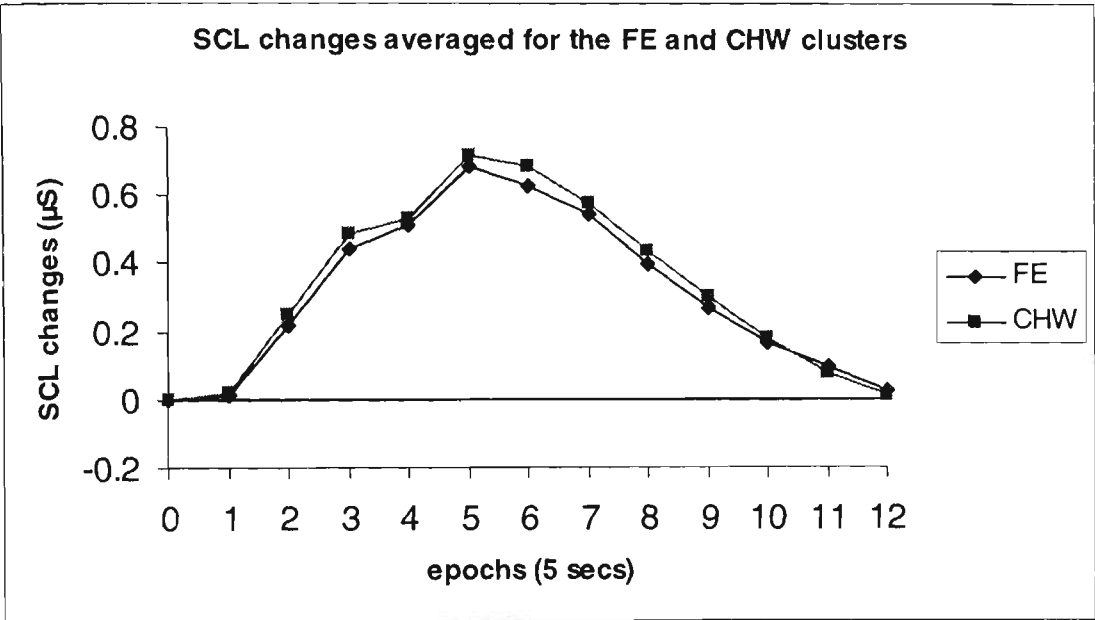
Figure 9.3f SCL changes averaged for the high (**high FE + high CHW**) and low (**low FE + low CHW**) clusters



VALENCE

There were no significant differences in SCL between the CHW and FE clusters (see Figure 9.3g).

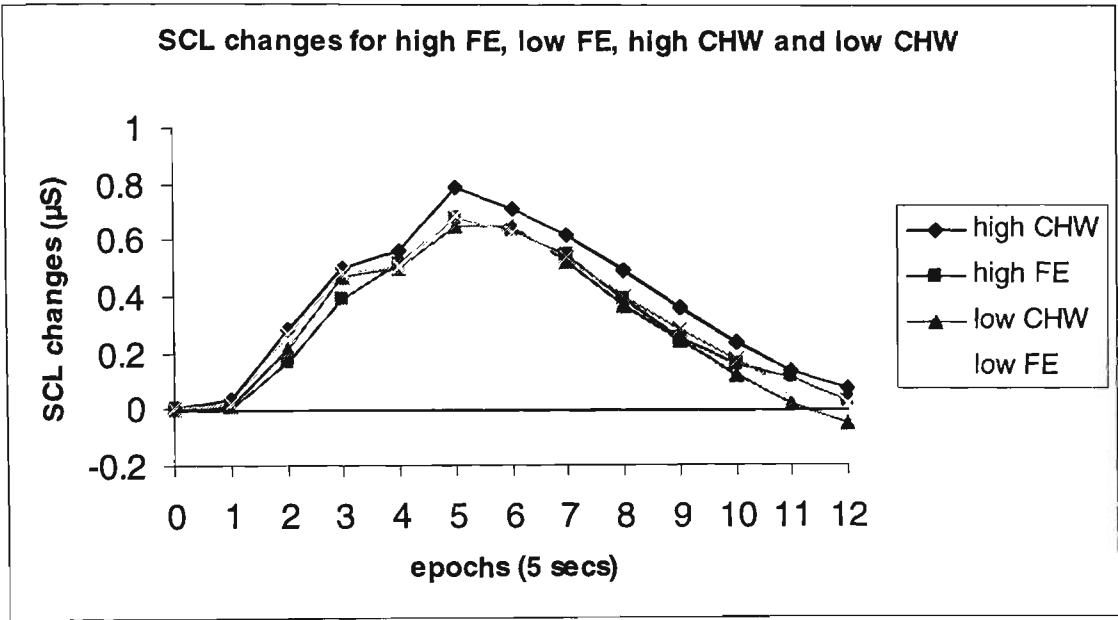
Figure 9.3g SCL changes averaged for the FE (high FE + low FE) and CHW (high CHW + low CHW) clusters



VALENCE X TIME

A significant valence X quadratic trend over time interaction ($F(1,49)=4.45$, $p<.05$) was found over the entire imagery period. As indicated in Figure 9.5g, compared to the FE cluster, the CHW cluster showed a greater quadratic trend over the course of the imagery period, with a greater increase and decrease in SCL noted for this cluster. A valence X linear trend over time interaction approached significance for the SCL decrease between epoch 5 and epoch 12. This finding reflects the greater SCL decrease for the CHW clusters than the FE clusters during this period of imagery. Together, these findings indicate a greater response to FE than CHW clusters.

Figure 9.3h SCL changes for the **high FE, low FE, high CHW** and **low CHW** clusters.



There were no other significant interactions found in the SCL measure. (Figure 9.3h shows SCL for each of the four clusters.) In summary, the SCL response described for these four clusters was similar in pattern but more enhanced than that obtained for the same clusters examined in Study 6. SCL did not show any main effects of level or valence, although the significant results in the level X time and valence X time interactions indicate that the SCL response across the imagery period did reflect some cluster differences.

ANALYSES SET 2

Differences between high and low levels for each of the FE and CHW clusters

The results from Analyses Set 1 showed that HR changes reflected the main effects of valence and level. Significant interactions obtained in the first analyses set indicated that level differences in HR were more marked in the CHW clusters than the FE clusters. There were no significant main effects obtained in the SCL data, although

the significant interactions found in Analyses Set 1 indicated that SCL reflected level differences over the course of the imagery period.

Using the same imagery session clusters described above, differences in HR and SCL were examined between the high and low levels for each of the positive (FE) and negative (CHW) clusters separately. As for the first analyses set, this second analyses set is consistent with that carried out in Study 6. The statistical outcomes from Analyses Set 2 are presented in Table 9.4.

Heart Rate Changes

FE clusters

Figure 9.4a illustrates the pattern of HR activity for the **high FE** and **low FE** clusters. HR increases for the **high FE** cluster were generally larger than the **low FE** cluster from the 3rd epoch until the end of the imagery period.

TIME

A significant time effect in HR ($F(1,49)=55.32, p<.001$) was apparent in the quadratic trend across the imagery period. Analysis of the HR response from epoch 0 to epoch 3 showed a significant linear increase, ($F(1,49)=20.02, p<.001$) while a significant linear decrease ($F(1,49)=8.42, p<.01$) was noted between epoch 3 and epoch 12.

LEVEL

There were no significant differences observed in HR between the **high FE** and **low FE** clusters (see Figure 9.4a) in any of the imagery periods examined.

Table 9.4 Statistical outcomes for Analyses Set 2.

Clusters	EFFECTS	Imagery Period	HR changes		SCL changes	
			Trend	F(1,49)	Trend	F(1,49)
FE	Time	E0 to E12	quad.	55.32 ***	quad.	64.45 ***
		Increase	linear	20.02***	linear	39.94 ***
		Decrease	linear	8.42 **	linear	43.97 ***
	Level	E0 to E12		n.s.		n.s.
		Increase		n.s.		n.s.
		Decrease		n.s.		n.s.
	Level X Time	E0 to E12		n.s.		n.s.
		Increase		n.s.	quad	4.29 *
		Decrease		n.s.		n.s.
CHW	Time	E0 to E12	quad	27.33 ***	quad	72.64 ***
		Increase	linear	18.74 ***	linear	44.66 ***
		Decrease	linear	18.32 ***	linear	49.43 ***
	Level	E0 to E12		3.55 #		n.s.
		Increase		n.s.		n.s.
		Decrease		4.69 *		n.s.
	Level X Time	E0 to E12	linear	26.07 ***		n.s.
			cubic	4.67 *		
		Increase		n.s.		n.s.
		Decrease	cubic	24.97 ***		n.s.

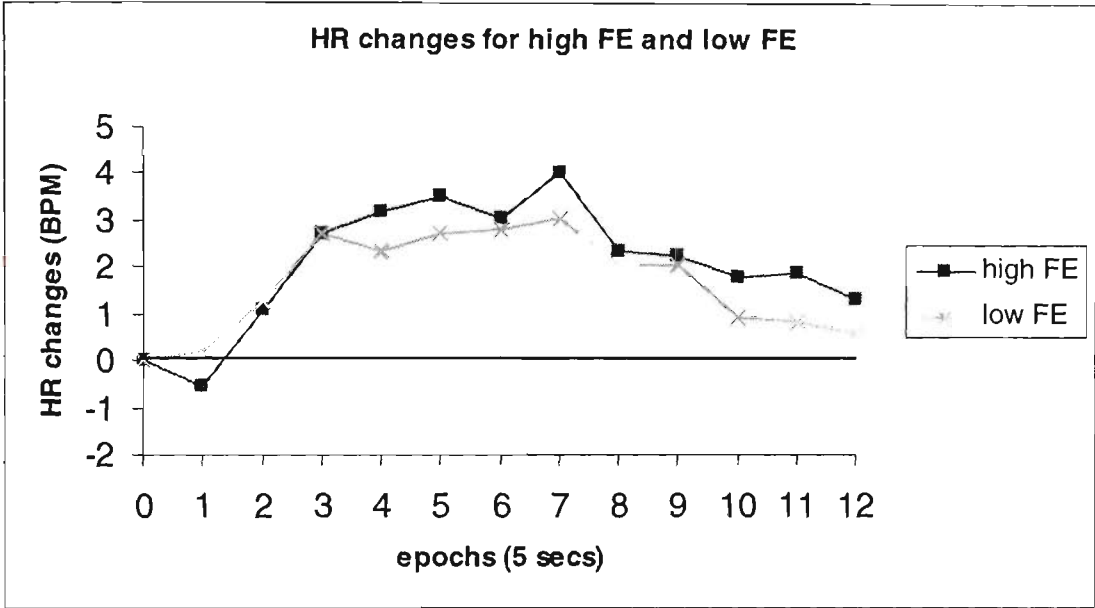
KEY

- *** significant at .001 level
- ** significant at .01 level
- * significant at .05 level
- # approached significance

LEVEL X TIME

There were no significant level X time interactions found in HR for the FE clusters.

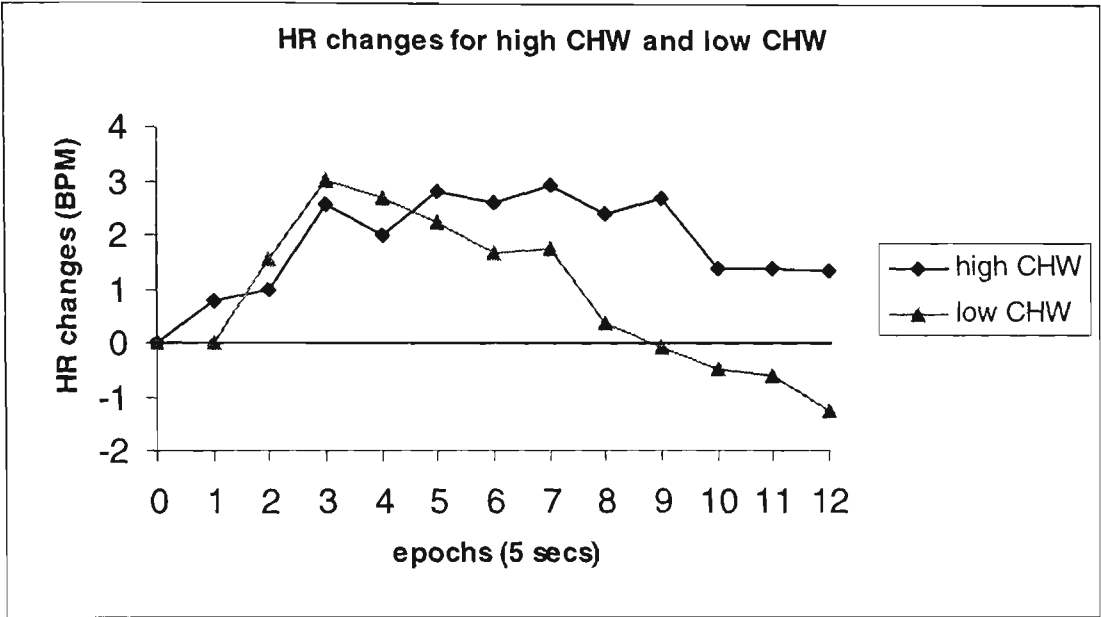
Figure 9.4a HR changes for the **high FE** and **low FE** clusters



CHW clusters

As illustrated in Figure 9.4b, the **high CHW** and **low CHW** clusters produced similar HR acceleration across the first three epochs. After epoch 4, HR levels for the **high CHW** cluster continued to increase reaching a peak at epoch 7. The **high CHW** cluster showed a slight HR deceleration from epoch 7 to epoch 12. The **low CHW** cluster peaked at epoch 3, after which HR deceleration occurred. This resulted in HR levels below the baseline during the final epochs of imagery for the **low CHW** cluster.

Figure 9.4b HR changes for the **high CHW** and **low CHW** clusters.



TIME

A significant quadratic trend over time ($F(1,49)=27.33, p<.001$) was found for the CHW clusters over the entire imagery period. Analysis of the HR increase between epoch 0 and epoch 3 showed a significant linear trend over time ($F(1,49)=18.74, p<.001$). The large linear decrease noted between epoch 3 and epoch 12 was also found to be significant ($F(1,49)=18.32, p<.001$).

LEVEL

The average HR level difference across the entire imagery period between the **high CHW** and the **low CHW** clusters approached significance ($F(1,49)=3.55, p<.06$). This difference between the same two clusters was significant for the period of imagery associated with the imagery experience after the developmental phase, that is between epoch 3 and epoch 12 ($F(1,49)=4.69, p<.05$).

LEVEL X TIME

As illustrated in Figure 9.4b, after the developmental phase (up to epoch 3), HR

increases for the **high CHW** cluster were larger than the **low CHW** cluster, and this resulted in a level difference that increased over the remainder of the imagery period. Three significant interaction effects were found in HR for the CHW clusters. A significant level X linear trend over time interaction was found for the whole period ($F(1,49)=26.07, p<.001$), which confirmed that the difference between these two groups did increase over the course of the imagery period with the **high CHW** cluster showing greater HR acceleration. Significant level X cubic trend over time interactions were also found for the entire imagery period ($F(1,49)=4.67, p<.05$), and for the HR response between epoch 3 and epoch 12 ($F(1,49)=24.97, p<.001$). These last two findings in the cubic trend are due to the difference between the high and low CHW clusters which first showed an increase (epoch 5 to epoch 8), before decreasing at epoch 10, and finally increasing again across the last two epochs.

Skin Conductance Level Changes

FE clusters

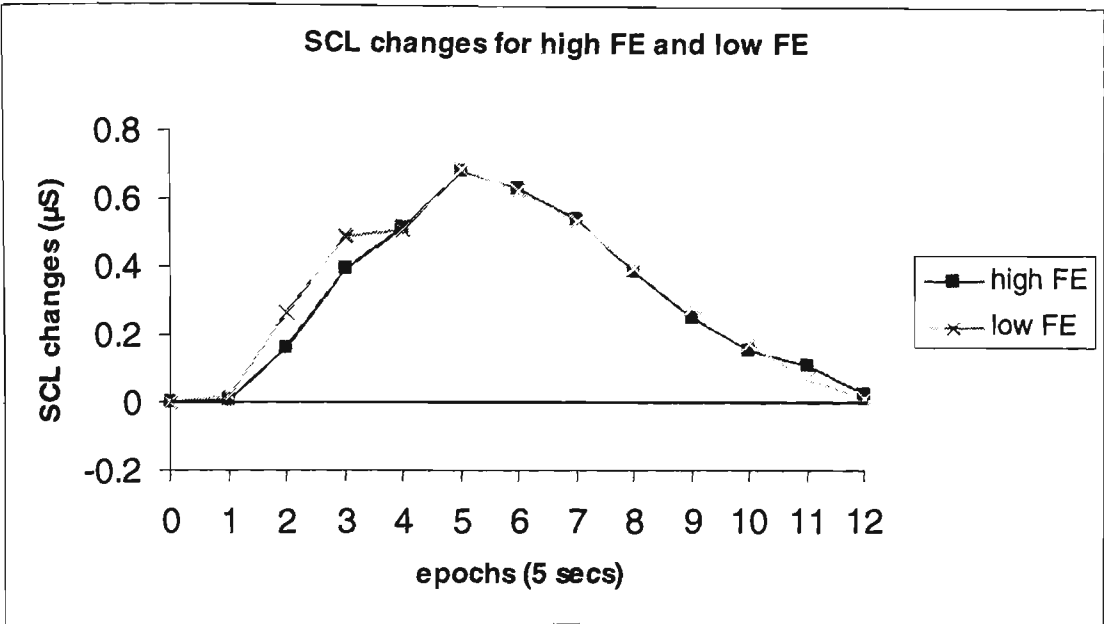
TIME

Figure 9.4c shows SCL across the imagery period for the **high FE** and **low FE** clusters. A significant time effect in the quadratic trend was found for SCL over the entire imagery period ($F(1,49)=64.45, p<.001$). The SCL increase from epoch 0 to epoch 5 was found to be significant in the linear trend ($F(1,49)=24.44, p<.001$), as was the SCL decrease from epoch 5 to epoch 12 ($F(1,49)=17.44, p<.001$).

LEVEL

There were no significant average level differences in SCL for the FE clusters.

Figure 9.4c SCL changes for the **high FE** and **low FE** clusters



LEVEL X TIME

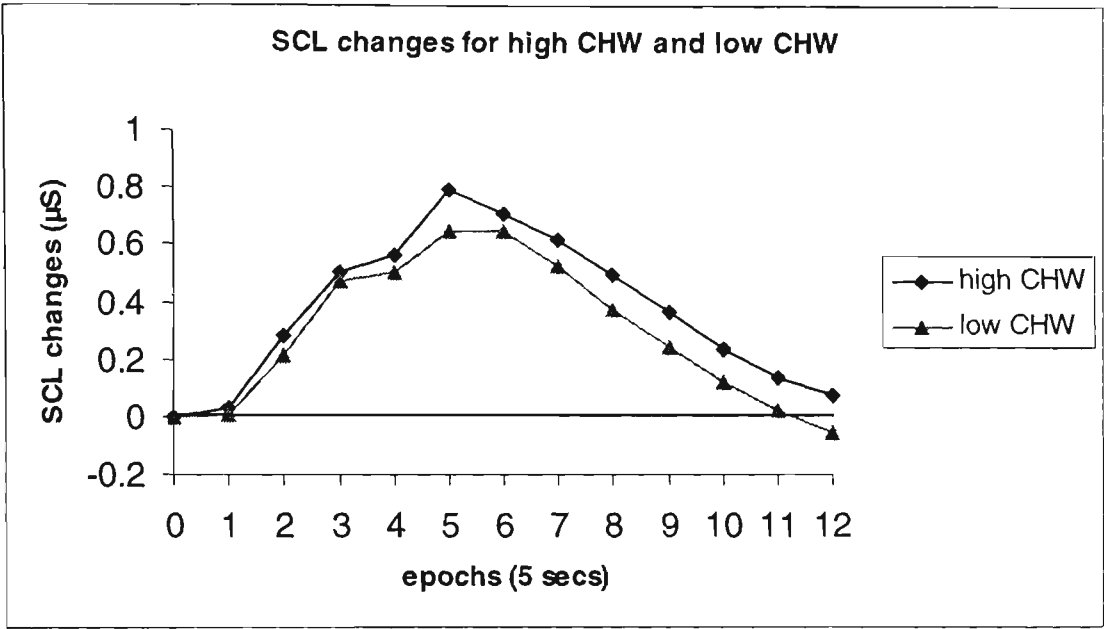
A significant level X quadratic time interaction was found for the **high FE** and **low FE** clusters ($F(1,49)=4.29, p<.05$) between epochs 0 and 5. This finding reflects the more rapid SCL increase for the **low FE** cluster between epoch 0 and epoch 3.

CHW clusters

TIME

The **high CHW** cluster produced larger SCL increases than the **low CHW** cluster, and as illustrated in Figure 9.4d, this difference was more pronounced during the second half of the imagery session. Analysis of the SCL response for the CHW clusters confirmed a significant quadratic time effect across the entire imagery period ($F(1,49)=72.64, p<.001$), and a significant linear increase ($F(1,49)=44.66, p<.001$) and a significant linear decrease ($F(1,49)=49.43, p<.001$) for epochs 0 to 5 and 5 to 12 respectively.

Figure 9.4d SCL changes for the **high CHW** and **low CHW** clusters



LEVEL

Similar to the FE clusters, there were no significant level differences in SCL for the **high CHW** and **low CHW** clusters.

LEVEL X TIME

There were no significant time X level interaction effects in any of the linear, quadratic or cubic trends tested in the CHW clusters for SCL.

Results Summary

In summary, Analyses Set 2 showed a level effect in HR for the CHW clusters that approached significance across the entire imagery period, and was found to be significant for the period of imagery between epoch 3 and epoch 12. A significant level X linear trend over time interaction for HR across the entire imagery period was also found in the CHW clusters. These findings were not replicated in the FE clusters. These results indicate that HR was more reflective of differences in the level of CHW than FE.

In regard to SCL, there were no significant average level differences for either the CHW or FE clusters. Only the FE clusters showed a significant level X quadratic trend over time interaction, and this was found for the period of imagery between epoch 0 and epoch 5. This finding reflected the more rapid SCL increases in the **low FE** cluster between epoch 0 and epoch 3, and therefore is similar to the pattern of HR observed for these two clusters during the initial (developmental) stages of imagery.

To conclude, these first two sets of analyses support the previous Study findings, particularly in the HR response. HR activity reflected level differences in negative emotions but not positive emotions. The Analyses Set 1 findings in SCL suggested some cluster differences, however, Analyses Set 2 failed to identify strong level differences in either the FE or CHW clusters.

ANALYSES SET 3

Differences between high and low levels for each of the high pole/low pole PA and NA clusters.

In Analyses Set 3, patterns of HR and SCL activity were examined for differences between clusters of imagery sessions that differed in NA while remaining stable for PA, and between clusters of imagery sessions that differed in PA, but not NA. The average PA score for the four imagery sessions "fun", "excitement", "enthusiasm" and "challenge" (**high pole PA**) was found to be significantly greater than the "drowsy" (**low pole PA**) imagery session ($F(1,49)=427.60, p<.001$). There were no significant differences in NA ($F(1,49)=.31, p=.580$). Average NA for the four imagery sessions: "anxious", "hard", "worry" and "distress" (**high pole NA**) was found to be significantly greater than the "calm" (**low pole NA**) imagery session ($F(1,49)=335.49, p<.001$), while there was no significant difference in PA ($F(1,49)=.60, p=.442$).

Table 9.5 Statistical outcomes for Analyses Set 3.

Clusters	EFFECTS	Imagery Period	HR changes		SCL changes	
			Trend	F(1,49)	Trend	F(1,49)
PA	Time	E0 to E12	quad.	41.76 ***	quad.	56.87 ***
		Increase	linear quad.	11.74 *** 6.39 *	linear	34.58 ***
		Decrease	linear	25.13 ***	linear	34.09 ***
	Level	E0 to E12		n.s.		n.s.
		Increase		n.s.		n.s.
		Decrease		4.44 *		3.54 #
	Level X Time	E0 to E12	linear	18.77 ***	linear	4.70 *
		Increase		n.s.	linear	2.94 #
		Decrease	linear	12.41 ***		n.s.
NA	Time	E0 to E12	linear quad. cubic	4.50 * 19.62 *** 4.68 *	quad.	70.83 ***
		Increase	linear	17.61	linear	42.17 ***
		Decrease	linear	23.71 **	linear cubic	57.14 *** 4.66 *
	Level	E0 to E12		5.97 *		n.s.
		Increase		n.s.		n.s.
		Decrease		8.54 **		n.s.
	Level X Time	E0 to E12	linear cubic	35.56 *** 11.22 **		n.s.
		Increase		n.s.		n.s.
		Decrease	linear quad.	25.21 *** 8.89 **	linear	3.01 #

KEY

*** significant at .001 level

** significant at .01 level

* significant at .05 level

approached significance

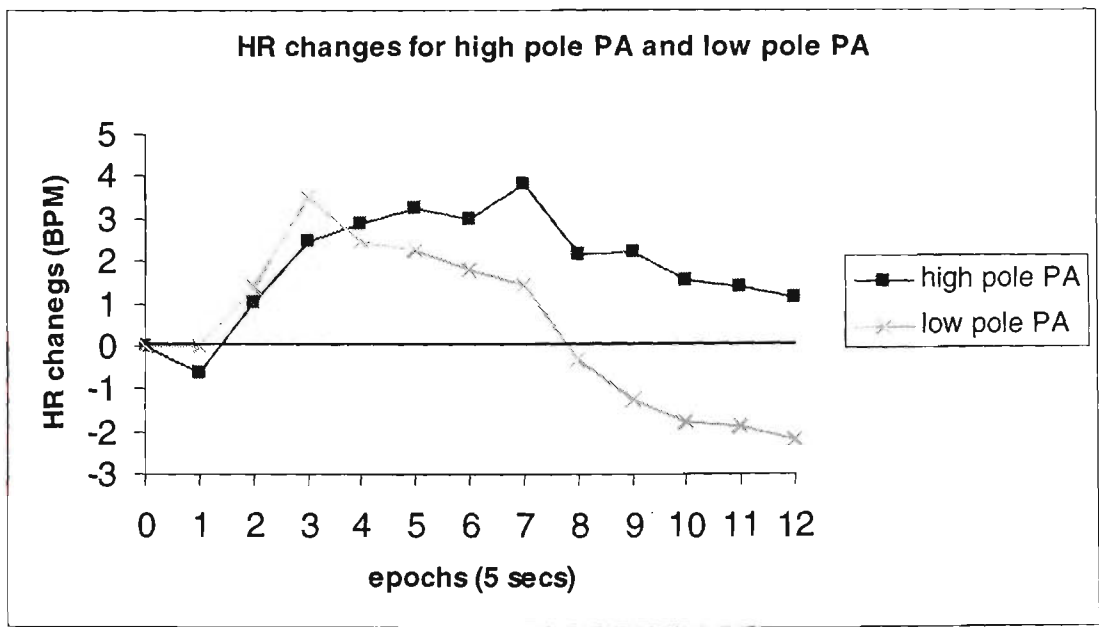
Cardiac and electrodermal activity were examined for differences between the **high pole PA** and **low pole PA** clusters, and between the **high pole NA** and **low pole NA** clusters. Table 9.5 provides a summary of the results for this third set of analyses.

Heart Rate Changes

High pole PA and low pole PA

Figure 9.5a illustrates the HR changes for the **high pole PA** and **low pole PA** clusters. Initially both clusters showed HR acceleration with the **low pole PA** cluster showing larger HR increases across the first three epochs. After epoch 4 the **low pole PA** cluster showed a marked HR deceleration while the **high pole PA** cluster continued to show HR increases, reaching a peak at epoch 7. Both clusters showed HR deceleration from epoch 7 and epoch 12, with the **low pole PA** cluster recording lower HR levels that fell below the baseline after epoch 8.

Figure 9.5a HR changes for the **high pole PA** and **low pole PA** clusters



TIME

The pattern of HR acceleration and deceleration for the **high pole PA** and **low pole PA** clusters across the entire imagery period was reflected in a significant quadratic trend over time ($F(1,49)=4.76$, $p<.001$). The pattern of HR activity was also supported with a significant linear increase between epoch 0 and epoch 3 ($F(1,49)=11.74$, $p<.001$), and a significant linear decrease between epoch 3 and epoch 12 ($F(1,49)=25.13$, $p<.001$) for the two PA clusters. A quadratic trend over time was also significant in the HR data between epoch 0 and epoch 3 ($F(1,49)=6.39$, $p<.05$).

LEVEL

The average HR level difference between the **high pole PA** and **low pole PA** clusters was not significant when tested over the entire imagery period, or for the imagery period between epoch 0 and epoch 3. However, HR level for the **high pole PA** cluster was significantly higher than the **low pole PA** cluster between epoch 3 and epoch 12 ($F(1,49)=4.44$, $p<.05$). This level difference is apparent in Figure 9.5a.

LEVEL X TIME

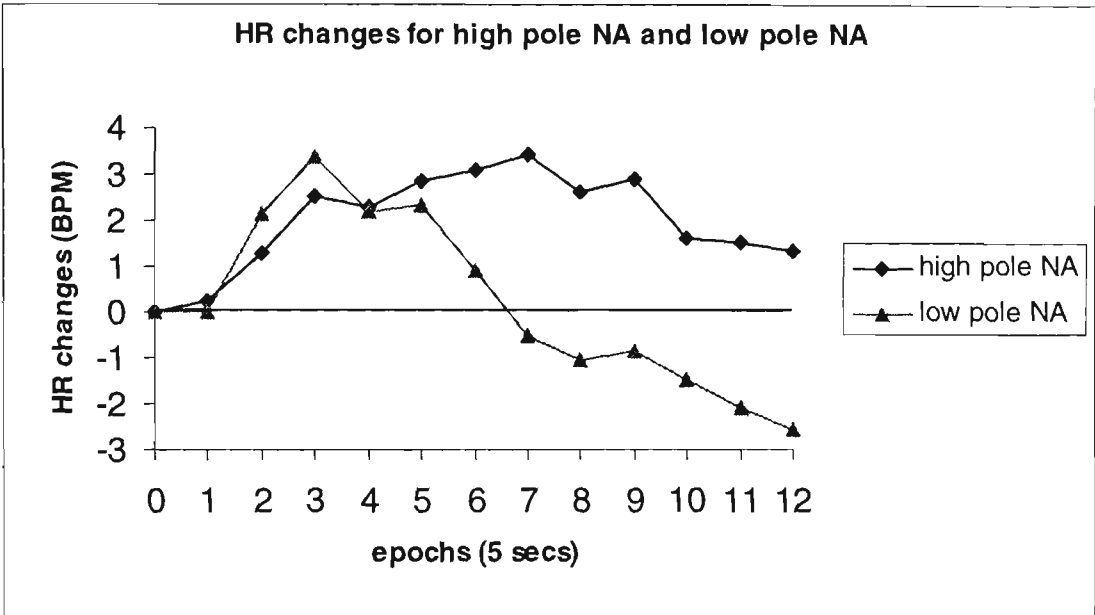
Significant level X linear trend over time interactions were found for the entire imagery period ($F(1,49)=18.77$, $p<.001$) and for the period of imagery between epoch 3 and epoch 12 ($F(1,49)=12.41$, $p<.001$). As illustrated in Figure 9.5a, these findings reflect the relationship between the two clusters over time, with the **low pole PA** cluster recording larger HR increases between epoch 0 and epoch 3, and larger HR decreases after epoch 4 that resulted in lower HR levels for the remainder of the imagery period.

High pole NA and low pole NA

Figure 9.5b shows the HR changes recorded for the two clusters of **high pole NA** and **low pole NA**. Similar to the PA clusters, the **low pole NA** cluster produced

greater HR increases during the early stages of the imagery period. At epoch 3, this pattern reversed, with the **low pole NA** cluster showing strong HR deceleration and the **high pole NA** cluster recording HR acceleration. HR deceleration was evident for the **high pole NA** cluster after epoch 7, although this cluster continued to record higher HR levels compared to its low pole counterpart for the remainder of the imagery period.

Figure 9.5b HR changes for the **high pole NA** and **low pole NA** clusters



TIME

This pattern of HR activity for the NA clusters was confirmed with a significant time effect found in the linear $F(1,49)=4.50, p<.05$), quadratic $F(1,49)=19.62, p<.001$) and cubic ($F(1,49)=4.68, p<.05$) trends examined over the imagery period. Further testing showed that the average linear increase described between epoch 0 and epoch 3 was significant ($F(1,49)=17.61, p<.001$), as was the decrease in the linear trend over time described between epoch 3 and epoch 12 ($F(1,49)=23.71, p<.001$).

LEVEL

Testing for differences between the **high pole NA** and **low pole NA** clusters

showed a significant HR level difference across the imagery period ($F(1,49)=5.97$, $p<.05$) and for the HR response between epoch 3 and epoch 12 ($F(1, 49)=8.54$, $p<.01$). This confirmed that the **high pole NA** group displayed significantly larger average HR levels across the imagery session, and in particular during the later stages of the imagery period.

LEVEL X TIME

A significant level X linear trend over time ($F(1,49)=35.56$, $p<.001$) interaction was found across the imagery period. This result indicated that the relationship between the **high pole NA** and **low pole NA** clusters changed over the course of the imagery period. As illustrated in Figure 9.5b, it is readily apparent that a relatively larger HR response occurred in the **high pole NA** cluster compared to the **low pole NA** cluster, and this difference developed linearly over time. A significant level X cubic trend over time interaction ($F(1,49)=11.22$, $p<.01$) was also found. This finding indicated that the development described above was not entirely uniform across epochs. Significant level X time interactions in the linear ($F(1,49)=25.21$, $p<.001$) and quadratic ($F(1,49)=8.89$, $p<.01$) trends were found for the HR decrease described between epoch 3 and epoch 12. These findings support the different HR deceleration patterns for the **high pole NA** and **low pole NA** clusters, resulting in a large level difference towards the end of the imagery period.

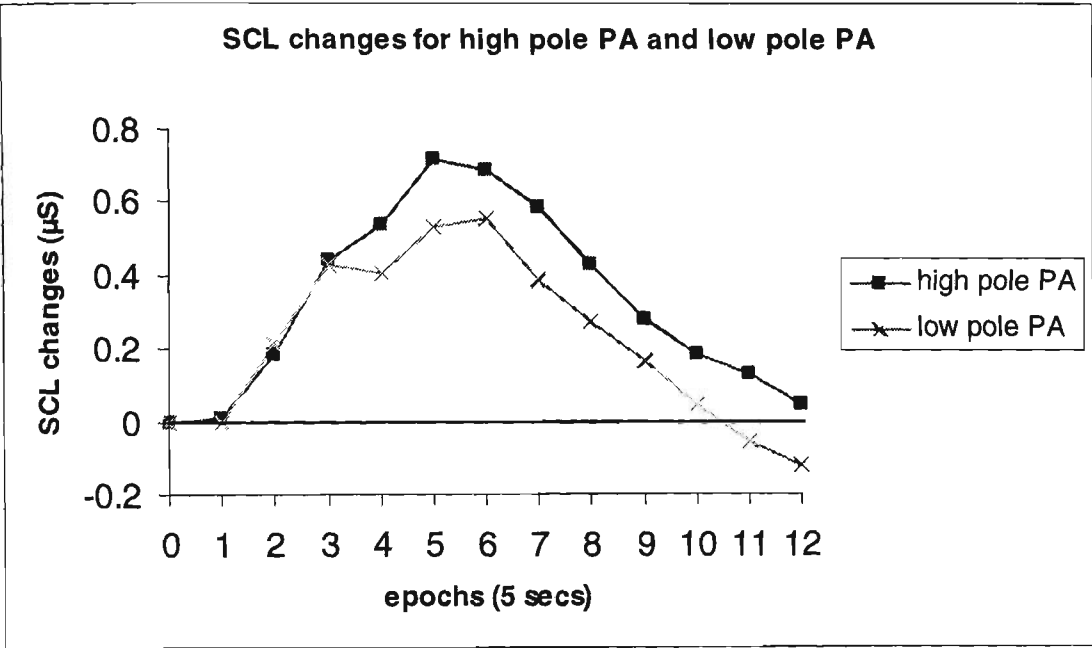
Skin Conductance Level changes

High pole PA and low pole PA

Figure 9.5c illustrates the SCL response for the **high pole PA** and **low pole PA** clusters. SCL changes for both clusters showed a general increase that peaked at epoch 5, followed by a linear decrease (epoch 5 to epoch 12). After epoch 3, the **high pole PA** cluster produced greater SC levels. Due to a similar rate of decrease in SCL for the two

clusters, this difference remained stable for the remainder of the imagery period. The SC decrease for the **low pole PA** cluster resulted in SCLs below the baseline for the final two epochs.

Figure 9.5c SCL changes for the **high pole PA** and **low pole PA** clusters



TIME

Analyses confirmed a significant quadratic trend in SCL across the entire imagery period ($F(1,49)=56.87, p<.001$). The linear increase between epoch 0 and epoch 5 was found to be significant ($F(1,49)=34.58, p<.001$), as was the linear decrease between epoch 5 and epoch 12 ($F(1,49)=34.09, p<.001$).

LEVEL

The difference in SCL between the **high pole PA** and **low pole PA** clusters was found to approach significance ($F(1,49)= 3.54, p=.066$) for the imagery period from epoch 5 to epoch 12. There were no significant level differences found in the other periods of imagery tested.

LEVEL X TIME

A significant level X linear trend over time interaction was recorded over the entire imagery period ($F(1,49)=4.70$, $p<.05$), indicating that SCL did differ between the two clusters over the course of the imagery period. As illustrated in Figure 9.7c, the SCL increase observed during the initial 15 seconds of imagery was similar in both the PA clusters, however, the SCL increase between epoch 3 and epoch 5 was noticeably greater for the **high pole PA** cluster. This difference in the SCL increase resulted in higher SC levels for the **high pole PA** cluster for the remainder of the imagery period.

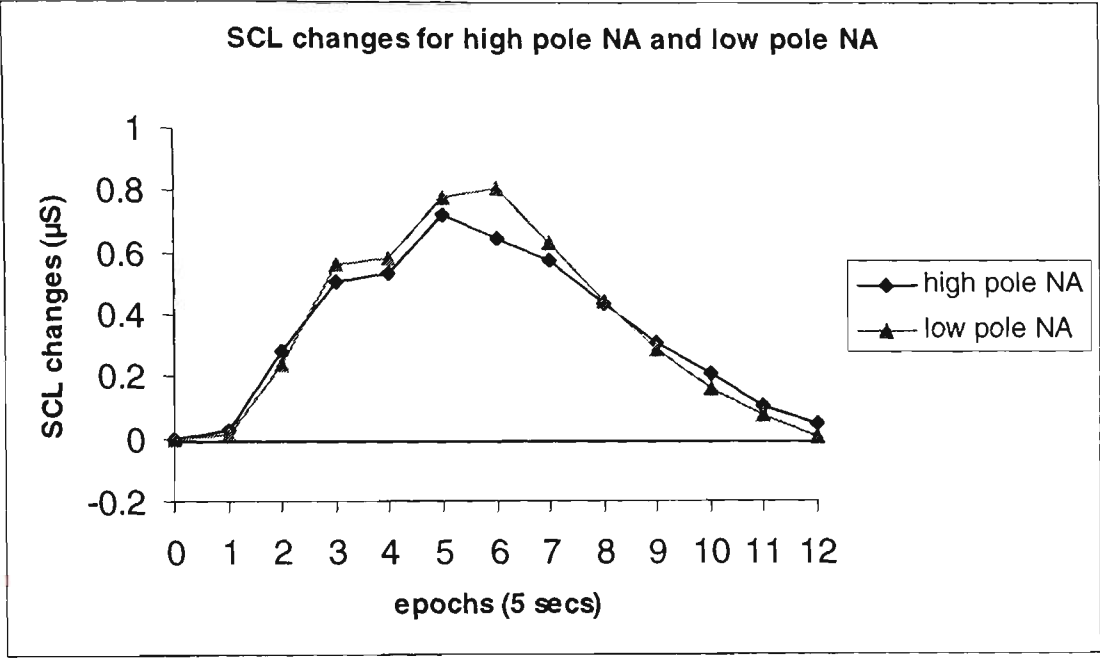
High pole NA and low pole NA

Figure 9.5d shows SCL for the **high pole NA** and **low pole NA** clusters. Both these clusters produced a SCL increase for the first part of the imagery period, with the **low pole NA** cluster recording a peak SCL at epoch 6 and the **high pole NA** cluster showing a SCL peak at epoch 5. During the second phase of the imagery period (epoch 5 to epoch 12), decreases in SCL for the two clusters showed a linear pattern, with the **low pole NA** cluster recording relatively lower SC levels towards the end of the imagery period.

TIME

The SCL response described for the NA clusters was confirmed with a significant quadratic trend over time across the entire imagery period ($F(1,49)=70.83$, $p<.001$). The linear increase observed in the first phase (epoch 1 to epoch 5) was found to be significant ($F(1,49)=42.17$, $p<.001$), as was the linear decrease noted between epoch 5 and epoch 12 ($F(1,49)=57.14$, $p<.001$). A significant cubic trend was also found for the imagery period from epoch 5 to epoch 12 ($F(1,49)=4.66$, $p<.05$).

Figure 9.5d SCL changes for the **high pole NA** and **low pole NA** clusters



LEVEL

There were no significant level differences in the mean SCL for the **high pole NA** and **low pole NA** clusters across the imagery period, or for the imagery periods from epoch 0 to 5, or epoch 5 to 12.

LEVEL X TIME

There were no significant level X time interactions observed in SCL for the NA clusters tested across the entire imagery period or for the period of imagery between epoch 0 and epoch 5. A level X linear trend over time interaction approached significance for SCL between epoch 5 and epoch 12 ($F(1,49)=3.01, p=.089$). This finding reflected the greater SCL decrease for the **low pole NA** cluster, which resulted in lower SC levels for this cluster during the final stages of imagery.

These findings in SCL for Analyses Set 3 provided evidence of SCL sensitivity to level differences in the positive emotions, with a significant level X linear trend over

time interaction and a level difference that approached significance in the PA clusters. These results were not found for the negative clusters.

In summary, Analyses Set 3 indicated that the differences in the pattern of HR activity for the high and low PA clusters and the high and low pole NA clusters showed some similarities. For both valence conditions, the low pole clusters produced greater HR increases during the initial stages of imagery (epoch 0 to epoch 3), after which strong HR deceleration resulted in lower HR levels for the low pole clusters compared to their high level counterparts. Both the **high pole PA** and **high pole NA** clusters showed HR acceleration until epoch 7, after which a relatively smaller HR deceleration was observed for the remainder of the imagery period. The **high pole PA** and **high pole NA** clusters sustained higher levels of HR than their low counterparts, and this level difference was found to be significant across the entire imagery period for the NA clusters. This level effect was also found to be significant between epoch 3 and epoch 12 in both the PA and NA clusters, although analyses indicate that the HR difference was greater for the NA clusters during this second HR response phase. Both the NA and PA clusters showed significant level X time interactions, but as indicated in Table 9.7, these interactions were stronger in the NA clusters. Together these results clearly suggest that the HR measure was more strongly reflective of differences in NA compared to PA.

In regard to SCL, a significant quadratic time effect was found in SCL for both the PA and NA clusters across the entire imagery period. Both the PA and NA clusters indicated level X linear trend over time interactions although this particular interaction measured across the entire imagery period only reached significance in the PA clusters. In addition, the SCL increases produced by the PA were in the anticipated direction. The **low pole NA** cluster produced higher SCL increases than the **high pole NA** cluster, whereas the **high pole PA** cluster produced higher SCL increases than the **low pole PA**

cluster (see Figure 9.5d and Figure 9.5c). Compared to the NA clusters, the SCL response for the **high pole PA** and **low pole PA** clusters was more sensitive to the level effect and this was reflected in an average level difference that approached significance for the period of imagery from epoch 5 to epoch 12. Overall these findings suggest that while SCL was less responsive to both PA and NA than HR, the largest response difference as a function of emotion level were in PA.

9.1.4 Discussion

This study explored differences in SCL and HR activity accompanying emotions that differed in valence (positive versus negative) and level (high versus low). Guided by 10 different descriptors: challenge, hard, worry, fun, excitement, calm, drowsy, anxious, distress and enthusiasm, positive and negative types of emotions were elicited during a series of one minute imagery sessions. Subjects were continuously monitored for HR and SCL changes during the imagery sessions. Similarly to the previous study, descriptor ratings and the PANAS scores were used to detect the presence of positive or negative types of emotions.

Three sets of analyses involving the physiological data were carried out in Study 7a. The descriptor ratings data were used to select imagery sessions representing the four clusters of **high FE**, **low FE**, **high CHW** and **low CHW**. The PANAS data confirmed the imagery session selection for the **high pole PA**, **low pole PA**, **high pole NA** and **low pole NA** clusters. The three sets of analyses involving ANOVAs tested the HR and SCL data for significant differences reflecting valence and level effects in the imagery session clusters.

Ratings Data

As for Studies 3,5 and 6, the five descriptors of challenge, hard, worry, fun and

excitement were used to monitor the presence of positive and negative related emotions. Analyses of the ratings questionnaire indicated that, compared to the experiment average, the imagery sessions of "hard" and "anxious" scored significantly high for the challenge, hard and worry descriptors, while the imagery sessions of "drowsy", "calm" and "fun" showed low levels for these same three descriptors. These two groups of imagery sessions were subsequently averaged and taken to represent the **high CHW** and **low CHW** clusters. The imagery sessions of "fun", "excitement" and "enthusiasm" showed significantly high levels of fun and excitement, and were averaged to form the **high FE** cluster. Likewise, the five imagery sessions: "anxious", "hard", "worry", "distress" and "drowsy" scored significantly low for the two positive descriptors and were subsequently averaged to form the **low FE** cluster.

PANAS Data

As illustrated in Figure 9.2, subjects experienced an array of emotional states that scored in three quadrants of the affective space defined by the PA and NA axes centered on the experiment average. Subjects experienced emotions that involved either high levels of NA (e.g., "anxious" and "distress") or PA (e.g., "excitement" and "enthusiasm"), while extreme low levels of PA and NA were experienced during the "drowsy" and "calm" imagery sessions respectively. Compared to the experiment average, the subject affective states on arrival at the laboratory were relatively low in PA and NA. On completion of the experiment subject affective states were significantly lower in PA and significantly higher in NA than the initial PA and NA levels. This finding suggests that subjects did experience strong emotions, in particular negative emotions, that influenced their overall affective state measured at the conclusion of the experiment. This result is in contrast to the previous study where no significant differences were found between subjects' initial and final affective states.

Compared to the previous study, only three quadrants of the affective space

(centred on the experiment average) were represented, but the imagery sessions were generally more evenly distributed across the experiment's affective space. Compared to the previous study, the inclusion of the "enthusiasm" and "drowsy" imagery sessions in Study 7 created a wider area of affective space to explore. Analyses confirmed that relative to the baseline PA and NA, significantly high and significantly low levels of PA and NA were represented in this array of imagery sessions. For example, analyses confirmed that the imagery sessions of "enthusiasm", "excitement" and "fun" showed significantly higher levels of PA compared to the baseline, and inter-imagery comparisons within this positive cluster revealed significant differences in PA (e.g., between "fun" and "enthusiasm") and NA (e.g., between "excitement" and "fun"). Compared to the baseline, the four imagery sessions of "hard", "worry", "anxious" and "distress" recorded significantly higher NA levels. Inter-imagery session comparisons carried out on this negative cluster showed that only the "worry" and "distress" imagery sessions failed to differ in PA or NA. The "drowsy" and "calm" imagery sessions produced significantly lower PA levels than the baseline, while only the "calm" imagery session resulted in significantly lower NA.

The "challenge" imagery session showed significantly higher PA and NA levels compared to the baseline. This is consistent with our finding in the previous study for the "challenge" imagery session. It should be noted that, compared to Study 6, the "challenge" imagery session did not feature in the high NA / high PA quadrant centered on the experiment average (see Figure 9.2). This is partly due to a shift in experimental average along the NA axis as well as the lower NA score recorded for the "challenge" imagery session in this experiment. This last finding suggested that the nature or type of challenge imagined differed from the previous study, and this was possibly related to the new imagery instructions requesting subjects to imagine themselves "physically involved" in the challenging situation.

The PANAS data from the imagery sessions were used to determine imagery session clusters that differed in PA or NA levels only. Specific comparisons between the **high pole PA** cluster ("enthusiasm", "excitement", "fun" and "challenge" and the **low pole PA** cluster ("drowsy") confirmed a significant difference in PA but not NA. A significant difference in NA, but not PA, was found between the **high pole NA** cluster ("anxious", "hard", "worry" and "distress") and the **low pole NA** ("calm") cluster.

In summary, the PANAS data supported the use of imagery to evoke emotions that differed significantly from a neutral or baseline state. The PANAS also confirmed that the emotions experienced reflected a broad area of the affective space defined by the PA and NA axes, with emotion states represented by both a PA and NA score.

Physiological Data

The physiological data (HR and SCL changes) were initially examined for differences between the **high FE, low FE, high CHW and low CHW** clusters as a function of time (E0 to E12), level (high versus low) and valence (FE versus CHW) factors. As for Study 6, time, level and valence differences were examined in the physiological response across the entire imagery period, and across the epochs representing a response increase and a response decrease. This first set of analyses confirmed that significant HR and SCL changes occurred over the course of the imagery period. Compared to the previous study, larger HR increases were obtained in this study and these were sustained for 25 seconds (epoch 2 to epoch 7) of the imagery period, with an average peak HR increase recorded at epoch 7. Average HR levels did not fall below the baseline value for these imagery sessions clusters. The pattern of changes in SCL for the four clusters were similar to that obtained in the previous study, although larger changes in SCL were obtained and the average SCL did not fall below the baseline value throughout the imagery session. The SCL peak for the four clusters was recorded at epoch 5, and this was consistent with the SCL peak found in Study 6. These

findings in both the HR and SCL data suggest that, compared to Study 6, the emotions elicited in this study were accompanied by relatively stronger physiological changes.

Significant HR differences were found for the high and low clusters. The high clusters recorded significantly higher HR increases across the entire imagery period and for the imagery period representing the HR deceleration, that is between epochs 3 and 12. Compared to the low clusters, SCL changes for the high clusters were larger and this difference approached significant levels in SCL between epoch 5 and epoch 12.

HR changes were found to be significantly higher for the FE clusters than the CHW clusters across the entire imagery period and for the period of imagery between epoch 3 and epoch 12. Changes in SCL did not significantly differ between the two valence conditions (Analyses Set 1). The result in the HR response can be explained by examining the imagery sessions selected for the two valence groups. Removing the imagery sessions common to both the FE and CHW clusters, it is interesting to note that the CHW clusters include the additional "anxious " and "calm" imagery sessions, while the FE clusters include an additional four high pole imagery sessions of "enthusiasm," "excitement", "worry" and "distress". Thus, compared to the CHW clusters, the additional imagery sessions representing the FE clusters involved high pole emotions. It is therefore more likely that the relatively larger HR increases observed for the FE cluster reflected a level factor as opposed to a valence factor.

The second set of analyses investigated HR and SCL differences between the high and low clusters, separately for each valence condition. HR changes were higher for the **high CHW** compared to the **low CHW** cluster, and this difference increased over the course of the imagery period, with a significant difference found between epoch 3 and epoch 12. HR increases for the **high FE** cluster were larger than the **low FE** cluster after the 3rd epoch, however, this finding was not significant, and may have

simply reflected the presence of "drowsy" in the **low FE** cluster configuration. There were no significant average level differences in SC for either the FE or CHW clusters, however a significant level X quadratic trend over time was found in the SCL data between epoch 0 and epoch 5. This result was found in the developmental stage of the imagery period, and as found in HR, higher SCL increases were produced for the **low FE** cluster than the **high FE** cluster across the first four epochs of imagery. This result compares to a significant level X linear trend over time interaction in Study 6 for the SC response in the FE and PA clusters between epoch 5 and epoch 12. That result was interpreted as evidence of greater SCL increases associated with the high level positive clusters compared to the low level positive clusters. Together, these findings in the electrodermal measure were somewhat disappointing. While Analyses Set 1 suggested some cluster differences in the SCL measure, Analyses Set 2 failed to identify strong level differences in either the FE or CHW clusters.

In summary, the first two analyses sets showed that the overall pattern of HR and SCL changes accompanying the **high FE**, **low FE**, **high CHW** and **low CHW** clusters was similar to that obtained in the previous study, although HR and SCL increases were higher in the present study and average levels remained above the baseline for the duration of the imagery period. This enhanced physiological responding may be a result of the methodological changes implemented in the current study, but is likely to also reflect the different types of emotions and emotion intensities evoked during this experiment. Significant level differences and level X linear trend over time interactions were found in the HR data for the negative clusters only, with greater differences noted during the second component of the HR response. There were no significant level or level X time effects in HR for the positive emotions. SCL was found to be not as differentially responsive as HR in either the positive or negative clusters. There were no significant average level differences in SCL found in either FE or CHW clusters suggesting that the SCL measure was not sensitive to level differences in either positive

or negative emotions.

The results from the first two analyses drew attention to the more common problems associated with monitoring emotions and, in this study, the use of ratings to select the imagery session clusters for physiological comparison analyses. For example, while the imagery sessions representing the **low FE** cluster scored below the experiment average for the fun and excitement descriptors, some of the representative imagery sessions (e.g., "anxious") also scored highly for the opposing challenge, hard and worry descriptors. The presence of these opposing high pole emotions would undoubtedly influence the accompanying physiological activity. To help combat the problem of secondary emotions a second pre-determined cluster set based on PA and NA scores was examined in this study.

As mentioned in the Introduction, this cluster set involved emotions identified in the emotion literature as being high or low in PA while remaining essentially similar in NA, and vice versa. This effectively limited differences in the opposing emotion within the high and low positive or negative clusters.

The third set of analyses examined differences in HR and SCL activity between the **high pole PA** and **low pole PA** clusters, and between the **high pole NA** and **low pole NA** clusters. As mentioned earlier, analyses of the PANAS data confirmed that the positive high and low pole clusters differed significantly in PA levels only, while remaining stable for NA. Similarly, the high and low pole negative clusters were found to significantly differ in NA but not PA. Compared to our previous analyses, and those conducted in Study 6, this procedure ensured that the imagery sessions selected for comparison did not also elicit emotions that were associated with the opposing affective state.

Analyses of the HR and SCL data across the entire imagery period confirmed a significant response in the quadratic trend in both measures for the positive (PA) and negative (NA) clusters. Only the **low pole NA** and the **low pole PA** clusters produced HR changes that fell below the baseline level, and this occurred during the later stages of the imagery period. Analyses of the average HR acceleration (epoch 0 to epoch 3) and the average HR deceleration (epoch 3 to epoch 12) phases indicated (respectively) a linear increase followed by an even stronger linear decrease in both the PA and NA clusters. In regard to the HR response for the negative emotions, the **low pole NA** cluster initially recorded greater HR acceleration across the first three epochs, after which a marked deceleration was found. The **high pole NA** cluster produced HR increases from epoch 0 to epoch 7 before showing HR deceleration. This pattern of HR activity for the NA clusters was similar to the CHW clusters described above. A significant HR level difference was found in the NA clusters for the data tested across the entire imagery period, and for the data representing the HR deceleration phase. A significant level X linear trend over time result for HR across the entire imagery period indicated that the HR difference between the **high pole NA** and **low pole NA** clusters increased over the course of the imagery period.

A similar pattern of HR activity was found in the PA clusters, with the **high pole PA** cluster recording significantly higher HR levels between epoch 3 and epoch 12. While a significant HR difference was found for the high and low pole PA clusters, it should be noted that this difference was not found in the HR data tested across the entire imagery period. In addition, the difference found in the later stages of the imagery for the PA clusters was not as great as that found for the NA clusters across this same period of imagery. Significant level X linear trend over time results in HR across the entire imagery period were obtained in both the PA and NA clusters, however, these results indicated that response differences in the linear trend were greater between the NA clusters. Both the PA and NA clusters showed significant level X linear time

interactions for the HR data during the acceleration phase.

The SCL response for both the PA and NA clusters showed a significant quadratic trend across the entire imagery period. This finding was supported with a significant SCL linear increase and a significant linear decrease found in both the PA and NA clusters for the imagery periods of epoch 0 to epoch 5, and epoch 5 to epoch 12. Over the entire imagery period, SCL for the **high pole PA** cluster was larger than the **low pole PA** cluster, and this difference approached significance for the SCL between epoch 5 and epoch 12. This finding represents the first strong main level effect in SCL for any of the imagery session clusters under investigation in this or the previous laboratory study, and provided some indication of differential SCL activity for the level factor in the positive clusters. A significant level X linear trend over time interaction was also found for the PA clusters across the entire imagery period. This finding suggests that the overall SCL response is able to differentiate between levels for the positive clusters, and that this develops over time. There were no average level differences in SCL for the NA clusters in any of the imagery periods examined, nor were there any significant level X time interactions.

In summary, this third analyses set found differences in HR that were consistent with previous results. Strong level differences and level X time interactions were found across the entire imagery period and between epochs 3 and 12 for the NA clusters. While a significant HR difference were observed for the PA clusters between epoch 3 and 12, this difference was smaller than that found for NA. These results clearly indicate that HR activity is more responsive to level differences in negative emotions. In regard to SCL, a SCL difference that approached significance was found for the **low pole PA** and **high pole PA** clusters between epochs 5 and 12. This differential SCL response in the PA clusters was also supported by a significant level X linear time interaction recorded across the entire imagery period. While SCL has not proved as responsive to

level differences as HR in either the positive or negative clusters, these results in the PA clusters indicate that SCL does reflect level differences in positive emotions.

Our results from the comparison of different imagery session clusters reflecting different valence and level characteristics demonstrated heightened HR and SCL changes accompanying high level or high pole emotional states. HR change differences for the high clusters were significantly larger than the low level clusters and this effect was more apparent during the later stage of the imagery period. SCL increases were also greater for the high level clusters, although these response differences failed to reach significance for the two valence conditions. Together these findings suggest that the more intense emotions (utilised in Study 7a) appear to have generated larger responses in both HR and SCL. The results in Study 7a also indicated that level effects in each valence seemed to increase towards the end of the imagery period. These findings therefore support the use of prolonged imagery in the study of the psychophysiology of emotion, and suggest that the use of an even longer period of imagery may be worth investigating.

In regard to our experimental hypothesis concerning HR and SCL changes as a function of levels of negative and positive emotions respectively, HR differences were reliably produced between high and low levels of negative types of emotions and this result was found in both the CHW and NA clusters. Demonstration of differential SCL activity for positive or negative emotions proved more elusive, with only the difference between the **high pole PA** and **low pole PA** clusters approaching significance. This last difference developed significantly with time.

While these findings largely support the main hypotheses, a small number of inconsistent results found in the first three sets of analyses raised concerns about its complete acceptance. One example is the HR activity obtained for the **high pole PA** and

low pole PA clusters. The PANAS data confirmed that the **high pole PA** and **low pole PA** groups did not significantly differ in NA, thus eliminating the possible interference of negative emotions present in either of these two clusters. While the difference in HR levels between the **high pole PA** and **low pole PA** clusters was not as large as that observed between the **high pole NA** and **low pole NA** clusters, the difference did reach significance in the imagery period from epoch 3 and epoch 12. One explanation for this result is that, as shown in the first set of analyses, under imagery conditions changes in HR reflect level differences, and typically this effect is stronger in the second half of the imagery period, irrespective of the valence condition. The lack of significant HR differences between the positive and negative clusters also supports this notion.

In the previous study, the disappointing findings in SCL were attributed to experiment methodology, in particular concerns relating to the elicitation of emotions of suitable intensity. The present study did produce significant SCL increases that were responsive to cluster differences in the level factor. Differences in SCL for the **high pole PA** and the **low pole PA** clusters approached significance, and a significant level X linear trend over time interaction was obtained between epoch 5 and epoch 12. Previous research has argued that SCL reflects arousal (e.g., Lang, Greenwald, Bradley & Hamm, 1993), and it is possible that the difference in SCL measured for the high and low pole PA clusters reflects arousal differences. Arousal and valence effects on these data are explored further in the following Chapter. This, however does not explain the lack of SCL differences in the NA clusters, or in any of the clusters tested previously, which would also be associated with different arousal levels. It would seem therefore that SCL is responsive to differences in PA but not NA, but this differential responsiveness is weaker under imagery conditions, as has previously been noted in the literature (e.g., de Jong-Meyer et al., 1993).

In conclusion, the results from Study 7a largely supported the experimental

hypotheses with HR and SCL activity responding differentially to (respectively) negative and positive emotions. Using the PA and NA scores, an attempt to limit the effect of secondary emotions in this study proved successful, with strong differences found in both HR and SCL with the high and low pole PA and NA clusters. The PANAS and other similar questionnaires may also be used to monitor arousal and valence dimensions and this will provide more objective methods with which to control and monitor these emotion characteristics in future psychophysiological studies.

CHAPTER 10

HR and SCL changes as a function of emotion; relationship with arousal, valence and emotion intensity

10.1 STUDY 7B

10.1.1 Introduction

The results from Study 6 indicated that while both the HR and SCL measures recorded a significant response across the imagery period, only HR showed significant average level differences across the imagery session clusters. Further analyses in Study 6 indicated that HR reflected level differences in the negative emotions while SCL showed some sensitivity to level differences in the positive emotions. The results in Study 7a supported these findings with HR reflecting level differences in negative emotion and SCL reflecting a level difference in the high and low pole PA clusters.

Some of the findings from for the last two studies suggest that these two measures may also be influenced by other emotion characteristics such as arousal and valency. For example, arousal levels may have influenced the lack of significant differences in SCL in Study 6 and the HR level difference obtained in the PA clusters in Study 7a. According to Witvliet and Vrana (1995) the earlier studies reported in the psychophysiology of emotion literature failed to control or monitor the valence (which depends on the emotional context imagined) and arousal dimensions of the emotions examined, and as discussed in Study 6 and Study 7a, the influence of valence and arousal on HR and SCL has been demonstrated in a number of recent studies, particularly those employing picture presentation methodology (e.g., Lang, Greenwald, Bradley & Hamm, 1993).

According to Witvliet and Vrana (1995), studies that attempted to monitor the emotional context in terms of valence and arousal (e.g., Cook et al., 1991; Hawk, Stevenson & Cook, 1992) showed that high-arousal emotions resulted in greater HR increases than the low-arousal emotions. This finding is supported in Study 6 and Study 7a, with significantly higher HR levels found for the high level clusters for both sets of clusters examined (FE and CHW, PA and NA). In regard to SCL, a significant response was also obtained across the imagery sessions for Study 6. Analyses indicated that these changes were not as responsive to the imagery manipulations as the HR measure. Perhaps, as suggested by earlier research findings (e.g., Carroll, 1982; Vrana, 1993; 1995), changes in SCL simply reflect arousal levels, and under the imagery conditions employed in the previous study, the arousal levels were such as to not produce strong differential SCL activity within either of the valence conditions. In Study 7a, level differences in the electrodermal data were greater in the high pole PA clusters. It would be reasonable to suggest that this finding reflected a relatively greater arousal level difference in the high/low pole PA clusters compared to the clusters examined in Study 6. However, based on this explanation alone, one would also have anticipated a strong SCL difference in the high/low pole NA clusters. These mixed findings, particularly in the SCL response, raise doubt as to the influence of arousal on the physiological activity accompanying emotion elicited through imagery.

In a study carried out concurrently with the study described shortly, Witvliet and Vrana (1995) explored the psychophysiological responses accompanying the four emotions of fear, sadness, joy and pleasant relaxation. These four states were selected as they represented the four quadrants of negative high arousal (fear), negative low arousal (sadness), positive high arousal (joy) and positive low arousal (pleasant relaxation). Compared to the studies described earlier, their research study was influenced by theoretical developments concerning the description of emotions in relation to an "affective space" (e.g., Mehrabian & Russell, 1974; Russell, 1980; Watson & Tellegen,

1985). As well as other physiological indices (e.g., startle reflex, EMG, SCRs), HR and SCL activity were explored for the four emotion descriptors (or, as termed by Witvliet and Vrana, *emotion labels*) within what they described as "dimensional affectivity". The emotional contexts in the imagery trials were controlled using a series of sentences that were associated with the specific emotion category under investigation. The sentences used in the study were selected from 70 sentences that were rated for arousal and valence levels by an independent sample of 55 students. Using 7-point Likert Scales, the sentences were also rated for fear, joy, anger, sadness, surprise, grief and pleasant relaxation. Sentences selected represented emotions most extremely located in each of the four quadrants of the affective space, and were representative of their specific emotion category. This attempt to measure "extremely located" emotions is consistent with the objectives behind the selection of high/low pole clusters in the previous study.

Post imagery ratings using a visual-analog scale (scale 0-20, see Hodes, Cook & Lang, 1985) confirmed the expected valence and arousal (respectively) levels for the fear (5.02, 17.17), sadness (5.79, 10.50), joy (17.69, 15.19) and pleasant relaxation (16.38, 5.52) descriptors. Heart rate increases were recorded for each of the fear (1.91 BPM), sadness (1.03 BPM), joy (1.51 BPM) and pleasant relaxation (1.06 BPM) imagery sessions. Analyses showed that HR was greater during high arousal than during low arousal imagery. However, it is interesting to note that the difference in arousal between fear and sadness (6.67) is considerably less than the difference in arousal between joy and pleasant relaxation (9.67), yet a considerably larger HR difference was found between the two negative descriptors (fear and sadness). This supports findings in Study 6 and Study 7 which showed that while HR did reflect general level differences (i.e., high versus low), the negative clusters produced the largest HR difference between the high and low clusters.

Witvliet and Vrana found no significant effects of valence or arousal in the SCL

response for the four emotion descriptors. The highest SCL increase was recorded for the fear (0.007 μ S) imagery session and the lowest SCL increase was recorded for the joy (-0.009 μ S) imagery session. The largest (but non-significant) difference in SCL was found for the negative clusters, while average SCL changes for the two positive imagery sessions were essentially the same. This compares to Study 7a findings which showed greater SCL differences between the positive clusters. Similarly to Study 6 and Study 7a, their results also indicated a weaker response in SCL compared to HR. The authors concluded that the lack of significant differences in SCL was consistent with other studies (e.g., Cook et al., 1991) which failed to find any relationship between SC and the emotional content of imagery.

Arousal, Valence and Emotion Intensity

The hypotheses put forward in this thesis were that HR and SCL changes reflect differences in, respectively, the levels of negative and positive type emotions present. The results from the previous study showed that for both valence conditions, high level imagery sessions produced larger HR and SCL changes, reaching significance for the HR measure, particularly towards the later stages of the imagery period. This raises the possibility that these two measures are simply indicators of arousal, and that HR changes are somehow more responsive to imagery conditions. Another possibility not yet addressed in the emotion literature is that HR changes reflect the level of affect, or in other words, the emotion intensity. This would be consistent with the results found in the HR data in this thesis. The larger HR difference found between the high and low negative clusters in, say, Study 6, may simply reflect the larger difference in emotion intensity (valence level) between the negative clusters compared to the positive clusters.

The term *emotion intensity* is introduced here to describe the degree to which a person feels "emotional", irrespective of the type of emotion, positive or negative, experienced. It can be equated to the valence magnitude score. The emotion intensity

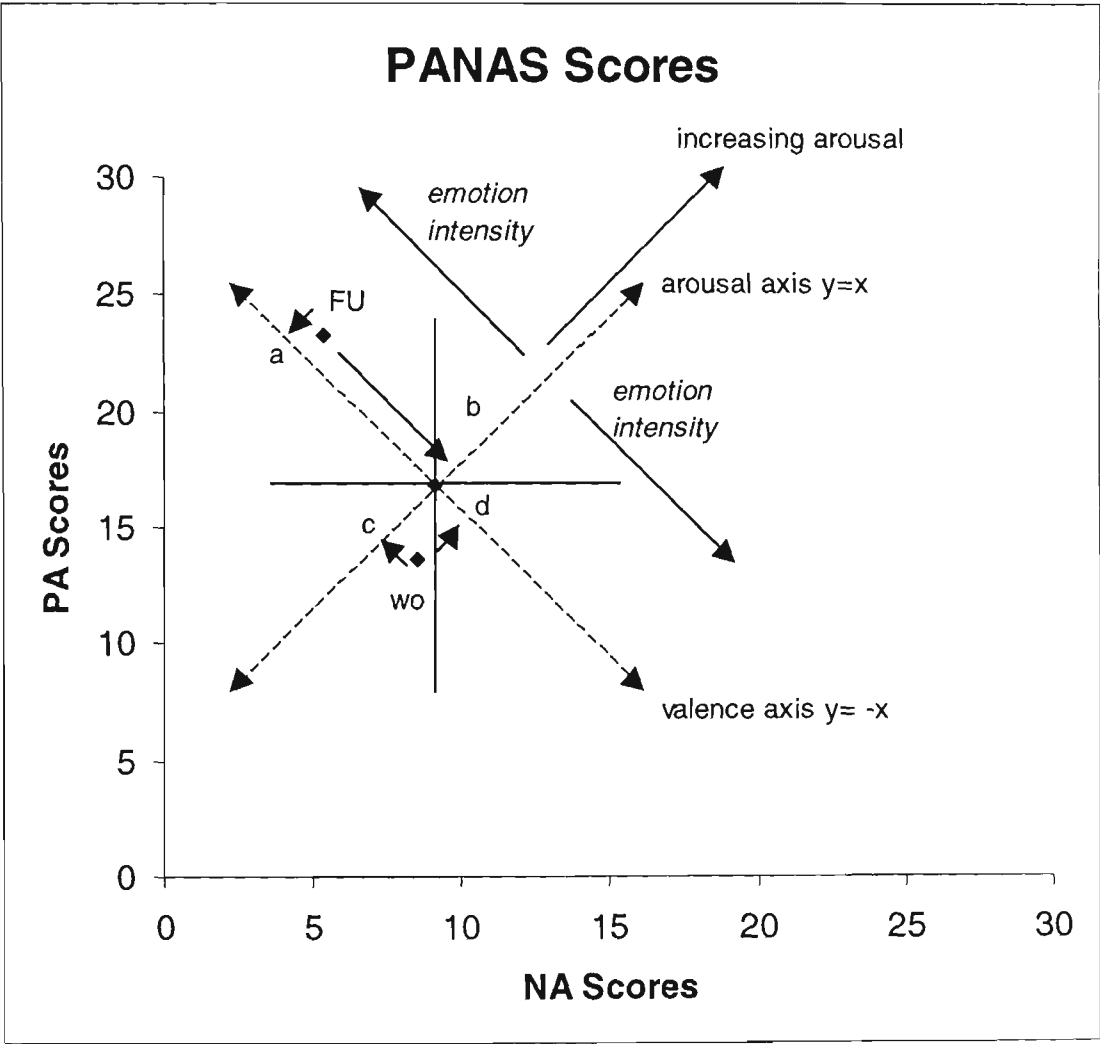
score therefore allows comparisons between emotions of different valence, (e.g., enthusiasm and distress) in regard to their emotional impact on the subject and the accompanying physiological activity. Figure 10.1 illustrates the relationship between arousal, valence and emotion intensity on the geometrical "affective space" defined by the PA and NA axes (see also Watson & Tellegen, 1985; Vrana and Witvliet, 1995). The two examples of "high fun" and "low worry" are shown using PA and NA scores obtained in Study 6.

While the term "emotional intensity" features in the emotion literature (e.g., Fridja, 1986), compared to arousal and valence characteristics of emotion it has been somewhat neglected in psychophysiological investigations of emotion. For example, Haney and Euse (1976) report using self report ratings on "affective intensity" and image clarity to monitor quality and content of images during the development of a hierarchy of visual imagery tasks. These ratings data on emotional intensity, however, were not examined for association with the physiological data gathered in the same study, but tested separately for correlations with personality traits such as neuroticism and anxiety (Euse & Haney, 1975).

Based on the above description, emotion intensity is orthogonal to arousal. According to Neiss (1988), the construct of arousal has been popular in the psychological literature because it offered a quantifiable equivalent to states of high emotion, for example emotional constructs such as fear and anxiety, and thus has been used interchangeably with high emotional states. Neiss described a number of studies such as the surgical study conducted by Sprague, Cambers and Stellar (1961) that showed affect and activation are quite distinct. In addition Neiss noted other studies (e.g., Mewborn & Rogers, 1979; Watson, Gaird & Marks, 1972) that have demonstrated that various measures of fear and anxiety have only low-level correlations with indices of global arousal. The term emotion intensity therefore, allows emotion's to be

categorised according to their affect intensity or affect level, which is not to be confused with the arousal/physiological activation components of the emotion.

Figure 10.1 The relationship between arousal, valence and emotion intensity as represented on an “affective space”. The two case examples of “high fun” and “low worry” are taken from Study 6. The letters “a” and “d” represent projections of the “high fun” (FU) and “low worry” (wo) imagery sessions onto the valence axis. Similarly, “b” and “c” represent projections onto the arousal axis.



This chapter describes two sets of exploratory analyses conducted to investigate the effects of arousal, valence and emotion intensity on average HR and SC levels. These analyses were conducted on the subject data from Study 7a. Analyses Set 1

explored the association between average SCL and HR levels with arousal, valence and emotion intensity. To determine the arousal and valence scores, the (x,y) co-ordinates for each of the 10 imagery sessions were translated to a new set of co-ordinates centred on an experiment average as (0,0). A set of simultaneous equations were solved to calculate intercepts for straight lines (with gradient 1 or -1) drawn through the imagery session co-ordinates and running perpendicular to the $y=x$ (arousal) or $y=-x$ (valence) axes. The formula for the distance between two points was used to calculate the relative distances along the arousal and valence axes from the centre to the points of intercept for each imagery session. The emotion intensity score was computed by taking the magnitude of the valence score. Appendix 23 shows step by step calculations for the arousal, valence and emotion intensity scores for the Anxious imagery session.

A series of multiple regression analyses were performed on the HR, SCL, arousal, valence and emotion intensity scores to determine any association between the physiological measures and the three dimensions characterising emotion. Based on the findings from Study 6 and Study 7a, it was hypothesised that, under imagery conditions, both the HR and SCL average changes would reflect the arousal dimension underlying the emotional states. This would account for elevated HR and SCL levels during high level imagery clusters compared to low level clusters. It was hypothesised that HR would also reflect emotion intensity. This would support the findings from both the laboratory studies showing HR level differences in both the positive and negative clusters. The larger HR difference found for the negative clusters may simply reflect a greater emotion intensity difference compared to the positive clusters.

This first set of analyses was repeated on a subset of subjects from Study 7a identified as good imagers. As mentioned in the previous chapter, imagery ability was determined from scores on imagery vividness in Study 7a using the Bett's Questionnaire Upon Mental Imagery (QMI) (Sheehan, 1967). HR, SCL, PA and NA scores were

averaged for the best 25 imagers and examined in Analyses Set 2. As for the first set of analyses, it was anticipated that these exploratory analyses would show a link between the physiological measures and arousal, and an association between HR and emotion intensity.

10.1.2 Method

This study used the physiological and psychological data collected for the 50 subjects involved in Study 7a. The method used for data collection is described in Chapter 9. Average HR and SCL for the 10 imagery sessions and the statistical outcomes for Study 7b are presented in Appendix 24.

10.1.3 Results

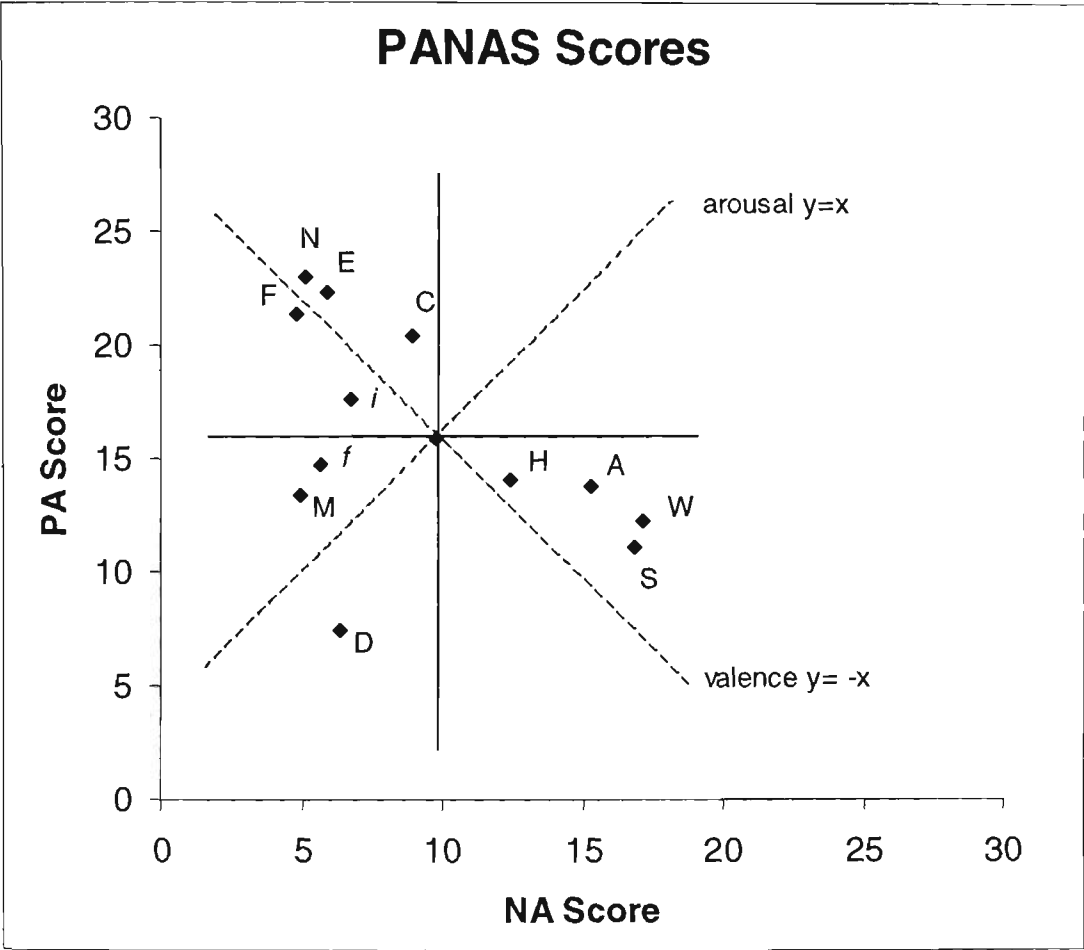
The arousal, valence and emotion intensity scores were calculated (as described in the Introduction) for each of the 10 imagery sessions. Multiple regression analyses were carried out on the average SCL and HR changes with the arousal, valence and emotion intensity scores. These analyses were repeated on the data for a sub-set of subjects ($n=25$) (Analyses Set 2) that were ranked relatively high in imagery ability.

Arousal, Valence and Emotion Intensity scores

Figure 10.2 shows the 10 imagery sessions located in the affective space defined by the PA and NA axes and centered on the experiment average PA and NA scores. The PA and NA scores for the 50 subjects are listed in Table 9.2 (Chapter 9). Rotating these two axes 45 degrees indicates the valence and arousal dimensions (Russell, 1980) (see Figures 10.1 and 10.2). The $y=x$ axis denotes the arousal dimension, with the upper end of the axis indicating higher arousal levels. The $y=-x$ line indicates the valence dimension, with negative valence levels scored below the $y=0$ line. The "level" of

valence (positive or negative) or what has been termed as emotion intensity is reflected in the distance from the centre co-ordinates along the valence axis, with larger distances associated with higher emotion intensity levels. For example, a high level of positive emotion would be indicated at the extreme upper end of the $y=-x$ line while a high level of negative emotion would be indicated at the extreme lower end of the $y=-x$ line.

Figure 10.2 The 10 imagery sessions plotted in an affective space ($n=50$) defined by the PA and NA axes, and the arousal and valence dimensions.



The locations of the 10 imagery sessions on these two dimensions (arousal and valence) were calculated using simultaneous equations to determine the projections on these axes. Emotion intensity was calculated by taking the modulus of the valence score. Table 10.1 shows the arousal and valence scores with the emotion intensity score and valence sign for each of the 10 imagery sessions. The "worry" imagery session scored

the highest in arousal (2.64), followed by the "challenge" (2.55), "anxious" (2.39) and "excitement" (1.80) imagery sessions. The "drowsy" (-8.44), "calm" (-5.19) and "fun" (0.32) imagery sessions provided the lowest arousal scores. In regard to the valence score, the "enthusiasm" (+8.30) and "fun" (+7.37) imagery sessions were the most positive, while the "distress" (-8.43) and "worry" (-7.1) imagery sessions were the most negative. Disregarding the positive or negative characteristic (valence sign) of the imagery sessions, the highest level of emotion intensity was calculated for the "distress" (8.43) and "enthusiasm" (8.30) imagery sessions. The "calm" (1.65) and "hard" (3.15) imagery sessions showed the lowest levels of emotion intensity.

Analyses carried out on the PA and NA scores in the previous Study suggested that all but the "worry" and "distress" imagery sessions were significantly different. While the "worry" and "distress" imagery sessions showed similar valence scores, these two imagery sessions were not ranked similarly for the arousal and emotion intensity scores computed for each of the 10 imagery sessions. For example, the "distress" imagery session was ranked the highest in emotion intensity while the "worry" imagery session was ranked fifth for this emotion characteristic. Along with the analyses described in Chapter 9 on the PA and NA scores for the 10 imagery sessions, these findings in the arousal and emotion intensity scores confirm the relative uniqueness of each of the 10 affective states evoked in Study 7, and this compares to Study 6 and the study by Witvliet and Vrana (1995) which used a limited number of emotion types.

Separate Pearson correlation analyses on these emotion characteristic scores ($n=10$) indicated that arousal and valence were not significantly related ($r=.066$), nor were arousal and emotion intensity ($r=.585$), arousal and valence sign ($r=.068$) or valence sign and emotion intensity ($r=.031$). In summary, these analyses confirmed the statistical independence of the emotion dimensions of arousal, valence and emotion intensity.

Table 10.1 Average arousal and valence scores with emotion intensity and valence sign for the 10 imagery sessions.

Imagery session	Projection on y=x axis	arousal score	Projection on y=-x axis	valence score	emotion intensity score	valence sign
Anxious	(1.69, 1.69)	+2.39	(-3.81, -3.81)	-5.39	5.39	-
Hard	(0.39, 0.39)	+0.55	(-2.23, -2.23)	-3.15	3.15	-
Worry	(1.87, 1.87)	+2.64	(-5.52, -5.52)	-7.10	7.10	-
Distress	(1.14, 1.14)	+1.61	(-5.96, -5.96)	-8.43	8.43	-
Challenge	(1.80, 1.80)	+2.55	(2.66, 2.66)	+3.76	3.76	+
Calm	(-3.67, -3.67)	-5.19	(1.17, 1.17)	+1.65	1.65	+
Drowsy	(-5.97, -5.97)	-8.44	(-2.54, -2.54)	-3.59	3.59	-
Fun	(0.23, 0.23)	+0.32	(5.21, 5.21)	+7.37	7.37	+
Excitement	(1.27, 1.27)	+1.80	(5.16, 5.16)	+7.30	7.30	+
Enthusiasm	(1.23, 1.23)	+1.74	(5.87, 5.87)	+8.30	8.30	+
Mean (s.d.)		-0.003 (3.75)		0.07 (6.38)	5.60 (2.42)	

ANALYSES SET 1

For each of the two dependent measures (average HR changes, average SCL changes) two exploratory step-wise multiple-regression analyses were carried out. In the first, arousal and valence score were used as independent variables. In the second, arousal, emotion intensity and valence sign were used as independent variables. These regression analyses employed relaxed probability criteria for entry ($p=.050$) and removal ($p=.100$) of the single variables into and out of the regression equation to obtain an indication of relevant predictors for future research rather than confirmation of the experimental hypotheses.

HR

In the first regression analysis, average HR change was found to depend on arousal only ($F(1,8)=11.77$, $p<.01$). The second regression analysis involving HR average used arousal, emotion intensity and valence sign as the independent variables. This analyses indicated a strong association between average HR changes and emotion intensity only ($F(1,8)=17.08$, $p<.01$).

SCL

The same regression analyses as described above for HR were carried out on SCL. These analyses showed no relationship of SCL with any of the independent variables.

In summary, these exploratory step-wise multiple regression analyses were carried out on average scores in both the independent and dependent variables obtained for each of the 10 imagery sessions. When emotions were considered in terms of arousal and valence scores, HR reflected arousal. When emotions were considered in terms of arousal, emotion intensity and valence sign, HR was found to reflect the emotion intensity characteristic. Together these findings suggest that while HR did reflect arousal, emotion intensity was more strongly linked to variation in the HR measure.

There were no relationships established between SCL and the independent variables examined. This finding suggests that, compared to HR, this measure did not show differential responsiveness to these emotion characteristics manipulated through imagery.

ANALYSES SET 2

In this final set of analyses, the step-wise multiple regression analyses described

in Analyses Set 1 were repeated on a subset of subjects (n=25) that were ranked relatively high for imagery ability according to the Bett's Questionnaire Upon Mental Imagery (QMI) (Sheehan, 1967). As mentioned earlier, subjects were administered this questionnaire after completion in the experiment to determine their ability to engage in imagery. The QMI scores were used to rank students according to their imagery ability and the data (PANAS scores and physiological data) for the best imagers (n=25) were used in the following analyses.

PA and NA

Table 10.2 shows the mean PA and NA scores across the 10 imagery sessions for the subset of good imagers. The mean PA and NA scores showed only slight variations from those recorded for the total subject sample (see Table 9.2). The ranking of the 10 imagery sessions in PA were consistent with that obtained for the total subject group. The ranking of the 10 imagery sessions in NA for this subset of subjects did show a slight variation from the larger sample group, with the "enthusiasm" (NA 4.75) and "calm" (NA 4.64) imagery sessions ranked 9th and 10th respectively in NA levels. This compares to the NA scores for the total subject sample which ranked the imagery sessions of "calm" (NA 4.94) and "fun" (NA 4.78) as 9th and 10th respectively. The emotion characteristic scores of arousal, valence and emotion intensity were calculated from the PA and NA scores for this subset of good imagers (see Table 10.3). The differences in arousal, valence and emotion intensity levels for this subset of subjects compared to the total sample reflected differences in both the PA and NA scores. As indicated in Table 10.1 and Table 10.3, the arousal scores across the 10 imagery sessions for the good imagers versus the total subject sample showed only slight mean differences in all but the "worry" imagery session. Both the subject samples ranked the "worry" imagery session as the highest for arousal, with the good imagers indicating an arousal score of +3.66 compared to the total subject sample score of +2.64. The

imagery session valence scores for the good imagers were ranked in the same order as that obtained for the total subject sample, while slight variations in the ranking of the 10 imagery sessions for the emotion intensity score were found. It is interesting to note that the emotion intensity scores were slightly higher in only some of the imagery sessions for the subset of good imagers. In summary, comparing the results in Table 10.1 with Table 10.3 indicated that the subset of good imagers did show some differences in the arousal, valence and emotion intensity scores, although the rank order of these scores in the 10 imagery sessions reflected only slight variations.

Table 10.2 Imagery Session PANAS Scores for the subset of good imagers (n=25)

IMAGERY SESSION	__PA SCORE__		__NA SCORE__	
	MEAN	S.D.	MEAN	S.D.
ANXIOUS (A)	14.64	4.16	14.88	4.59
HARD (H)	15.38	4.87	11.37	4.36
WORRY (W)	13.92	5.31	17.18	3.51
DISTRESS (S)	11.69	4.56	16.81	5.26
CHALLENGE (C)	21.30	6.58	8.18	3.35
CALM (M)	14.05	6.23	4.64	0.72
DROWSY (D)	7.27	3.08	6.12	1.57
FUN (F)	21.53	5.53	4.87	1.62
EXCITEMENT (E)	22.26	5.83	5.83	2.09
ENTHUSIASM (N)	22.63	5.02	4.75	1.65
INITIAL (<i>i</i>)	17.41	5.21	6.63	3.16
FINAL (<i>f</i>)	14.77	4.74	5.29	1.22

Table 10.3 Computations for the imagery session arousal, valence and *emotion intensity* scores (n=25)

Imagery session	Intercept on y=x axis	arousal score	Intercept on y=-x axis	valence score	emotion valence intensity score	sign
Anxious	(1.79, 1.79)	+2.54	(-3.62, -3.62)	-5.13	5.13	-
Hard	(0.41, 0.41)	+0.58	(-1.50, -1.50)	-2.12	2.12	-
Worry	(2.58, 2.58)	+3.66	(-5.14, -5.14)	-7.26	7.26	-
Distress	(1.28, 1.28)	+1.82	(-6.06, -6.06)	-8.58	8.59	-
Challenge	(1.77, 1.77)	+2.51	(3.06, 3.06)	+4.32	4.32	+
Calm	(-3.62, -3.62)	-5.12	(1.20, 1.20)	+1.70	1.70	+
Drowsy	(-6.27, -6.27)	-8.87	(-2.93, -2.93)	-4.14	4.14	-
Fun	(0.23, 0.23)	+0.33	(4.82, 4.82)	+6.82	6.82	+
Excitement	(1.16, 1.16)	+1.53	(4.71, 4.71)	+6.66	6.66	+
Enthusiasm	(1.45, 1.45)	+2.05	(5.44, 5.44)	+7.69	7.69	+
Mean (s.d.)		+0.10 (3.96)		-0.004 (6.20)	5.44 (2.35)	

As for Analyses Set 1, HR and SCL averages were calculated for each imagery session for the subset of good imagers. A series of step-wise multiple regression analyses were performed on each physiological measure with the arousal and valence scores used as independent variables for the first analysis. In the second analysis, arousal, valence sign and emotion intensity were used as independent variables. These analyses again employed relaxed probability criteria for entry ($p=.050$) and removal ($p=.100$) of the single variables into and out of the regression equation.

HR

The first regression analysis performed with the arousal and valence scores as the independent variables showed a significant dependency of average HR on arousal ($F(1,8)=15.00, p<.01$). In the second regression analysis the arousal, emotion intensity and valence sign were included as the independent variables. This second analyses also indicated a dependency between HR and arousal ($F(1,8)=15.00, p<.01$). The same analysis also identified an even stronger influence, namely the combined effect of the arousal and emotion intensity characteristics ($F(2,7)=19.31, p<.001$). Together, these findings support the relatively strong influence of arousal on HR. They also suggest that, out of the five emotion characteristics of valence, arousal, valence sign and emotion intensity, the total effect of the arousal and emotion intensity characteristics are the best predictors of HR activity.

SCL

As for the data tested from the total subject group, there were no significant findings in the regression analyses performed on the SCL measure for the subset of good imagers.

The analyses carried out on the data for the good imagers were consistent with the findings for the total subject sample analysed in Analyses Set 1. The PA and NA mean scores showed some slight variations in the subset of good imagers compared to the total subject set, and this resulted in some order differences in the arousal and emotion intensity scores across the 10 imagery sessions. A relationship between average HR was found with the arousal score and the arousal and emotion intensity scores together. Under the same entry and exit criteria, there were no significant findings in the SC measure for this set of analyses.

In summary, the exploratory regression analyses indicated an association

between HR and emotion intensity and arousal, while average SCL activity was not found to be significantly linked to variation in these emotion characteristics under the same regression analysis criteria. The non-significant results in SCL for the subset of relatively good imagers suggest that SCL activity in these studies, or rather the lack of differential responsiveness in SCL, may not be linked to the imagery ability of the subjects.

In regard to HR, these results suggest that, compared to SCL, HR was relatively more responsive to the variation in emotion characteristics across the imagery sessions. HR activity was significantly linked to changes in emotion intensity and arousal for both the total subject experiment group and the subset of good imagers.

10.1.4 Discussion

This chapter describes two sets of exploratory regression analyses used to examine the influence of the emotion characteristics of valence, valence sign, arousal and emotion intensity on HR and SCL activity. Using a unique approach, computations on the PA and NA scores provided average arousal, valence and emotion intensity scores for the 10 imagery sessions. Using Study 7a data, step-wise multiple regression analyses with the emotion characteristic scores as the independent variables were performed. The same regression analyses were repeated on the data of a subset of subjects ($n=25$) ranked relatively high in imagery ability in Study 7a.

As mentioned, arousal, valence and emotion intensity scores for the 10 imagery sessions were calculated from the PA and NA scores for the 10 imagery sessions in Study 7a. Simultaneous equations for the $y=x$ and $y=-x$ intercept for each imagery session (see Figure 9.1) were solved to calculate the arousal and valence scores respectively. The emotion intensity score was taken as the modulus of the valence score.

These results indicated that the average highest levels of arousal were associated with the "worry" and "challenge" imagery sessions, with the "drowsy" imagery session scoring the lowest on this dimension. "Distress" followed by the "worry" imagery session showed the highest negative valence level while the "enthusiasm" imagery session showed the highest levels of positive valence. The emotion intensity scores indicated that the "distress" and "enthusiasm" imagery session resulted in the highest affect levels experienced by the subjects. The "calm" and "hard" imagery sessions scored the lowest in emotion intensity, indicating that these two imagery sessions had the least emotional impact on the subjects.

These emotion intensity calculations also provided further information regarding the differences between the emotion types used in Study 7. For example, the inter-imagery session comparisons of the PA and NA scores in Study 7a indicated that the two imagery sessions, "worry" and "distress", were similar in positive and negative affect. The arousal and emotion intensity scores calculated for these two imagery sessions in Study 7b (see Table 10.1) indicated that they were not relatively close for these two dimensions, and therefore differences in physiological activity may be attributed to differences in these emotion characteristics.

Correlation analyses carried out on the emotion characteristic scores indicated that the emotion characteristics of arousal, valence and emotion intensity were not significantly associated with each other and therefore could be considered as separate dimensions of emotion. It should be noted, however, that while the correlation between arousal and emotion intensity was not statistically significant, a relatively high level of association was indicated and this warrants further research investigation.

Using relaxed entry and exit criteria, the first regression analysis performed in Study 7b tested HR average changes for dependency with arousal and valence. This

indicated a strong association between HR and arousal. A second regression analyses with emotion intensity, arousal and valence sign as the independent variables indicated a strong relationship between emotion intensity and HR only. This finding suggested that emotion intensity was more responsible than arousal for the resulting variation in HR. The same regression analyses were repeated with average SCL change as the new dependent variable. These analyses did not show any significant linkages of SCL with any of the emotion characteristics tested.

In Analyses Set 2 the same step-wise multiple regression analyses were performed on the data for a subset of good imagers. Results for this subset indicated a strong association between HR and arousal. An association between HR and the arousal and emotion intensity scores was also identified. The results indicated that these two emotion characteristics combined were most strongly linked to HR variability. Consistent with the results from the entire subject sample (Analyses Set 1), there were no significant findings in SCL using the same statistical approach. This suggested that the relative lack of SCL activity may not be attributed to imagery ability, as has been suggested in the literature addressed in the previous Chapter.

In summary, these results suggest that the behaviour of the HR measure accompanying emotion evoked through imagery is also linked to emotion intensity and arousal characteristics. In other words, these results in the HR data imply that experiences of emotions reported to be more "valent" or "emotional" may be associated with stronger HR changes regardless of their valence sign. It would therefore seem important to take these characteristics into consideration when exploring physiological activity accompanying positive and negative emotions. This notion is consistent with studies that have demonstrated heightened HR activity for positive and negative emotions such as sad and joyful (e.g., Stemmler, 1989 and de Jong-Meyer et al., 1993), and large HR increases for the more intense emotions of fear and anxiety (e.g., Ax,

1953; Sinha, Lovallo & Parsons, 1992). Characteristically, the more intense emotions elicited in laboratory studies described in the psychophysiological literature (e.g. fear and anxiety) have typically included emotions of negative valence, and this may have contributed to the popular association between negative valence and HR. This notion, along with the findings described above raises the possibility that previous research studies reporting heightened HR activity for negative emotions such as fear and anxiety have failed to consider differences in emotion intensity and/or arousal for the emotions under investigation.

These results in Study 7b are consistent with evidence of significantly higher HR levels for the Study 6 and Study 7a imagery session clusters associated with higher arousal and affect levels. The association of these two emotion characteristics with HR provide the most likely reason why higher HR levels were obtained for the **high pole PA** cluster compared to the **low pole PA** cluster in Study 7a. It does not however explain why HR differences between high and low clusters were greater for negative clusters (CHW and NA) than positive clusters as found in both Study 6 and Study 7a. In other words, if the differences between **high NA** and **low NA** were comparable to the difference between **high PA** and **low PA** clusters in Study 6, why did the negative clusters show greater HR differences? The same situation is demonstrated in the Ropes Course data (see Study 3) with the elements representing **high CHW** and **low CHW** recording greater HR differences than the elements representing **high FE** and **low FE**, even though large affect and arousal differences are observed in both cluster sets. Incidentally, the level of FE and CHW experienced on the Ropes Course, as shown in Table 6.2, suggests that positive emotion was the dominant and more intense affect experienced during the Ropes Course attempt, and this compares to the dominance of negative emotion types in laboratory based studies of emotion as noted above, which may result in skewed data.

The exploratory regression analyses failed to find any significant relationships for SCL with the emotion characteristics. In the previous Chapter it was suggested that this may be due to low imagery ability resulting in poor imagery vividness, or other issues relating to imagery methodology. The data from a subset of “good” imagers also failed to show any significant effects in SCL, and this suggests that other factors may underlie this measure’s relative non-sensitivity to the effects of emotion’s evoked with imagery. Perhaps, as supported by the strong findings in SCL for the field studies, other methods of emotion elicitation need to be considered in order to explore the SCL response to emotion more fully.

The two sets of analyses in Study 7b were exploratory, and due to the use of average values for each variable they should be treated with some caution. They do however represent the first attempt to explore HR and SCL activity accompanying emotions as a function of arousal, valence and emotion intensity scores calculated from PA and NA scores. These scores derived from PA and NA provided an objective measure for valence and arousal, as well as providing a method to compute emotion intensity. As implied by Witvliet and Vrana (1995), these three emotion characteristics should be monitored in future studies investigating the psychophysiology of emotion.

The results from Study 7b indicated that HR reflects the arousal and emotion intensity dimensions of emotion. More importantly however, the results from both the laboratory and field studies suggest that HR shows greater differential responsiveness to arousal and emotion intensity differences in negative emotion types than positive emotion types. In other words, HR reflects variations in negative emotion to a greater degree than positive emotion. The findings in SCL in the laboratory studies were not as conclusive. Supporting this thesis hypothesis concerning the behavior of SCL, strong SCL differences were reported for elements representing high and low positive emotions on the Ropes Course. In comparison, the findings in both laboratory studies were

somewhat disappointing. The SCL measure did not show differential responses in the FE clusters, and only weak differential responses were found for the more extreme differences in positive emotion for the high/low pole positive clusters in Study 7a. In conclusion, the laboratory study findings offer partial support for the experimental hypothesis. Linkages between HR and negative emotion were demonstrated in both the field and laboratory studies, while the field studies provided strongest support for linkages between SCL and positive emotion.

10.2 GENERAL SUMMARY OF THE LABORATORY STUDIES

In 1980, Fowles proposed an explanation for the fractionation of two autonomic measures, heart rate and skin conductance level. Fowles hypothesised that HR and SCL activity reflected the differential activation of, respectively, the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS). Based on linkages between the BAS and positive affect and the BIS with negative affect (e.g., Larsen & Ketelaar, 1991; see also Chapter 2 discussion) an obvious interpretation of Fowles' hypothesis was that HR activity reflected positive emotion and SCL activity reflected negative emotion. Contrary to expectations based on Fowles' hypothesis, the field studies involving the Ropes Course activity (Study 3 and Study 5) showed linkages of HR with negative emotion and SCL with positive emotion. Based on these findings, and the lack of consistent results in the psychophysiology of emotion literature, two laboratory studies, Study 6 and Study 7, were carried out to explore HR and SCL activity accompanying positive and negative emotions elicited through imagery.

Directed by the five descriptors challenge, hard, worry, fun and excitement derived from the field studies, fifty adult subjects in Study 6 imagined situations that resulted in high and low levels of positive and negative emotions. A ratings questionnaire based on the same five descriptors was used to identify and select imagery

sessions representing the four clusters of **high FE**, **low FE**, **high CHW** and **low CHW**.

The PANAS questionnaire was administered to confirm the positive or negative classification of the five descriptors used in Study 6, and to select those imagery sessions representing the four clusters: **high PA**, **low PA**, **high NA** and **low NA**. There were some differences in the sessions constituting these two sets of clusters.

The four sets of analyses carried out on the imagery sessions clusters representing high and low levels of positive and negative emotions showed differences in HR and SCL activity that were largely consistent with results from the field studies. That is, HR activity reflected differences in the level of negative (CHW and NA) emotions and the SC response reflected differences in levels of positive (FE and PA) emotions.

The lack of a significant affect level effect in SCL for the positive (FE and PA) clusters in Study 6 was largely attributed to the use of low level imagery sessions and issues relating to the imagery methodology. Using 10 one minute imagery sessions, Study 7 examined HR and SCL activity accompanying positive and negative emotions identified by the 10 descriptors; challenge, hard, worry, fun, excitement, anxious, distress, calm, drowsy and enthusiasm. In regard to the 10 imagery trials, subjects were monitored individually and were instructed to imagine themselves physically involved in a situation that resulted in high levels of emotion associated with each of the 10 descriptors. Subjects were also measured and ranked for imagery vividness using the Betts Questionnaire Upon Mental Imagery (QMI, Sheehan, 1967). These imagery rankings were used for further analyses conducted in Study 7b.

Similar to Study 6, the imagery sessions were grouped into two sets of clusters using the Ratings data and the PA and NA scores. The three sets of analyses carried out

on the FE, CHW, PA and NA clusters in Study 7 data suggested that the SCL response was sensitive to level variations within the positive clusters only and that the HR response was more sensitive to level differences in the negative clusters. However, as discussed above, some of the results in both the HR and SCL measures warranted further explanation.

The lack of significant level differences in SCL for the positive clusters in Study 6, and the significant HR difference obtained in the PA clusters in Study 7a caused some concern as to the complete acceptance of the experimental hypothesis. In order to explore the role of other aspects of emotion in these data, two further analyses were conducted (Study 7b). In Analyses Set 1, a series of step-wise multiple-regression analyses were performed on the average HR and SC levels with the arousal, valence, valence sign and emotion intensity scores as independent variables. These emotion characteristic scores were averaged for each of the 10 imagery sessions. Exploratory analyses indicated a dependency in the HR response on emotion intensity and arousal. There were no significant findings in SCL with the four emotion characteristic scores. Similar analyses carried out on the data of the best 25 imagers (Analyses Set 2) also supported this association between HR and emotion intensity and arousal. While these analyses provided some interesting data, the use of averages for each of the dependent and independent variables in the regression analyses may have weakened these findings, particularly in the SCL data. These results nevertheless highlight the need to monitor arousal, valence and emotion intensity characteristics of emotions under investigation.

In conclusion, it is suggested that changes in HR activity reflected the emotion intensity and arousal dimensions of emotion. This would account for the main level effect in the HR measure observed across all clusters in Study 6 and Study 7, and for the significant HR difference observed between the extreme **high pole PA** and **low pole PA** clusters in Study 7a. Consistent with the experimental hypothesis, level differences were

greater in negative clusters in both studies and this suggested that the HR measure was more sensitive to variations in negative type emotions. Compared to HR, the SCL measure was not as responsive to imagery manipulations in both laboratory studies, even though methodological improvements were undertaken in the second study. This measure did however reflect level differences in the **high pole PA** and **low pole PA** clusters in Study 7a with a level effect that approached significance. This finding suggested some sensitivity to differences in positive emotion only, although the lack of a significant main effect difference in the FE clusters in Study 6 and Study 7 causes some concern as to the responsiveness of the SCL measure to emotion evoked through imagery. The imagery methodology and other factors that may have contributed to the relatively poor findings in SCL in the two laboratory studies are addressed in the following section.

10.3 SOME METHODOLOGICAL CONCERNS

As is typical of research studies involving emotion, the studies described in this thesis encountered a number of difficulties that were primarily associated with the elicitation, monitoring and sampling of emotion. For example, two of the field studies and the first laboratory study relied on five descriptors to determine the level of positive and negative emotion present. Analyses conducted in Study 6 clearly showed that the use of descriptors to generate specific emotions allowed the presence of secondary or non-target emotions. As suggested by a number of scientists (Plutchik & Ax, 1967; Ekman, Levenson & Friesen, 1983; Wagner, 1989), these secondary emotions may influence the resulting physiological activity. The results in the physiological data for Study 6 also indicated that, compared to HR, SCL was relatively insensitive to the imagery manipulations of the valence and level factors. This was attributed to the use of a number of low level imagery sessions, the presence of secondary emotion and/or issues relating to the use of imagery itself. The following section examines some of

these methodological issues regarding the study of emotion, and their effects on the results of some of the studies described in this thesis.

10.3.1 Emotion elicitation

As outlined in Chapter 3, many studies exploring the psychophysiology of emotion have identified different patterns of HR and SCL accompanying discrete emotions (e.g., Ax, 1953, Ekman, 1983). The earlier laboratory studies relied on methods such as shock and threat to elicit emotional states. Under more ethical guidelines, recent studies have employed methodologies such as imagery and picture presentation to induce emotion states. Studies involving picture presentation (e.g., Lang, Greenwald, Bradley & Hamm, 1993) have recorded physiological changes, particularly in the HR measure, accompanying different emotions. However, a number of these studies have conceded that the physiological changes measured may also be linked to other factors such as subject interest/arousal, and may not reflect the emotion experienced, but rather the subject interpretation of the picture content. For example, a person viewing a picture of a flower may register it as a pleasant subject, but may not actually experience pleasurable emotions.

Studies employing imagery to evoke emotion have experienced limited success (e.g., de Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993; see also Carroll, Marzillier & Merian, 1982), with SCL proving resistant to imagery manipulations, and at best reflecting subject involvement in the imagery task. Relatively more successful studies (e.g., Sinha et. al., 1992; Haney & Euse, 1976) have provided subjects with imagery training and extended relaxation periods prior to experiment involvement. The importance of training is addressed by Cuthbert and Lang, 1989. Due to time restrictions, subjects in Study 6 and Study 7 of this thesis investigation of emotion did not undergo any imagery training. However, other measures were implemented to

improve emotion elicitation with imagery in these two laboratory studies. For example, subjects were instructed to imagine situations that were meaningful to them and which they thought would evoke the desired emotions. In Study 7, subjects were also instructed to imagine themselves physically involved in the imagined situation. Consistent with the study by Haney & Euse (1976), they were allowed a relatively longer resting period (1 minute) between imagery trials to allow baseline recovery.

The experimental hypothesis adopted for the laboratory studies rested on the success of the imagery to produce emotional responses similar in intensity and valence to that experienced on the Ropes Course. In the two laboratory studies, both the target and secondary emotions evoked were monitored with the use of descriptor ratings and a standardised inventory, the PANAS scale (Watson, Clark & Tellegen, 1988). While the PANAS scores indicated that the imagery resulted in significantly different emotional states in both laboratory studies, the changes in the physiological data were not as great as those observed in the Ropes Course data. For example a HR difference of approximately 10 BPM was recorded for the elements associated with high and low levels of negative emotion in Study 3. This contrasts markedly with the maximum HR difference of approximately 2 BPM for the **high CHW** and **low CHW** imagery session clusters in Study 6.

The methodological changes and the use of 10 high/low pole emotion states resulted in enhanced physiological responding in Study 7a. For example, in Study 6 an average peak HR increase of 1.1 BPM was recorded for the FE and CHW clusters, and average HR levels for these same clusters fell below the baseline after 30 seconds of imagery. In Study 7a, peak HR levels for the same clusters reached approximately 3 BPM above the baseline, and average HR levels did not fall below baseline for the entire imagery period. A maximum HR difference of 2.8 BPM was found for the high and low CHW clusters in Study 7a and this compares to the smaller difference of

approximately 2 BPM found for the CHW clusters in Study 6.

As mentioned, due to subject numbers and time limitations, subjects in both laboratory studies were not involved in imagery training. However, subjects in Study 7 were tested for imagery vividness using the Betts Questionnaire Upon Mental Imagery (Sheehan, 1967). As discussed above, comparison of the PANAS data for the subset of good imagers in Study 7b with the total subject sample (Study 7a) indicated only slight differences in the PA and NA scores for each of the 10 imagery sessions. Regression analyses carried out on the data for both subject groups also yielded similar findings. That is, the data from the total subject sample and the subset of good imagers indicated a dependency in HR on arousal and emotion intensity, and neither subject sample showed significant results for the same analyses in the SCL measure.

The PANAS data indicated similarities between the total subject sample and the subset of good imagers in regard to positive and negative affect experienced during the imagery sessions. However, it is reasonable to suggest that imagery ability and some aspects of the experiment procedure may have contributed to some of the disappointing results in the physiological data, particularly in SCL, in Study 6 and Study 7. Future consideration of factors such as subject gender and age (White, Ashton & Brown, 1977), imagery training and pre-experiment familiarisation and relaxation procedures (Haney & Euse, 1976; Roberts & Weerts, 1982) may lead to greater physiological responsiveness during imagery, with a reduced interference of stress-induced novelty in the physiological measures (Lindsley, 1951; see also Lyvers, Boyd & Maltzman, 1988; Maltzman & Marinkovic, 1996).

In summary, emotions evoked under imagery conditions were not accompanied by as large a physiological response as those recorded during the Ropes Course activity. The imagery sessions however, did evoke significant emotion states that were

distinctively different to each other and the baseline, as indicated in the PANAS and descriptor ratings data. In regard to the physiological response during the imagery sessions, HR was more responsive to imagery manipulations, with average HR reflecting level differences in the negative clusters. Only the high pole PA clusters in Study 7a produced a main level effect in SCL. The lack of average SCL differences in the FE and PA clusters in Study 6 may be attributed to other characteristics of the imagery session clusters, such as the presence of too many low level imagery sessions or secondary emotion effects. However, in the light of poor findings in SCL in other studies involving imagery (e.g., De Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993), it is more likely that this measure is simply not as responsive as the HR measure to imagery manipulations on emotion. Notwithstanding these problems, it remains apparent that the results in both HR and SCL contradict expectations based on Fowles' hypothesis, with linkages of HR and negative emotion and SCL with positive emotion supported in both laboratory studies.

10.3.2 The identification and selection of emotion

In the past, psychophysiological studies of emotion have relied on ratings on emotion words (e.g., Ekman, Levenson & Friesen, 1983) to monitor the type of emotions experienced. However, many emotion theorists have questioned the use of self report data and raised concerns regarding the relationship between self report and the physiological concomitants (e.g., Wagner, 1989; Forgays, Sosnowski & Wrzwesniewski, 1992). It is also questionable whether a few emotion descriptors are able to identify and select target emotions for analyses, and at the same time monitor the presence of other secondary or non-target emotions present.

Ratings on the five descriptors; fun, excitement, challenge, hard and worry were used to determine relative levels of positive and negative emotion experienced on the

Ropes Course. The same descriptors were adopted for the two laboratory studies and used to monitor positive and negative emotion evoked for each of the 10 imagery sessions. A standardised PANAS questionnaire was also administered during the two laboratory studies. Using ratings on 20 emotion words, this standardised questionnaire monitored the level of positive and negative affect for each imagery session. Analyses on the PANAS data for the 10 imagery sessions confirmed the positive or negative valence of the five descriptors used in these studies. It also provided another means of imagery session selection for the valence and level factors.

The use of the PANAS questionnaire to select PA and NA clusters in both laboratory studies enabled the selection of imagery sessions to be based on the overall level of affect experienced. This process took into consideration the valence and level contribution of opposing emotions present and eliminated the need to monitor the array of discrete emotions possibly experienced. As illustrated in Study 6 and Study 7a, each imagery session was plotted on an experiment “affective space” using PA and NA dimensions as the “x” and “y” axes. This method provided a picture of the overall affective state of the subjects during each imagery session and allowed comparison with a baseline state. Analyses based on the PA and NA scores in both studies indicated that, compared to the baseline affective state, subjects did experience significantly different affective states during the 10 imagery sessions.

Emotion characteristics such as arousal and valence have typically been monitored using ratings scales or graphical visual analog displays, such as that used in the study by Hodes, Cook and Lang (1985). In the two laboratory studies described in this thesis, these emotion characteristics were taken into consideration with the use of PA and NA scores calculated on each imagery session (PANAS; Watson, Clark & Tellegen, 1988). As illustrated in Study 7b (Figure 10.2), a 45° rotation performed on the PA and NA axes in the affective space indicated the valence and arousal axes, and

subsequently the relative arousal and valence levels of each imagery session could be identified.

While the analyses performed in Study 7b were exploratory and relied on average scores across subjects, the results indicated that emotion characteristics other than valence were associated with physiological variation, particularly in the HR measure. The extended use of the PANAS data provided, for the first time, a unique and standardised method of measuring emotion characteristics such as arousal, valence and emotion intensity. It is anticipated that future studies examining the psychophysiology of emotion will need to measure such emotion characteristics, and researchers may therefore adopt the novel and simple method of emotion characteristic measurement used in Study 7b.

In summary, the laboratory studies utilised an alternative method for the identification and selection of emotion states. The use of the PANAS questionnaire provided a standardised method of selecting imagery sessions for analyses on the valence and level factors. It also proved to be a more effective means of monitoring the presence or rather the contribution of secondary emotion states to the overall affective state of subjects, thus controlling the influence of secondary emotions on the accompanying physiological data. Calculations on the PA and NA scores also provided a unique approach to the identification and measurement of the valence, arousal, and emotion intensity characteristics of emotion.

CHAPTER 11

The psychophysiology of emotion in review

11.1 INTRODUCTION

Studies reported in the psychophysiological literature prior to 1990 have demonstrated heightened autonomic activity accompanying different emotion states such as fear, worry, anxiety, sadness, joy and excitement (e.g., Ax, 1953; Sterbach, 1962; Averill, 1969; Roberts & Weerts, 1982; Ekman, Levenson & Friesen, 1983). As discussed in Chapter 3, most of these studies have not provided consistent findings in the physiological measures, with only the cardiac response associated with the negative emotions of fear and anger proving reliable (Ax, 1953; Schachter, 1957; Roberts & Weerts, 1982; see also Sinha, Lovallo & Parsons, 1992). More recent studies have suggested a relationship between HR and valence (Lang, Greenwald, Bradley & Hamm, 1993; Johnsen, Thayer & Hugdahl, 1995), HR and arousal (e.g., Jones & Johnson, 1980; Witvliet & Vrana, 1995) and SCL and arousal (e.g., Greenwald, Cook & Lang, 1989; Lang, Greenwald, Bradley & Hamm, 1993; Johnsen, Thayer & Hugdahl, 1995). Other studies have simply failed to demonstrate differential HR or SCL activity (e.g., de Jong-Meyer, Hubert, Ostkamp-Hovekamp & Vennen, 1993).

Compared to the studies involving discrete emotion states, this thesis investigation of HR and SCL activity as a function of emotion was initially based on Fowles' 1980 hypothesis. As discussed in some detail in Chapter 2, Fowles (1980) proposed that HR and SCL activity was linked to the differential activation of the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS) respectively. Fowles' hypothesis was based on Gray's (1975, 1976) work and his

research interests in the area of motivation and incentive effects (e.g., Fowles, 1983; Fowles, Fisher & Tranel, 1982). Some emotion theorists (e.g., Watson & Clark, 1984; Watson and Tellegen, 1985; Larsen and Ketelaar, 1991) have reported their support for the association between the BAS and the BIS emotional systems with, respectively, positive affect (PA) and negative affect (NA). Based on the connection between the two activation systems with PA and NA, the main experimental hypothesis introduced in Study 3 argued that significant differences in HR would reflect differences in positive type emotions and SCL would reflect level differences in negative type emotions.

In contradiction to expectations based on Fowles hypothesis, the results from the field studies conducted in this thesis indicated relationships of HR with negative emotion and SCL with positive emotion. Results from the two laboratory studies also supported this relationship, although affect level differences in SCL and HR were not as great as those reported in the field studies. While the results from the final laboratory study identified other factors contributing to HR activity, none of the results in the field or laboratory studies suggested relationships between HR and positive affect or SCL and negative affect. The following discussion provides a brief overview of the study findings relevant to the experimental hypothesis concerning HR and SCL activity as a function of positive and negative emotion. A discussion on some of the methodological issues relating to emotion elicitation and measurement and recommendations for future research activity in this area follows the review.

11.1.1 HR and SCL Activity as a Function of Positive and Negative Affect

The data from the first two preliminary studies carried out on the Ropes Course activity supported the fractionation of arousal measures noted by the Lacey's (1967; 1970). In Study 1, dissociation between the closely related heart rate and blood pressure measures were demonstrated, with only the systolic blood pressure measure reflecting

changes in state anxiety. The results from Study 2 also indicated substantial autonomic variability in the autonomic measures of HR and SCL during the Ropes Course activity. Results from this second study also supported the suitability of the Ropes Course activity for further research activity investigating the pattern of HR and SCL activity as a function of emotion.

In Study 3, Fowles' hypothesis concerning the fractionation of HR and SCL measures was adopted as a platform from which to examine HR and SCL activity as a function of positive and negative emotion. As described in detail in Chapter 6, the individual elements of the Ropes Course were monitored for the presence of negative and positive emotions using the five child-generated descriptors of challenge, hard, worry, (CHW) and fun and excitement (FE). The results from this study indicated that HR activity reflected differences in the level of negative emotion recorded on the Ropes Course elements, while SCL activity reflected level differences in positive emotions measured across the Ropes Course elements. In other words, HR activity was linked to NA and SCL activity was linked to PA. These findings were the direct opposite to predictions based on Fowles' hypothesis.

In light of the concern regarding the influence of movement in the autonomic data gathered during the Ropes Course activity, the data from a second study, Study 5, were used to re-examine some of the main findings in Study 3. Subjects in this study carried an updated version of the ambulatory monitor that incorporated motility measures. As discussed in detail in Chapter 7, descriptor ratings of the six Ropes Course elements and findings from the initial analyses of the physiological data in Study 5 largely reflected those obtained in Study 3. That is, HR reflected levels of negative emotion and SCL reflected level differences in positive emotion. As in Study 3, the SCL difference between the elements identified as significantly high or low in the negative emotions was not significant. However, in this study, significant differences in HR

levels were found across the elements representing high (Flying Fox) and low (Bridge + Exit ladder) levels of positive emotions. The difference in HR between these elements was not as large or as significant as that obtained between the elements associated with high and low levels of negative emotion, and may have reflected the differences in negative emotion between these two element groups. While this last finding was not consistent with Study 3, it should be noted that HR levels for the Flying Fox were higher than the Bridge + Exit Ladder in Study 3, but this difference had not reached statistical significance. As the Flying Fox element recorded the lowest motility levels, it was suggested that another factor, other than motility and negative emotion, contributed to this particular HR difference.

Another possible explanation for this result in the HR data may rest in the slightly different procedures adopted for Study 5. Subjects in Study 5 completed the Ropes Course activity once, whereas Study 3 subjects completed three consecutive attempts of the Course prior to completing the Element Descriptor Questionnaire. More time spent on the Ropes Course by subjects in Study 3 may have influenced the novelty of the activity and the type of emotions experienced on the various elements, which in turn influenced the physiological response. In hindsight, given the novel nature of the Ropes Course element, it is more likely that the elevated HR levels obtained on the Flying Fox in Study 5 reflected other aspects or dimensions of emotion such as arousal and emotion intensity (see Study 7b). This explanation would be consistent with the relatively high ratings on the fun and excitement descriptors found for this particular element, and which, as indicated in Figure 10.2, are associated with relatively high levels of arousal and emotion intensity.

A positive outcome from the analyses carried out in Study 5 was that while motility did show significant variation across the Ropes Course activity, this factor was not found to over-ride the main experimental findings for the element comparisons in

the HR and SCL measures. This was supported further in the second set of analyses carried in Study 5 in which the psychophysiological changes across the six elements were examined for group differences associated with General self esteem. As expected, the motility changes for the two subject groups were found to be similar across each of the six elements. Group differences in the HR and SCL measures were found on three elements of the Ropes Course, and these differences in the physiological measures were therefore not linked to motility.

In regard to the experimental hypothesis, the results from two field studies (Study 3 and Study 5) suggested that HR activity reflected levels of negative emotion while SCL activity reflected levels of positive emotion. As discussed in the Chapter 7 summary of the field studies, these findings were convincing. Only one result in the HR data for the FE element comparison in Study 5 produced an unexpected result, and, in light of findings in the final laboratory study, this result most likely reflected elevated arousal and emotion intensity levels experienced on the Flying Fox element. While these findings were convincing, in light of mixed and inconsistent findings reported in the psychophysiology literature it was important to continue this psychophysiological investigation of emotion under more controlled conditions.

In the two laboratory studies, Study 6 and Study 7, imagery was used to evoke different positive and negative emotions that were monitored for their accompanying physiological changes. Similar to the field studies, the five descriptors of fun and excitement, challenge, hard and worry were used to identify imagery session clusters associated with significantly high or significantly low levels of positive and negative emotion. Positive Affect (PA) and Negative Affect (NA) scores for each imagery session were used in a second partitioning of the imagery sessions representing high and low levels of positive and negative emotion.

The results from Study 6 are discussed in detail in Chapter 8, and the main findings are summarised in the General Summary of the Laboratory Studies in Chapter 10. In brief, preliminary analyses on the physiological measures indicated that both measures were sensitive to level differences. Analyses conducted separately on the FE and CHW clusters indicated that HR activity reflected level differences of negative emotion only, while SCL across the imagery period reflected levels of positive emotion. Results from analyses of the PA and NA clusters in Study 6 were similar to those obtained in the FE and CHW clusters.

With some changes to the experimental procedure and the use of strong positive and negative descriptor emotion terms, Study 7 continued the laboratory based investigation into the behavior of the HR and SCL measures as a function of emotion. As for Study 6, analyses tested the effect of level and valence on the HR and SCL measures for the positive (FE) and negative (CHW) clusters. A second set of clusters (high pole PA versus low pole PA and high pole NA versus low pole NA) involving pre-determined imagery sessions were also used to test for level and valence effects in the physiological data.

Initial analyses in Study 7a showed that the effect of level was apparent in both the HR and SCL measures. Analyses carried out on the FE, CHW, high pole PA and high pole NA clusters in Study 7a suggested that the SCL response reflected level variations within the positive clusters only and that HR showed greater differential responsiveness to negative emotion.

While the results in the laboratory studies were not as strong as those reported for the field studies, the results did support linkages of HR with negative emotion and SCL with positive emotion. Two findings, the lack of a main level effect in the SCL measure in Study 6 and the significant result in the HR measure for the high pole PA

clusters in Study 7a did raise concerns regarding the complete acceptance of the experimental hypothesis. However, these findings in the laboratory studies did not suggest associations of HR with positive emotion or SCL with negative emotion as required by Fowles' hypothesis. Instead, the weaker results were taken to reflect other aspects of the experimental methodology, such as emotion elicitation or the influence of other emotion characteristics, such as emotion intensity and arousal (see Study 7b). In fact, the set of exploratory multiple regression analyses carried out in Study 7b on the same data indicated a significant dependency between HR and emotion intensity and, to a lesser but still significant extent, arousal. The same multiple regression analyses failed to identify relationships between SCL and the emotion characteristics of arousal, emotion intensity, valence and valence sign. These findings in Study 7b indicated that, compared to HR, the SCL measure did not show differential responsiveness to emotion evoked through imagery under the present experimental conditions.

In conclusion, the results from the field studies indicated strong linkages of HR with negative emotion and SCL with positive emotion. The laboratory study findings were not as strong, particularly in the SCL data. However, they did broadly support the revised experimental predictions, with HR reflecting level differences in negative emotion and SCL showing some sensitivity to level effects in positive emotion only. Both the field and laboratory studies showed some results in the HR data that were best interpreted as reflecting other aspects of emotion, such as emotion intensity and arousal. As with the effect of motility on the physiological data during the Ropes Course attempt, the effects of the emotion characteristics on the physiological data for the laboratory studies did not over-ride the main findings in regard to the experimental hypothesis. These effects should however, be taken into consideration in future psychophysiological investigations of emotion, and therefore are addressed in the methodology section presented later in this Chapter.

11.1.2 Fowles' Hypothesis Questioned

Fowles (1980) hypothesised that HR and SCL activity were linked to activation of the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS) respectively. In regard to the study of emotion, interpretation of Fowles' (1980) hypothesis provided a theoretical base for the investigation of HR and SCL activity as a function of positive and negative emotion.

As outlined above, the results from the field studies showed quite conclusively that HR activity reflected levels of negative emotion while SCL activity reflected levels of positive emotion. Level differences in the physiological measures for the imagery sessions were not as large as those observed in the field studies, although they are consistent with the field study findings. These results were in the opposite direction to predictions arising from Fowles' hypothesis. Indeed, there were no findings in either the field or laboratory studies that supported linkages of HR and positive emotion or SCL with negative emotion.

Two findings in the HR data did need further clarification. One analysis in Study 7a showed significant HR level differences for the high and low pole PA clusters, but an even larger difference was observed in HR for the high and low pole NA clusters. As mentioned above, exploratory analyses in Study 7b on the same data showed HR to be associated with emotion intensity and arousal. It is likely therefore that the HR differences obtained in the high and low pole PA clusters reflected one or both of these other emotion characteristics. These emotion characteristics may also have contributed to some findings in the field studies data. For example, as mentioned earlier, Study 5 showed that the Flying Fox (**high FE**) was associated with higher HR levels compared to the average of the Bridge and Exit Ladder (**low FE**) elements. Descriptor ratings for the Flying Fox indicated that this element was rated significantly high for the fun and

excitement descriptors. It also showed moderate levels of challenge, hard and worry, which were incidentally rated higher than the corresponding levels for the elements representing **low FE**. These ratings suggest that the relatively higher levels of challenge, hard and worry experienced on the Flying Fox influenced HR differences for the FE elements. Another more likely possibility is that HR reflected emotion intensity and/or arousal effects.

In Chapter 6, the possible influence of a third activation system, the fight/flight system, on the HR data was discussed. Ropes Course element comparisons in Study 3 indicated that HR reflected element differences in negative emotion, as indicated by the challenge hard and worry ratings. On the other hand, Fowles' hypothesis predicted an association between HR and the BAS system. He also expected to find increased cardiovascular activity during activation of a third emotion/motivation system, the flight/fight system (Fowles, 1992; 1993). In his writings, Barlow (Barlow, 1988; Barlow & Cerny, 1988) equated fear, as opposed to worry, with the flight/fight system, and described it as an alarm reaction / response to a potentially life-threatening situation, characterised by extreme levels of negative affect and arousal. It is argued that increased HR activity experienced on certain elements of the Ropes Course was due to negative emotion mediated by the BAS, as opposed to the activation of the flight/fight system. Observations made by the experimenter support this notion, noting that none of the children monitored on the Ropes Course showed behaviours associated with a fear response. In addition, children's average ratings on the positive descriptors were higher than the negative descriptors, suggesting that the Ropes Course activity was, on balance, a positive experience. It should also be noted that participation on the Ropes Course and in the study itself was voluntary, and subjects in Study 3 voluntarily repeated the Ropes Course twice. It is also highly unlikely that subjects were influenced by the fight/flight system during the imagery trials in the two laboratory studies, where HR activity was consistently linked to negative emotion.

In regard to the SCL measure, the lack of significant differences in average SCL between positive and negative imagery session clusters caused some concern regarding complete acceptance of the experimental hypothesis. While level X linear trend over time interactions were significant for the SCL response as a function of the positive clusters, only one analysis, performed on Study 7a data, indicated a main level effect in the SCL measure, and this was found for the high pole positive clusters. The lack of a main level effect in either the positive or negative clusters in the other analyses was attributed to imagery methodology. This was supported by the exploratory multiple regression analyses carried out in Study 7b, which, contrary to expectations, failed to find significant results in the SCL measure with arousal, emotion intensity, or valence scores.

While the main study findings were contrary to predictions arising from Fowles' hypothesis, a number of points should be noted. Fowles applied his hypothesis to the study of motivation and incentive effects (e.g., Fowles, Fisher & Tranel, 1982). It was not Fowles' intention to apply his hypothesis to the study of emotion. In his 1980 paper he did not refer to findings published in the psychophysiology of emotion literature concerning autonomic activity accompanying discrete emotions. While many emotion theorists attempted to apply the work of Gray and Fowles to the study of positive and negative emotion (e.g., Pennebaker & Chew, 1985; Wegner, Shortt, Blake & Page, 1990; Larsen & Ketelaar, 1991), Fowles (1992) initially rejected any association of the BIS and BAS with negative and positive emotion. As discussed in detail in Chapter 2, Fowles later conceded a possible association between PA and BAS (Fowles, 1993), however Fowles himself did not conduct any research investigations regarding the relationship of PA and NA with HR and SCL activity.

Self report ratings on five emotion descriptors were used to identify levels of positive and negative emotion in the field and laboratory studies. While the PANAS

data in Study 6 indicated that the use of the five descriptors was quite successful in determining positive and negative emotion, the suitability of the same few descriptors to accurately determine and monitor the differential activation of either the BAS or BIS was not tested. In research studies conducted by Fowles and his colleagues (e.g., Fowles, Fisher & Tranel, 1982; Tranel, 1983; Sosnowski, 1988, 1991), descriptor ratings were not used to monitor emotion states identified with the BAS or the BIS. Instead, experimental conditions, such as reward, the removal of reward and other situations involving incentives were used and examined in terms of the accompanying physiological responses. Whether the conditions employed by Fowles and his colleagues to encourage differential activation of the BIS and the BAS also evoked related positive and negative emotion has not been examined. It is also questionable whether the emotions experienced during the experimental situations utilised by Fowles and his colleagues were similar in nature to those experienced during “real life” situations, particularly in regard to emotion intensity, valence and arousal levels.

The results from this thesis’ psychophysiological investigation of emotion did not support predictions based on Fowles’ hypothesis. However, his research concerning the activation of motivation systems and the approach to the study of emotion described in this thesis may be relevant to current investigations of emotion involving other physiological measures. For example, while EEG studies have found an inconsistent pattern of brain activity during emotional states, some studies have indicated greater right than left hemisphere activation during either positive or negative emotional states (Thompson, 1988). From his review of the EEG literature and research activities, Davidson (Davidson, 1983, 1984; Sutton & Davidson, 1997) suggested that hemispheric asymmetries reflect approach/avoidance motives rather than specific emotions. These positive results suggest that future investigations of emotion adopting the same approach should consider both CNS and ANS measures. In regard to testing Fowles’ 1980 hypothesis, future investigations using a more broad selection of cardiac and

electrodermal measures will increase the generalisability of these findings.

In conclusion, contrary to predictions arising from Fowles' (1980) hypothesis, the results from the field studies indicated linkages of HR activity with negative emotion, and of SCL with positive emotion. While the results from the laboratory studies were not as conclusive, they largely supported the field studies' findings. In regard to Fowles' hypothesis, it is suggested that future studies attempt to monitor the types of emotion elicited under situations specifically designed to activate the BAS and/or the BIS. This would help determine the presence and/or strength of activation of the BIS or the BAS, and allow further examination of the relationship between positive and negative emotion and the accompanying cardiac and electrodermal activity.

11.2 THE PSYCHOPHYSIOLOGY OF EMOTION: FUTURE DIRECTIONS

This thesis investigation of the psychophysiology of emotion used both field and laboratory studies. Ambulatory monitoring of 10-12 year old children participating on a Ropes Course activity was conducted to monitor changes in emotion and autonomic activity. In the laboratory studies, adult university students participated in imagery sessions to evoke positive and negative emotions. Together, these studies provide a unique approach to the study of emotion, as they examined emotion states that were elicited naturally as well as under more controlled conditions. They also mark a different approach to the study of the psychophysiology of emotion, with an emphasis on valence and affect level effects upon the accompanying physiological data across longer time periods.

The studies on the Ropes Course provided some unique and valuable information in regard to the study of emotion. Both positive and negative emotions were

elicited during the Ropes Course activity, and the variation in valence and affect level was reflected in the accompanying physiological data. The findings on the Ropes Course activity illustrated the value of “in situ” monitoring and indicated that some activities or situations outside the laboratory provide suitable environments in which to investigate the psychophysiology of emotion. Important limitations of the Ropes Course studies included the presence and identification of secondary or non-target emotions and the use of five descriptors only to monitor the presence of positive and negative emotion. These experimental limitations were evident in Study 5, where, for example, more information concerning the types of emotion experienced during the Flying Fox may have aided interpretation of HR activity recorded during this element.

HR and SCL changes associated with level and valence factors for the two laboratory studies were not as great as that observed for the field studies. However the results (see Chapter 11) did support those obtained in the field studies, with linkages of HR and negative emotion and SCL with positive obtained. Equally important as these findings, the laboratory studies provided information concerning the measurement and identification of emotion types that was not possible in the field studies (see also Chapter 10 General Discussion, Methodological Concerns). The use of the PANAS (Watson, Clark & Tellegen, 1988) questionnaire provided a more objective and standardised means of measuring positive and negative emotion. The PANAS data was also able to confirm the valence nature and other characteristics of the challenge, hard, worry, fun and excitement descriptors used in both the field and laboratory studies.

Using a slightly different approach in Study 7a, the imagery sessions representing the high and low pole PA and NA clusters were pre-determined. Analyses on the PA and NA scores for these clusters confirmed that the high and low pole PA clusters differed in PA, but not NA, and the high and low pole NA clusters differed in NA, but not PA. This procedure ensured that the effects of secondary or non-target

emotions were minimised, and that more extreme PA or NA level differences between the valence clusters were achieved. The success of this procedure was reflected in the physiological responses, in particular the SCL response, for the high/low pole clusters. Compared to poor results in the SCL measure for all other cluster comparisons, the average SCL difference between the high and low pole PA clusters in Study 7a approached significance.

This approach to the study of the psychophysiology of emotion in the laboratory both complemented and extended recent developments described in the emotion literature (e.g., Johnsen, Thayer & Hugdahl, 1995). Rather than reporting on discrete emotions, the physiological changes that reflect the valence and level (intensity) dimensions of emotion evoked over a relatively longer period of time (60 seconds) were examined. Adopting a similar approach to the laboratory studies in this thesis, a concurrent study carried out by Witvliet and Vrana (1995) also tested the physiological changes accompanying four different emotion states located in the four quadrants of the experimental “affective space”. As discussed in Chapter 3, Witvliet and Vrana’s study was limited by the use of four emotions only, and they acknowledged that the “ultimate utility” of the arousal/valence models in psychophysiological studies rests on the use of a broader range of emotions.

Chapter 10 describes two exploratory analyses carried out on the data gathered in Study 7a. These analyses (Study 7b) explored the relationship between the average HR and SCL measures with other emotion characteristics related to the arousal and valence dimensions. A valence, arousal and emotion intensity score were calculated for each of the 10 imagery sessions using computations on the PA and NA scores. As mentioned in Chapter 10, this method of calculating arousal, valence and emotion intensity has not been documented in the emotion literature. There is also no known record of the examination of the effect of affect level, or what this thesis termed as emotion intensity,

on the accompanying physiological response.

While the influence of emotion intensity has not been tested previously, the relationship between HR and arousal has been demonstrated on a number of occasions, including the more recent study by Witvliet & Vrana, (1995). The exploratory analyses in Study 7b indicated a dependence of the HR response on emotion intensity, and to a slightly lesser degree, on arousal. There were no significant findings in the SCL measure with any of the four emotion characteristic scores. These results suggest that the effects of the primary emotion characteristics on the accompanying physiological response need to be taken into consideration in future psychophysiological studies of emotion.

The identification of emotion intensity as an important component of the emotion experience also has implications for recent developments concerning the categorisation of emotion (for a recent overview see Yik, Russell & Barrett, 1999). As mentioned in this thesis, circumplex models of emotion identified arousal and valence as the primary dimensions of emotion (e.g., Russell, 1980; Larsen & Diener, 1992). Developed from factor analytic investigations, Watson and Tellegen's (1985) model of affect argued that the two independent dimensions of positive affect and negative affect best represent variations in emotion. To avoid ambiguity in terminology, the same authors recently renamed these factors as positive activation (PA) and negative activation (NA) (Watson, Clark and Tellegen, 1999a). This model has attracted some criticism, particularly in regard to the independence of the PA and NA dimensions (Green, Goldman & Salovey, 1993; Green & Salovey, 1999). The data from Study 7, however, supported the independence of these two dimensions, and identified arousal and emotion intensity as important components of emotion.

Recent developments on Watson and Tellegen's 1985 model of affect have resulted in a multilevel or three-level hierarchical structure incorporating a general bi-

polar Happiness versus Unhappiness dimension, the relative independent PA and NA dimensions at the level below, and the discrete emotions at the base (Watson et al., 1999a). In this model, the arousal and valence dimensions may be aligned to the Pleasant versus Unpleasant and Engagement versus Disengagement dimensions produced by the 45° rotation of the PA/NA axes (see also Figure 10.1). Watson et al., (1999b) note that factor analyses of representative affect terms have not yielded an Arousal-Calm dimension of “comparable scope” (p.309) to the valence dimensions. With its valence base, emotion intensity may yield better results than arousal with factor analyses of representative terms and provide further differentiability to low activation terms. In any case, its relationship to other dimensions such as Friendliness versus Unfriendliness identified in this model warrant attention in future investigations of emotion categorisation.

In summary, the studies described in this thesis reflect the latest developments in the study of the psychophysiology of emotion. The physiological changes accompanying a broad range of affective states were evoked under laboratory and “real-life” conditions and tested for valence and level effects. The use of the PANAS questionnaire provided an alternative means of imagery session selection that took into account the influence of secondary or non-target emotions. The PA and NA scores enabled each imagery session in these studies to be represented on the experimental “affective space”, defined by the valence and arousal dimensions. The mapping of emotion onto an “affective space” allowed the integration of two popular approaches to the study of the psychophysiology of emotion in the laboratory; the examination of autonomic activity accompanying discrete emotions, with consideration to the valence, arousal and emotion intensity characteristics.

CHAPTER 12

FINAL DISCUSSION

12.1 INTRODUCTION

Using a more theoretical approach to the study of the psychophysiology of emotion, this thesis describes a total of seven field and laboratory studies that together explored HR and SCL profiles accompanying positive and negative emotion. In the light of the existing literature regarding the pattern of autonomic measures accompanying emotion, the first aim of this thesis was to provide an explanation for the fractionation of two measures, HR and SCL, as a function of emotion. Based on Fowles' (1980) hypothesis, HR and SCL activity were tested for linkages with positive and negative emotions respectively. Results from the field studies showed the contrary linkages of HR with negative emotion and SCL with positive emotion. Analyses of the imagery session clusters in Study 6 and Study 7a also supported these findings with HR activity associated with negative emotion and SCL activity showing some sensitivity to variation in positive emotion. As discussed in detail in the previous chapter, these findings were in direct contradiction to predictions arising from Fowles' (1980) hypothesis.

The second aim of this thesis was to monitor the types of emotional and physiological changes experienced during outdoor education activities and to see whether these changes were related to participant changes in self esteem. Research studies in Outdoor Education have reliably shown increases in self esteem and confidence due to successful participation in challenging activities (McIntyre, 1987; Iso-Ahola, LaVerde & Graefe, 1988). However, there is no record of an attempt to determine the sort of changes that occur during these activities which are responsible, or

at least related to, positive changes in self esteem. Interestingly, the results from Study 5 showed that the physiological measures (HR and SCL) were related to participant changes in self esteem, while the emotion descriptor ratings were not. The data from the studies conducted on the Ropes Course also provided a psychophysiological profile of participants during this activity. As mentioned in Chapter 4, this type of information is invaluable for all staff involved in Outdoor Education, in particular personnel responsible for Ropes Course construction, activity programming and instruction.

Detailed reviews of the field and laboratory studies are presented in Chapter 7 and Chapter 10 respectively. The previous chapter, Chapter 11, discussed the main findings in this thesis as they related to the experimental hypothesis regarding HR and SCL activity as a function of positive and negative emotion. The following discussion attempts to highlight some aspects of the studies conducted in this thesis investigation of emotion that may influence future psychophysiological research activities in the area of emotion and Outdoor Education. This chapter also briefly addresses other areas of research that will benefit from advances in research concerning the psychophysiological basis of emotion.

12.2 OUTDOOR EDUCATION: PSYCHOPHYSIOLOGICAL MEASURES AND EMOTION

The use of psychophysiological measures in Outdoor Education is just starting to emerge. For example, a recent study reported in the Journal of Leisure Research used psychophysiological measures to compare physiological responses and changes in affect during recollections of outdoor education experiences (Tarrant, Manfredo & Driver, 1994). This study measured HR, blood pressure and skin conductance levels during recollections of active and passive outdoor education experiences and a stressful exam experience. The results indicated that physiological activation was greatest for exam and

active recollections, positive mood was highest for active recollections and negative mood was lowest for passive recollections. The authors interpreted their findings within the framework of arousal theory and therefore did not address the differential behavior of the autonomic measures used. It should also be noted that this study, and another similar study by Tarrant (1996), was conducted in the laboratory and this limited their investigation of outdoor education experiences to “recollections”.

A study by Nettleton and Dickinson (1996) examined the fluctuation of emotional states in Wilderness settings in the context of Apter’s (1989) “reversal theory”. Apter argued that emotion states fluctuated between two behavioral modes, namely Arousal and Hedonic tone. According to Nettleton and Dickinson (1996), the arousal mode was likened to “emotion intensity” or the degree one feels “worked-up” (p30). The hedonic tone refers to the whether the experience felt was “pleasant” or “unpleasant. Using a laboratory environment, the authors investigated whether emotions experienced in wilderness settings alternated between anxiety, excitement and relaxation. Twenty-four adult subjects responded to a series of slides (e.g., turbulent rivers versus reflective waters) depicting various outdoor settings they had experienced in previous expeditions. A number of different scales, such as the linear Arousal and Stress scale, (King, Burrows & Stanley, 1983), the Affective Appraisal Inventory (Russell & Pratt, 1980), and the Adjective Check List (see Apter, 1989), were used to monitor the affective response of the subjects. Data from these scales confirmed that various outdoor settings resulted in a *“quick initial affective response to the setting which reverberated with a slower more cognitive response which engaged past experiences and feelings”* (Nettleton & Dickinson, 1996, p34). The authors also suggested that other methods, in addition to the use of rating scales and limited verbal discussions, should be enlisted for future research in this area.

It should be noted that, similar to the techniques employed in this thesis

investigation of emotion, the study by Nettleton and Dickinson (1996) attempted to map the emotions associated with the various wilderness settings onto an “affective map”. Ratings on the two dimensions of arousal/sleepy and unpleasant/pleasant (see Russel & Pratt, 1980) confirmed that the “pool” setting was significantly different from the “mountain view” in terms of the arousal dimension, while differences in “pleasantness” and arousal were identified for two mountain scenes. This study, along with the research presented in this thesis, reflects a renewed interest and a more theoretically based approach to the study of emotion during adventure / wilderness activities.

12.2.1 Outdoor Education and Ambulatory Monitoring

The body of experimental work presented in this thesis started with a small exploratory study to examine cardiovascular changes on the Ropes Course as a function of state anxiety. The main aim of this first study was to determine whether the Ropes Course activity evoked strong emotional and physiological changes that could be monitored during the course of the activity. A portable sphygmomanometer was used to measure HR, SBP and DBP levels at two pre-determined points on the Ropes Course platforms for a group of 20 child subjects. The results indicated that participation on the Ropes course influenced state anxiety levels, with changes in the cardiovascular measures observed. The group of subjects recording an increase in state anxiety at the fourth element showed a significant increase in SBP. This study highlighted the benefits of using multiple measures and indicated the potential use of the Ropes Course activity as a natural activity capable of eliciting significant emotional changes.

The first study of this thesis indicated that significant emotional and physiological changes occurred during the Ropes Course attempt. As noted in Chapter 5, the behavior of the cardiovascular measures in Study 1 were consistent with other studies (e.g., Sinha, Lovallo & Parsons, 1992; McCann et al., 1993) exploring the

cardiovascular response to different stressors. However, with only two measurement occasions, the information about the physiological and emotional changes that occurred during the Ropes Course activity was limited. That is, while a relationship between SBP and state anxiety was found, the use of only two sampling points limited our understanding of the types and changes that take place during this popular Outdoor Education activity. For example, at what stages (elements) do these emotional changes take place? Are the effects of the various Ropes Course elements cumulative? Study 4 confirmed that participants on the five day Outdoor Education program at the Broken Bay Centre increased their self esteem. However, again due to the limitations of pre and post test measures, information relating to the processes that underlie the observed changes in self esteem is not readily identified.

In Study 2 and Study 3, an ambulatory monitoring device (HGM1) was used to monitor HR and SCL activity during the Ropes Course studies. Study 2 indicated fractionation of the HR and SCL measures across the element epochs and a range of cardiac and electrodermal response patterns for the six Ropes Course elements. Analyses in Study 3 indicated that HR and SCL activity was linked to negative and positive emotion respectively. Equally important, these data also provided a psychophysiological profile of individual subjects as they traversed each element of the Ropes Course. The use of psychophysiological monitoring provided an insight into the types of physiological and psychological changes that occurred during each element of the Ropes Course.

The value of this psychophysiological “in situ” monitoring was further illustrated in Study 5, where differences in the physiological changes reflected group changes in self esteem. In the second part of Study 5, subjects were divided into two groups according to whether they increased in General SE (Group 1) or decreased or showed no change in General SE (Group 2) for the five day Outdoor Education

program. The psychophysiological changes experienced on the Ropes Course were tested for subject group differences. In regard to the ratings data on the five descriptors fun + excitement and challenge + hard + worry, there were no significant group differences. Analysis of the physiological data indicated there were no group differences in the average HR, SCL or motility changes across the Ropes Course attempt. Significant group differences in the physiological response across three Ropes Course elements were found. HR increases for Group 2 on the Tyre Walk and Postmans Walk in the linear and quadratic trends (respectively) were significantly greater than Group 1. The SCL increase for Group 1 was found to be significantly greater than Group 2 on the Postmans Walk in both the linear and cubic trends while the greater SCL increase on the Spiders Web for Group 1 approached significance in the quadratic trend.

Analysis of the ratings data showed that the Postmans Walk and Spiders Web were rated as significantly high on the three descriptors; challenge, hard and worry by both subject groups. While the Element ratings on the five descriptors did not show any group differences, the findings in the physiological data suggested that the two subject groups did experience different psychophysiological changes during the more challenging stages of the Ropes Course. Based on Study 3 results, one interpretation of these data is that Group 1 experienced higher levels of positive emotion on the Postmans Walk and Spiders Web and Group 2 experienced higher levels of negative emotion on the Tyre Walk and Postmans Walk. In other words, the group of subjects reporting an increase in General SE experienced relatively higher levels of positive emotion and lower levels of negative emotion during the more challenging elements of the Ropes Course.

Study 5 also highlighted some methodological concerns previously identified with Outdoor Education research. For example, the lack of group differences in the element descriptor ratings in Study 5 may have reflected problems associated with the

use of “before” and “after” sampling, the subjective nature of rating emotion descriptors, social context influences or experimenter expectations. A study by Lewis, Ray, Wilkinson and Ricketts (1984) found discrepancies between the physiological data and the self-report data taken on a Flying Fox activity using “before” and “after” sampling methods. In their study, gender differences were found in the self report data that were not reflected in the HR increases recorded across the Flying Fox. Lewis et al. (1984) attributed the conflicting results in their self report data to socially based expectations and/or observer influences, thus highlighting the need for more objective measures with this sort of research. Another concern or limitation of Study 5 was that group self esteem changes were measured across the five day program. While the Ropes Course activity was found to be a major component of this program, it is envisaged that future studies would need to measure self esteem changes associated with the Ropes Course attempt only. Another option would be to determine whether these same group differences occurred during other challenging program activities offered in the Outdoor Education program.

The studies on the Ropes Course focused on group emotional and physiological changes relating to specific elements of the Course. Future studies may focus on the cumulative effects of challenge by examining an individual’s psychophysiological profile, with reference to changing perceptions and responses as they progress through the course. Information relating to an individual’s experience of the Ropes Course could be gathered through observation data and in-depth interviews (e.g., Dickinson, 1997). Judicious combined use of these methods may shed light on both the task requirements and variation in the accompanying psychophysiological changes measured across the activity. Variables such as personality, past experience, audience or social effects that may differentially influence an individual’s Ropes Course experience could also be considered. In any case, caution should be taken with factors, such as wearing electrodes and experimenter observation, which relate to participation in the experiment

itself.

The availability of suitable monitoring equipment supported by knowledge and understanding of physiological measures will encourage more research activity in Outdoor Education. There has been no known attempt to test the relationship between challenge, the emotional and physiological changes experienced during these challenging activities, and the subsequent change in self esteem. Yet these relationships underlie activities implemented in Outdoor Education programs. The data collected on the Ropes Course activity provided a detailed psychophysiological profile of participants involved in challenging activities. The studies on the Ropes Course provided a unique opportunity for the study of the psychophysiology of emotion. They also clearly highlighted the benefits gained from the use of objective physiological measures obtained “in situ”.

12.3 PSYCHOPHYSIOLOGY OF EMOTION: IMPLICATIONS FOR OTHER RESEARCH AREAS

In this thesis psychophysiological investigation of emotion, Fowles’ 1980 hypothesis was adopted as a theoretical platform from which to investigate the fractionation patterns of HR and SCL as a function of emotion. This approach differed from previous psychophysiological studies of emotion that have simply examined the physiological response accompanying discrete emotions. As well as influencing future approaches to the study of emotion, the examination of the physiological response linked to different emotion systems such as the BAS and the BIS allows integration with research in disparate areas. For example, a recent paper by Barry and Sokolov (1993), on phasic and tonic indices of the Orienting Reflex (OR), regarded SCL as a tonic arousal measure. This research pointed to strong links between this aspect of

Sokolov's theory of the OR and the sensitisation process of dual-process theory (Groves & Thompson, 1970). Some of the findings described in this thesis, particularly in the SCL measure, are directly compatible with that work, and may serve to encourage a renewed interest in the fundamental role of autonomic state measures in a wide range of human behaviour.

More recently, the use of autonomic state measures in research areas such as sport performance and health have attracted considerable attention. For example, there is a strong interest in the cardiovascular response during panic attacks (e.g., Barlow & Cerny, 1988). This has resulted in a number of studies attempting to monitor the accompanying physiological activity in order to gain a clearer understanding of the anxiety / panic response. Barlow's research on panic and anxiety (Barlow, 1988; Barlow & Cerny, 1988) suggested that "panic attacks" were the same as "alarm reactions", and in the absence of a life threatening event these "false alarms" resulted in a sudden burst of anxiety accompanied by gross somatic symptoms and a sense of fear. Outside the laboratory, studies on panic and anxiety have successfully used ambulatory equipment and Experiential Sampling Methods to monitor the cardiovascular and emotion response during moments of high anxiety or panic (e.g., Roth, Breivik & Elbert, 1991). Ambulatory equipment has also been used to examine the effects of anxiety and relaxation programs on sport performance using physiological "in situ" monitoring (e.g., Landers, 1985; Tremayne & Barry, 1990; see also Martin, 1961 and reviews in Iso-Ahola & Hatfield, 1986; Neiss, 1988, 1990 and Gould & Udry, 1994).

Psychophysiological research also holds practical applications and benefits for the health of the general community. For example, psychophysiological research into anxiety and stress will contribute to the knowledge and control of health ailments such as chronic stress / hypertension (see reviews in Hallam, 1985; Cuthbert & Lang, 1989; Strelau, 1992; Forgays, Sosnowski & Wrzesniewski, 1992; see also Houston, 1983; and

Spielberger & Rickman, 1990) and depression (e.g., Appel, Holroyd & Gorkin, 1983). Studies testing the cardiovascular health and fitness of children have also relied on psychophysiological measures (e.g., Matthews & Stoney, 1988; Halberg et al., 1989; Klesges, Haddock & Eck, 1990; Stratton, 1996,1997).

More specifically, psychophysiological investigations of emotion states, such as those described in this thesis, may influence health related research activity in areas such as the selection of physiological measures and the appropriate emotional and/or environmental context in which to monitor patient responses. For example, scientists and medical practitioners have typically used blood pressure to monitor patient stress levels. However, the effect of anger/hostility, particularly suppressed anger, has been shown to be equally, if not more detrimental to cardiovascular health (see Chapter 2, also review in Brannon & Feist, 1992). Psychophysiological studies of emotion (e.g., Roberts & Weerts, 1982; Schwartz, Weinberger & Singer, 1981; see also review in Wagner, 1989) have indicated that DBP, rather than SBP, reflects changes in anger (see Chapter 3). It would therefore seem that changes in DBP in the presence of stressors are a more sensitive indicator of cardiovascular health in high-risk myocardial infarction patients. Psychophysiological studies (e.g., Schwartz et al., 1981) have also indicated that exercise, or rather the skeletal behavioral state of the individual, may also influence cardiovascular patterns in emotion (Schwartz, 1986).

There is accumulating evidence of the importance of emotion in illness, in terms of mediation by the physiological changes that accompany emotion. Psychosomatic studies have demonstrated the importance of emotion on patient recovery. For example, a study by Appel, Holroyd and Gorkin (1983) showed the anger response to be helpful in cancer patients if it was able to counteract maladaptive depression and feelings of hopelessness. The relationship between the psychological changes accompanying physiological activity and observed health improvements is not completely understood.

Health benefits are suggested if the physiological changes are able to be controlled using methods such as biofeedback (Gatchel & Barnes, 1989), but the role of the physiological changes that accompany positive changes in the affective state of a patient should also be considered. With advances in the study of the psychophysiology of emotion, it is likely that this area will attract further research attention.

The physiological changes accompanying positive and negative affect were examined in this thesis. Watson and his colleagues developed a standardised questionnaire to monitor PA and NA (Watson, Clark & Tellegen, 1988), and this along with other research activity in emotion (e.g., Watson, 1985, 1988; Diener & Emmons, 1985; Watson & Pennebaker, 1989; King & Emmons, 1990) has instigated a resurgence in research exploring emotion and general health. For example, studies by Watson and Clark (1984), Watson (1988) and Larsen and Ketelaar (1991) examined the relationship of PA and NA with daily moods states, health complaints, perceived stress and susceptibility to health problems. Their studies did not employ physiological measures but relied on numerous self-report questionnaires. The use of physiological indices may prove to be a less intrusive and more objective method of monitoring emotion changes as subjects go about their daily routines.

Each of the studies described in this thesis provided new information regarding HR and SCL activity accompanying positive and negative emotion. Future application of psychophysiological research of emotion to other research areas, such as health, rests on a more solid understanding of autonomic activity and the experience of emotion in a wide variety of contexts. It is anticipated that a more reliable and greater understanding of the psychophysiology of emotion will result from the adoption of a more theoretically based approach to emotion research, and the use of both field and laboratory studies.

12.4 GENERAL CONCLUSION

As mentioned in the Introduction to this thesis, the success of psychophysiological research on emotion relies on the experimenter's ability to select appropriate physiological indices and the reliable interpretation of their behavior. In his review of anxiety research, Forgays et al. (1992) noted that a theoretically based approach to the study of anxiety was required. He also advocated the need to develop new methods of measurement for future research studies, and proposed that at the very least, multiple measures of anxiety should be used. For example, Forgays et al. (1992) recommended that any psychophysiological study of anxiety should include a measure such as Spielberger's (1970) STAI, as well as self report measures, and the use of multiple physiological indices. The beneficial use of multiple measures was first demonstrated in Study 1 of this thesis, where it was found that SBP reflected changes in state anxiety. In comparison, HR did not reflect state anxiety changes. HR change across the two sampling points was taken to reflect other factors associated with the Ropes Course attempt. The benefits of adopting multiple measures to monitor state anxiety was thus demonstrated, with the results showing that under the sampling conditions employed in this first study, the SBP measure was most sensitive to state anxiety changes.

The collection of studies described in this thesis explored HR and SCL behavior as a function of positive and negative emotion. This approach was based on Fowles' (1980) hypothesis, which predicted associations of HR with the BAS, and SCL with the BIS. The theoretical approach to the study of the psychophysiology of emotion adopted in this thesis was also influenced by developments described in the emotion literature. This included the measure of positive and negative affect (Watson & Tellegen, 1985; Watson, Clark & Tellegen, 1988) and their relationship to the BAS and the BIS (Larsen & Ketelaar, 1991).

In the field studies, the HR and SCL responses were tested for differences that reflected levels of positive and negative emotion experienced across elements of the Ropes Course activity. In contrast to predictions based on Fowles' hypothesis, analyses in Study 3 showed that HR activity reflected level differences in negative emotion and SCL activity reflected levels of positive emotion. In Study 5, analyses of the physiological data took into account the influence of movement on the HR and SCL measures. Findings from this study also supported linkages of HR with negative emotion and SCL with positive emotion.

In the laboratory, positive and negative emotions were evoked during 10 imagery sessions, each of one minute duration. Analyses from Study 6 and Study 7 indicated that HR and SCL changes were not as great as those found in the field studies, but the laboratory study findings did confirm the linkage of HR with negative emotion, and suggested that the SCL response was somewhat sensitive to level differences in positive emotion. Exploratory analyses in Study 7b indicated that HR was also influenced by arousal and emotion intensity.

In this Study, the emotion characteristics of arousal, valence and emotion intensity for each imagery session were calculated from the NA and PA scores. The term emotion intensity was used to describe how strongly a person felt emotional, irrespective of valence. In other words it is a measure of the emotion strength, and is calculated by taking the modulus of the valence score. The relationship of emotion intensity with physiological changes, or even its measurement, has not previously been addressed in the psychophysiology literature. While exploratory, these findings suggest that these aspects of emotion should be monitored in future psychophysiological investigations of emotion.

Other aspects associated with the subject's emotion experience, such as situation

context and individual differences, should also be considered in future studies of emotion. For example, studies conducted by Sosnowski (1992) and others (e.g., Naveteur & Freixa i Baqué, 1987; Forgas, Sosnowski & Wrzwesniewski, 1992) suggest that electrodermal responses are evoked by different situational demands. This immediately holds implications for emotion research and implies that while Gray may provide adequate descriptions of behavioural-emotional systems, human subjects and the intricacies and complexity of everyday situations makes the emotional-motivational meanings difficult to determine and replicate in the laboratory.

The discussion in Chapter 10 indicated that a great deal of work needs to be done to identify the best methods of evoking, sampling and measuring emotion and the accompanying physiological responses. As illustrated in the Chapter 3 literature review and in this thesis investigation of emotion, variation in methodologies and even the type of emotions studied, mean that comparisons between individual studies need to be treated with caution. For example, the studies in this thesis clearly showed that the types of emotion identified with challenge during a “real-life” adventure setting were not necessarily similar to emotions evoked through challenge imagery. However, as also illustrated in this thesis, conducting studies of emotion both inside and outside the laboratory may provide a clearer and more informative picture of the “emotion” experience and the accompanying physiological responses.

One aim of this research work was to highlight potential benefits of research activity in Outdoor Education. The above discussion illustrates the value of psychophysiological research activity in Outdoor Education. It is anticipated that the use of precise ambulatory monitoring equipment will herald a renewed interest in the study of emotion under “real-life” situations. In regard to Outdoor Education, the use of psychophysiological measures allows a fresh approach to the study of the psychological changes and processes underlying Outdoor Education activities.

REFERENCES

- Andreassi, J. (1989). *Psychophysiology, human behavior and physiological response*. 2nd Ed. Hillsdale, NJ: Erlbaum.
- Appel, M.A., Holroyd, K.A. & Gorkin, L. (1983). Anger and the etiology and progression of physical illness. In L. Temoshok, C. VanDyke and L.S. Zegans (Eds.), *Emotions in Health and Illness: Theoretical and Research Foundations* (pp.73-87). New York: Grune and Stratton.
- Apter, M.J. (1989). *Reversal Theory. Motivation, Emotion and Personality*, New York: Routledge.
- Ax, A.F. (1953). The physiological differentiation between fear and anger in humans. *Psychosomatic Medicine*, 15, 433-442.
- Averill, J.R. (1969). Autonomic response patterns during sadness and mirth. *Psychophysiology* 5, 399-414.
- Bandura, A. (1977). Self efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191-215.
- Bakker, F.C. & Kayser, C.S. (1994). Effect of a self-help mental training programme. *International Journal of Sport Psychology*, 25, 158-175.
- Barlow, D.H. (1988). *Anxiety and its disorders: The nature and treatment of anxiety and panic*. NY: Guilford Press.

- Barlow, D.H. & Cerny, J.A. (1988). *Psychological treatment of pain*. New York: Guilford Press.
- Barlow, D.H. & Craske, M.G. (1986). *Psychological treatments of panic disorder*. Paper presented at the 94th Annual Convention of the American Psychological Association, Washington, DC.
- Barry, R.J., Moroney, R., Orlebeke, J.F. & de Vries, J. (1991). HGM1: A research-oriented portable heart rate and galvanic skin response monitor. *International Journal of Psychophysiology*, 11, 161-165.
- Barry, R.J. & Sokolov, E.N. (1993). Habituation of phasic and tonic components of the orienting reflex. *International Journal of Psychophysiology*, 15, 39-42.
- Beidel, D.C., Turner, S.M. & Dancu, C. (1985). Physiological, cognitive and behavioural aspects of social anxiety. *Behaviour Research and Therapy*, 23, 109-118.
- Blair, D.A., Glover, W.E., Greenfield, A.D.M. & Roddie, I.C. (1959). Excitation of cholinergic vasodilator nerves to human skeletal muscles during emotional stress. *Journal of Physiology*, 148, 633-647.
- Bledsoe, J.C. (1964). Self-concepts of children and their intelligence, achievement, interests, and anxiety. *Journal of Individual Psychology*, 20, 55-58.
- Bodwin, R. & Bruck, M. (1962). The relationship between self-concept and the presence and absence of scholastic underachievement. *Journal of Clinical Psychology*, 18, 181-182.

- Bohlin, G. (1976). Delayed habituation of the electrodermal orienting response as a function of increased level of arousal. *Psychophysiology*, 13, 345-351.
- Borkovec, T.D., Weerts, T.C. & Bernstein, D.A. (1976). Behavioral assessment of anxiety. In A. Ciminero, K. Calhoun & H.E. Adams (Eds.), *Handbook of Behavioral Assessment* (pp.367-428). New York: Wiley.
- Bouchard, F. (1973). Wilderness Meeting Ground: Challenge. *Independent School Bulletin*, 32, 53-56.
- Bouchard, C. & Corson, J.A. (1976). Heart regulation with success and failure signals. *Psychophysiology*, 13, 69-74.
- Boucsein, W., Baltissen, R. & Euler, M. (1984). Dependence of skin conductance reactions and skin resistance reactions upon previous level. *Psychophysiology*, 21, 212-218.
- Boutcher, S.H., McAuley, E. & Courneya, K.S. (1997). Positive and negative affective response of trained and untrained subjects during and after aerobic exercise. *Australian Journal of Psychology*, 49, 28-21.
- Brannon, L. & Feist, J. (1992). *Health Psychology: An Introduction to Behavior and Health*, (2nd ed.). Belmont, CA: Wadsworth.
- Bundy, R.S. & Mangan, S.M. (1979). Electrodermal indices of stress and cognition: Possible hydration artifacts. *Psychophysiology*, 16, 30-33.

- Bunker, L.K. (1991). The role of play and motor skill development in building children's self-confidence and self esteem. *The Elementary School Journal*, 91, 467-471.
- Bunting, C.J. (1989). The compatibility of physical education and outdoor education. *Journal of Physical Education, Recreation and Dance*, 60, 35-39.
- Bunting, C.J., Little, M.J., Tolson, H. & Jessop, G. (1986). Physical fitness and eustress in the adventure activities of rock climbing and rappelling. *Journal of Sports Medicine*, 26, 11-20.
- Cannon, W.B. (1929). *Bodily changes in pain, hunger, fear and rage*. New York: Appleton-Century-Crofts.
- Carroll, D., Marzillier, J.S. & Merian, S. (1982). Psychophysiological changes accompanying different types of arousing and relaxing imagery. *Psychophysiology*, 19, 75-82.
- Cattell, R.B., Eber, H.W. & Tatsuoka, M.M. (1970). *Handbook for the Sixteen Personality Factor Questionnaire (16 PF)*. Champaign, IL: Institute for Personality and Ability Testing.
- Cason, D. & Gillis, H.L. (1994). A meta-analysis of outdoor adventure programming with adolescents. *Journal of Experiential Education*, 17, 40-47.
- Clements, K. & Turpin, G. (1995). Effects of feedback and task difficulty on electrodermal activity and heart rate: An examination of Fowles' three arousal model. *Journal of Psychophysiology*, 9, 231-242.

- Cohen, D.H. (1974). The neural pathways and informational flow mediating a conditional autonomic response. In L.V. DiCara (Ed.), *Limbic and Autonomic Nervous Systems Research* (pp.223-275). New York: Plenum.
- Coles, M.G.H., Donchin, E. & Porges, S.W. (1986). *Psychophysiology: Systems, Processes and Applications*. New York: Guilford Press.
- Conrad, D. & Hedin, D. (1995). National assessment of experiential education: Summary and implications. In R.J. Kraft & J. Kielsmeier (Eds.), *Experiential Learning In Schools and Higher Education* (pp.382-403). Dubuque, IA: Kendall/Hunt.
- Cook, E.W.III, Hawk, L.W., Davis, T.L. & Stevenson, V.E. (1991). Affective individual differences and startle reflex modulation. *Journal of Abnormal Psychology*, 100, 5-13.
- Cooper, G. (1996). The role of Outdoor Education in education for the 21st Century. *Australian Journal of Outdoor Education*, 1, 10-14.
- Coopersmith, S. (1975). Building self-esteem in the classroom. In, *Developing motivation in young children* (pp. 95-132). Palo Alto, CA: Consulting Psychologists Press.
- Coopersmith, S. (1981). Coopersmith Inventory, SEI School Form. Palo Alto, CA: Consulting Psychologists Press.
- Coopersmith, S. (1991). SEI Self Esteem Inventories. Palo Alto, CA: Consulting Psychologists Press.

- Cuthbert, B.N. & Lang, P.J. (1989). Imagery, memory and emotion: a psychophysiological analysis of Clinical Anxiety. In G. Turpin (Ed.), *Handbook of Clinical Psychophysiology*, (pp.105-134). New York: Wiley.
- Cuthbert, B.N., Bradley, M.M. & Lang, P.J. (1990). Valence and arousal in slide modulation. *Psychophysiology*, 27 (Suppl.), S24 (abstract).
- Csikszentmihalyi, M. (1975). *Beyond Boredom and Anxiety*. San Francisco, CA: Jossey-Bas.
- Darrow, C.W. (1929). Electrical and circulatory responses to brief sensory and ideational stimuli. *Journal of Experiential Psychology*, 12, 267-300.
- Davidson, R.J. (1983). Affect, cognition and hemispheric specialisation. In C.E. Izard, J. Kagan & R. Zajonc (Eds.), *Emotion, cognition and behavior*. New York: Cambridge University Press.
- Davidson, R.J. (1984). Hemispheric asymmetry and emotion. In K.R. Scherer & P. Ekman (Eds.), *Approaches to emotion*. Hillsdale, N.J.: Erlbaum.
- Davis, R.C., Buchwald, A.M. & Frankmann, R.W. (1955). Autonomic responses and their relation to simple stimuli. *Psychological Monographs*, 69, 1-71.
- De Jong-Meyer, R., Hubert, W., Ostkamp-Hovekamp, G. & Vennen, J. (1993). Bodily sensations, facial EMG, and autonomic changes in the course of prolonged emotional imagery. *Journal of Psychophysiology*, 7, 34-45.

- DiCara, L.V. & Miller, N.E. (1968). Instrumental learning of systolic blood pressure responses by curarized rats: Dissociation of cardiac and vascular changes. *Psychosomatic Medicine*, 30, 489-494.
- Dickinson, S. (1989). *Experiencing emotion in outdoor adventure activities*. Conference Proceedings from the 6th National Outdoor Education Conference, Narrabeen, Sydney. (pp.97-104).
- Dickinson, S. (1997). *A gender analysis of major emotional episodes on a three day wilderness canoe trip*. Conference Proceedings from the 10th National Outdoor Education Conference, Collaroy, Sydney. (pp.58-62).
- Diener, E. & Emmons, R.A. (1985). The independence of positive and negative affect. *Journal of Personality and Social Psychology*, 47, 1105-1117.
- Dimsdale, J.E., Pierce, C., Schoenfeld, D., Brown, A., Zusman, R. & Graham, R. (1986). Suppressed anger and blood pressure; the effects of race, sex, social class, obesity, age. *Psychosomatic Medicine*, 48, 430-436.
- Drummond, R.J., McIntire, W.G. & Ryan, C.W. (1977). Stability and sex differences on the Coopersmith Self-Esteem Inventory for students in grades two to twelve. *Psychological Reports*, 40, 943-946.
- Duffy, E. (1957). The psychological significance of the concept of "arousal" or "activation". *Psychological Review*, 64, 265-275.
- Duffy, E. (1962). *Activation and Behavior*. New York: Wiley.

- Duffy, E. (1972). Activation. In N.S. Greenfield & R.A. Sternbach (Eds.), *Handbook of Psychophysiology*, (pp. 577-622). New York: Rinehart & Winston.
- Edelberg, R. (1967). Electrical properties of the skin. In C.C. Brown (Ed.), *Methods in Psychophysiology*, (pp.1-53). Baltimore: Williams & Wilkins.
- Edelberg, R. (1970). The information content of the recovery limb of the electrodermal response. *Psychophysiology*, 6, 527-539.
- Edelberg, R. (1972). Electrical activity of the skin: Its measurement and uses in psychophysiology. In N.S. Greenfield & R.A. Sternbach (Eds.), *Handbook of Psychophysiology*, (pp.367-418). New York: Holt, Rinehart & Winston.
- Edelberg, R. (1983). The effects of initial sweat duct filling and skin hydration on electrodermal response amplitude. *Psychophysiology*, 20, 550-557.
- Edelberg, R. & Burch, N.R. (1962). Skin resistance and galvanic skin response: Influence of surface variables and methodological implications. *Archives of General Psychiatry*, 7, 163-169.
- Ehrlich, D.J. & Malmö, R.B. (1967). Electrophysiological concomitants of simple operant conditioning in a rat. *Neuropsychologia*, 5, 219-235.
- Ekman, P. & Davidson, R.J. (1994). *The nature of emotion*. New York: Oxford University Press.
- Ekman, P. & Friesen, W.V. (1975). *Unmasking the face*. Englewood Cliffs, NJ: Prentice Hall.

- Ekman, P., Friesen, W.V. & Ellsworth, P.C. (1972). *Emotion in the human face*. Elmsford, NY: Pergamon Press.
- Ekman, P., Levenson, R.W. & Friesen, W.V. (1983). Autonomic nervous system distinguishes among emotions. *Science*, 221, 1208-1210.
- Elliott, R. (1969). Tonic heart rate: Experiments on the effects of collative variables lead to a hypothesis about its motivational significance. *Journal of Personality and Social Psychology*, 12, 211-228.
- Elliott, R. (1974). The motivational significance of heart rate. In P.A. Obrist, A.H. Black, J. Brener & L.V. DiCara (Eds.), *Cardiovascular Psychophysiology - current issues in response mechanisms, biofeedback and methodology*, (pp.136-162). Chicago: Aldine.
- Elliott, R., Bankart, B. & Light, T. (1970). Differences in the motivational significance of heart rate and palmar conductance: Two tests of a hypothesis. *Journal of Personality and Social Psychology*, 14, 166-172.
- Elster, J. (1999). *Strong feelings*. Cambridge, MA: The MIT Press.
- Euse, F.J. & Haney, J.N. (1975). Image clarity, controllability, and emotional intensity: Correlations with introversion, neuroticism, and anxiety. *Perceptual and Motor Skills*, 40, 443-447.
- Ewert, A.W. (1987). Research in Experiential Education: An overview. *Journal of Experiential Education*, 10, 4-7.

- Ewert, A.W. (1989). *Outdoor Adventure Pursuits: Foundations, Models and Theories*. Columbus, Ohio: Publishing Horizons.
- Ewert, A.W. (1995). Research and evaluation of experiential learning. In R.J. Kraft & J. Kielsmeier (Eds.), *Experiential Learning In Schools and Higher Education*, (pp. 376-381). Dubuque, IA: Kendall/Hunt.
- Eysenck, H.J. & Eysenck, S.B.G. (1975). Manual of the Eysenck Personality Questionnaire (EPQ). London: Hodder & Stoughton.
- Fenz, W.D. & Epstein, S. (1967). Gradients of physiological arousal in parachutists as a function of an approaching jump. *Journal of Somatic Medicine*, 29, 33-51.
- Féré, C. (1888). Note sur les modifications de la résistance électrique sous l'influence des excitations sensorielles et des émotions. *Comptes rendus des Seances de la Société de Biologie*, 5, 217-219.
- Ford, P. (1981). *Principles and practices of Outdoor /Environmental Education*. New York: Wiley.
- Forgays, D.G., Sosnowski T. & Wrzwesniewski, K. (1992). Anxiety research: Present and future. In D.G. Forgays, T., Sosnowski & K. Wrzwesniewski, (Eds.), *Anxiety: recent developments in cognitive, psychophysiological and health research*, (pp.263-277). Washington: Hemisphere.

- Fowles, D.C. (1980). The Three Arousal Model: Implications of Gray's two-factor learning theory for heart rate, electrodermal activity and psychopathy. *Psychophysiology*, 17, 87-104.
- Fowles, D.C. (1982). Heart rate as an index of anxiety: Failure of a hypothesis. In J.T. Cacioppo & R.E. Petty (Eds.), *Focus on cardiovascular psychophysiology*, (pp.93-126). New York: Guilford.
- Fowles, D.C. (1983). Motivational effects on heart rate and electrodermal activity: Implications for research on personality and psychopathology. *Journal of Research in Personality*, 17, 48-71.
- Fowles, D.C. (1984). Arousal: Implications of Behavioral Theories of Motivation. In M. Coles & J. Richard (Eds.), *Psychological perspectives: Festschrift for Beatrice & John Lacey*, (pp.143-156). New York: Guilford.
- Fowles, D.C. (1986). The Eccrine system and electrodermal activity. In M.G.H. Coles, E. Donchin & S.W. Porges (Eds.), *Psychophysiology: Systems Processes and Applications*, (pp. 51-96). New York: Guilford.
- Fowles, D.C. (1987). Application of a behavioral theory of motivation to the concepts of anxiety and impulsivity. *Journal of Research in Personality*, 21, 417-435.
- Fowles, D.C. (1988). Presidential address, 1987. Psychophysiology and psychopathology: a motivational approach. *Psychophysiology*, 25, 373-391.

- Fowles, D.C. (1992). Motivational approach to anxiety disorders. In D.G. Forgays, T. Sosnowski & K. Wrzesniewski (Eds.), *Anxiety: Recent developments in cognitive, psychophysiological and health research*, (pp.181-192). Washington: Hemisphere.
- Fowles, D.C. (1993). Electrodermal activity and antisocial behavior: Empirical findings and theoretical issues. In J.C. Roy, W. Boucsein, D.C. Fowles & J.H. Gruselier (Eds.), *Progress in electrodermal research*, (pp.223-237). New York: Plenum Press.
- Fowles, D.C., Christie, M.J., Edelberg, R., Grings, W.W., Lykken, D.T. & Venables, P.H. (1981). Committee report: Publication recommendations for electrodermal measurements. *Psychophysiology*, 18, 232-239.
- Fowles, D.C., Fisher, A.E. & Tranel, D.T. (1982). The heart rate beats to reward: The effect of monetary incentive on heart rate. *Psychophysiology* 19, 506-513.
- Fridja, N.H. (1986). *The Emotions*. Cambridge, England: Cambridge University Press.
- Funkenstein, D.H., King, S.H. & Drolette, M.E. (1954). The direction of anger during a laboratory stress-inducing situation. *Psychosomatic Medicine*, 16, 404-413.
- Furedy, J.J. (1993). Electrodermal activity as a tool for differentiating psychological processes in human experimental preparations: Focus on the psyche of psychophysiology. In J.C. Roy, W. Boucsein, D.C. Fowles & J.H.

- Gruzelier (Eds.), *Progress in electrodermal research*, (pp.61-72). New York: Plenum Press.
- Garwood, M., Engel, B. & Capriotti, R. (1982). Autonomic nervous system functioning and ageing: Response sensitivity. *Psychophysiology*, 19, 378-385.
- Gatchel, R.J. & Barnes, D. (1989). Physiological self-control and emotion. In H. Wagner & A. Manstead, (Eds.), *Handbook of Social Psychophysiology*, (pp.121-140). New York: Wiley.
- Gill, D.L., Dzewaltowski, D.A. & Deeter, T.E. (1988). The relationship of competitiveness and achievement orientation to participation in sport and non-sport activities. *Journal of Sport and Exercise Psychology*, 10, 139-150.
- Gill, D.L. & Martens, R. (1977). The role of task-type and success-failure in group competition. *International Journal of Sport Psychology*, 8, 160-177.
- Gould, D. & Udry, E. (1994). Psychological skills for enhancing performance: arousal regulation strategies. *Medicine and Science in Sports and Exercise*, 26, 478-485.
- Gray, J.A. (1973). Causal theories of personality and how to test them. In J.R. Royce (Ed.), *Multivariate analysis and psychological theory*, (pp. 409-463). New York: Academic Press.
- Gray, J.A. (1975). *Elements of a two-process theory of learning*. New York: Academic Press

- Gray, J.A. (1976). The behavioural inhibition system: a possible substrate for anxiety. In M.P. Feldman & A.M. Broadhurst (Eds.), *Theoretical and experimental bases of the behaviour therapies*, (pp. 3-41). New York: Wiley.
- Gray, J.A. (1982). *The neuropsychology of anxiety: An inquiry into the functions of septo-hippocampal system*. New York: Oxford University Press.
- Gray, J.A. (1987). *The psychology of Fear and Stress* (2nd Ed.). Cambridge, England: Cambridge University Press.
- Gray, T.L., Patterson, J.W. & Linke, R.D. (1993). *A progress report on the impact of extended stay outdoor education programs – The Glengarry experience*. Proceedings of the 3rd Annual NSW Outdoor Education Conference. Illaroo Shoalhaven, NSW (pp.57-63).
- Gray, T. & Perusco, D. (1993). Footprints in the sand: the value of outdoor education in the school curriculum. *The ACHPER National Journal*, Autumn, 17-20.
- Green, D.P., Goldman, S.L. & Salovey, P. (1993). Measurement error masks bipolarity in affect ratings. *Journal of Personality and Social Psychology*, 64, 1029-1041.
- Green, D.P. & Salovey, P. (1999). In what sense are positive and negative affect independent? A reply to Tellegen, Watson and Clark. *Current Directions in Psychological Science*, 10, 304-306.

- Greenstadt, L., Shapiro, D. & Whitehead, R. (1986). Blood pressure discrimination. *Psychophysiology*, 23, 500-509.
- Greenwald, M.K., Cook, E. III & Lang, P.J. (1989). Affective judgement and psychophysiological response: Dimensional covariation in the evaluation of pictorial stimuli. *Journal of Psychophysiology*, 3, 51-64.
- Grings, W.W. & Dawson, M.E. (1978). *Emotions and bodily responses: A psychophysiological approach*. New York: Academic press
- Groves, P.M. & Rebec, G.V. (1992). *Introduction to Biological Psychology*. (4th Ed.) Dubuque, IA: Wm C Brown Publishers.
- Groves, P.M. & Thompson, R.F. (1970). Habituation: A dual-process theory. *Psychological Review*, 77, 419-450.
- Halberg, F., Bakken, E., Cornelissen, G., Halberg, J., Halberg, E. & Delmore, E. (1989). Blood pressure assessment in a broad chronobiological perspective. In H. Refsum, I. A. Sulg & K. Rasmussen, (Eds.), *Heart and Brain, Brain and Heart*, (pp.142-162). Berlin, Heidelberg: Springer-Verlag.
- Hallam, S. (1985). *Anxiety: psychological perspectives on panic and agoraphobia*. London: Harcourt, Brace & Jovanovich.
- Haney, J.N. & Euse, F.J. (1976). Skin conductance and heart rate responses to neutral, positive and negative imagery: Implications for covert behavior therapy procedures. *Behavior Therapy*, 7, 494-503.

- Hanley, J. & LaMotta, A. (1988). Outdoor Adventure...Who teaches who? *The ACHPER National Journal*, June, 9-11.
- Hassett, J. (1978). *A Primer of Psychophysiology*. New York: Freeman.
- Hawk, L.W., Stevenson, V.E. & Cook, E.W., III. (1992). The effect of eyelid closure on affective imagery and eyeblink startle. *Journal of Psychophysiology*, 6, 299-310.
- Heilman, K.M. (1997). The neurobiology of emotional experience. *Journal of Neuropsychiatry and Clinical Neuroscience*, 9, 439-448.
- Hendrick, C. & Lilly, R.S. (1970). The structure of mood: A comparison between sleep deprivation and normal wakefulness conditions. *Journal of Personality*, 38, 453-465.
- Hodes, R.L., Cook, W.W.III & Lang, P.J. (1985). Individual differences in autonomic response: Conditioned association or conditioned fear? *Psychophysiology*, 22, 545-560.
- Houston, B.K. (1983). Psychophysiological responsivity and the type A behavior pattern. *Journal of Research in Personality*, 17, 22-39.
- Hubert, W. & de Jong-Meyer, R. (1990). Psychophysiological response patterns to positive and negative film stimuli. *Biological Psychology*, 31, 73-93.
- Humberstone, B. (1990). Gender, change and adventure education. *Gender and Education*, 2, 199-215.

Iso-Ahola, S.E. & Hatfield, B. (1986). *Psychology of Sports – A social psychological approach*. Dubuque, IA: Wm C Brown.

Iso-Ahola, S., LaVerde, D. & Graefe, A. (1988). Perceived competence as a mediator of the relationship between high risk sports participation and self esteem. *Journal of Leisure Research*, 21, 32-39.

Izard, C.E. (1991). *The psychology of emotions*. New York: Plenum.

James, G.D., Yee, L.S., Harshfield G.A., Blanke, S.G. & Pickering, T. (1986). The influence of happiness, anger and anxiety on the blood pressure of borderline hypertensives. *Psychosomatic Medicine*, 15, 8-21.

James, W. (1884) What is an emotion? *Mind*, 9, 188-205.

Janis, I.L. (1958). *Psychological stress*. New York: Wiley.

Jennings, J.R., Averill, J.R., Opton, E.M. & Lazarus, R.J. (1971). Some parameters of heart rate change: Perceptual versus motor task requirements, noxiousness and uncertainty. *Psychophysiology*, 7, 194-212.

Johnsen, B.H., Thayer, J.F. & Hugdahl, K. (1995). Affective judgement of the Ekman faces: A dimensional approach. *Journal of Psychophysiology*, 9, 193-202.

Jones, G.E. & Johnson, H.J. (1980). Heart rate and somatic concomitants of mental imagery. *Psychophysiology*, 17, 339-347.

- Kemper, T.D. (1978). *A social interactional theory of emotions*. New York: Wiley
- Kilpatrick, D.G. (1972). Differential responsiveness of two electrodermal indices to psychological stress and performance of a complex cognitive task. *Psychophysiology*, 9, 218-226.
- Kimball, O.M. (1973). Development of norms for the Coopersmith Self-Esteem Inventory: Grades 4-8. Doctoral dissertation, Northern Illinois University, 1972. *Dissertation Abstracts International*, 34, 1131-1132.
- King, L.A. & Emmons, R.A. (1990). Conflict over emotional expression: Psychological and physical correlates. *Journal of Personality and Social Psychology*, 58, 864-877.
- King, M.G., Burrows, G.D. & Stanley, G.V. (1983). Measurement of stress and arousal. *British Journal of Psychology*, 437-479.
- Klausner, S.Z. (1967). Sport parachuting. In R. Slovenko & T.A. Knight (Eds.), *Motivations in play, games and sports*, (pp. 670-694). New York: Charles Thomas.
- Klesges, R.C., Haddock, C.K. & Eck, L.H. (1990). A multimethod approach to the measurement of childhood physical activity and its relationship to blood pressure and body weight. *The Journal of Pediatrics*, 116, 888-893.
- Krantz, D.S., Manuck, S.B. & Wing, R.R. (1986). Psychological stressors and task variables as elicitors of reactivity. In K.A. Matthews, S.M. Weiss, T. Detre, T.M. Dembroski, B.Falkner, S.B. Manuck & R.B. Williams (Eds.),

Handbook of Stress, Reactivity and Cardiovascular Disease, (pp. 85-107).
New York: Wiley.

Lacey, J.I. (1959). Psychophysiology approaches to the evaluation of
psychotherapeutic process and outcome. In E.A. Rubenstein & M.B.
Parloff (Eds.), *Research on psychotherapy*, (pp. 160-208).
Washington: American Psychological Association.

Lacey, J.I. (1967). Somatic response patterning and stress: Some revisions of
activation theory. In M.H. Appley & R. Trumbull (Eds.), *Psychological
stress: Issues in research*, (pp. 14-44). New York: Appleton-Century
Crofts.

Lacey, J.I., Kagan, J., Lacey, B.C. & Moss, H.A. (1963). The visceral level:
Situational determinants and behavioral correlates of autonomic response
patterns. In P.H. Knapp (Ed.), *Expression of Emotion in Man*, (pp. 161-196).
New York: International University Press.

Lacey, J.I. & Lacey, B.C. (1970). Some autonomic-central nervous system inter-
relationships. In P. Black (Ed.), *Physiological correlates of emotion*, (pp.
205-227). New York: Academic Press.

Lacey, B.C. & Lacey, J.I. (1974). Studies of heart rate and other bodily processes
in sensorimotor behavior. In P. Obrist, A.H. Black, J. Brener and L.V.
DiCara, (Eds.), *Cardiovascular Psychophysiology*, (pp. 538-564).
Chicago: Aldine.

- Landers, D. (1985). Psychophysiological assessment and biofeedback: applications for athletes in closed-skill sports. In J. Sandweiss and S. Wolf (Eds.), *Biofeedback and Sport Science*, (pp. 63-105). New York: Plenum.
- Lang, P.J. (1975). Acquisition of heart rate control: Method, theory, and clinical applications. In D.C. Fowles (Ed.), *Clinical applications of psychophysiology*, (pp. 167-191). New York: Columbia University Press.
- Lang, P.J. (1980). Behavioral treatment and bio-behavioral assessment: Computer applications. In J.B. Sidowski, J.H. Johnson & T.A. Williams (Eds.), *Technology in mental health care delivery*, (pp. 119-137). Norwood, NJ: Abex.
- Lang, P.J., Greenwald, M.K., Bradley, M.M. & Hamm, A.O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology*, 30, 261-273.
- Lang, P.J., Kozak, M.J., Miller, G.A., Levin, D.N. & McLean, A. Jr. (1980). Emotional imagery: Conceptual structure and pattern of somatic-visceral response. *Psychophysiology*, 17, 179-192.
- Lang, P.J., Levin, D.N., Miller, G.A. & Kozak, M.J. (1983). Fear behavior, fear imagery, and the psychophysiology of emotion: The problem of affective response integration. *Journal of Abnormal Psychology*, 92, 276-306.

- Larsen, P.B., Schneiderman, N. & DeCarlo Pasin, R. (1986). Physiological bases of cardiovascular psychophysiology. In M.G.H. Coles, E. Donchin & S.W. Porges (Eds.), *Psychophysiology: Systems Processes and Applications*, (pp. 122-165). New York: Guilford.
- Larsen, R.J. & Diener, E. (1992). Promises and problems with the circumplex model of emotion. In M.S. Clark (Ed.), *Review of personality and social psychology: Emotion* (Vol. 13, pp. 25-59). Newbury Park, CA: Sage.
- Larsen, R. J. & Ketelaar, T. (1991). Personality and susceptibility to positive and negative emotional states. *Journal of Personality and Social Psychology*, 61, 132-140.
- Lazarus, R.S. (1991). *Emotion and adaptation*. New York: Oxford University Press.
- Lebo, M.A. & Nesselroade, J.R. (1978). Intraindividual differences in dimensions of mood change during pregnancy identified in five P-technique factor analyses. *Journal of Research in Personality*, 12, 205-224.
- LeDoux, J. (1996). *The emotional brain*. New York: Simon and Schuster.
- LeDoux, J. (1998). *The emotional Brain: The mysterious underpinnings of emotional life*. London: Phoenix
- Levenson, R.W. (1988). Emotion and the autonomic nervous system: A prospectus for research on autonomic specificity. In H.L. Wagner (Ed.), *Social psychophysiology and emotion: Theory and clinical applications*, (pp.17-42). New York: Wiley.

- Levensen, R.W., Ekman, P. & Friesen, W.V. (1990). Voluntary facial action generates emotion specific autonomic nervous system activity. *Psychophysiology*, 27, 363-384.
- Lewis, D., Ray, W.J., Wilkinson, M.O. & Ricketts, R. (1984). Self-report and heart rate responses to a stressful task. *International Journal of Psychophysiology*, 2, 33-37.
- Libby, W.L.Jr., Lacey, B.C. & Lacey, J.I. (1973). Pupillary and cardiac activity during visual attention. *Psychophysiology*, 10, 270-294.
- Lindsley, D.B. (1951). Emotion. In S.S. Stevens (Ed.), *Handbook of experimental psychology* (pp.473-516). New York: Wiley.
- Luria, A. R. (1932). *The nature of human conflicts*. New York: Liveright.
- Lykken, D.T. & Venables, P.H. (1971). Direct measurement of skin resistance and conductance: A proposal for standardisation. *Psychophysiology*, 8, 656-672.
- Lyvers, M., Boyd, G. & Maltzman, I. (1998). Effects of cigarette smoking on bilateral electrodermal measures of the orienting reflex. *Psychophysiology*, 25, 408-417.
- Malmo, R.B. (1959). Activation: A neuropsychological dimension. *Psychological Review*, 66, 367-386.

- Maltzman, I. & Marinkovic, K. (1996). Alcohol, alcoholism, and the autonomic nervous system: A critical account. In H. Begleiter & B. Kissin (Eds.), *The pharmacology of alcohol and alcohol dependence* (pp. 248-306). New York: Oxford University Press.
- Mannell, R.C. & Kleiber, D.A. (1997). *A Social Psychology of Leisure*. State College, PA: Venture.
- Marsh, H., Richards, G. & Barnes, J. (1984). Multidimensional self concepts: The effect of participation in an Outward Bound Program. *Journal of Personality and Social Psychology*, 50, 195-204.
- Martens, R. & Gill, D.L. (1976). State anxiety among successful and unsuccessful competitors who differ in competitive trait anxiety. *Research Quarterly*, 47, 698-708.
- Martin, B. (1961). The assessment of anxiety by physiological behavioral measures. *Psychological Bulletin*, 58, 234-255.
- Martin, P. & Priest, S. (1986). Understanding the adventure experience. *Journal of Adventure Education*, 3, 18-21.
- Martin, I. & Venables, P.H. (1980). *Techniques in Psychophysiology*. New York: Wiley.
- Maslow, A. (1964). *Religions, Values and Peak-experiences*. Middlesex, England: Penguin Books.

- Matthews, K.A., Manuck, S.B. & Saab, P.G. (1986). Cardiovascular responses of adolescents during a naturally occurring stressor and their behavioral and psychophysiological predictors. *Psychophysiology*, 23, 198-209.
- Matthews, K.A., Rakaczky, C.J., Stoney, C.M. & Manuck, S.B. (1987). Are cardiovascular responses to behavioral stressors a stable individual difference variable in childhood? *Psychophysiology*, 24, 464-473.
- Matthews, K.A. & Stoney, C.M. (1988). Influences of sex and age on cardiovascular responses during stress. *Psychosomatic Medicine*, 50, 46-56.
- Maynard, I.W., MacDonald, A.L. & Warwick-Evans, L. (1997). Anxiety in novice rock climbers: a further test of the matching hypothesis in a field setting. *International Journal of Sport Psychology*, 28, 67-78.
- McAvoy, L., Curtis-Schatz, E., Stutz, M., Schleien, S.J. & Lais, G. (1989). Integrated wilderness adventure: Effects on personal and life style traits of persons with and without disabilities. *Therapeutic Recreation Journal*, 3rd Quater, 50-64.
- McCann B.S., Carter, J., Vaughan, R.N., Raskind, M., Wilkinson, C.W. & Veith R.C. (1993). Cardiovascular and neuroendocrine responses to extended laboratory challenge. *Psychosomatic Medicine*, 55, 497-504.
- McIntyre, M. (1987). *Self-Concept change as a result of an extended outdoor education residential Experience*. Conference Proceedings from the Fifth National Outdoor Education Conference, Perth, WA (pp. 84-99).

- McNair, D.M., Lorr, M. & Droppleman, L.F. (1981). Manual. *Profile of Mood States*. Educational and Industrial Testing Service, San Diego.
- Mewborn, C.R. & Rogers, R.W. (1979). Effects of threatening and reassuring components of fear appeals on physiological and verbal measures of emotion and attitudes. *Journal of Experimental and Social Psychology*, 15, 242-253.
- Miles, J. (1987). Wilderness as healing place. *Journal of Experiential Education*, 10, 4-10.
- Miller, G.A., Levin, D.N. Kozak, M.J., Cook, E.W., III, McLean, A. & Lang, P.J. (1987). Individual differences in emotional imagery. *Cognition and Emotion*, 1, 367-390.
- Mortlock, C. (1984). *The Adventure Alternative*. Cumbria, England: Cicerone.
- Nadler, R. & Luckner, J. (1992). *Processing the Adventure Experience*. Dubuque, IA: Kendall/Hunt.
- National Institute of Occupational Health and Safety Blood Pressure Study. (1987). Australian Government Publishing Service. Canberra, Australia.
- Naveteur, J. & Freixa i Baqué, E. (1987). Individual differences in electrodermal activity as a function of subjects anxiety. *Personality and Individual Differences*, 8, 615-626.

- Naveteur, J. & Freixa i Baqué, E. (1992). Anxiety and Inhibition: A psychophysiological approach. In D.G. Forgays, T. Sosnowski & K. Wrzesniewski (Eds.), *Anxiety: Recent developments in cognitive, psychophysiological and health research*, (pp. 143-151). Washington: Hemisphere.
- Naveteur, J. & Roy, J.C. (1990). Electrodermal activity of low and high trait anxiety subjects during a frustrative video game. *Journal of Psychophysiology*, 4, 221-227.
- Neill, J. (1997). *Outdoor Education in the Schools: What can it achieve?* Conference Proceedings for the 10th National Outdoor Education Conference. Collaroy, NSW (pp. 193-201).
- Neill, J.T. & Heubeck, B. (1995a). Abseil anxiety and confidence: A pilot study. *Australian Journal of Outdoor Education*, 1, 28-30.
- Neill, J.T. & Heubeck, B. (1995b). *Insights into adolescents' mental health during Outward Bound programs*. Paper presented to the 9th National Outdoor Education Conference, Southport, QLD.
- Neiss, R. (1988). Reconceptualising Arousal: Psychobiological states in motor performance. *Psychological Bulletin*, 103, 345-366.
- Neiss, R. (1990). Reconceptualizing relaxation treatments: Psychobiological states in sport. *Clinical Psychological Review*, 8, 139-159.

Nesse, R.M., Curtis, G.C., Thyer, B.A., McCann, D.S., Huber-Smith, M.J. & Khopf, R.F. (1985). Endocrine and cardiovascular response during phobic anxiety. *Psychosomatic Medicine*, 47, 320-331.

Nettleton, B. (1987). *The outdoors as a therapeutic environment*. Conference Proceedings from the Fifth National Outdoor Education Conference, Perth WA (pp. 172-175).

Nettleton, B. (1997). *The Heart of Outdoor Education - inside the Head*. Conference Proceedings for the 10th National Outdoor Education Conference. Collaroy, NSW. (pp. 202-204).

Nettleton, B. & Dickinson, S. (1989). *Emotional profiles of adventure activities*. Conference Proceedings for the 6th Outdoor Educational Conference. NSW Academy of Sport, Sydney. (pp. 69-87).

Nettleton, B. & Dickinson, S. (1996). Reversals of emotional states in wilderness settings. *Australian Leisure*, 7, 29-35.

New South Wales Department of Education Board of Studies. (1991). *Personal Development, Health and Physical Education*. Syllabus Years 7-10. Board of Studies NSW, North Sydney.

New South Wales Department of Education Board of Studies. (1992a). *Personal Development, Health and Physical Education*. Syllabus Years K-6. Board of Studies NSW, North Sydney.

New South Wales Department of Education Board of Studies. (1992b). *Sport, Lifestyle and Recreation Studies Syllabus* Board of Studies NSW, North Sydney.

New South Wales Department of Education Board of Studies. (1992c). *Skills for Living Syllabus*. Board of Studies NSW, North Sydney.

New South Wales Department of Education Board of Studies. (1992d). *Life Management studies Years 11-12 Syllabus*. Board of Studies NSW, North Sydney.

Ney, T. & Gale, A. (1988). A critique of laboratory studies of emotion with particular reference to psychophysiological aspects. In H.L. Wagner (Ed.), *Social psychophysiology and emotion: Theory and clinical applications*, (pp.65-83). Chichester: Wiley.

O'Brien, M. (1989). *The Outdoor Educator as evaluator*. Conference Proceedings for the 6th Outdoor Educational Conference. Narrabeen, Sydney (pp.120-130).

Obrist, P. A. (1976). The cardiovascular-behavioral interactions - as it appears today. *Psychophysiology*, 13, 95-107.

Obrist, P.A., Howard, J.L., Lawler, J.E., Galosy, R.A., Meyers, K.A. & Gaebelein, C.J. (1974). The cardiac-somatic interaction. In P.A. Obrist, A.H. Black, J. Brener & L.V. DiCara (Eds.), *Cardiovascular psychophysiology – Current issues in response mechanisms, biofeedback, and methodology*, (pp.136-162). Chicago: Aldine.

- Obrist, P.A., Howard, J.L., Lawler, J.E., Stutterer, J.R., Smithson, K.W. & Martin, P.L. (1972). Alterations in cardiac contractility during classical aversive conditioning in dogs: Methodological and theoretical implications. *Psychophysiology*, 9, 246-261.
- Obrist, P.A., Lawler, J.E. & Gabelein, C.J. (1974). A psychobiological perspective on the cardiovascular system. In L.V. DiCara (Ed.), *Limbic and Autonomic Nervous Systems Research*, (pp. 311-334). New York: Plenum.
- Obrist, P.A., Webb, R.A., Sutterer, J.R. & Howard, J.L. (1970). The cardiac-somatic relationship: Some reformulations. *Psychophysiology*, 6, 569-587.
- Okely, A., Gray, T. & Cotton, W. (1997). *Effect of an extended stay outdoor education school program on aerobic fitness*. Conference Proceedings for the 10th National Outdoor Education Conference. Collaroy, NSW, (pp. 206-210).
- Oken, D. (1960). An experimental study of suppressed anger and blood pressure. *Archives of General Psychology*, 2, 441-456.
- Outdoor pursuits. (1990). Guidelines for Educators, NZ Ministry of Education, Wellington.
- Papillo, J. & Shapiro, D. (1990). The Cardiovascular System. In J. Cacioppo & L. Tassinary (Eds.), *Principles of Psychophysiology*, (pp. 456-512). Cambridge, England: Cambridge University Press.

- Pennebaker, J.W. & Chew, C.H. (1985). Behavioral inhibition and electrodermal activity during deception. *Journal of Personality and Social Psychology*, 49, 1427-1433.
- Plutchik, R. (1962). *The emotions: Fact, theories and a new model*. New York: Random House
- Plutchik, R. (1980). A language for the emotions. *Psychology Today*, Feb, 68-78.
- Plutchik, R. & Ax, A.G. (1967). A critique of determinants of emotional state by Schachter and Singer (1962). *Psychophysiology*, 4, 79-82.
- Policy for use of Broken Bay Ropes Course. (1988). Broken Bay Sport and Recreation Centre. NSW Department of Sport and Recreation. Australia.
- Priest, S. (1990). The adventure experience paradigm. In C. Miles & S. Priest, (Eds.), *Adventure Education*, (pp.157-162). Pennsylvania: Venture.
- Priest, S. (1993). A new model for risk taking. *Journal of Experiential Education*, 16, 50-53.
- Priest, S. & Gass, M.A. (1997). *Effective Leadership in Adventure Programming*. Champaign, Ill.: Human Kinetics.
- Priest, S. & Klint, K. (1994). Competence motivation revisited: A new theory for risk taking. *Journal of Adventure Education and Outdoor Leadership*, 11, 4.
- Rebuffat, G. (1965). *On snow and rock*. London: Nicholas Kay.

- Reid, D.H., Doerr, J.E., Doshier, H.D. & Ellertson, D.G. (1971). Heart rate and respiration rate response to parachuting: Physiological studies of military parachutists via FM/FM telemetry -II. *Aerospace Medicine*, Nov, 1200-1206.
- Rickles, W.H. & Day, J.L. (1968). Electrodermal activity in non-palmer skin sites. *Psychophysiology*, 4, 421-435.
- Rimé, B., Philippot, P. & Cisamolo, D. (1990). Social schemata of peripheral changes in emotion. *Journal of Personality and Social Psychology*, 59, 28-49.
- Roberts, L. (1974). Comparative psychophysiology of the electrodermal and Cardiac control systems. In P.A. Obrist, A.H. Black, J. Brener & L.V. DiCara (Eds.), *Cardiovascular Psychophysiology-Current issues in response mechanisms, biofeedback, and methodology*, (pp.163-189). Chicago: Aldine.
- Roberts, R.J. & Weerts, T.C. (1982). Cardiovascular responding during anger and fear imagery. *Psychological Reports*, 50, 219-230.
- Roberts, L.E. & Young, R. (1971). Electrodermal responses are independent of movement during aversive conditioning in rats, but heart rate is not. *Journal of Comparative and Physiological Psychology*, 77, 495-512.
- Robinson, T.T. & Carron, A.V. (1982). Personal and situational factors associated with dropping out versus maintaining participation in competitive sport. *Journal of Sport Psychology*, 4, 364-378.

- Rohnke, K.E. (1989). *Cowtails and Cobras II: A guide to games, initiatives, ropes courses and adventure curriculum*. Hamilton, MA: Project Adventure.
- Rohnke, K.E. (1991). Ropes Courses: A constructed adventure environment. In J. C. Miles & S. Priest (Eds), *Adventure Education*, (pp. 357-365). State College, PA: Venture.
- Roth, W.T., Brievik, G. & Elbert, T. (1991). Parachute jumping: a model for coping with anxiety. *Supplement to Psychophysiology*, 28 (3A), S3.
- Roth, W.T., Tinklenberg, J.R., Doyle, C.M., Horvath, T.B. & Kopell, B.S. (1976). Mood states and 24 hour cardiac monitoring. *Journal of Psychosomatic Research*, 20, 179-186.
- Royce, D. (1987). Outdoor Education – aims and approaches-an inherent dilemma. *Adventure Education*, 4, 12-14.
- Russell, J.A. (1979). Affective space is bipolar. *Journal of Personality and Social Psychology*, 37, 345-356.
- Russell, J.A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39, 1161-1178.
- Russell, J.A. (1991). Culture and the categorisation of emotions. *Psychological Bulletin*, 110, 426-450.

- Russell, J.A. & Mehrabian, A. (1977). Evidence for a three factor theory of emotions. *Journal of Personality and Social Psychology*, 39, 1161-1178.
- Russell, J.A. & Pratt, G. (1980). A description of the affective quality attributed to environments. *Journal of Personality and Social Psychology*, 38, 311-322.
- Russell, J.A. & Ridgeway, D. (1983). Dimensions underlying children's emotion concepts. *Developmental Psychology*, 19, 795-804.
- Scerbo, A.S., Freedman, L.W., Raine, A., Dawson, M.E. & Venables, P.H. (1992). A major effect of recording site on measurement of electrodermal activity. *Psychophysiology*, 29(2), 241-246.
- Schachter, J. (1957). Pain, fear, and anger in hypertensives and normotensives; a psychophysiological study. *Psychosomatic Medicine*, 19, 17-29.
- Schachter, S. (1964). The interaction of cognitive and physiological determinants of emotional state. *Advances in Experimental Social Psychology*, 1, 49-80.
- Schachter, S. & Singer, J. (1962). Cognitive, social and physiological determinants of emotional state. *Psychological Review*, 69, 379-399.
- Scherl, L. (1989). Self in Wilderness: Understanding the Psychological Benefits of individual-wilderness interaction through self control. *Leisure Sciences*, 11, 123-135.

- Schneider, R.H., Egan, B.M., Johnson, E.H., Drobny, H. & Julius, S. (1986). Anger and anxiety in borderline hypertension. *Psychosomatic Medicine*, 48, 242-248.
- Schwartz, G.E. (1986). Emotion and psychophysiological organisation: A systems approach. In M. Coles, E. Donchin & S. Porges (Eds.), *Psychophysiology, Systems, Processes and Applications*, (pp. 354-377). New York: Guilford.
- Schwartz, D. (1974). Operant-feedback control of human blood pressure. In P. Obrist, A.H. Black, J. Brener & L. V. DiCara. (Eds.), *Cardiovascular Psychophysiology*, (pp. 406-440). Chicago: Aldine.
- Schwartz, G.E., Weinberger, D.A. & Singer, J.A. (1981). Cardiovascular differentiation of happiness, sadness, anger, and fear following imagery and exercise. *Psychosomatic Medicine*, 43, 343-363.
- Schwartz, G.E., Brown, S.L. & Ahern, G.L. (1980). Facial muscle patterning and subjective experience during affective imagery: Sex differences. *Psychophysiology*, 17, 75-82.
- Shapiro, D., Tursky, B., Gershon, E. & Stern, M. (1969). Effects of feedback and reinforcement on the control of human systolic blood pressure. *Science*, 163, 588-590.
- Shapiro D., Tursky, B. & Schwartz, G. E. (1970). Differentiation of heart rate and systolic blood pressure in man by operant conditioning. *Psychosomatic Medicine*, 32, 417-423.

- Shapiro, D., Schwartz, G.E. & Tursky, B. (1972). Control of diastolic blood pressure in man by feedback and reinforcement. *Psychophysiology*, 9, 296-304.
- Sheehan, P.W. (1967). A shortened form of Betts' Questionnaire upon mental imagery. *Journal of Clinical Psychology*, 23, 386-389.
- Siddle, D.A & Turpin, G. (1980). Measurement, quantification and analysis of cardiac activity. In I. Martin & P.H. Venables (Eds.), *Techniques in Psychophysiology*, (pp.139-246). New York: Wiley.
- Sinha, R. & Lovallo, W.R. & Parsons, O.A. (1992). Cardiovascular differentiation of emotions. *Psychosomatic Medicine*, 54, 422-435.
- Smith C.A. (1989). Dimensions of appraisal and physiological response in emotion. *Journal of Personality and Social Psychology*, 56, 339-353.
- Smith, R.E. & Smoll, F.L. (1990). Sport performance anxiety. In H. Leitenberg (Ed.), *Handbook of social and evaluation anxiety*, (pp. 417-454). New York: Plenum.
- Smith, T.E., Roland, C.C., Havens, M.D. & Hoyt, J.A. (1992). *The theory and practice of challenge education*. Dubuque, IA: Kendall/Hunt.
- Sosnowski, T. (1988). Patterns of skin conductance and heart rate changes under anticipatory stress conditions. *Journal of Psychophysiology*, 2, 231-238.

- Sosnowski, T. (1992). Skin conductance heart rate and active-passive coping. In D.G. Forgays, T. Sosnowski & K. Wrzwesniewski (Eds.), *Anxiety: recent developments in cognitive, psychophysiological and health research*, (pp. 129-141). Washington: Hemisphere.
- Sosnowski, T., Nurzynska, M. & Polec, M. (1991). Active-passive coping and skin conductance and heart rate changes. *Psychophysiology*, 28, 675-682.
- Spatz, K. & Johnston, S. (1973). Internal Consistency of the Coopersmith Self-Esteem Inventory. *Educational and Psychological Measurement*, 33, 875-876.
- Spielberger, C.D. (1975). The Measurement of State and Trait Anxiety: Conceptual and Methodological Issues. In L. Levi (Ed.), *Emotions-Their Parameters and Measurement*, (pp. 713-724). New York: Raven.
- Spielberger, C.D., Gorsuch, R.L., Lushene, R., Vagg, P. & Jacobs, G.A. (1970). Manual for the state-trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press.
- Spielberger, C.D. & Rickman, R.L. (1990). Assessment of state and trait anxiety in cardiovascular disorders. In D.G. Byrne & R.H. Rosenman (Eds.), *Anxiety and the heart*, (pp. 73-92). Washington: Hemisphere.
- Sprague, J.M., Chambers, W.W. & Stellar, E. (1961). Attentive, affective and adaptive behavior in the cat. *Science*, 133, 165-173.

Sproul, S. & Priest, S. (1992). The Ropes Course as an educational tool. *The Ontario Journal of Outdoor Education*, 4, 9-12.

Stemmler, G. (1989). The autonomic differentiation of emotions revisited: Convergent and discriminant validation. *Psychophysiology*, 26, 617-632.

Stephoe, A. (1980). Blood Pressure. In I. Martin & P. H. Venables, (Eds.), *Techniques in Psychophysiology*, (pp. 247-273). New York: Wiley.

Sternbach, R. A. (1960). A comparative analysis of autonomic responses in startle. *Psychosomatic Medicine*, 22, 204-210.

Sternbach, R.A. (1962). Assessing differential autonomic patterns in emotions. *Journal of Psychosomatic Research*, 6, 87-91.

Stimpson, D. & Pedersen, D. (1970). Effects of survival training experience upon evaluation of self and others for underachieving high school students. *Perceptual and Motor skills*, 31, 337-338.

Stratton, G. (1995). Measuring 12-13 year old children's physical activity levels during indoor European handball lessons: Combining systematic observation and heart rate techniques. *Journal of Human Movement Studies*, 29, 35-49.

Stratton, G. (1996). Children's heart rates during physical education lessons: A review. *Paediatric Exercise Science*, 6, 215-233.

- Stratton, G. (1997). Children's heart rates during British physical education lessons. *Journal of Teaching in Physical Education*, 16, 357-367.
- Strelau, J. (1992). Introduction: Current Studies on Anxiety from the Perspective of Research Conducted During the Last Three Decades. In D.G. Forgays, T. Sosnowski & K. Wrzwesniewski, (Eds.), *Anxiety: recent developments in cognitive, psychophysiological and health research*, (pp. 263-277). Washington: Hemisphere.
- Strongman, K.T. (1978). *The psychology of emotion*. Chichester: Wiley.
- Sutton, S.K. & Davidson, R.J. (1997). Prefrontal brain asymmetry: A biological substrate of the behavioral approach and inhibition systems. *Psychological Science*, 8, 204-210.
- Tarrant, M.A. (1996). Attending to past outdoor recreation experiences: Symptom Reporting and Changes in Affect. *Journal of Leisure Research*, 28, 1-17.
- Tarrant, M.A., Manfredi, M.J. & Driver, B.L. (1994). Recollections of outdoor recreation experiences: A psychophysiological perspective. *Journal of Leisure Research*, 26, 357-371.
- Taylor, C.B., King, R., Ehlers, A., Margraf, J., Clark, D., Hayward, C., Roth, W.T. & Agras, S. (1987). Treadmill exercise test and ambulatory measures in panic attacks. *American Journal of Cardiology*, 60, 48J-52J.

- Taylor, C.B., Sheikh, J., Agras, W.S., Roth, W.T., Margraf, J., Ehlers, A., Maddock, R.J. & Gossard, D. (1986). Ambulatory heart rate changes in patients with panic attacks. *American Journal of Psychiatry*, 143, 478-482.
- Tellegen, A. (1982). Brief manual for the Differential Personality Questionnaire. Unpublished manuscript, University of Minnesota, Minneapolis.
- Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety, with an emphasis on self report. In A. Tuma & J. Maser (Eds.), *Anxiety and the Anxiety Disorders*, (pp. 681-706). Hillsdale, NJ: Erlbaum.
- Tellegen A., Watson, D. & Clark, L.A. (1999a). On the dimensional and hierarchical structure of affect. *Current Directions in Psychological Science*, 10, 297-303.
- Tellegen A., Watson, D. & Clark, L.A. (1999b). Further support for a hierarchical model of affect: Reply to Green and Salovey. *Current Directions in Psychological Science*, 10, 307-309.
- Thompson, J.G. (1988). *The psychobiology of emotions*. New York: Plenum.
- Tomkins, S.S. (1991). *Affect, imagery, consciousness: (Vol 3). The negative affect, anger and fear*. New York: Springer-Verlag.
- Tranel, D.T. (1983). The effects of monetary incentive and frustrative nonreward on heart rate and electrodermal activity. *Psychophysiology*, 20, 652-657.

- Tranel, D.T., Fisher, A.E. & Fowles, D.C. (1982). Magnitude of incentive effects on heart rates. *Psychophysiology*, 19, 514-519.
- Treiber, F.A., Musante, L., Hartdagan, S., Davis, H., Levy, M. & Strong, W.B. (1989). Validation of a heart rate monitor with children in laboratory and field settings. *Medicine and Science in Sports and Exercise*, 21, 338-342.
- Tremayne, P. & Barry, R.J. (1990). Repression of anxiety and its effects on psychophysiological responses to stimuli in competitive gymnasts. *Journal of Sport and Exercise Psychology*, 12, 333-352.
- Venables, P.H. & Christie, M.J. (1980). Electrodermal activity. In I. Martin & P.H. Venables, (Eds.), *Techniques in Psychophysiology*, (pp. 3-67). New York: Wiley.
- Venables, P.H. & Martin, I. (1967). Skin resistance and skin potential. In P.H. Venables & I. Martin (Eds.), *A manual of psychophysiological methods*, (pp. 53-102). Amsterdam: Wiley.
- Vrana, S.R. (1993). The psychophysiology of disgust: Differentiating negative emotional contexts with facial EMG. *Psychophysiology*, 30, 279-286.
- Vrana, S.R. (1994). Startle reflex response during sensory modality specific disgust anger and neutral imagery. *Journal of Psychophysiology*, 8, 211-218.
- Vrana, S.R. (1995). Emotional modulation of skin conductance and eyeblink responses to a startle probe. *Psychophysiology*, 32, 351-357.

- Voight, A. (1988). The use of Ropes Courses as a treatment modality for emotionally disturbed adolescents in hospitals. *Therapeutic Recreation Journal*, 2, 57-64.
- Wagner, H. (1989). The peripheral physiology differentiation of emotions. In H. Wagner & A. Manstead (Eds.), *Handbook of Social Psychophysiology*, (pp. 77-98). New York, Wiley.
- Wallace, J.F. & Newman, J.P. (1990). Differential effects of reward and punishment cues on response speed in anxious and impulsive individuals. *Personality and Individual Differences*, 11, 999-1009.
- Watson, D. (1988). Intraindividual and interindividual analyses of positive and negative affect: Their relation to health complaints, perceived stress, and daily activities. *Journal of Personality and Social Psychology*, 54, 1020-1030.
- Watson, D. & Clark, L.A. (1984). Negative affectivity: The disposition to experience aversive emotional states. *Psychological Bulletin*, 96, 465-490.
- Watson, D., Clark, L.A. & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS Scales. *Journal of Personality and Social Psychology*, 54, 1063-1070.
- Watson, D. & Pennebaker, J.W. (1989). Health complaints, stress and distress: Exploring the central role of negative affectivity. *Psychological Review*, 96, 234-254.

- Watson, D. & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin*, 98, 219-235.
- Watson, J.P., Gaid, R. & Marks, I.M. (1972). Physiological habituation to continuous phobic stimulation. *Behavior, Research and Therapy*, 10, 269-278.
- Watts, J.M.J. (1975). Anxiety and the habituation of the skin conductance response. *Psychophysiology*, 12, 596-601.
- Webster, S.E. (1989). *Ropes Course Safety Manual: An instructors guide to initiatives, and high and low elements*. Dubuque, IA: Kendall/Hunt.
- Wegner, D.M., Shortt, J.W., Blake, A.W. & Page, M.S. (1990). The suppression of exciting thoughts. *Journal of Personality and Social Psychology*, 58, 409-418.
- Weiner, B. (1972). *Theories of motivation: From mechanism to cognition*. Chicago: Rand McNally
- Weiner, B. (1985). An attribution theory of achievement motivation and emotion. *Psychological Review*, 92, 548-573.
- Weiten, W. (1998). *Psychology: Themes and variations*. Pacific Grove, CA; Brooks/Cole
- White, R. (1959). Motivation reconsidered: The concept of competence. *Psychological Review*, 66, 297-333.

- White, K.D., Ashton, R. & Brown, R.M.D. (1977). The measurement of imagery vividness: normative data and their relationship to sex, age, and modality differences. *British Journal of Psychology*, 68, 203-211.
- Winton, W.M., Putnam, L.E. & Krauss, R.M. (1984). Facial and autonomic manifestations of the dimensional structure of emotion. *Journal of Experimental Social Psychology*, 20, 195-216.
- Witvliet C.V. & Vrana, S.R. (1995). Psychophysiological responses as indices of affective dimensions. *Psychophysiology*, 32, 436-443.
- Yik, M.S.M., Russell, J.A. & Barrett, L.F. (1999). Structure of self-reported current affect: Integration and Beyond. *Journal of Personality and Social Psychology*, 77, 600-619.
- Zevon, M.A. & Tellegen, A. (1982). The structure of mood change: An idiographic/nomothetic analysis. *Journal of Personality and Social Psychology*, 42, 111-122.
- Zook, L.R. (1986). Outdoor adventure programs build character in five ways. *Parks and Recreation*, Jan. 54-57.
- Zuckerman, M. (1978). The search for high sensation. *Psychology Today*, 11, 38-43.

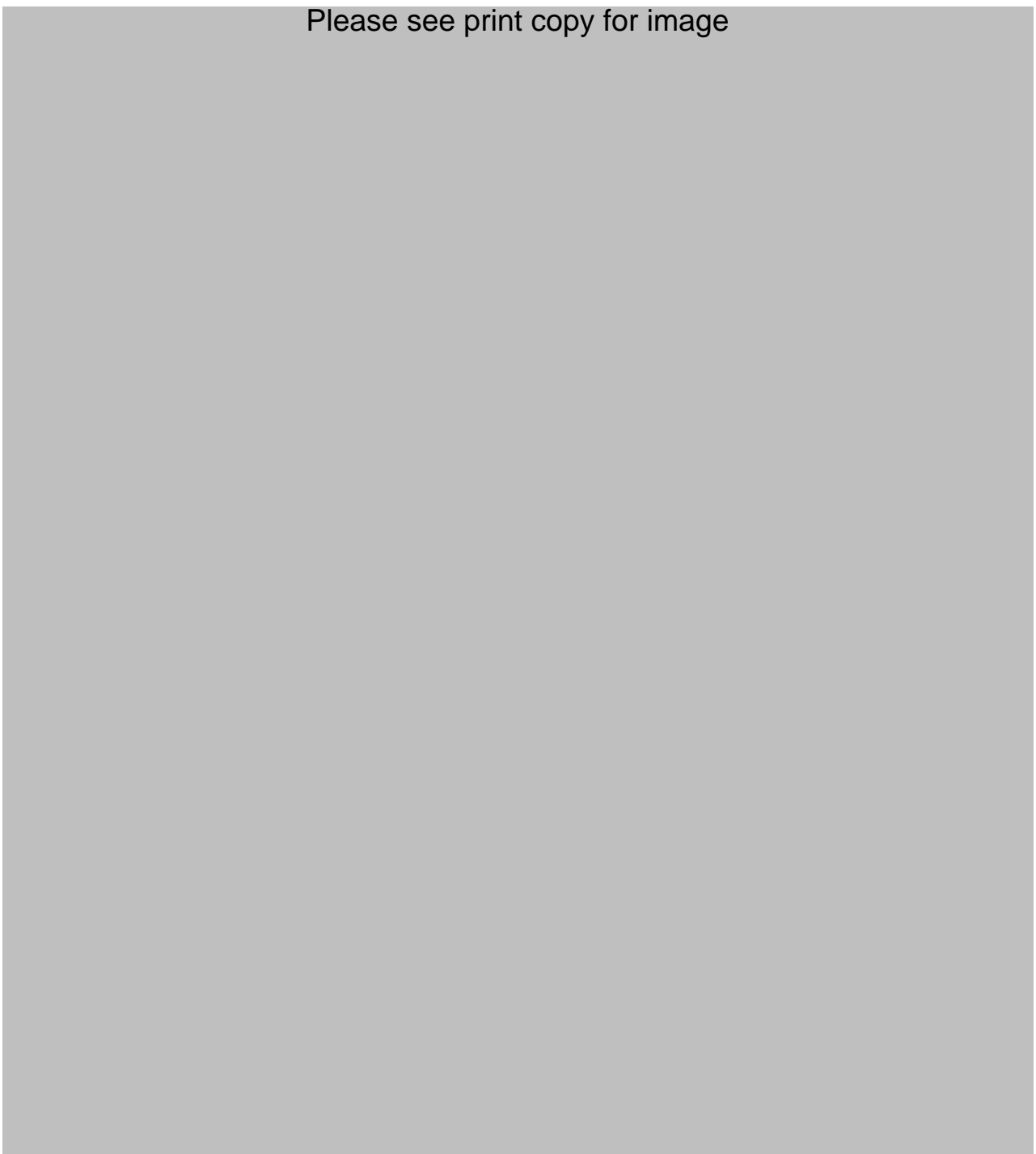
LIST OF APPENDICES

<u>Appendix 1</u>	School form Spielberger State-Anxiety Inventory (STAI, 1991)
<u>Appendix 2</u>	Study 1 HR, SBP, DBP and state anxiety scores
<u>Appendix 3</u>	Study 2 HR and SCL means over 29 epochs for six subjects
<u>Appendix 4</u>	Element Ratings Questionnaire
<u>Appendix 5</u>	Study 3 Element Ratings data
<u>Appendix 6</u>	Study 3 HR and SCL data
<u>Appendix 7</u>	Study 3 Statistical outcomes
<u>Appendix 8</u>	The Coopersmith Self Esteem Inventory (SEI) School Form (Coopersmith, 1981)
<u>Appendix 9</u>	Study 4 Self Esteem scores
<u>Appendix 10</u>	Study 4 Statistical outcomes
<u>Appendix 11</u>	AMSO3 printout for one subject
<u>Appendix 12</u>	Study 5 Element Ratings data
<u>Appendix 13</u>	Study 5 HR, SCL & MOT raw data
<u>Appendix 14</u>	Study 5 Statistical outcomes
<u>Appendix 15</u>	The PANAS Questionnaire (Watson, Clark & Tellegen, 1988)
<u>Appendix 16</u>	Study 6 Ratings and PANAS raw data
<u>Appendix 17</u>	Study 6 HR and SCL raw data
<u>Appendix 18</u>	Study 6 Statistical outcomes
<u>Appendix 19</u>	Bett's Questionnaire Upon Mental Imagery (QMI) (Sheehan, 1967)
<u>Appendix 20</u>	Study 7a Ratings, PANAS and QMI scores
<u>Appendix 21</u>	Study 7a HR and SCL raw data
<u>Appendix 22</u>	Study 7a Statistical outcomes
<u>Appendix 23</u>	Arousal, valence and emotion intensity score calculations for "anxious"
<u>Appendix 24</u>	Study 7b average HR and SCL scores and statistical outcomes

APPENDIX 1

Spielberger State-Trait Anxiety Inventory (STAI; 1991, School form)

Please see print copy for image



APPENDIX 2

Study 1 HR, BP and State Anxiety Scores

STUDY 1 CARDIOVASCULAR AND STATE ANXIETY DATA

GROUP	HR 1	HR 2	DBP1	DBP2	SBP1	SBP2	STAI1	STAI2
2	74	77	91.5	106.5	124.5	108	26	22
2	64	62	99.5	104.5	106.5	111.5	17	12
2	80.5	67.5	107.5	106.5	113.67	117.5	38	17
2	90	91	79	95	125.5	121	18	18
1	99.5	107	117.5	129	136.5	138	26	30
2	69	69.5	71	83	108	110.5	18	14
1	74	84.5	88	105	106	115.5	20	24
1	67.5	68	94	98.5	134	138	17	18
2	74.5	81.5	77	83	110	105.5	18	10
1	81.5	95	85.5	88.5	120	128	26	29
2	76	74.5	97.5	97.5	100.5	105	20	16
2	53.5	63	66	93.5	122.5	99.5	14	14
1	70	68	62.5	68.5	107.5	107.5	14	21
1	67	67	93	97.5	97	119	13	15
2	56.5	55.5	95.5	86.5	92	104.5	14	14
1	62.5	47.5	86	92	115	126	10	12
1	66.5	71.67	86	91	98.5	102	24	25
2	78.5	80	103.5	112.5	125	113.5	20	15
2	87.5	84	78.5	75.5	113	114	11	10
1	65.5	79.5	87.5	93	116.5	127.5	16	20
1	64	55.5	79	84.5	98	106.5	20	21
1	75.5	73	93	93.5	98	108	22	29
1	70.5	71	116.5	110	105.5	105	16	20
2	71.67	76.5	88	98	104.33	100.5	14	14

APPENDIX 3

Study 2 HR and SCL means over 29 epochs for six subjects

Study 2 HR and SCL data

epochs	sub1 HR	sub1 SC	sub 2 HR	sub 2 SC	sub 3 HR	sub 3 SC	sub 4 HR	sub 4 SC	sub 5 HR	sub 5 SC	sub 6 HR	sub 6 SC
1a	118.88	11.71	118.13	11.65	98.64	11.38	128.33	1.75	139.22	9.27	104.76	10.2
b	123.14	12.45	120.13	11.97	113.5	12.67	136.56	1.91	142.3	9.06	101.64	12.86
c	123.63	12.14	111.22	12.15	108	14.08	118.86	2.14	140.11	11.03	93.27	14.54
d	124.11	11.85	122.63	12.1	111.86	17.03	122.57	2.17	130	11.95	96.73	10.17
e	128.17	8.45	121.22	10.54	107.5	15.7	124.13	2.02	127.67	10.86	96.62	9.98
2a	123.57	7.32	119	10.01	78	10.77	109.86	1.38	124.57	9.56	107.29	9.86
b	119.63	8.34	121.5	11.84	106.71	13.31	122.5	1.85	114.29	9.37	111.43	13.11
c	120.5	9.65	124.67	10.88	101.34	17.3	124.75	2.35	116.48	10.46	115.25	13.94
d	121.67	8.62	133.89	10.83	106.71	15.91	139.4	2.12	118.67	10.17	117.2	14.5
e	126.89	8.19	132.89	9.32	113.5	16.19	138.25	2.01	125.5	9.3	117.38	13.23
3a	100	9.2	115.13	12.37	114.57	14.16	139	1.82	118.67	7.42	101.09	11.37
b	120.33	7.84	128.67	13.1	120.67	13.23	135.25	1.89	132	7.44	103.33	12.26
c	142.11	7.25	137.56	12.29	124.75	12.69	125.14	2.35	133.89	6.83	118.11	12.92
d	158.2	7.19	152.11	10.13	137.2	13.67	159.29	2.24	129.18	6.65	112	13.94
e	154.91	9.7	153.7	10.17	131	14.84	155.86	2.01	138.78	7.45	119.5	13.03
4a	131.38	9.72	115.14	10.45	104.01	13.22	136.44	1.92	105.74	6.95	103.83	10.23
b	125	10.08	130.13	10.08	115.2	14.43	130.83	2.18	125.63	7.45	110.63	11.18
c	129.8	14.17	130.89	10.62	142	17.66	145	2.26	125.33	8.42	118.63	11.36
d	128.22	13.12	141.78	11.47	131	15.74	150.29	3.41	124.83	8.91	131.22	13.14
e	129	11.09	137.56	10.5	126	18.56	149.6	3.55	133.11	9.53	127	13.68
5a	107.75	10.71	135.33	9.75	91.25	11.64	130	3.41	123.13	10.49	126.78	15
b	130.75	11.45	148.9	13.63	118	14.25	152.33	4.64	148.3	12.83	147.14	15.76
d	137.71	12.42	157.64	15.17	110.43	14.53	154.57	4.72	161.5	13.71	154.7	16.43
e	139.5	12.88	151.7	16.76	115.29	19.69	155.4	3.77	152	14.34	163.18	16.61
6a	117.14	9.19	126.11	11.91	115	13.57	125.14	3.1	123.89	10.44	114.5	13.84
b	113.63	9.79	128.38	11.47	114.38	13.9	139.14	3.64	126.25	11.14	113.1	15.14
c	114.17	11.67	137	10.56	113.5	13.4	137	3.78	125.55	10.47	117.88	14.32
d	114.17	4.61	145.22	11.18	128	14.92	133.86	3.75	136.11	10.16	122.75	11.8
e	118.29	6.4	50.5	9.87	125.63	15.55	135.5	3.59	134.22	9.84	118.5	13.47

APPENDIX 4

Element Ratings Questionnaire

ELEMENTS OF THE ROPES COURSE

NAME_____DATE_____

Using the five words below, give each element a number on a scale between 0 (not at all) and 6 (too much):-

<u>Elements</u>	<u>Hard</u>	<u>Challenging</u>	<u>Fun</u>	<u>Worrying</u>	<u>Exciting</u>
Bridge	_____	_____	_____	_____	_____
Tyre Walk	_____	_____	_____	_____	_____
Spiders Web	_____	_____	_____	_____	_____
Postmans walk	_____	_____	_____	_____	_____
Flying-fox	_____	_____	_____	_____	_____
Exit Ladder	_____	_____	_____	_____	_____

APPENDIX 5

Study 3 Element ratings Data (H,C,F,W,E)

Element	sub 1	sub 2	sub 3	sub 4	sub 5
E1	3 4 5 3 4	6 5 4 5 1	6 3 4 5 5	3 3 6 4 5	4 5 6 2 6
E2	4 3 5 2 5	4 4 5 4 3	3 6 5 5 4	4 5 6 6 5	4 5 5 5 4
E3	3 4 5 3 6	4 3 1 3 4	6 4 5 6 4	2 5 6 4 6	4 5 4 4 5
E4	3 2 6 2 6	3 2 3 3 2	3 5 6 4 6	3 6 5 1 6	4 3 5 4 5
E5	3 2 6 2 6	3 3 4 4 2	5 5 6 6 6	4 5 6 3 6	4 4 5 3 5
E6	3 2 6 2 6	2 2 3 4 3	5 6 6 5 6	3 6 6 2 6	2 3 5 2 5
	sub 6	sub 7	sub 8	sub 9	sub 10
E1	4 3 4 2 4	5 3 4 4 4	3 3 5 3 4	1 4 6 1 5	1 3 4 0 5
E2	3 4 3 4 3	4 3 4 3 5	4 3 5 4 5	4 5 6 2 5	0 5 6 0 5
E3	3 4 4 4 3	3 3 4 3 5	2 3 5 2 4	3 5 5 2 5	0 4 5 0 6
E4	4 3 4 4 3	3 3 4 3 5	3 2 5 2 5	4 5 5 1 5	0 4 5 0 5
E5	3 4 4 3 3	3 3 4 3 4	3 2 5 2 5	4 5 5 1 5	1 5 6 0 5
E6	3 4 4 3 3	2 3 4 2 3	2 2 6 1 5	4 5 5 1 5	2 5 6 2 5
	sub 11	sub 12	sub 13	sub 14	sub 15
E1	3 4 3 2 3	1 2 5 3 4	3 4 5 2 5	4 3 5 3 2	3 4 4 5 4
E2	4 4 6 3 4	3 5 3 2 4	5 2 3 2 1	2 4 5 4 5	3 4 3 4 6
E3	4 4 4 3 3	5 1 4 2 6	4 1 3 2 2	4 4 5 4 4	3 5 6 4 3
E4	4 4 5 2 4	1 2 4 3 5	3 1 4 3 3	3 3 5 3 5	3 4 6 4 5
E5	3 5 4 2 3	1 4 3 5 6	2 1 3 1 4	3 3 5 3 5	3 4 6 4 6
E6	2 5 4 2 4	3 4 6 1 2	1 1 4 1 4	3 3 5 2 5	3 5 6 4 3
	sub 16	sub 17	sub 18	sub 19	sub 20
E1	5 3 4 3 5	1 2 5 1 5	2 2 5 3 5	1 3 4 2 5	4 3 6 3 5
E2	3 4 5 3 5	3 5 5 3 4	3 4 5 4 5	3 6 5 4 5	5 5 6 5 6
E3	2 4 4 1 5	3 4 5 1 6	3 4 5 4 5	0 1 6 4 5	5 5 5 5 6
E4	1 1 6 1 5	1 4 6 2 6	3 4 4 4 5	2 5 6 1 6	5 5 5 5 6
E5	1 1 5 0 5	4 6 6 2 5	4 5 5 4 5	2 5 6 3 6	5 5 5 6 5
E6	1 0 6 0 6	1 5 6 2 6	4 5 5 4 5	3 1 5 2 6	5 5 5 4 5

APPENDIX 6

Study 3 HR and SCL data

HR data for Study 3 n=20 3 attempts on the Ropes Course

subject	joa	ama	tra	hea	cla	reb	may	lam	che	sta	wray	pau	dan	jae	eco	pet	dene	robs	ross	ella
bridge 1	112.6	129	130	105.14	113.98	129	101.72	121.86	135.66	113.63	130.13	98.63	122.67	131.67	99.83	128.75	121.75	92.43	82.56	101.93
	123.25	131.67	137.67	114	131.75	133.11	103	120.88	134.56	124.73	128.14	109.71	133	126	103.75	124	124.78	120.63	104.33	115.63
	117.26	112.41	128.63	105	131.5	121.13	96.07	115.4	128.38	132	134	110.13	128	113.63	97.95	122	118.5	115	93.7	113
	125.63	121	134.22	114.5	124.25	133.56	103.19	112.25	124.88	129.86	127.13	111.14	129.33	127.38	106.75	127.88	120.25	125.63	99.9	110.57
	125.75	129.56	134	119.13	125.75	136.44	97.8	113.2	127.43	126.91	129	113.25	128.78	130.33	103.86	126	120.38	131.44	105.43	121.22
	137.56	134.89	128.13	114.5	123.75	119	119.63	107.14	112.43	121.71	133.5	127.11	130.44	143.86	101.92	128.38	110.3	144.25	141.9	96.11
	130.22	127.3	139.33	115.75	99.2	130.13	118	112.75	113.13	130.75	137.44	127	132.78	128.33	104.75	127.38	117.5	143.5	131.13	103.97
bridge 2	126.13	124.38	133	100.83	105.38	121	92.02	103.67	119.38	130	143.7	126	131.67	138.78	103.5	122	111	137	146.25	111
	124.67	120.86	136.44	108.75	131.5	132	102.47	102.29	124.88	122	140.71	128.11	129.11	138.5	109.6	126.75	125	141.3	122.33	114.86
	131.43	120.13	140.11	122.25	123.5	130.63	105.43	98.8	130.67	118.14	141.56	129.13	133.11	141	112.5	125.44	121.22	139.67	117.63	118.88
	140.67	139.9	129.56	118.17	116.25	142.29	128.13	105.17	161.6	114.75	140.11	126.25	139.4	149.4	115	135.8	166.09	116	128	116.57
	132	131.75	137.11	127.89	118.5	129.22	125.75	110.29	147.2	124.13	141.63	123.75	134.33	154.27	118.75	130.9	160	109.54	127	110.63
	124.44	125.5	122.38	120.83	102.75	122.38	121.75	84.15	150.44	127.38	140.4	125.88	133.89	153	117.25	134.56	181.29	122.75	147.87	112.86
	122.62	130.13	125.38	113	119	126.5	118.88	96.14	146.58	119.25	136.43	112.43	135.56	146.56	115.75	134.78	160.25	132.88	134	106.57
bridge 3	127.13	131.13	137.78	115.75	126.5	132.78	117.88	101.05	146.9	130.33	135.75	108.38	135.11	150	117.25	133.71	157.5	131.11	129	107.43
hye 1	124.56	138	132.11	103.67	131.67	132.67	107.29	112.29	107.17	97.4	111.5	96.97	126.38	97.33	99.9	104.75	113.63	115.71	93.86	93.33
	125.67	131.2	135.44	111.5	132.33	140.3	100.65	90.78	126.67	114.31	118.57	100.94	128.67	109.75	113.25	123.2	120.83	123.33	118.04	105.86
	122.33	132.8	132.44	114.88	138	131	113	98.3	125.83	120.29	119.75	100.43	127.13	109	109.67	123.62	126	129.14	110.75	112.14
	141.56	131	132.25	127.12	138	141.57	125.75	116	130.67	117.58	120.86	110	126.5	115.67	129	123.8	141	137.33	128.68	117.86
	142.5	138.13	137.7	130.33	144.5	140.2	117.5	119.13	129.44	120	130.6	118.63	128.89	123.13	134	125	134.67	143.9	123.67	123.88
	128.67	116.5	106.19	103.69	130	125.25	101.67	92.52	114.44	109.71	117.25	97.07	125	110.92	109.25	119.86	122.28	121.5	94.3	99.2
	105.27	123.26	131.38	109	124.33	113.17	99.27	90.03	113.57	110.13	128.63	109.88	129.17	125	104	144.17	107.5	125.33	103.17	107.5
hye 2	135.29	126.8	143	110.86	127	122.6	103.8	96	132.71	120	119.75	102.1	134.5	132.18	109.5	144.57	124	124.8	112.25	112.75
	138.33	133.63	142.7	128.11	129.75	135.29	113	101.11	141.83	119.68	124.38	109.5	130.13	139.33	110.5	130	129	133.29	109.67	119.13
	133	129.86	145.85	116.63	141.75	138	110.25	100.48	134	121.75	131.57	119	138.2	138.89	115.25	129.44	132.67	140.8	107.14	118.43
	104.47	121.4	123.75	108.5	123.33	118.75	93.8	94.2	126.57	111.02	119.29	112.43	127.38	95.43	100.25	126.17	115.29	123.13	110.71	103.71
	115.61	131	131.11	123.38	112.5	132.17	91.95	99.07	126.38	120	124.33	108.36	145.33	102	102.5	158.33	137	127	112.5	116.17
	119.15	133.4	138.68	107.14	111.5	131.78	84.84	93.58	146.38	124.83	120.38	114	187.5	111.06	104.5	144.15	126.67	119.5	117.29	115.76
	124.14	154.5	142.56	123	126	134	109.57	104.84	131.78	121.83	126.43	114.5	138.5	120.17	111.5	130.33	136	132.57	118.13	116
spk1	132.33	138.69	143.54	124.89	133.75	132.25	112.38	112	135.33	123.67	131.89	120.5	132	122.75	115.75	129.38	148.38	136.11	120.75	121.5
spk2	122.78	127.67	106.71	118.88	129.75	131.22	103.18	106.71	123.13	67.62	118.13	107.29	127.13	102.23	105.9	116.75	91.93	126.14	117	101.71
	120	133.33	128.22	107.87	138.75	136.22	111.43	112	122.25	99.98	122.25	119	129.4	126	106.5	127.43	107.6	141.9	126.67	103.1
	150.1	148.9	151.3	121.75	164.25	153	121	117.38	137.78	121.33	124.17	130.44	138.3	139.5	119.5	136.63	132.5	170.73	141.63	127.22
	141.11	144.9	162.18	133.86	147.75	153.22	120.13	125.11	142	126	129.5	132.87	141.75	148.8	122	135.67	149.5	169.56	134.67	133.22
	153.18	161.2	162.09	125.58	143.25	151.83	126	130.9	143.7	128.25	133.25	136.11	145.4	142.29	123.8	141.5	148.4	172.55	134.78	132.89
	136.4	129.89	131.5	103.17	132.25	132.86	99.05	90.8	127.25	112.27	111	112.2	127	127	107.75	113.49	128.36	134.33	100.28	110.1
	123.83	128.75	134	112.14	131.25	125.38	117.29	104.98	132.33	120.68	125	122.29	137.2	142.17	112.25	120	121.33	142.5	106	124.83
spk3	132.89	148.2	164.7	118.29	144	152.22	121.14	117.38	140.22	134	137	123.48	139.89	150.22	116.5	138.14	143	157.5	134.67	124.25
	137.33	145.3	187.09	129.57	139.5	160.3	124.17	131	159.25	126.5	132.5	126.22	148.38	150	119	143.5	155.44	174.92	137.43	125.86
	142.2	148.22	186.73	136.44	138.75	159.54	124.38	131.56	146.4	127.11	131.56	131.29	147.7	140	127	144.3	156	175.63	138.13	126.89
	133.2	131.67	148.7	103.91	134.5	119.25	99.58	104.33	128.33	118.5	127.13	107.71	112.08	134.44	106.25	139.38	120.5	131	102.7	103.29
	127.57	132.89	150.3	112.14	125.5	100.88	105	130.75	125.88	127.2	121.29	130.67	139	109.75	123.57	129.13	143	128.25	117.67	116.29
	146	143.89	164.5	107.43	135.25	151.58	121.71	121.29	147.44	138.25	135.88	128.5	139.4	147.86	116.5	148.13	141.71	161.25	135.25	126.88
	135.56	142.75	171.64	134.44	144.5	158.22	117.38	123.89	147.31	135.88	145.3	127.57	148.88	138	121	139.13	142.11	189.67	143.7	125.11
post 1	139.9	144.1	172.5	140	148.5	160.82	122.38	122.5	147.8	138.78	142.78	132.88	148.4	133.33	121.75	148	145.5	166.5	137	123.86
post 2	121.17	131.78	132.56	109.29	124.25	141.89	114	122.5	118.88	94.77	111.5	102.45	111.5	133.75	115	102.45	112.86	132.88	100.34	99.42
	125.4	138.71	134.83	110.14	126.5	151	118.13	137.57	128	118.8	125	117.63	139.71	138.94	110.75	187.8	133.8	132.67	87.92	100.07
	144.33	138.5	153.7	122.86	153	165	119	120.86	153.33	138.5	128.57	121.29	1							

SCL data for Study 3 n=20 3 attempts on the Ropes Course

subject	joa	ama	tra	hea	cia	reb	may	tam	che	ste	way	pau	dan	las	sco	pet	done	robs	ross	alla
bridge 1	6	10.2	5.93	2.2	10.14	2.09	6.19	4.88	2.03	6.35	12.05	2.57	3.79	3.83	6.42	4.93	11.86	4.33	12.19	5.26
	6.52	9.55	6.46	2.31	10.72	3.02	6.91	6.07	8.95	7.7	11.69	2.94	5.08	4.5	6.39	6.09	12.72	5.49	13.01	6.08
	7.2	9.3	6.92	2.83	11	3.44	7.27	5.83	6.47	9.33	12.19	3.69	6.44	5.07	6.69	7.34	14.95	5.2	12.89	6.62
	6.6	8.79	6.09	3.24	10.24	3.28	7.88	5.48	6.46	8.68	11.14	3.85	6.54	4.81	6.86	7.14	13.25	5.15	11.7	6.31
	6.64	8.85	5.93	3.17	9.86	3.07	7.19	5.36	6.22	7.6	10.47	3.7	5.79	4.22	6.43	6.41	11.92	5.34	13.48	5.98
bridge 2	8.32	8.25	5.42	5.9	9.96	5.35	7.04	5.7	6.09	9.71	9.37	4.55	6.03	5.31	4.96	6.43	17.53	5.74	9.39	8.53
	8.55	8.74	5.96	8.2	7.83	6.58	7.08	8.47	5.96	11.14	9.85	4.88	7.75	5.73	5.18	7.88	22.12	6.26	10.09	8.25
	9.63	10.92	6.5	6.98	6.86	10.46	8.4	8.87	12.57	12.17	4.91	10.28	5.84	5.15	8.93	21.99	6.29	10.15	9.5	
	9.24	11.38	5.94	7.4	9.46	6.41	11.18	6.19	6.5	12.07	10.36	4.71	10.23	5.73	5.4	8.48	18.26	6.4	9.63	9.45
	9.04	11.2	5.91	7	9.24	6.01	9.79	5.78	8.42	10.96	10.96	4.57	9.04	5.24	5.18	7.56	18.71	5.49	9.65	9.13
bridge 3	16.86	7.61	5.47	5.81	18.68	8.94	8.16	5.61	8.46	11.83	11.52	5.03	7.87	7.57	10.48	6.73	18.09	5.66	8.2	10.03
	14.22	6.79	6.51	6.12	17.88	6.72	8.36	7.01	6.88	16.29	12.24	5.38	8.7	6.76	10.85	11.33	18.26	5.5	9.96	10.65
	13.48	9.35	8.92	8.9	15.95	9.02	8.81	6.71	7.29	19.66	10.86	5.74	9.44	5.63	10.9	12.48	16.91	5.54	10.88	11.58
	12.33	8.88	6.82	6.25	14.93	8.2	11.29	6.57	6.37	15.19	9.95	5.8	10.07	6.48	11.53	12.41	19.32	5.65	10.21	11.63
	12.62	9.06	6.51	8.2	12.86	6.4	11.33	8.4	6.41	17.92	11.21	5.65	9.17	6.35	10.25	11.79	20.12	5.66	9.77	10.97
tyre 1	5.97	10.02	5.33	2.86	7.77	2.77	8.14	4.87	5.89	6.1	9.45	3.32	4.96	3.79	6.85	4.52	8.31	4.83	9.63	4.98
	7.42	10.39	8.31	2.77	7.9	3.06	7.47	5.52	7.7	6.99	9.75	3.41	8.12	4.98	6.11	5.26	9.79	5.51	11.8	6.28
	10.71	10.11	8.83	2.87	10.09	3.28	8.16	4.6	7.4	9.44	8.42	3.61	8.04	4.97	6.52	6.2	19.3	5.22	11.32	8.37
	10.94	10.49	8.54	3.91	10.5	4.09	8.63	4.97	8.28	6.6	9.72	3.51	5.22	5.52	6.71	6.73	16.78	5.4	12.76	7.98
	11.88	11.44	6.16	3.74	10.41	3.95	8.76	5.19	6.53	6.43	9.48	3.4	5.6	5.35	6.88	6.92	16.67	4.89	14.12	6.02
tyre 2	8.31	9.96	6.15	6.36	9.69	4.81	7.8	4.98	6.76	7.72	10.1	3.57	7.28	4.69	4.88	6.25	15.26	5.35	10.01	7.98
	10.89	9.28	5.87	7.12	10.11	5.09	9.15	5.62	8.83	7.46	10.03	4.17	8.12	5.38	4.98	7.38	15.8	6.53	10.64	8.89
	12.02	11.42	6.76	7.16	9.56	5.46	10.22	8.87	9.01	9.22	10.09	4.62	9	5.97	5.18	8.33	20.14	6.95	10.85	9.57
	10.42	11.23	6.86	7.29	8.43	5.27	9.02	6.41	9.03	10.18	8.84	4.97	9	5.91	5.27	10.18	21.01	6.68	10.17	9.4
	10.08	12.24	6.67	7.2	8.53	6.08	12.43	6.48	8.51	10.82	10.19	8.01	8.78	5.61	5.28	8.82	16.93	6.37	9.1	10.25
tyre 3	12.6	9.49	6.35	6.72	13.35	7.34	8.62	8.38	3.8	17.58	9.96	4.71	7.7	6.03	9.97	10.44	14.7	4.28	9.96	8.45
	10.59	9.62	6.16	6.1	14.06	7.72	8.38	6.1	6.46	19.8	10.06	5.29	9.1	8.19	10.85	10.91	17.66	5.79	10.16	12.2
	15.19	9.39	7.08	6.86	16.13	8.35	11.21	6.66	8.88	20.24	10.85	5.64	9.96	7.1	10.31	12.3	17.77	5.62	10.08	12.67
	11.16	10.06	7.31	6.89	16.28	8.39	11.28	8.31	5.85	16.37	10.86	5.65	9.64	6.84	10.73	12.77	18.86	7.37	9.58	12.06
	12.91	10.49	6.9	6.96	16.25	8.57	9.51	6.22	5.26	17.64	11.47	5.51	9.83	8.98	9.92	10.06	18.27	7.01	9.15	12.43
spid 1	10.02	9.07	5.05	2.98	7.11	3.3	7.96	4.78	3.64	4.4	8.27	3.42	5.72	5.48	5.34	5.24	13.78	4.56	12.65	5.78
	11.45	10.85	5.27	2.93	7.85	3.59	7.89	5.1	3.44	5.08	9.38	3.58	6.71	5.85	5.69	5.91	17.87	5.21	12.1	7.22
	9.1	8.29	6.18	4.01	10.72	6.2	8.25	4.79	8.3	5.87	9.34	3.43	5.43	4.78	5.8	16.52	4.93	10.82	6.83	
	9.84	9.13	5.84	3.67	9.19	4.77	7.76	4.79	6.09	5.91	10.25	3.42	5.23	4.84	5.47	6.3	14.85	8.37	8.49	7.3
	10.72	11.49	6.1	3.92	9.46	6.19	8.46	5.8	7.74	5.31	11.76	3.38	5.41	4.65	5.49	5.8	13.81	6.66	11.02	7.96
spid 2	9.62	11.08	6.03	6.11	7.9	4.81	12.01	6.51	7.49	8.67	8.39	4.19	7.32	5.78	5.45	8.42	17.14	6.38	9.06	9.85
	9.64	10.67	6.16	6.26	9.72	4.94	7.76	6.17	6.18	9.54	9.33	4.97	8.25	5.97	5.34	8.72	17.98	6.38	9.42	9.52
	11.91	11.55	6.06	6.77	10.12	5.45	10.62	6.57	6.66	11.32	9.4	6.19	7.72	6.37	5.02	7.53	16.05	5.51	7.07	10.75
	11.96	12.73	5.8	6.96	9.1	5.36	13.08	5.34	7.12	13.18	10.36	5.1	6.82	5.23	4.48	9.41	18.3	6.57	6.28	9.86
	13.08	16.57	6.19	6.97	9.65	6.24	12.74	7.14	6.78	12.46	11.84	4.75	6.22	5.03	6.11	9.04	18	7.2	7.15	11.6
spid 3	10.75	11.07	7.71	8.45	15.53	6.72	9.48	8.18	6.02	18.24	10.78	6.2	7.92	6.51	11.25	12.39	16.2	6.42	8.99	12.55
	6.73	8.61	7.76	7.21	15.45	6.51	6.97	6.23	5.24	14.8	9.21	6.52	10.65	7.44	10.04	11.47	16.13	6.24	6.27	11.01
	4.11	9.12	6.92	8.49	11.38	6.73	11.61	6.19	7.86	13.42	10.8	6.01	10.28	8.22	9.41	11.5	16.37	6.42	6.19	10.01
	7.22	11.18	6.69	7.84	11.53	6.7	10.42	5.68	6.28	14.76	10.9	6.82	10.37	6.08	10.17	12.95	17.67	6.72	5.57	8.69
	12.08	13.86	7.92	7.21	12.7	8.48	11.18	8.36	6.19	20.34	10.11	5.87	11.85	5.82	9.11	13.62	19.15	7.86	6.69	10.65
post 1	9.33	8.73	4.98	3.63	7.87	4.84	7.9	4.87	3.67	4.61	10.45	2.58	5.39	4.77	4.84	4.71	13.41	5.88	6.25	7.4
	9.88	8.15	6.19	3.67	7.87	5.41	7.64	5.92	8.17	6.99	10.1	3.4	5.85	4.79	6.29	5.49	16.89	4.62	8.32	7.62
	11.65	6.84	6.95	6.67	8.11	5.57	6.74	8.21	7	7.23	9.02	3.81	4.76	4.56	6.79	5.58	12.67	5.02	9.28	8.4
	10.33	6.81	5.62	6.95	6.84	6.47	7.46	6.5	6.4	7.82	9.78	3.79	4.96	4.39	6.05	5.87	11.66	4.64	5.75	9.2
	11.53	8.93	5.62	6.73	10.32	6.27	7.54	6.09	5.28	7.59	9.5	3.82	5.29	3.9	6.66	7.36	12.72	4.85	8.47	8.53
post 2	13.58	10.61	6.49	6.36	9.75	5.56	6.67	5.65	7.43	11.65	10.9	4.64	5.91	5.83	4.96	9.16	10.73	5.84	7.47	10.98
	11.49	9.61	8.33	6.31	8.33	5.87	8.97	8.18	6.97	12.46	10.13	5.25	6.16	5.36	6	10.26	19.48	5.3	7.44	10.64
	14.13	10.78	6.29	4.93	7.81	6.31	8.97	5.48	6.86	16.3	10.47	5.02	9.06	5.01	4.92	9.28	15.92	4.34	7.81	10.91
	12.31	10.02	6.22	4.84	6.56	6.99	8.1	5.71	6.8	14.76	10.43	4.88	4.85	4.86	4.77	9.68	16.7	4.47	7.27	10.26
	13.1	14.17	6.84	4.67	10.24	7.7	9.8	5.8	8.27	15.19	11.3	4.84	8.83	4.91	4.93	10.29	19.39	4.37	7.58	11.81
post 3	7.97	10.54	7.71	6.62	12.15	6.11	10.53	6.02	6.09	16.41	9.89	5.04	8.38	6.05	9.82	12.04	18.64	6.16	4.93	10.87
	7.63	10.58	7.84	7.62	13.05	6.99	9.22	6.19	6.12	12.71	9.08	5.81	10.24	6.52	9.7	11.13	20.27	6.49	5.8	9.38
	10.92	9.76	6.69	6.81	10.33	6.52	8.77	5.84	7.13	23.99	10.19	5.49	10.2	8.34	8.63	11	19.73	5.41	7.29	8.93
	10.76	11.17	6.53	6.03	10.27	7.4	10.05	6.94	6.14	22.59	9.65	5.22	9.37	6.12	8.72	10.78	22.67	5.66	6.74	8.74
	11.79	12.28	6.82	6.36	15.53	7.36	11.65	6.62	5.89	21.78	9.79	5.09	9.41	6.23	9.33	10.23	22.99	5.53	5.97	9.64
fox 1	13.06	10.66	8.83	6.92	10.17	7.23	8.21	6.42	9.56	7.25	7.98	4.46	8.4	6.46	6.13	5.96	20.44	4.92	11.44	9.38
	15.17	13.3	7.16	7.57	13.25	8.41	9.3	9.65	12.38	9.49	3.62	4.2	7.82	5.9	5.81	5.92				

APPENDIX 7

Study 3 Statistical Outcomes

HR

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	179191.10	19	9431.11		
CONSTANT	28918707.09	1	28918707	3066.31	.000

EFFECT (elements)
Univariate F=-tests with (1,19)D.F.

HR for **high FE** versus **low FE**

HYPOTH SS	ERROR SS	HYPOTH MS	ERROR MS	F	Sig of F
846.30193	18113.49431	846.30193	953.34181	.88772	.358

HR for **high CHW** versus **low CHW**

HYPOTH SS	ERROR SS	HYPOTH MS	ERROR MS	F	Sig of F
22331.5073	7755.91225	22331.50730	408.20591	54.70648	.000

SCL

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	15306.14	19	805.59		
CONSTANT	140861.58	1	140861.58	174.86	.000

EFFECT (elements)
Univariate F=-tests with (1,19)D.F.

SCL for **high FE** versus **low FE**

HYPOTH SS	ERROR SS	HYPOTH MS	ERROR MS	F	Sig of F
751.49249	537.07598	751.49249	28.26716	26.58536	.000

SCL for **high CHW** versus **low CHW**

HYPOTH SS	ERROR SS	HYPOTH MS	ERROR MS	F	Sig of F
6.37000	188.20704	6.37000	9.90563	.64307	.433

APPENDIX 8

Coopersmith SEI (School form, 1967)

Please see print copy for image



Consulting Psychologists Press, Inc.
Palo Alto, CA

[illegible]

1

1461

x2 =

1

© 1967 by W.H. Freeman & Co. Published in 1981 by Consulting Psychologists Press, Inc. All rights reserved. It is unlawful to reproduce or adapt this form without written permission from the Publisher.

APPENDIX 9

Study 4 Self Esteem Scores

Study 4 Self esteem Scores

Gender	GEN1	SOC 1	HOM1	SCH1	LIE1	GEN 2	SOC2	HOM2	SCH2	LIE2
1	19	7	7	5	1	19	7	8	5	0
1	16	5	6	6	6	16	3	3	7	3
1	17	8	4	3	0	20	8	5	7	1
1	22	7	8	7	2	26	8	8	7	1
2	18	5	6	7	5	14	5	7	5	3
1	22	6	8	5	5	22	7	8	6	3
1	17	4	4	4	2	18	6	6	4	2
2	19	8	8	8	2	22	8	8	7	3
1	21	8	7	7	3	16	8	6	5	3
2	16	3	6	7	2	15	4	5	5	2
2	13	4	7	4	4	10	3	6	4	4
2	15	8	6	6	2	20	6	8	7	3
2	13	3	7	3	2	12	2	8	1	0
1	21	7	8	7	5	23	7	7	7	5
1	23	8	7	8	2	22	8	7	7	2
1	16	7	5	5	1	15	7	6	6	1
2	17	7	5	6	0	19	5	7	5	0
2	15	7	1	2	3	13	6	0	1	2
1	26	8	8	8	2	26	8	8	8	2
1	18	5	5	5	4	17	4	7	5	2
1	17	7	6	1	4	12	6	7	4	3
2	20	8	6	7	5	17	6	7	7	5
1	26	7	8	8	7	24	8	8	8	6
2	13	6	3	6	6	15	5	4	5	6
1	24	8	8	6	6	25	7	8	8	7
2	25	6	8	8	0	24	7	8	8	0
2	11	5	6	5	2	15	3	4	5	1
2	19	7	7	6	2	23	7	8	6	2
2	15	6	6	5	3	17	7	6	6	3
2	19	7	8	8	4	17	7	8	5	4
1	20	6	4	7	5	23	5	4	7	6
1	24	7	8	7	6	26	7	8	6	6
2	19	4	8	8	0	15	4	8	8	2
1	25	7	6	7	3	25	8	8	8	6
2	19	8	6	8	4	22	4	8	6	5
2	22	7	6	3	4	24	7	7	5	5
2	23	8	7	6	6	25	6	8	8	7
2	26	6	7	5	2	25	7	8	7	5
2	16	6	6	6	3	20	6	7	7	5
2	25	8	8	8	7	24	7	8	8	7
2	24	8	7	8	6	24	8	7	8	4
2	26	8	8	8	4	26	8	8	8	3
2	21	8	5	5	1	15	7	4	5	4
2	22	5	7	3	4	26	7	8	6	5
2	19	8	3	4	0	22	7	4	5	1
2	21	7	8	6	2	22	8	8	8	2
2	15	6	1	3	2	18	7	1	6	1
2	19	7	4	7	6	17	6	5	4	4
2	15	6	7	4	3	18	5	6	5	7
2	11	8	5	4	3	21	6	5	5	5
2	16	6	6	5	4	22	6	5	6	3
2	22	6	8	6	4	24	4	8	7	3
2	25	6	8	4	6	23	6	8	5	6
2	17	7	4	3	2	16	6	6	6	4
2	21	6	5	5	4	22	4	7	5	5
2	18	6	6	3	0	14	4	6	5	0
2	19	6	6	6	4	21	7	7	7	2
2	15	4	4	4	5	15	6	7	3	5
2	23	7	7	8	5	25	8	7	8	2
2	25	8	8	6	1	25	8	8	7	4
2	23	8	7	5	2	22	8	8	7	3
2	16	4	7	3	3	18	4	6	4	2
2	14	4	6	4	3	14	4	4	2	2
2	10	5	6	4	6	14	7	7	5	6
2	18	5	8	7	5	17	4	7	3	2
2	19	6	7	7	4	21	6	7	7	6
2	10	6	5	6	5	16	6	7	5	4
2	24	7	8	7	4	24	8	8	8	5
2	20	6	8	6	1	25	5	8	6	3
2	21	7	8	8	6	23	8	8	6	4

APPENDIX 10

Study 4 Statistical Outcomes

ONE WAY ANOVA ON THE INITIAL SELF ESTEEM SCORES (GENDER DIFFERENCES)

		Sum of Squares	df	Mean Square	F	Sig.
SET1	Between Groups	10.081	1	10.081	.185	.669
	Within Groups	3715.405	68	54.638		
	Total	3725.486	69			
F1	Between Groups	.188	1	.188	.065	.800
	Within Groups	197.598	68	2.906		
	Total	197.786	69			
G1	Between Groups	11.728	1	11.728	.680	.413
	Within Groups	1173.357	68	17.255		
	Total	1185.086	69			
H1	Between Groups	.641	1	.641	.227	.635
	Within Groups	192.059	68	2.824		
	Total	192.700	69			
L1	Between Groups	2.932	1	2.932	1.255	.266
	Within Groups	158.839	68	2.336		
	Total	161.771	69			
S1	Between Groups	2.201	1	2.201	.660	.420
	Within Groups	226.885	68	3.337		
	Total	229.086	69			

STUDY 4 SELF ESTEEM TOTAL n=70

Cell Means and Standard Deviations

Variable .. SET1				
FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	36.966	8.095	29
SEX	2	36.195	6.856	41
For entire sample		36.514	7.348	70

Variable .. SET2				
FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	38.310	8.694	29
SEX	2	37.585	7.940	41
For entire sample		37.886	8.207	70

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	7778.41	68	114.39		
SEX	18.99	1	18.99	.17	.685

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	575.15	68	8.46		
TIMES	63.53	1	63.53	7.51	.008
SEX BY TIMES	.02	1	.02	.00	.964

STUDY 4 GENERAL SELF ESTEEM n = 70

Cell Means and Standard Deviations

Variable .. G1				
FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	19.172	4.201	29
SEX	2	18.341	4.121	41
For entire sample		18.686	4.144	70

Variable .. G2				
FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	19.655	4.498	29
SEX	2	19.488	4.365	41
For entire sample		19.557	4.389	70

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	2213.97	68	32.56		
SEX	8.46	1	8.46	.26	.612

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	288.18	68	4.24		
TIMES	22.54	1	22.54	5.32	.024
SEX BY TIMES	3.74	1	3.74	.88	.351

STUDY 4 SOCIAL SELF ESTEEM (F) n=70

Cell Means and Standard Deviations
Variable .. F1

FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	6.276	1.998	29
SEX	2	6.171	1.465	41
For entire sample		6.214	1.693	70

Variable .. F2

FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	6.414	1.862	29
SEX	2	5.829	1.657	41
For entire sample		6.071	1.756	70

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	349.10	68	5.13		
SEX	4.04	1	4.04	.79	.378

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	55.33	68	.81		
TIMES	.35	1	.35	.43	.513
SEX BY TIMES	1.95	1	1.95	2.40	.126

STUDY 4 HOME SELF ESTEEM n=70

Cell Means and Standard Deviations
Variable .. H1

FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	6.414	1.593	29
SEX	2	6.220	1.739	41
For entire sample		6.300	1.671	70

Variable .. H2

FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	6.759	1.573	29
SEX	2	6.610	1.869	41
For entire sample		6.671	1.742	70

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	364.97	68	5.37		
SEX	1.00	1	1.00	.19	.667

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	36.15	68	.53		
TIMES	4.59	1	4.59	8.63	.005
SEX BY TIMES	.02	1	.02	.03	.857

STUDY 4 SCHOOL SELF ESTEEM n=70
Cell Means and Standard Deviations
Variable .. S1

FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	5.103	1.896	29
SEX	2	5.463	1.776	41
For entire sample		5.314	1.822	70

FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	5.483	1.939	29
SEX	2	5.659	1.811	41
For entire sample		5.586	1.853	70

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	366.71	68	5.39		
SEX	2.44	1	2.44	.45	.504

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	96.63	68	1.42		
TIMES	2.80	1	2.80	1.97	.165
SEX BY TIMES	.29	1	.29	.20	.654

STUDY 4 LIE SCALE n=70
Cell Means and Standard Deviations
Variable .. L1

FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	2.414	1.476	29
SEX	2	2.829	1.564	41
For entire sample		2.657	1.531	70

FACTOR	CODE	Mean	Std. Dev.	N
SEX	1	2.069	1.334	29
SEX	2	2.927	1.603	41
For entire sample		2.571	1.547	70

Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	253.40	68	3.73		
SEX	13.77	1	13.77	3.70	.059

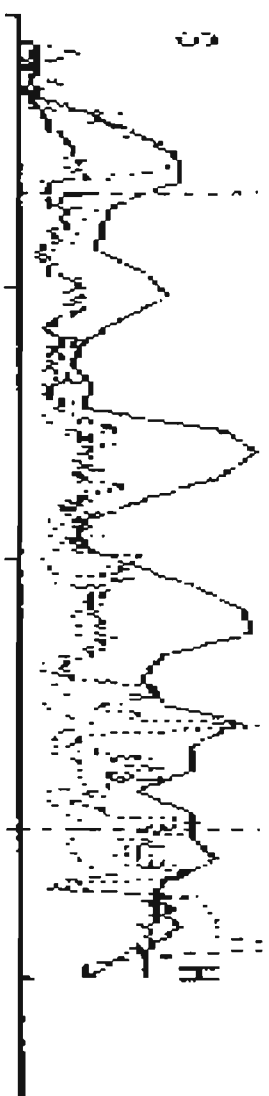
Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	58.08	68	.85		
TIMES	.52	1	.52	.61	.438
SEX BY TIMES	1.66	1	1.66	1.95	.168

APPENDIX 11

AMS03 printout for one subject

EGS HPT MOT

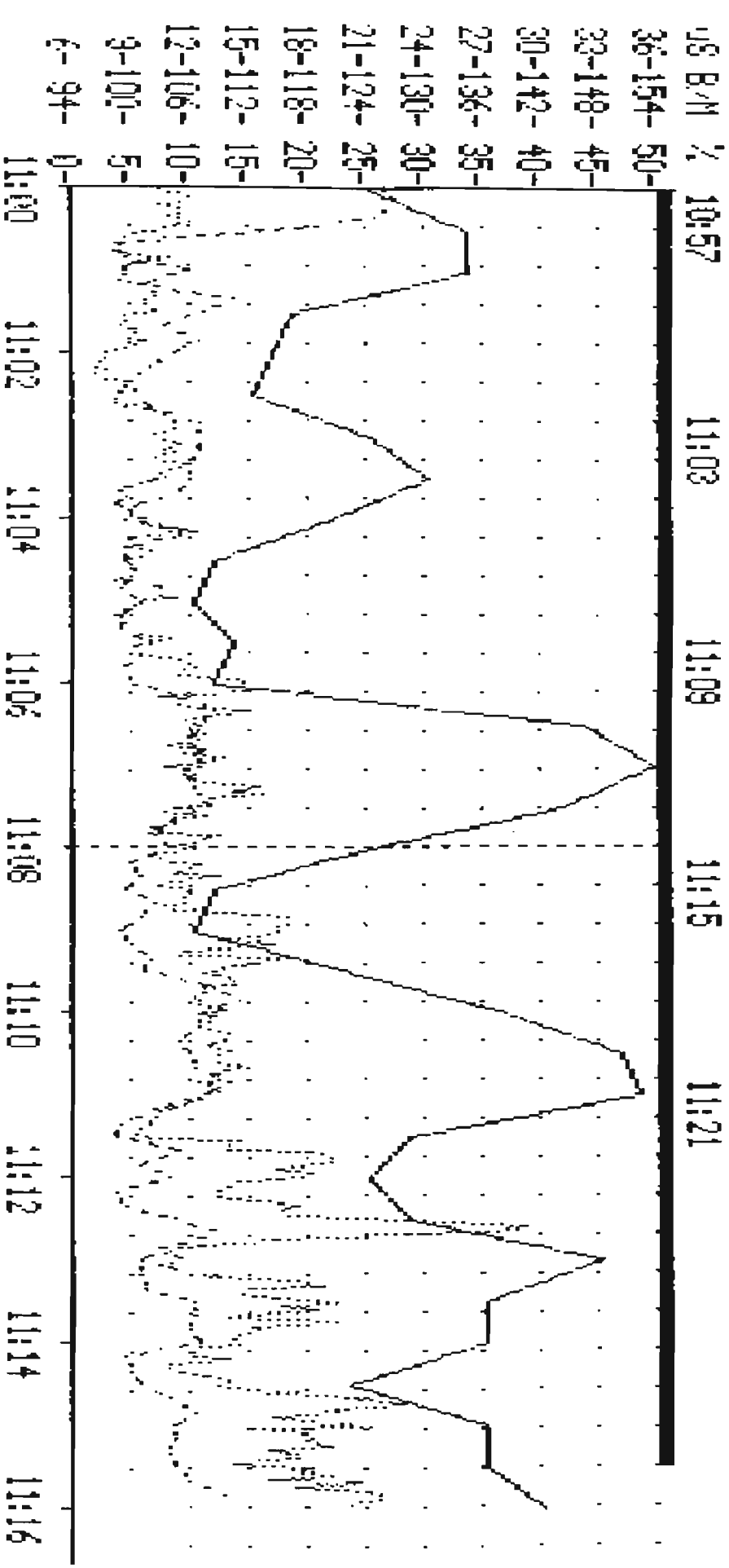


Serial Number : 9913

frances

Starttime: 10:57:36

Date: 5-11-1992



APPENDIX 12

Study 5 Element Ratings Data

Study 5 General SE scores and ratings data

sub ID	sex	i1	i2	q1	q2	ra1	ra2	ra3	ra4	ra5	ra6	ra7	ra8	ra9	ra10	ra11	ra12	ra13	ra14	ra15	ra16	ra17	ra18	ra19	ra20	ra21	ra22	ra23	ra24	ra25	ra26	ra27	ra28	ra29	ra30	
1	1	2	4	79	77	2	4	6	1	3	3	4	5	1	4	5	4	5	1	4	6	6	6	6	6	6	0	0	6	0	5	0	4	6	3	3
2	1	1	3	68	69	0	1	0	0	3	3	2	4	5	4	2	2	5	1	4	4	3	3	5	1	6	1	6	0	6	4	5	2	4	5	2
3	1	1	5	56	59	0	0	1	0	1	1	2	3	0	2	5	0	6	5	6	6	6	0	0	6	0	0	0	6	0	6	4	1	2	1	6
4	1	4	4	81	83	0	0	2	0	1	1	2	3	1	2	1	1	1	1	2	4	3	5	3	1	4	0	2	0	0	0	0	0	0	0	4
5	1	4	4	54	70	3	2	3	4	5	1	3	6	5	2	6	3	3	3	4	4	3	5	3	1	5	0	3	6	1	2	0	0	0	0	
7	2	3	2	55	50	1	2	5	3	2	3	3	4	4	4	5	5	4	5	4	5	4	4	5	3	1	1	5	5	3	3	2	4	2	4	
8	2	4	5	65	64	0	0	4	0	3	1	1	5	2	4	3	4	5	4	6	5	4	4	6	5	5	6	6	6	5	0	4	0	4	2	
9	2	4	5	71	79	1	2	3	0	1	3	3	6	4	5	6	6	2	6	4	6	6	6	6	6	6	6	6	6	1	3	0	1	2	2	
10	1	2	1	78	77	0	0	0	0	0	0	3	4	1	5	2	4	3	3	3	6	6	6	6	6	0	2	0	0	1	8	2	0	0	1	
11	2	1	2	59	60	0	0	2	0	3	1	0	3	1	4	0	0	0	0	1	6	4	5	0	6	4	0	2	0	0	1	8	2	0	0	1
12	1	4	5	85	90	0	0	1	0	1	0	1	1	0	2	1	1	2	1	2	4	3	5	3	4	4	2	1	6	0	1	6	0	0	0	0
13	1	2	2	80	66	0	0	1	0	1	1	1	3	1	4	2	2	4	2	3	3	4	3	1	3	0	1	6	1	6	0	1	0	1	0	1
14	1	0	1	77	76	1	1	4	1	4	2	2	3	4	3	4	3	4	3	5	2	3	4	2	4	3	6	0	2	6	1	0	2	1	1	
15	2	3	1	91	102	1	2	6	1	5	2	3	6	2	3	1	2	6	2	5	2	3	5	3	5	1	6	6	0	6	1	1	0	2	1	1
16	2	3	6	79	82	1	2	4	1	3	3	4	3	6	2	2	5	4	2	5	3	3	2	2	2	3	2	5	6	5	6	2	3	1	4	4
17	2	2	3	74	82	0	3	6	0	5	2	4	4	3	6	2	5	4	2	4	3	3	5	5	4	5	6	3	6	0	2	3	1	4	3	6
18	2	1	0	89	90	1	1	3	0	2	1	3	3	2	3	2	3	3	2	3	3	2	4	3	2	0	2	4	1	5	1	3	5	2	4	4
19	2	1	0	63	64	2	1	6	3	5	2	6	6	6	0	3	6	6	6	5	6	4	2	5	6	0	6	0	6	0	0	0	0	0	0	0
20	2	1	1	68	85	0	1	6	0	1	2	1	5	0	5	6	6	0	4	2	5	6	4	3	2	0	6	0	6	0	0	0	0	0	0	0
21	2	3	1	79	76	0	0	2	0	3	1	2	3	0	2	1	4	3	3	3	4	2	3	5	2	5	0	6	0	6	0	0	0	0	0	0
22	2	3	3	74	86	0	1	3	0	4	1	2	4	1	3	2	4	3	3	5	3	4	6	2	4	5	0	6	0	6	0	1	2	4	2	2
23	2	2	3	80	83	0	2	1	0	1	1	3	2	3	3	2	4	5	3	4	4	5	3	3	5	3	2	6	2	6	0	2	0	1	0	0
24	2	3	4	71	59	1	2	4	0	6	3	4	3	4	2	4	5	4	3	6	5	6	4	3	5	3	6	6	0	6	0	2	2	0	3	3
25	2	3	3	77	73	2	1	3	2	1	2	2	4	1	1	1	2	4	2	1	3	5	3	5	3	4	0	6	0	5	1	3	4	0	2	4
27	1	2	2	76	61	1	1	4	0	4	3	3	4	2	5	2	5	4	2	5	0	6	6	0	4	0	0	6	0	6	0	1	4	0	4	0
28	1	1	6	77	79	1	3	4	2	4	2	6	4	3	4	4	4	4	4	4	4	4	3	2	6	1	6	4	5	6	0	1	2	2	3	3
29	2	4	5	73	66	1	2	5	0	3	5	6	4	5	6	6	6	4	5	6	6	6	6	2	6	4	1	6	4	5	6	0	1	3	0	3
30	2	4	5	75	72	1	0	6	0	2	3	1	5	3	5	6	6	3	2	6	6	6	2	6	6	2	0	6	0	6	1	2	3	0	3	2
32	2	3	5	93	90	1	2	5	0	4	3	5	5	2	4	6	5	2	6	6	4	5	3	3	6	6	2	6	0	6	1	2	3	0	3	2
33	2	2	5	76	74	1	2	6	0	4	1	3	5	4	2	3	4	0	5	3	3	2	3	4	4	5	6	2	6	1	2	4	1	3	2	3
34	1	4	5	85	86	1	1	4	1	3	2	1	3	2	4	2	3	4	2	4	3	3	3	4	4	4	5	6	0	6	1	1	4	3	5	2
35	1	6	3	71	66	0	1	3	2	3	1	1	4	1	4	3	3	4	2	5	1	1	3	3	3	5	0	1	6	2	0	1	1	2	0	1

APPENDIX 13

Study 5 HR, SCL & MOT Data

Study 5 HR, SCL and MOT data

subject	group	sc1	hr1	mot1	sc2	hr2	mot2	sc3	hr3	mot3	sc4	hr4	mot4	sc5	hr5	mot5	sc6	hr6	mot6	sc7	hr7	mot7	sc8	hr8	mot8	sc9
1	1	6.21	129.12	19	5.55	129.08	19	9.48	132.87	56	11.32	127.79	84	12.2	130.78	67	7.92	122.03	22	8.05	126.24	23	10.82	127.23	65	15.03
2	1	7.17	107.68	19	7.17	101.64	32	8.18	100.23	32	9.5	123.46	75	9.38	107.99	49	6.91	111.29	18	7.08	117.05	31	10.12	116.07	56	11.05
3	1	5.11	130.83	8	4.85	128.47	8	5.59	119.35	43	5.78	100.54	55	5.39	99.72	55	4.07	118.96	14	3.88	112.59	14	4.15	119.01	16	4.95
4	1	4.27	119.31	62	4.28	121.51	62	8.07	116.75	62	8.48	121.62	92	8.34	116.21	92	3.98	115.12	31	3.82	115.8	76	4.81	114.25	76	6.49
5	1	3.4	147.49	53	3.35	149.43	36	4.64	146.12	96	5.04	148.58	95	4.9	148.07	95	3.64	142.56	56	3.73	145.4	56	5.07	139.97	70	4.97
7	2	7.76	130.45	15	7.92	131.3	53	7.16	126.74	94	8.03	123.85	43	7.9	127.26	43	5.66	122.71	39	6.11	121.9	92	6.53	123.72	92	7.06
8	2	8.47	120.07	15	8.92	93.34	37	8.27	122.12	44	8.22	121.02	47	8.15	124.2	47	8.28	110	33	8.13	115.4	33	10.19	129.43	44	9.77
9	2	2.3	96.7	18	2.58	102.58	25	3.54	109.93	86	4.86	116.9	78	4.56	110.27	78	2.88	97.48	21	3.2	102.95	12	5.34	108.2	57	4.56
10	1	5.9	79.04	20	6.11	76.71	20	5.96	79.04	42	5.99	93.01	42	6.26	78.75	95	5.63	96.9	23	5.58	92.78	23	5.98	97.58	32	7
11	2	2.16	110.98	57	2.38	116.35	57	2.77	121.85	80	2.58	116.2	45	2.54	114.9	45	2.3	112.48	64	2.4	114.44	64	2.57	120.19	71	2.71
12	1	4.49	115.45	38	4.36	122.18	21	3.74	106.3	17	3.78	106.91	52	4.08	110.99	39	10.54	106.69	26	4.35	117.97	29	3.84	99.61	21	4.35
13	1	11.54	142.19	46	11.61	141.39	46	10.31	135.04	24	10.42	124.46	77	9.88	123.11	39	6.2	113.87	24	5.97	111.52	24	10.1	111.16	49	8.25
14	1	5.94	123.03	16	6.05	110.89	16	5.81	110.95	64	12.5	131.85	94	11.38	128.75	94	7.66	118.89	43	9	124.36	43	12.02	122.96	62	12.81
15	2	7.35	118.56	24	7.9	126.29	24	9.82	118.43	78	5.71	112.95	109	5.56	118.54	64	3.41	105.23	21	3.35	102.4	61	5.85	106.81	61	4.54
16	2	5.54	131.57	34	5.45	114.86	26	6.1	112.04	109	5.5	113.94	72	5.48	152.67	46	5.44	164.85	32	4.86	168.19	32	5.85	163.76	50	6.14
17	2	5.11	166.56	27	5.23	169.54	27	5.4	153.94	72	5.5	153.65	59	5.39	131.08	77	8.82	125.77	28	8.54	122.16	28	8.03	130.37	32	12.36
18	2	8.55	114.63	24	8.81	119.59	24	8.48	113.32	28	9.45	129.87	77	8.79	127.32	73	8.35	125.2	39	9.16	127.13	39	10.56	131.84	48	11.66
19	2	6.5	123.79	18	6.48	119.85	18	9.2	128.14	68	8.13	124.03	28	8.2	99.9	51	6.78	112.4	26	6.89	114.87	26	6.58	104.14	24	10.98
20	2	6.82	110.42	16	6.88	112.39	16	5.59	117.18	18	6.82	103.07	28	1.36	122.05	51	1.23	113.04	28	1.2	111.27	22	1.27	105.34	23	1.73
21	2	0.93	134.44	26	0.99	124.43	26	0.88	113.54	29	1.24	123.82	29	8.84	108.65	32	4.5	101.74	32	4.89	105.44	32	7.76	114.77	93	9.69
22	2	4.9	98.85	19	5.25	102.54	82	8.22	117.46	82	8.91	104.75	69	8.84	144.27	62	3.1	129.95	32	3.58	131.3	39	3.46	141.09	46	3.55
23	2	3.59	156.58	43	3.34	159.16	19	3.39	147.63	90	4.24	150.12	90	4.46	144.27	62	6.24	99.63	20	6.08	103.19	27	6.09	109.71	37	6.33
24	2	6.54	145.48	25	6.38	134.8	25	6.65	124.22	16	7.13	112.07	31	7.71	126.08	90	8.67	107.98	32	9.65	123.93	52	10.27	126.8	54	10.48
25	2	9.09	111.08	28	9.82	126.42	69	9.61	116.32	56	9.09	113.68	43	9.08	125.15	43	6.34	118.61	34	6.49	113.51	34	9.03	115.77	49	8.83
27	1	7.98	127.8	24	6.55	131.29	24	9.55	127.88	91	10.12	107.12	62	10.22	104.58	62	6.88	100.56	13	6.74	102.48	13	6.87	113.12	19	7.9
28	2	5.8	98.18	11	6.26	81.36	11	6.16	76.16	21	6.21	70.18	21	7.02	113.45	89	6.88	110.56	13	6.21	125.64	13	6.25	121.13	13	8.74
29	1	7.79	133.4	47	7.5	133.48	35	7.12	122.13	29	9.29	112.62	42	8.72	115.22	42	6.3	115.39	13	6.21	125.64	13	6.25	121.13	13	8.74
30	1	6.99	121.14	20	7.05	119.22	8	7.7	121.45	27	7.93	108.72	121	8.16	115.45	121	5.4	112.24	13	5.26	105.57	13	5.65	109.88	63	8.13
32	2	2.9	113.18	24	3.2	123.36	24	3.25	120.17	47	3.65	119.36	42	3.87	124.12	42	2.92	118.87	32	3.22	123.09	32	3.17	125.28	35	3.26
33	2	6.13	160.05	67	6	164.07	26	5.97	153.1	26	6.3	150.39	79	6.37	152.25	79	5.81	120.26	25	5.88	121.32	36	6.76	122.39	33	6.63
34	1	4.33	123.06	17	5.76	125.83	20	5.53	125.16	47	7.97	130.34	87	8.26	149.59	87	6	124.1	16	5.96	118.36	21	7.65	138.67	45	8.74
35	1	4.33	83.88	4	5.81	101.59	115	7.8	107.73	115	6.63	99.32	68	6.6	101.02	68	4.75	94.66	38	5.89	95.1	38	7.61	102.15	87	7.59

hr9	mo9	sc10	hr10	mo10	sc11	hr11	mo11	sc12	hr12	mo12	sc13	hr13	mo13	sc14	hr14	mo14	sc15	hr15	mo15	sc16	hr16	mo16	sc17	hr17	mo17	sc18
143.42	80	14.34	135.91	80	15.03	131.63	19	12.29	131.08	22	16.54	148.58	55	15.4	152.86	73	17.82	149.89	46	15.88	142.52	56	16.79	146	66	13.97
136.44	33	10.72	130.01	33	7.6	103.17	22	8.07	98.39	19	6.54	134.51	47	10.82	140.71	35	10.56	135.25	35	8.82	142.52	20	8.92	113.06	20	11.91
112.2	72	5.52	118.89	72	3.85	108.9	11	4.04	103.9	11	5.14	125.12	45	4.77	137.7	40	4.79	139.19	40	5.07	135.54	22	4.86	132.47	22	5.92
119.73	71	5.33	118	71	6.07	123.89	40	6.41	126.5	72	7.35	136.86	96	6.33	142.43	83	6.72	141.99	58	5.74	123.68	31	5.94	128.95	85	10.02
130.14	71	5.44	134.6	71	3.63	139.56	27	3.66	140.53	27	4.13	179.46	75	4.37	156.5	72	4.37	157.45	66	3.94	130.97	38	3.93	109.51	38	4.49
128.06	76	6.6	146.3	59	8.33	146.02	43	8.58	113.05	53	9.06	127.11	55	7.17	126.55	58	8.52	122.8	58	8.8	105.77	38	8.73	103.96	38	7.06
133.47	36	9.46	131.44	36	9.89	123.72	17	10.25	123.79	17	5.55	134.64	42	12.25	144.09	39	11.75	146.12	39	11.02	107.81	34	10.07	116.99	34	10.6
112.11	66	4.6	124.2	66	3.88	93.85	13	3.82	94.89	13	5.55	125.72	41	5.21	125.44	64	5.16	127.54	64	3.7	98.82	26	4	100.02	26	4.84
126.19	62	6.99	115.7	62	7.9	100.48	20	7.41	93.91	20	8.1	127.22	51	8	103.7	49	8.28	109.53	52	8.38	74.27	29	8.4	78.58	29	8.62
126.05	75	2.76	126.62	75	2.24	121.8	43	2.5	126.59	43	2.7	135.14	80	2.85	141.83	59	2.91	140.82	29	3.53	127.37	52	3.79	134.13	52	3.41
113.45	50	4.27	108.76	50	3.97	110.84	11	3.98	116.67	11	3.68	116.67	33	4.35	126.72	52	4.34	124.99	57	4.23	103.86	6	4.13	106.54	6	5.17
105.06	29	10.96	108.17	29	11.92	102.41	29	10.94	96.94	30	10.98	105.28	31	13.28	117.52	63	12.91	120.79	63	11.38	113.84	27	11.26	120.15	27	11.91
113.98	44	8.53	120.71	44	5.03	126.32	21	4.73	121.88	21	8.79	138.63	55	9.09	152.33	60	9.08	152.02	60	5.57	115.05	19	5.21	130.25	19	8.67
129.82	48	13.02	131.53	42	13.53	122.4	39	11.46	117.21	43	12.93	133.75	63	12.41	145.46	62	11.18	147.79	62	10.3	129.94	27	10.4	130.25	27	8.93
104.2	70	4.08	106.55	70	3.02	97.14	26	2.96	100.18	37	4.19	114.92	67	3.72	127.17	53	3.97	129.57	53	5.23	138.37	87	4.75	134.88	87	3.83
170.25	42	6.09	169.9	42	5.92	156.62	32	6.01	156.44	32	6.35	163.5	48	6.49	179.28	42	6.12	175.88	39	6.54	153.95	33	6.15	145.97	23	8.14
156.72	74	12.44	136.27	74	10.82	127.86	74	10.08	124.13	31	13.54	144.95	48	12.75	142.46	64	13.02	147	64	17.53	132.16	39	16.55	128.01	48	13.87
128.22	68	11.7	131.65	68	7.45	125.4	21	8.07	118.43	21	12.74	144.54	52	10.11	146.95	57	11.02	141.8	54	6.8	117.58	24	7.3	120.62	29	10.86
123.34	34	11.83	104	58	7.6	116.62	26	8.17	126.5	26	9.25	114.49	45	8.57	127.37	61	8.81	130.18	61	8.27	128.09	48	7.28	124.89	17	10.03
107.9	40	1.72	112.14	72	1.56	118.29	28	1.48	122.46	28	1.71	115.26	55	1.89	135.51	73	1.74	133.67	73	1.39	111.01	23	1.4	108.62	23	1.65
112.32	70	8.63	114.32	70	4.87	86.08	16	5.05	90.19	33	7.37	110.8	55	7.56	114.49	39	7.48	114.9	39	4.73	107.53	57	5.22	111.62	57	9.35
136.78	63	3.85	140.04	63	2.84	127.14	27	3.15	128.83	27	3.26	159.2	70	3.16	157.78	68	3.19	146.37	67	2.81	128.2	17	2.82	132.17	17	3.8
107	59	6.96	120.76	59	6.98	100.55	15	6.71	91.79	15	7.22	115.51	54	7.36	137.66	50	7.22	136.9	69	6.88	100.89	23	6.48	98.14	21	6.48
133.39	48	10.66	134.29	48	14.74	128	48	12.19	147.01	48	12.26	156.41	49	14.59	147.21	52	15.02	146.08	52	13.86	124.41	29	12.71	124.44	58	12.26
102.76	48	8.72	102.55	48	10.59	103.06	35	10.07	101.58	35	9.93	128.04	78	9.35	134	81	8.7	129.48	63	7.75	86.42	15	7.96	96.88	15	10.31
124.23	70	8.02	104.92	70	6.78	118.85	29	6.94	142.57	29	7.95	138.82	46	9.36	130.16	45	9.21	140.66	52	6.49	112.27	31	6.51	111.82	45	8.05
124.58	41	8.89	125.06	44	7.06	123.27	22	6.93	122.2	22	8.18	140.27	32	8.43	141.42	32	8.29	144.04	32	6.33	133.96	17	6.36	128.62	17	8.41
131.55	92	9.62	132.77	92	8.45	112.7	23	7.99	114.38	21	8.37	129.08	62	9.6	141.05	68	8.67	144.33	68	9.67	118.84	18	9	98.32	18	10.48
140.57	32	3.04	141.4	51	2.55	116.18	30	2.91	123.35	30	2.82	164.31	39	3.45	160.97	44	3.28	161.34	54	4.38	126.02	43	4.15	133.95	43	3.59
135.69	47	6.68	138.72	40	6.2	128.72	38	6.35	117.23	32	6.42	145.62	28	7.06	139.77	36	6.87	142.61	36	6.06	136.65	23	6.56	127.82	21	6.76
126.8	59	8.76	130.84	59	6.29	137.15	17	6.27	140.7	17	8.93	132.93	63	9.31	151.93	51	9.36	147.49	44	6.49	120.82	22	6.17	127.81	24	6.47
119.23	52	6.45	123.83	36	5.13	114.23	38	6.25	114.32	38	7	124.67	61	6.25	127.74	54	7.1	127.01	54	7.8	106.16	21	9.82	115.16	53	8.7

	hr18	mo18	sc19	hr19	mo19	sc20	hr20	mo20	sc21	hr21	mo21	sc22	hr22	mo22	sc23	hr23	mo23	sc24	hr24	mo24	sc25	hr25	mo25	sc26	hr26	mo26	sc27
149.2	91	14.29	154.45	84	13.78	144.06	64	12.13	157.26	26	11.75	153.88	26	11.76	152.12	41	13.14	164.39	41	10.29	131.68	25	8.38	128.12	25	10.35	
146.23	60	11.96	158.02	77	11.65	165.27	77	11.23	130.84	15	11.19	123.49	15	11.25	121.78	15	12.23	138.35	65	10.29	119.62	28	9.97	118.83	28	12.84	
126.08	54	5.35	137.06	49	5.05	136.67	58	4.7	131.65	9	5.23	130.92	9	4.94	131.08	9	4.81	135.72	34	4.18	115.6	37	4.12	122.75	41	4.51	
135.94	55	11	140.41	57	11.36	133.91	64	10.26	105.88	17	10.8	114.57	44	14.82	133.67	44	13.86	136.71	59	8.65	117.3	29	7.74	123.81	39	11.13	
133.01	87	4.18	140	98	4.05	140.49	94	3.61	109.53	26	3.76	139.5	26	3.81	140.44	84	4.36	137.74	84	3.47	112.32	35	3.78	122.16	50	3.96	
125.49	88	6.25	132.58	51	6.71	133.05	51	6.1	119.73	36	7.79	125.08	46	8.46	129.82	46	7.54	138.31	46	6.4	115.45	26	7.7	113.01	26	7.97	
111.05	32	9.7	138.97	45	9.49	139.6	46	12.21	143.68	19	11.99	143.72	19	11.02	128.07	32	13.41	158.34	97	9.7	121.63	21	10.44	120.95	33	10.84	
95.94	63	4.49	124.58	64	4.33	123.23	64	5.04	113.16	28	5.56	123.02	22	6.13	127.31	22	6.12	130.02	22	4.82	98.8	25	4.74	84.07	25	5.16	
136.66	76	8.86	102.59	65	8.88	103.02	65	8.31	77.69	17	8.39	70.77	23	8.39	75.22	23	8.54	107.92	23	7.74	81.96	25	7.85	123.83	37	4.21	
122.15	55	2.99	144.98	49	3.03	140.72	49	4.14	121.32	31	4.33	134.72	31	4.67	138.71	31	5.52	146.06	45	3.23	113.04	23	4.05	123.83	37	4.21	
103.96	25	5.19	121.59	49	5.38	125.15	43	6.22	116.81	31	5.44	120.62	17	5.3	123.67	17	5.96	122.6	20	4.88	119.67	14	4.68	110.51	21	4.53	
123.96	48	7.79	121.25	47	7.95	120.06	47	8.14	135.2	21	9.52	122.46	21	9.74	117.2	21	12.13	109.43	23	12.65	107.64	45	11.85	111.24	19	11.75	
136.69	65	10.03	139.18	74	9.63	138.15	74	11.03	117.12	19	10.49	123.67	25	10.78	120.65	25	13.08	118.15	25	11.19	115.16	27	5.14	118.61	24	6.95	
125.71	57	3.88	130.81	53	3.54	126.44	43	8.7	99.14	50	9.58	118.49	50	9.24	121.38	50	6.79	126.32	34	6.61	102.58	47	5.94	111.59	48	5.14	
160.04	71	8.42	168.62	71	7.95	166.29	71	9.84	158.01	14	9.64	161.41	11	13.95	166.77	11	9.04	156.77	20	7.87	152.62	23	7.66	141.77	23	10.03	
130.68	51	16.55	142.9	62	16.14	144.01	62	13.91	125.66	26	13.21	128.72	40	13.95	126.49	40	14.21	126.21	40	11.69	130.19	34	10.49	123.28	34	9.94	
130.77	65	10.38	130.91	77	10.1	135.91	62	11.77	124.6	25	13.76	133	62	13.75	134.85	62	14.8	136.92	62	7.35	121.47	24	7.62	123.78	32	11.74	
121.46	87	9.84	163.27	94	9.51	166	94	7.17	111.77	17	9.09	114.18	17	9.36	113.36	17	9.27	115.3	10	7.27	105.76	32	7.04	110.86	22	7.7	
119.53	103	1.72	119.53	76	1.81	115.03	74	1.57	106.86	18	1.59	110.8	18	1.6	110.8	22	1.77	98.65	22	2.08	113.25	32	2.08	112.96	20	1.97	
113.42	60	7.99	110.86	70	8.63	110.29	72	10.15	107.93	15	11.54	112.53	100	15.03	123.99	100	18.74	138.97	100	18.74	138.97	100	9.57	98.81	42	11.88	
152.9	114	3.27	163.09	109	3.16	162.85	109	2.7	131.05	21	2.65	124.62	27	2.57	124.42	27	2.92	140.41	27	3.19	130.17	19	3.25	127.71	37	3.48	
102.44	28	7.74	120.21	67	7.98	125.78	67	7.59	108.3	19	7.29	116.3	19	7.22	103.14	19	7.68	116.62	32	7.1	110.41	30	6.78	106.76	30	6.49	
150.77	44	12.64	148.94	56	13.21	145.54	56	16.31	123.39	43	21.95	147.54	61	24.61	155.44	61	28.05	162.18	61	16.14	134.02	40	19.63	140.77	51	15.78	
135.08	84	11.18	117.63	74	11.23	112.82	74	8.42	115.19	21	8.02	116.66	46	10.38	116.77	46	13.7	122.46	46	7.73	118.53	27	8.04	120.31	49	13.88	
133.11	55	8.72	137.16	72	8.93	134.01	52	5.89	95.5	27	5.98	101.69	35	5.94	99.6	35	5.97	115.43	35	7.18	123.79	31	6.89	109.57	31	7.6	
135.61	45	8.47	145.89	52	8.51	146.6	52	8.3	128.23	8	8.28	136.64	8	8.38	130.9	5	8.21	135.05	5	7.5	128.38	37	8.26	124.86	37	8.51	
148.84	50	11.39	164.35	60	11.18	160.06	60	8.42	121.82	17	9.28	119.7	17	9.5	122.59	32	12.89	128.3	32	10.3	114.78	17	10.12	115.73	17	12.17	
128.66	67	3.38	162.52	49	3.62	160.75	49	5.2	110.72	28	5.41	117.97	28	5.81	126.39	28	6.69	131.11	56	3.8	129.69	34	3.62	120.69	34	4.62	
154.08	43	7.15	155.15	41	6.88	160.71	41	6.57	154.61	33	6.82	157.32	14	6.89	157.28	14	6.82	163.17	14	6.43	124.66	28	6.34	130.07	28	6.48	
123	24	12.78	126.87	60	12.83	125.76	60	8.04	112.71	23	6.3	119.36	28	6.2	120.71	28	6.58	125.21	28	5.5	101.22	36	6.11	107.52	36	9.18	
122.53	54	6.37	121.04	67	6.38	115.34	41	8.04	112.71	28	8.49	125.4	51	8.77	127.69	51	9.66	136.17	51	5.5	101.22	36	6.11	107.52	36	9.18	

h ₂₇	m ₀₂₇	s ₀₂₈	h ₂₈	m ₀₂₈	s ₀₂₉	h ₂₉	m ₀₂₉
135.55	45	11.61	142.23	49	12.06	144.14	49
123.38	30	14.07	122.42	28	15.1	124.18	28
128.39	40	4.32	128.21	52	4.84	130.01	52
129.32	38	8.05	129.04	46	8.7	132.79	46
112.75	38	3.97	116.42	60	3.94	105.26	60
117.52	33	5.66	129.51	42	5.65	130.82	42
130.56	34	10.51	136.47	36	10.67	131.59	36
104.83	36	4.72	100.36	38	4.55	101.43	38
90.88	39	7.93	89.59	32	8.17	87.25	32
129.15	48	3.88	138	53	4.02	137.75	38
120.76	16	5.32	122.33	44	4.36	121.04	44
103.4	27	14.49	119.38	30	13.41	118.69	30
131.31	33	7.13	129.31	46	7.1	130.57	45
121.55	17	9.88	123.18	43	4.31	126.68	39
109.53	50	4.57	117.46	43	10.13	144.38	37
152.24	46	10.74	144.39	37	15.44	130.64	48
133.9	40	17.55	128.69	48	11.02	127.73	32
120.72	43	11.1	124.29	32	8.77	148.49	62
121.04	24	8.79	149.52	62	2.17	131.71	43
114.18	31	2.09	128.36	43	11.71	118.61	48
156.01	52	10.25	110.62	48	3.59	139.69	69
136.84	37	3.73	140.85	51	8.74	120.82	57
105.86	30	8.85	120.4	57	20.47	133.49	82
130.43	43	21.42	138.44	82	12.17	117.89	47
120.04	57	12.33	117.72	47	8.25	134.23	44
122.2	36	8.34	116.74	44	16.75	142.2	49
134.37	24	8.56	130.14	35	8.52	120.88	35
116.3	24	14.81	136.2	49	3.97	122.26	33
132.21	43	3.91	132.24	33	6.33	129.22	48
134.25	22	6.31	128.66	48	9.06	120.13	31
123.41	34	9.64	121.88	31	5.94	120.73	44
116.27	42	5.39	110.88	44			

APPENDIX 14

Study 5 Statistical Outcomes

STUDY 5 ANALYSES SET 1
PHYSIOLOGICAL ANALYSES

STUDY 5 HR HIGH FE VS LOW FE

Cell Means and Standard Deviations
Variable .. HRF

	Mean	Std. Dev.	N
For entire sample	126.066	15.849	32

Variable .. HRBE

	Mean	Std. Dev.	N
For entire sample	121.578	12.365	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	10914.05	31	352.07		
CONSTANT	981246.46	1	981246.46	2787.11	.000

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	1612.19	31	52.01		
TIMES	322.27	1	322.27	6.20	.018

STUDY 5 HR HIGH CHW VS LOW CHW

Cell Means and Standard Deviations
Variable .. HRSP

	Mean	Std. Dev.	N
For entire sample	129.233	13.223	32

Variable .. HRBE

	Mean	Std. Dev.	N
For entire sample	121.578	12.365	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	9149.07	31	295.13		
CONSTANT	1006500.35	1	1006500.4	3410.35	.000

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	1010.61	31	32.60		
TIMES	937.45	1	937.45	28.76	.000

STUDY 5 SCL HIGH FE VS LOW FE

Cell Means and Standard Deviations

Variable .. SCF					
	Mean	Std. Dev.		N	
For entire sample	8.937	4.113		32	
Variable .. SCBE					
	Mean	Std. Dev.		N	
For entire sample	7.369	2.832		32	

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	707.87	31	22.83		
CONSTANT	4254.02	1	4254.02	186.30	.000

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	65.18	31	2.10		
TIMES	39.31	1	39.31	18.69	.000

STUDY 5 SCL HIGH CHW VS LOW CHW

Cell Means and Standard Deviations

Variable .. SCSP					
	Mean	Std. Dev.		N	
For entire sample	7.705	3.332		32	
Variable .. SCBE					
	Mean	Std. Dev.		N	
For entire sample	7.369	2.832		32	

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	565.07	31	18.23		
CONSTANT	3635.89	1	3635.89	199.47	.000

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	27.83	31	.90		
TIMES	1.81	1	1.81	2.02	.166

STUDY 5 MOT HIGH FE VS LOW FE
Cell Means and Standard Deviations
Variable .. MF

	Mean	Std. Dev.	N
For entire sample	31.992	15.296	32

Variable .. MBE

	Mean	Std. Dev.	N
For entire sample	43.200	8.160	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	7006.12	31	226.00		
CONSTANT	90461.84	1	90461.84	400.27	.000

- Tests involving 'TIMES' Within-Subject Effect.					

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	2311.22	31	74.56		
TIMES	2009.84	1	2009.84	26.96	.000

STUDY 5 MOT HIGH CHW VS LOW CHW
Cell Means and Standard Deviations
Variable .. MSP

	Mean	Std. Dev.	N
For entire sample	40.469	6.753	32

	Mean	Std. Dev.	N
For entire sample	43.200	8.160	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	3040.84	31	98.09		
CONSTANT	112007.36	1	112007.36	1141.86	.000

- Tests involving 'TIMES' Within-Subject Effect.					

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	437.14	31	14.10		
TIMES	119.36	1	119.36	8.46	.007

STUDY 5 HR HIGH FE VS LOW FE WITH MOT AS CO-VAR

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	10869.83	30	362.33		
REGRESSION	44.22	1	44.22	.12	.729
CONSTANT	67171.51	1	67171.51	185.39	.000

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	1565.77	30	52.19		
REGRESSION	46.43	1	46.43	.89	.353
TIMES	315.99	1	315.99	6.05	.020

STUDY 5 ANALYSES 1 HR HIGH CHW VS LOW CHW WITH MOT AS CO-VAR

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	8976.84	30	299.23		
REGRESSION	172.23	1	172.23	.58	.454
CONSTANT	22546.47	1	22546.47	75.35	.000

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	1010.40	30	33.68		
REGRESSION	.21	1	.21	.01	.938
TIMES	724.97	1	724.97	21.53	.000

STUDY 5 ANALYSES SET 1 SCL HIGH FE VS LOW FE WITH MOT AS CO-VAR

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	638.38	30	21.28		
REGRESSION	69.49	1	69.49	3.27	.081
CONSTANT	89.41	1	89.41	4.20	.049

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	49.31	30	1.64		
REGRESSION	15.88	1	15.88	9.66	.004
TIMES	53.33	1	53.33	32.45	.000

STUDY 5 ANALYSES SET 1 SCL HIGH CHW VS LOW CHW WITH MOT AS CO-VAR

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	565.00	30	18.83		
REGRESSION	.07	1	.07	.00	.951
CONSTANT	101.36	1	101.36	5.38	.027

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	26.90	30	.90		
REGRESSION	.93	1	.93	1.03	.317
TIMES	2.68	1	2.68	2.99	.094

STUDY 5 ANALYSES SET 2
SELF ESTEEM ANALYSES n=32 (SEE TABLE 7.4)

STUDY 5 GENERAL SE BOYS VS GIRLS
Cell Means and Standard Deviations

Variable .. E1					
FACTOR	CODE	Mean	Std. Dev.	N	
SEX	1	74.571	9.476	14	
SEX	2	74.278	10.334	18	
For entire sample		74.406	9.811	32	

Variable .. E2					
FACTOR	CODE	Mean	Std. Dev.	N	
SEX	1	75.214	9.472	14	
SEX	2	78.167	12.557	18	
For entire sample		76.875	11.239	32	

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	5880.40	30	196.01		
SEX	27.83	1	27.83	.14	.709

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	949.50	30	31.65		
TIMES	80.86	1	80.86	2.55	.120
SEX BY TIMES	41.49	1	41.49	1.31	.261

- STUDY 5 LIE SCALE BOYS VS GIRLS
Cell Means and Standard Deviations

Variable .. L1					
FACTOR	CODE	Mean	Std. Dev.	N	
SEX	1	2.643	1.692	14	
SEX	2	2.500	.985	18	
For entire sample		2.562	1.318	32	

Variable .. L2					
FACTOR	CODE	Mean	Std. Dev.	N	
SEX	1	3.571	1.604	14	
SEX	2	3.167	1.823	18	
For entire sample		3.344	1.715	32	

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	101.18	30	3.37		
SEX	1.18	1	1.18	.35	.558

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	42.46	30	1.42		
TIMES	10.02	1	10.02	7.08	.012
SEX BY TIMES	.27	1	.27	.19	.665

ONE WAY ANOVA ON INITIAL SCORES BOYS VS GIRLS

		Sum of Squares	df	Mean Square	F	Sig.
E1	Between Groups	.679	1	.679	.007	.935
	Within Groups	2983.040	30	99.435		
	Total	2983.719	31			
L1	Between Groups	.161	1	.161	.090	.767
	Within Groups	53.714	30	1.790		
	Total	53.875	31			

STUDY 5 GENERAL SE FOR G1 VS G2

Cell Means and Standard Deviations

Variable .. E1			Mean	Std. Dev.	N
FACTOR		CODE			
GROUP	1		74.200	10.441	20
GROUP	2		74.750	9.097	12
For entire sample			74.406	9.811	32

Variable .. E2			Mean	Std. Dev.	N
FACTOR		CODE			
GROUP	1		80.950	9.693	20
GROUP	2		70.083	10.638	12
For entire sample			76.875	11.239	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	5509.11	30	183.64		
GROUP	399.13	1	399.13	2.17	.151

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	502.21	30	16.74		
TIMES	16.28	1	16.28	.97	.332
GROUP BY TIMES	488.78	1	488.78	29.20	.000

STUDY 5 LIE SCALES FOR G1 VS G2

Cell Means and Standard Deviations

Variable .. L1			Mean	Std. Dev.	N
FACTOR		CODE			
GROUP	1		2.350	1.387	20
GROUP	2		2.917	1.165	12
For entire sample			2.562	1.318	32

Variable .. L2					
FACTOR	CODE	Mean	Std. Dev.	N	
GROUP	1	3.400	1.875	20	
GROUP	2	3.250	1.485	12	
For entire sample		3.344	1.715	32	

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	101.71	30	3.39		
GROUP	.65	1	.65	.19	.664

Tests involving 'TIMES' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	40.81	30	1.36		
TIMES	7.18	1	7.18	5.28	.029
GROUP BY TIMES	1.93	1	1.93	1.42	.243

ONE WAY ANOVA ON INITIAL SE SCORES G1 VS G2

		Sum of Squares	df	Mean Square	F	Sig.
E1	Between Groups	2.269	1	2.269	.023	.881
	Within Groups	2981.450	30	99.382		
	Total	2983.719	31			
L1	Between Groups	2.408	1	2.408	1.404	.245
	Within Groups	51.467	30	1.716		
	Total	53.875	31			

STUDY 5 ANALYSES SET 2
PHYSIOLOGICAL ANALYSES (GROUP DIFFERENCES ON THE ELEMENTS)

STUDY 5 HR BRIDGE G1 VS G2

Cell Means and Standard Deviations

Variable .. HRV1					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	.000	.000	20	
G	2	.000	.000	12	
For entire sample		.000	.000	32	

Variable .. HRV2					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	-.496	7.274	20	
G	2	-.010	12.134	12	
For entire sample		-.314	9.205	32	

Variable .. HRV3					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	-3.558	10.678		20
G	2	-.879	12.080		12
For entire sample		-2.553	11.108		32

Variable .. HRV4					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	-3.358	14.691		20
G	2	-4.631	14.051		12
For entire sample		-3.835	14.239		32

Variable .. HRV5					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	-1.577	14.369		20
G	2	-2.003	12.633		12
For entire sample		-1.737	13.536		32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	9687.42	30	322.91		
G	3.22	1	3.22	.01	.921

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. G BY TIME (Cont.)
 Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	5.12024	4137.26970	5.12024	137.90899	.03713	.849
T3	15.75972	2066.62298	15.75972	68.88743	.22878	.636
T4	7.16818	1441.93081	7.16818	48.06436	.14914	.702

STUDY 5 HR TYRE WALK G1 VS G2
 Cell Means and Standard Deviations

Variable .. HRV6					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	.000	.000		20
G	2	.000	.000		12
For entire sample		.000	.000		32

Variable .. HRV7					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	2.271	4.781		20
G	2	1.356	6.041		12
For entire sample		1.928	5.212		32

Variable .. HRV8					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	4.688	8.328		20
G	2	4.838	8.287		12
For entire sample		4.744	8.178		32

Variable .. HRV9					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	6.666	9.087		20
G	2	14.350	13.760		12
For entire sample		9.548	11.493		32

Variable .. HRV10					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	6.697	8.321	20	
G	2	16.565	12.732	12	
For entire sample		10.397	11.114	32	

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	4799.59	30	159.99		
G	422.67	1	422.67	2.64	.115

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. G BY TIME (Cont.)
Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	602.18250	2359.15089	602.18250	78.63836	7.65762	.010
T3	85.99310	696.56366	85.99310	23.21879	3.70360	.064
T4	40.28385	842.39208	40.28385	28.07974	1.43462	.240

STUDY 5 HR SPIDERS WEB G1 VS G2
Cell Means and Standard Deviations

Variable .. HRV11					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	.000	.000	20	
G	2	.000	.000	12	
For entire sample		.000	.000	32	

Variable .. HRV12					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	1.119	6.975	20	
G	2	-2.640	12.412	12	
For entire sample		-.290	9.375	32	

Variable .. HRV13					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	14.971	12.913	20	
G	2	15.906	16.643	12	
For entire sample		15.322	14.167	32	

Variable .. HRV14					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	21.719	7.550	20	
G	2	18.794	16.661	12	
For entire sample		20.622	11.641	32	

Variable .. HRV15					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	21.723	6.824	20	
G	2	18.682	16.953	12	
For entire sample		20.582	11.522	32	

- - - - -

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	9041.58	30	301.39		
G	115.90	1	115.90	.38	.540

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. G BY TIME (Cont.)
Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	20.64826	3082.53629	20.64826	102.75121	.20095	.657
T3	.85998	1518.50718	.85998	50.61691	.01699	.897
T4	16.63925	1262.48937	16.63925	42.08298	.39539	.534

STUDY 5 HR POSTMANS WALK G1 VS G2

Cell Means and Standard Deviations
Variable .. HRV16

FACTOR	CODE	Mean	Std. Dev.	N
G	1	.000	.000	20
G	2	.000	.000	12
For entire sample		.000	.000	32

Variable .. HRV17

FACTOR	CODE	Mean	Std. Dev.	N
G	1	-.655	6.714	20
G	2	.666	8.933	12
For entire sample		-.160	7.508	32

Variable .. HRV18

FACTOR	CODE	Mean	Std. Dev.	N
G	1	6.978	12.176	20
G	2	19.083	13.545	12
For entire sample		11.517	13.835	32

Variable .. HRV19

FACTOR	CODE	Mean	Std. Dev.	N
G	1	15.281	12.997	20
G	2	24.758	10.725	12
For entire sample		18.834	12.887	32

Variable .. HRV20

FACTOR	CODE	Mean	Std. Dev.	N
G	1	15.547	14.589	20
G	2	22.908	12.188	12
For entire sample		18.307	14.009	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	7815.83	30	260.53		
G	1373.76	1	1373.76	5.27	.029

Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	392.48925	4773.03344	392.48925	159.10111	2.46692	.127
T3	220.49795	1415.61123	220.49795	47.18704	4.67285	.039
T4	60.10820	1080.12289	60.10820	36.00410	1.66948	.206

STUDY 5 HR FLYING FOX G1 VS G2

Cell Means and Standard Deviations

Variable .. HRV21					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	.000	.000	20	
G	2	.000	.000	12	
For entire sample		.000	.000	32	

Variable .. HRV22					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	5.633	9.344	20	
G	2	4.431	8.217	12	
For entire sample		5.182	8.822	32	

Variable .. HRV23					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	7.384	12.088	20	
G	2	4.447	12.397	12	
For entire sample		6.282	12.090	32	

Variable .. HRV24					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	11.087	12.296	20	
G	2	14.638	12.537	12	
For entire sample		12.418	12.308	32	

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	6824.94	30	227.50			
G	.65	1	.65	.00	.958	

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. G BY TIME (Cont.)

Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	29.81622	2512.05337	29.81622	83.73511	.35608	.555
T3	110.86577	1731.56797	110.86577	57.71893	1.92079	.176
T4	28.74048	401.53164	28.74048	13.38439	2.14731	.153

STUDY 5 HR EXIT LADDER G1 VS G2

Cell Means and Standard Deviations
Variable .. HRV25

FACTOR	CODE	Mean	Std. Dev.	N
G	1	.000	.000	20
G	2	.000	.000	12
For entire sample		.000	.000	32

Variable .. HRV26

FACTOR	CODE	Mean	Std. Dev.	N
G	1	1.809	7.193	20
G	2	.307	4.626	12
For entire sample		1.246	6.313	32

Variable .. HRV27

FACTOR	CODE	Mean	Std. Dev.	N
G	1	8.775	13.180	20
G	2	3.898	5.722	12
For entire sample		6.946	11.129	32

Variable .. HRV28

FACTOR	CODE	Mean	Std. Dev.	N
G	1	8.781	11.658	20
G	2	9.620	6.672	12
For entire sample		9.096	9.963	32

Variable .. HRV29

FACTOR	CODE	Mean	Std. Dev.	N
G	1	9.887	12.558	20
G	2	9.570	9.899	12
For entire sample		9.768	11.466	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	5943.19	30	198.11		
G	51.48	1	51.48	.26	.614

- Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	2.18496	2709.72591	2.18496	90.32420	.02419	.877
T3	51.29087	1213.24072	51.29087	40.44136	1.26828	.269
T4	18.74000	467.36402	18.74000	15.57880	1.20292	.281

STUDY 5 SCL BRIDGE G1 VS G2

Cell Means and Standard Deviations
Variable .. SCV1

FACTOR	CODE	Mean	Std. Dev.	N
G	1	.000	.000	20
G	2	.000	.000	12
For entire sample		.000	.000	32

Variable .. SCV2	FACTOR	CODE	Mean	Std. Dev.	N
G		1	.131	.406	20
G		2	.131	.647	12
For entire sample			.131	.500	32

Variable .. SCV3	FACTOR	CODE	Mean	Std. Dev.	N
G		1	.685	1.426	20
G		2	.737	1.329	12
For entire sample			.704	1.369	32

Variable .. SCV4	FACTOR	CODE	Mean	Std. Dev.	N
G		1	1.624	1.893	20
G		2	1.035	1.513	12
For entire sample			1.403	1.758	32

Variable .. SCV5	FACTOR	CODE	Mean	Std. Dev.	N
G		1	1.642	1.669	20
G		2	1.221	1.715	12
For entire sample			1.484	1.671	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	126.83	30	4.23		
G	1.38	1	1.38	.33	.573

- Tests involving 'TIME' Within-Subject Effect.
 EFFECT .. G BY TIME (Cont.)
 Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	1.53403	77.91672	1.53403	2.59722	.59064	.448
T3	.06834	12.41607	.06834	.41387	.16512	.687
T4	.42979	14.32611	.42979	.47754	.90001	.350

STUDY 5 SCL TYRE WALK G1 VS G2
 Cell Means and Standard Deviations

Variable .. SCV6	FACTOR	CODE	Mean	Std. Dev.	N
G		1	.000	.000	20
G		2	.000	.000	12
For entire sample			.000	.000	32

Variable .. SCV7	FACTOR	CODE	Mean	Std. Dev.	N
G		1	.085	.449	20
G		2	.224	.433	12
For entire sample			.137	.441	32

Variable .. SCV8					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	1.222	1.611	20	
G	2	1.210	1.144	12	
For entire sample		1.217	1.433	32	

Variable .. SCV9					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	2.116	1.708	20	
G	2	1.916	1.873	12	
For entire sample		2.041	1.745	32	

Variable .. SCV10					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	2.179	1.593	20	
G	2	1.866	1.794	12	
For entire sample		2.062	1.650	32	

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	125.10	30	4.17			
G	.22	1	.22	.05	.819	

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. G BY TIME (Cont.)
 Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	.69866	72.46167	.69866	2.41539	.28925	.595
T3	.15728	21.35396	.15728	.71180	.22096	.642
T4	.09965	10.42249	.09965	.34742	.28682	.596

STUDY 5 SCL SPIDERS WEB G1 VS G2

Cell Means and Standard Deviations

Variable .. SCV11					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	.000	.000	20	
G	2	.000	.000	12	
For entire sample		.000	.000	32	

Variable .. SCV12					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	-.055	.614	20	
G	2	-.406	1.145	12	
For entire sample		-.187	.852	32	

Variable .. SCV13					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	1.412	1.484		20
G	2	.427	1.380		12
For entire sample		1.043	1.503		32

Variable .. SCV14					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	1.458	1.312		20
G	2	.402	.999		12
For entire sample		1.062	1.296		32

Variable .. SCV15					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	1.426	1.486		20
G	2	.635	1.177		12
For entire sample		1.129	1.413		32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	99.61	30	3.32		
G	15.19	1	15.19	4.58	.041

- Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	3.92792	42.65845	3.92792	1.42195	2.76235	.107
T3	1.72448	13.84577	1.72448	.46153	3.73648	.063
T4	.29016	10.20839	.29016	.34028	.85272	.363

STUDY 5 SCL POSTMANS WALK G1 VS G2

Cell Means and Standard Deviations

Variable .. SCV16					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	.000	.000		20
G	2	.000	.000		12
For entire sample		.000	.000		32

Variable .. SCV17					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	-.093	.409		20
G	2	.017	.858		12
For entire sample		-.052	.605		32

Variable .. SCV18					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	1.229	2.042		20
G	2	-.116	1.303		12
For entire sample		.725	1.896		32

Variable .. SCV19					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	1.609	1.991		20
G	2	-.100	1.710		12
For entire sample		.968	2.043		32

Variable .. SCV20					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	1.548	2.140		20
G	2	-.060	1.673		12
For entire sample		.945	2.104		32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	177.81	30	5.93		
G	31.10	1	31.10	5.25	.029

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. G BY TIME (Cont.)

Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	19.01468	101.76039	19.01468	3.39201	5.60572	.025
T3	.61621	18.07689	.61621	.60256	1.02265	.320
T4	3.08408	13.62910	3.08408	.45430	6.78860	.014

STUDY 5 SCL FLYING FOX G1 VS G2

Cell Means and Standard Deviations

Variable .. SCV21					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	.000	.000		20
G	2	.000	.000		12
For entire sample		.000	.000		32

Variable .. SCV22					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	.329	.825		20
G	2	.658	1.678		12
For entire sample		.453	1.201		32

Variable .. SCV23					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	.795	1.581		20
G	2	1.128	2.466		12
For entire sample		.920	1.928		32

Variable .. SCV24					
FACTOR	CODE	Mean	Std. Dev.		N
G	1	1.149	2.173		20
G	2	2.418	3.372		12
For entire sample		1.625	2.705		32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	226.39	30	7.55			
G	7.00	1	7.00	.93	.343	

Tests involving 'TIME' Within-Subject Effect.
 Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	5.45497	119.47094	5.45497	3.98236	1.36978	.251
T3	.69236	20.29861	.69236	.67662	1.02326	.320
T4	.59189	6.88931	.59189	.22964	2.57743	.119

STUDY 5 SCL EXIT LADDER G1 VS G2
 Cell Means and Standard Deviations
 Variable .. SCV25

FACTOR	CODE	Mean	Std. Dev.	N
G	1	.000	.000	20
G	2	.000	.000	12
For entire sample		.000	.000	32

Variable .. SCV26				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	-.032	.742	20
G	2	.340	1.306	12
For entire sample		.107	.988	32

Variable .. SCV27				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	.947	1.501	20
G	2	.810	1.932	12
For entire sample		.895	1.646	32

Variable .. SCV28				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	1.284	1.861	20
G	2	1.467	2.124	12
For entire sample		1.353	1.932	32

Variable .. SCV29				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	1.208	1.651	20
G	2	1.648	2.239	12
For entire sample		1.373	1.870	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	146.62	30	4.89			
G	1.11	1	1.11	.23	.637	

Tests involving 'TIME' Within-Subject Effect.
 Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	.35932	94.32264	.35932	3.14409	.11428	.738
T3	.19104	20.27126	.19104	.67571	.28273	.599
T4	.50103	25.44895	.50103	.84830	.59062	.448

STUDY 5 MOT BRIDGE G1 vs G2
Cell Means and Standard Deviations

Variable .. MV1					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	.000	.000	20	
G	2	.000	.000	12	
For entire sample		.000	.000	32	

Variable .. MV2					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	1.250	16.603	20	
G	2	10.083	37.039	12	
For entire sample		4.563	25.974	32	

Variable .. MV3					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	28.300	30.733	20	
G	2	26.500	38.008	12	
For entire sample		27.625	33.050	32	

Variable .. MV4					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	38.100	29.109	20	
G	2	30.500	31.836	12	
For entire sample		35.250	29.883	32	

Variable .. MV5					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	34.050	26.734	20	
G	2	41.167	31.147	12	
For entire sample		36.719	28.187	32	

Tests of Between-Subjects Effects.					
Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	46159.29	30	1538.64		
G	64.35	1	64.35	.04	.839

EFFECT .. G BY TIME						
Univariate F-tests with (1,30) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	3.63000	19517.7200	3.63000	650.59067	.00558	.941
T3	147.62143	20740.4857	147.62143	691.34952	.21353	.647
T4	1199.00021	11718.3217	1199.00021	390.61072	3.06955	.090
T5	7.95503	7529.46595	7.95503	250.98220	.03170	.860

STUDY 5 MOT TYRE WALK G1 vs G2
Cell Means and Standard Deviations

Variable .. MV6					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	.000	.000	20	
G	2	.000	.000	12	
For entire sample		.000	.000	32	

Variable .. MV7					
FACTOR	CODE	Mean	Std. Dev.	N	
G	1	5.550	13.442	20	
G	2	7.167	15.954	12	
For entire sample		6.156	14.202	32	

Variable .. MV8					
FACTOR	CODE	Mean	Std. Dev.	N	

G	1	18.450	17.799	20
G	2	22.917	20.349	12
For entire sample		20.125	18.599	32

Variable .. MV9				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	29.100	17.514	20
G	2	27.750	23.472	12
For entire sample		28.594	19.594	32

Variable .. MV10				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	30.150	17.315	20
G	2	28.667	23.689	12
For entire sample		29.594	19.581	32

■ -----

■ Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation SS DF MS F Sig of F

WITHIN CELLS	16869.75	30	562.33		
G	15.84	1	15.84	.03	.868

EFFECT .. G BY TIME

Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	26.40333	10469.3467	26.40333	348.97822	.07566	.785
T3	79.30060	6131.90476	79.30060	204.39683	.38797	.538
T4	14.85187	3068.19500	14.85187	102.27317	.14522	.706
T5	63.00670	4024.55357	63.00670	134.15179	.46967	.498

STUDY 5 MOT SPIDERS WEB G1 vs G2

Cell Means and Standard Deviations

Variable .. MV11				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	.000	.000	20
G	2	.000	.000	12
For entire sample		.000	.000	32

Variable .. MV12				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	3.250	8.078	20
G	2	.167	3.563	12
For entire sample		2.094	6.841	32

Variable .. MV13				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	29.450	13.900	20
G	2	22.917	16.665	12
For entire sample		27.000	15.076	32

Variable .. MV14				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	29.950	12.245	20
G	2	26.917	18.178	12
For entire sample		28.813	14.539	32

Variable .. MV15				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	26.800	15.004	20
G	2	25.833	16.667	12
For entire sample		26.437	15.387	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	9728.52	30	324.28		
G	278.12	1	278.12	.86	.362

EFFECT .. G BY TIME					
Univariate F-tests with (1,30) D. F.					
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F Sig. of F
T2	2.66021	5960.51167	2.66021	198.68372	.01339 .909
T3	159.40848	3258.66071	159.40848	108.62202	1.46755 .235
T4	.85333	1376.14667	.85333	45.87156	.01860 .892
T5	26.40964	1598.17429	26.40964	53.27248	.49575 .487

STUDY 5 MOT POSTMANS WALK G1 vs G2

Cell Means and Standard Deviations

Variable .. MV16				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	.000	.000	20
G	2	.000	.000	12
For entire sample		.000	.000	32

Variable .. MV17				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	2.150	14.851	20
G	2	5.583	12.056	12
For entire sample		3.438	13.770	32

Variable .. MV18				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	27.900	26.246	20
G	2	34.833	25.186	12
For entire sample		30.500	25.669	32

Variable .. MV19				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	35.450	25.270	20
G	2	31.917	17.428	12
For entire sample		34.125	22.409	32

Variable .. MV20				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	33.950	25.981	20
G	2	28.000	17.929	12
For entire sample		31.719	23.159	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	27024.32	30	900.81		
G	1.17	1	1.17	.00	.971

EFFECT .. G BY TIME					
Univariate F-tests with (1,30) D. F.					
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F Sig. of F
T2	266.96333	15283.9867	266.96333	509.46622	.52401 .475
T3	352.91667	3616.33333	352.91667	120.54444	2.92769 .097
T4	47.80021	4059.92167	47.80021	135.33072	.35321 .557
T5	139.24313	7705.18500	139.24313	256.83950	.54214 .467

STUDY 5 MOT FLYING FOX G1 vs G2

Cell Means and Standard Deviations

Variable .. MV21				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	.000	.000	20
G	2	.000	.000	12
For entire sample		.000	.000	32

Variable .. MV22				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	8.550	20.935	20
G	2	5.250	12.226	12
For entire sample		7.312	18.008	32

Variable .. MV23				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	11.300	23.629	20
G	2	9.167	12.067	12
For entire sample		10.500	19.874	32

Variable .. MV24				
FACTOR	CODE	Mean	Std. Dev.	N
G	1	16.450	25.595	20
G	2	18.000	22.543	12
For entire sample		17.031	24.133	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	24427.78	30	814.26		
G	28.28	1	28.28	.03	.853

EFFECT .. G BY TIME
Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	12.68760	9230.93583	12.68760	307.69786	.04123	.840
T3	91.43802	4935.42917	91.43802	164.51431	.55581	.462
T4	1.42594	1623.87250	1.42594	54.12908	.02634	.872

STUDY 5 MOT EXIT LADDER G1 vs G2

Cell Means and Standard Deviations

Variable .. MV25				
FACTOR	CODE	Mean	Std. Dev.	N
GROUP	1	.000	.000	20
GROUP	2	.000	.000	12
For entire sample		.000	.000	32

Variable .. MV26				
FACTOR	CODE	Mean	Std. Dev.	N
GROUP	1	2.050	9.367	20
GROUP	2	2.750	8.540	12
For entire sample		2.313	8.931	32

Variable .. MV27				
FACTOR	CODE	Mean	Std. Dev.	N
GROUP	1	5.600	11.509	20
GROUP	2	8.500	9.812	12
For entire sample		6.688	10.834	32

■ -----				
Variable .. MV28				
FACTOR	CODE	Mean	Std. Dev.	N
GROUP	1	13.700	12.616	20

GROUP	2	18.417	11.828	12
For entire sample		15.469	12.352	32

Variable .. MV29				
FACTOR	CODE	Mean	Std. Dev.	N
GROUP	1	13.600	14.299	20
GROUP	2	18.417	11.828	12
For entire sample		15.406	13.438	32

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	8082.37	30	269.41		
GROUP	258.73	1	258.73	.96	.335

EFFECT .. GROUP BY TIME
Univariate F-tests with (1,30) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T2	139.74187	3666.35500	139.74187	122.21183	1.14344	.293
T3	1.34301	1727.31548	1.34301	57.57718	.02333	.880
T4	7.76021	820.11167	7.76021	27.33706	.28387	.598
T5	.03241	1735.67786	.03241	57.85593	.00056	.981

-

APPENDIX 15

PANAS (Watson, Clark & Tellegen, 1988)

Please see print copy for image



APPENDIX 16

Study 6 Ratings and PANAS raw data

Appendix 16
Study 6 PANAS (v1 to v200, fp1 o fp20) and RATINGS (r1 to r50) data

subject	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11	v12	v13	v14	v15	v16	v17	v18	v19	v20	v21	v22	v23	v24	v25	v26
1	3	1	3	1	3	1	1	1	3	4	1	3	1	3	1	3	3	2	3	1	3	2	2	3	3	1
2	3	1	2	1	3	1	1	1	3	2	1	3	1	3	1	4	3	2	3	1	3	2	2	3	2	1
3	5	4	4	1	3	1	4	5	5	4	1	5	1	3	1	5	5	1	5	1	4	5	2	4	2	4
4	5	6	1	1	3	3	5	2	2	4	5	5	1	4	5	5	5	5	5	5	3	4	2	1	2	4
5	4	3	1	1	2	1	4	1	5	3	2	5	1	5	5	4	4	5	5	3	3	4	2	1	4	1
6	5	3	4	1	5	1	4	1	5	5	5	5	1	4	5	4	4	5	5	5	4	4	3	2	4	3
7	4	3	3	2	4	1	3	2	3	4	3	4	1	4	4	5	4	5	5	5	3	3	3	2	1	1
8	4	1	5	2	5	1	1	1	4	2	1	4	1	1	1	1	2	1	5	1	4	1	2	2	1	1
9	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	3	4	5	1	2	1	1	1	1	1
10	2	3	2	1	1	1	4	2	1	1	2	5	1	1	4	4	3	4	3	4	1	2	2	1	1	1
11	5	2	4	1	1	1	1	1	5	1	2	4	1	1	1	2	4	4	3	2	1	2	2	4	1	3
12	3	6	4	1	4	1	4	1	1	3	4	2	4	1	4	4	3	1	4	4	2	5	2	4	2	3
13	3	3	1	4	2	1	4	2	1	3	4	2	4	1	4	4	4	4	1	5	2	5	2	4	2	4
14	4	3	3	2	3	1	2	2	2	2	2	2	3	1	2	4	3	2	3	2	3	3	2	4	1	2
15	3	1	3	1	3	1	4	1	3	3	1	3	1	3	1	4	3	3	3	3	1	3	3	4	1	1
16	3	3	2	2	1	1	2	2	1	1	2	1	1	1	3	3	3	2	3	2	3	4	3	4	3	2
17	4	1	5	1	1	1	3	3	5	1	1	4	1	4	2	4	4	4	4	4	2	2	1	2	1	1
18	3	4	1	3	1	2	3	3	1	2	2	3	1	1	3	4	4	2	4	4	1	4	1	4	3	1
19	5	1	5	1	3	1	2	3	5	1	1	5	1	3	3	4	4	2	1	5	1	2	5	4	3	1
20	5	2	5	1	1	1	1	1	3	1	1	5	1	1	1	4	4	1	4	2	4	4	1	1	3	1
21	5	3	3	2	3	1	2	1	1	3	2	5	1	3	1	5	5	1	4	1	4	2	4	2	2	1
22	5	3	4	2	4	1	2	4	4	4	1	5	1	2	1	5	3	3	1	1	2	4	3	2	3	1
23	5	1	4	1	3	1	3	1	4	4	1	4	1	4	1	5	4	1	5	1	3	5	1	2	3	1
24	4	3	2	1	1	1	3	1	1	2	3	4	1	3	3	1	4	4	4	3	3	2	3	4	4	1
25	2	3	1	2	2	1	2	2	1	4	3	3	1	1	3	4	4	1	3	4	4	2	1	3	1	1
26	4	4	4	4	1	3	4	2	4	4	1	3	1	3	3	3	3	4	4	4	4	4	1	4	4	1
27	4	1	4	1	4	1	1	1	5	1	1	5	1	1	4	4	5	2	4	5	5	2	2	3	1	1
28	5	2	5	1	1	1	3	1	1	3	1	2	2	1	1	5	5	1	1	5	1	2	2	2	2	1
29	1	1	1	1	1	2	1	1	1	2	1	2	1	2	1	1	4	1	1	2	4	1	3	2	2	1
30	5	1	4	1	5	1	1	3	3	1	1	2	2	2	1	1	5	1	2	1	1	2	4	3	2	1
31	4	4	2	3	2	2	3	4	2	2	1	5	1	1	5	4	4	4	4	4	2	4	4	4	4	1
32	5	4	5	3	5	1	1	4	5	5	1	3	1	5	5	3	3	1	5	5	4	4	3	3	4	1
33	4	3	5	2	4	1	3	1	2	1	1	4	1	1	4	4	4	4	4	4	4	5	1	4	1	1
34	4	4	4	4	4	2	3	2	2	4	1	3	2	1	4	4	4	4	2	2	4	3	3	3	1	2
35	3	2	4	4	1	1	1	1	2	4	1	4	1	2	2	2	2	2	4	1	2	4	1	4	2	1
36	3	1	1	1	3	1	3	1	2	3	1	4	2	3	4	4	3	4	4	4	2	5	1	4	1	1
37	5	3	5	2	4	2	1	1	4	5	2	4	1	1	2	2	4	4	1	4	4	3	2	4	1	1
38	5	4	5	1	4	1	4	1	5	4	1	4	1	1	4	4	4	1	5	5	5	4	4	4	1	1
39	5	3	4	2	4	1	2	3	4	4	2	5	1	4	4	4	4	4	4	4	2	4	4	4	1	1
40	5	5	5	2	5	1	4	5	2	4	2	4	1	1	4	4	4	2	1	4	4	2	2	4	1	1
41	3	3	2	2	3	1	4	2	2	4	2	5	1	1	1	4	4	4	5	5	3	3	2	4	3	2
42	5	3	4	1	1	1	4	2	2	2	1	1	1	1	1	2	4	1	3	4	4	4	2	2	2	1
43	3	2	2	4	3	4	5	4	2	1	2	3	1	4	2	4	3	4	4	3	3	3	2	1	1	1
44	4	4	1	5	2	4	5	4	2	1	5	5	1	4	2	4	4	1	1	4	4	3	2	2	2	1
45	4	2	4	1	3	1	3	1	3	4	2	4	1	2	4	4	4	4	4	4	4	4	4	2	2	1
46	4	2	4	2	2	1	3	1	3	1	2	5	1	3	1	2	3	4	1	2	2	3	1	2	1	1
47	2	2	2	2	2	2	3	1	1	1	1	4	1	2	2	2	4	4	4	4	3	4	3	1	1	1
48	4	1	4	1	3	3	3	3	4	1	1	4	1	4	4	4	4	3	4	4	2	2	3	1	1	1
49	4	2	4	2	3	1	3	3	4	1	2	4	1	4	4	4	4	3	4	4	3	3	3	1	1	1
50	4	4	5	1	5	1	5	3	2	5	1	5	1	3	5	5	5	5	4	5	5	4	4	1	4	1

	v81	v82	v83	v84	v85	v86	v87	v88	v89	v90	v91	v92	v93	v94	v95	v96	v97	v98	v99	v100	v101	v102	v103	v104	v105	v106	v107
3	1	3	1	3	1	1	1	1	3	2	3	3	1	1	3	3	4	1	1	1	3	2	3	1	2	4	1
5	3	5	5	2	3	1	2	3	4	4	1	5	1	3	4	4	4	3	4	5	3	5	3	1	3	1	1
5	3	5	5	5	5	1	4	3	5	5	1	5	1	5	5	5	5	5	5	5	5	1	1	1	1	1	1
5	1	5	5	1	5	1	1	1	4	3	1	4	1	4	5	4	4	2	4	4	4	1	1	1	1	1	1
5	1	5	5	1	5	2	1	1	5	3	1	5	1	4	2	3	4	3	4	4	2	3	1	2	4	1	1
3	1	2	4	1	3	1	3	1	1	1	1	2	1	1	1	1	1	3	1	1	1	1	1	1	1	1	2
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2	3	1	1	1	2	1	1	1	1	1	1
4	1	4	4	1	1	1	1	1	3	1	1	1	1	1	1	2											

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

APPENDIX 17

Study 6 HR and SCL raw data

Study 6 HR data											
subject	hc0	hc1	hc2	hc3	hc4	hc5	hc6	hc7	hc8	hc9	hc10
1	89.17	98.49	96.65	99.84	98.32	93.59	95.18	91.44	93.09	96.99	87.49
2	81.47	74.61	84.56	73.48	73.48	71.94	72.2	71.14	70.59	73.84	72.65
3	66.9	81.86	60.24	84.65	68.02	62.25	60.02	59.43	57.67	57.41	56.68
4	68.63	85.75	84.93	78.86	77.36	76.39	79.76	89.74	86.51	83.56	81.59
5	73.63	78.01	77.85	73.09	80.47	81.72	92.39	84.69	80.05	73.28	75.08
6	80.03	80.09	73.82	74.49	78.49	73.23	71.88	69.65	70.49	73.12	72.47
7	60.26	61.29	69.56	65.67	70.16	65.36	68.81	63.07	60.84	66.59	56.59
8	95.28	79.8	84.01	87.67	94.23	96.47	78.11	88.52	81.08	89.95	94.74
9	66.92	47.35	47.71	49.07	61.32	57.83	53.92	52.23	49.75	54.33	54.16
10	100.69	99.42	101.84	97.4	95.07	99.83	101.68	127.54	104.97	100.28	103
11	81.9	84.02	88.25	93.82	95.18	84.08	84.63	89.99	87.83	88.91	117.44
12	73.41	74.02	74.01	74.66	84.66	84.93	78.01	70.98	72.34	71.5	72.88
13	88.24	90.57	84.22	90.02	89.43	86.26	95.23	83.61	89.45	87.34	88.35
14	74.86	85.23	79.44	70.33	69.09	76.85	63.82	75.39	75.29	72.75	70.78
15	63.73	62.94	62.86	62.08	62.23	63.82	64.67	60.71	58.98	59.84	60.9
16	74.36	79.6	83.18	89.76	81.02	93.12	80.77	77.75	77.2	76.3	60.68
17	88.34	86.27	95.72	88.77	95.56	96.5	77.75	87.05	92.03	85.74	82.39
18	100.67	104.29	103.07	100.15	105.22	103.56	103.28	103.88	103.74	103.42	103.22
19	58.59	65.28	69.7	68.22	71.57	69.69	78.69	90.35	64.08	70.45	64.27
20	73.07	74.22	82.81	63.15	69.31	72.83	79.28	73.6	72.1	70.22	71.12
21	68.2	74.63	75.18	83.1	85.28	83.9	62.28	76.21	87.57	74.39	64.19
22	90.13	88.82	95.31	106.29	88.54	83.9	83.4	79.62	87.25	88.63	82.6
23	67.21	63.69	65.75	71.12	81.76	74.36	72.96	70.54	70.8	66.23	62.98
24	89.1	88.61	89.8	96.53	98.13	82.81	84.76	81.59	85.09	87.86	85.55
25	78.72	73.03	71.97	71.21	73.9	71.83	70.74	68.09	68.83	70.17	69.63
26	102.88	93.37	104.16	105.93	105.93	103.08	101.2	107.51	101.59	109.06	104.68
27	91.21	81.37	97.73	98.04	89.27	85.39	94.55	90.64	87.48	85.24	82.94
28	71.55	78.55	86.45	78.79	90.47	87.66	92.61	84.57	87.48	85.24	82.94
29	72.84	74.38	73.7	78.71	79.42	72.55	73.51	61.92	64.01	65.51	67.96
30	78.95	83.58	80.37	85.55	79.31	82.82	75.93	77.17	72.62	77.43	78.4
31	80.99	85.27	73.8	74.57	83.17	76.71	90.85	89.24	89.72	80.31	75.69
32	84.47	68.43	79.76	77.17	76.89	73.92	84.25	82.91	85.79	75.14	71.47
33	77.65	78.13	79.91	84.18	90.69	82.94	82.1	79.34	84.17	72.88	78.8
34	40.98	44.15	44.63	44.4	43.32	48.02	60.25	48.68	49.22	49.58	50.67
35	40.98	44.15	44.63	44.4	43.32	48.02	60.25	48.68	49.22	49.58	50.67
36	87.67	88.63	87.01	91.67	89.36	86.6	93.95	94.86	78.78	84.26	82.2
37	75.56	76.34	79.58	75.51	73.62	74.47	90.02	88.74	72.7	70.38	71.98
38	93.64	94.95	89.88	90.93	94.05	90.02	88.74	92.11	83.68	88.7	88.32
39	89.37	89.66	87.24	84.52	81.05	79.32	84.17	84.6	86.57	87.36	84.72
40	84.76	75.5	74.08	77.7	69.39	81.09	89.26	68.6	80.22	79.92	79.52
41	79.26	83.18	82.6	82.25	89.92	93.29	80.21	78.43	79.12	75.81	77.2
42	117.68	102.5	100.82	99.63	112.94	108.26	108.18	103.37	110.6	104.5	106.24
43	75.08	93.52	96.88	99.17	91.86	87.64	93.1	97.77	94.74	94.87	92.16
44	79.01	81.42	83.84	75.45	88.77	82.12	79.88	80.58	66.16	83.6	73.55
45	76.88	79.72	88.24	77.8	73.82	77.8	79.97	80.45	74	76.18	72.84
46	55.52	54.53	55.07	54.71	56.18	55.29	60.58	56.95	57.41	59.42	55.56
47	103.45	103.11	102.46	103.04	101.77	95.71	97.56	105.41	110.1	109.24	104.05
48	79.37	82.31	79.53	81.15	78.61	85.16	84.61	91.02	86.88	83.6	80.02
49	78.93	79.53	79.55	92.26	86.32	85.1	85.87	88.79	75.12	74.02	72.78
50	90.28	88.78	88.05	92.67	83.28	83.55	83.8	86.54	88.94	95.23	87.37

90.21	92.55	98.99	90.05	93.12	87.55	88.01	86.63	86.61	87.05	83.59	82.18	101.92	97.16	104.62	109.66	103.54	100.75	95.69	96.88	94.06	94.45	90.61	94.21	104.08	105.26
82.69	84.66	84.12	78.18	73.82	69.38	71.63	72.72	59.84	63.98	72.08	72.98	72.07	74.11	79.32	74.96	82.08	76.02	72.63	74.13	74.3	72.38	74.85	69.94	70.54	82.82
58.01	61.76	61.99	58.94	56.38	58.31	58.8	57.58	58.31	58.8	57.72	62.71	72.05	62.92	60.37	58.83	60.08	65.02	56.9	58.46	60.26	60.71	66.91	60.74	62.65	57.85
76.05	80.11	82.66	86.14	87.13	90.9	63.14	85.71	80.98	75.28	76.69	76.16	82.93	90.34	86.8	84.73	81.38	73.16	75.08	72.56	73.11	71.61	76.91	69.47	70.46	81.41
93.57	81.48	78.37	69.29	85.29	66.74	76.68	79.47	73.14	76.98	73.66	65.7	83.11	100.29	100.25	104.69	85.07	98.99	90.64	74.73	82.43	69.42	76.08	73.36	75.1	85.63
78.13	77.12	74.17	69.23	73.15	77.1	69.33	69.33	73.66	65.7	69.43	69.09	71.01	74.77	78.13	73.79	74.63	73.79	110.08	76.59	74.71	75.62	72.46	72.67	75.83	63.05
64.62	68.13	66.78	59.23	61.78	60.57	59.52	63.32	58.47	61.18	62.15	60.66	64.02	64.12	77.34	61.14	66.57	61.98	61.82	64.76	59.37	61.82	63.95	63.8	61.06	64.37
86.36	88.43	89.63	92.24	96.26	88.13	98.66	93.33	91.5	92.18	86.69	92.1	76.47	78.42	72.28	80.44	87.12	94.43	85.79	79.92	78.22	80.35	94.3	80.01	86.27	82.4
57.82	58.82	54.18	61.23	77.8	49.34	49.36	50.12	57.11	98.32	48.28	40.6	47.74	48.87	40.42	52.69	64.83	76.47	77.21	55.2	51.49	52.8	48.64	97.97	51.58	61.2
107.39	107.91	104.65	115.45	116.39	107.79	110.66	108.95	108.49	107.82	103.12	74.84	72.65	106.57	103.61	103.83	103.84	112.66	119.84	107.17	100.64	96.95	98.18	100.82	99.77	73.98
94.37	89.35	93.36	85.98	86.99	92.9	87.06	94.6	93.03	95.16	93.18	92.82	94.59	104.74	103.61	102.73	107.03	98.29	99.87	99.71	96.16	94.47	100.52	106.9	104.12	94.68
70.31	75.51	77.06	80.77	85.23	78.95	72.83	78.95	70.29	71.85	68.65	72.47	71.06	72.19	74.08	73.81	84.05	63.78	75.56	75.28	72.64	76.81	76.86	71.62	80.71	82.89
56.21	55.61	58.95	58.34	58.82	57.3	56.51	56.64	57.01	57.64	56.73	58.62	55.82	55.59	56.11	55.05	54.5	59.04	59.81	57.78	56.43	56.33	55.65	54.59	55.41	54.46
105	104.38	102.81	103.06	101.83	100.16	103.41	104.82	102.08	99.8	98.67	99.83	100.49	105.39	105.45	104.08	104.27	100.33	99.81	104.5	101.31	97.09	98.9	98.85	101.42	106.85
81.14	71.59	89.66	77.23	79.07	81.7	77.72	75.63	77.52	78.48	87.67	80.68	77.49	73.54	81.59	88.98	82.87	89.63	82.14	71.23	74.05	66.44	69.35	72.6	74.61	75.23
81.37	89.82	93.96	73.85	82.79	79.02	89.63	75.91	75.34	79.48	74.17	71.88	77.42	73.54	81.59	88.98	82.87	89.63	82.14	71.23	74.05	66.44	69.35	72.6	74.61	75.23
80.76	80.34	83.13	81.11	84.46	85.49	90.39	86.87	81.06	80.66	79.48	79.17	81.32	85.41	88.04	88.86	87.5	84.94	89.35	91.75	91.17	87.29	89.32	84.55	82.29	83.36

	hha2	hha3	hha4	hha5	hha6	hha7	hha8	hha9	hha10	hha11	hha12	hwo0	hwo1	hwo2	hwo3	hwo4	hwo5	hwo6	hwo7	hwo8	hwo9	hwo10	hwo11	hwo12	hwo	hwo	
	110.82	123.01	84.97	101.11	105.17	105.84	96.81	104.83	98.67	106.64	101.54	91.03	96.89	103.86	105.22	99.04	96.57	90.26	92.9	89.63	86.27	85.39	90.01	101.8	102.41	101.83	
79.58	84.34	86.07	81.13	79.53	78.53	80.84	78.16	78.13	79.15	75.92	75.27	83.41	78.74	73.06	77.18	73.37	80.42	69.2	77.55	71.22	73.04	68.42	71.5	65.54	77.1	84.13	
58.39	59.97	66.89	61.31	58.63	58.71	60.29	58.25	58.25	57.61	57.13	56.9	60.78	55.55	57.45	64.41	69.28	62.05	61.55	55.58	57.73	54.8	66.45	62.51	61.78	57.83	56.49	
81.09	80.78	89.86	84.05	70.17	82.34	65.7	68.33	70.85	79.85	89.43	74.83	71.03	98.31	75.63	73.03	73.03	89.46	76.15	75.53	67.6	74.86	84.28	76.51	76.18	79.12	79.6	
66.33	70.52	78.13	77.13	78.11	74.97	78.72	78.72	86.79	90.31	90.96	73.3	75.64	70.26	70.57	68.62	72.2	75.2	91.59	86.9	89.53	79.84	81.78	76.29	85.81	81.71	85.88	
74.03	71.31	68.18	71.19	73.87	70.24	69.27	72.04	72.97	75.98	70.81	72.62	70.29	73.25	73.25	68.56	67.31	68.39	69.64	69.46	68.06	68.54	68.78	69.36	69.76	67.02	69.55	
75.09	80.27	72.95	61.94	61.55	59.27	60.48	63.45	63.45	62.56	62.79	68.42	64.34	71.73	75.64	68.34	65.33	65.85	65.78	69.33	66.09	64.22	66.06	68.05	70.47	64.62	71.83	
82.79	89.61	87.09	91.09	87.98	80.67	83.84	48.34	74.53	85.04	79.99	82.56	91.63	89.17	86.35	93.37	97.22	88.49	48.57	47.51	46.51	80.58	80.7	78.95	78.8	53.86	88.16	
55.09	57.02	59.74	54.9	51.68	46.95	48.98	50.69	50.69	48.73	51.65	49.83	63.72	58.19	56.22	56.22	60.96	54.6	48.57	47.51	46.51	45.74	50.47	50.63	46.82	53.86	50.65	
100.14	93.85	96.75	96.75	102.34	105.49	98.55	99.13	99.13	87.95	101.59	101.65	100.98	102.88	97.97	100.87	98.62	123.95	104.11	98.34	98.78	98.35	99.55	104.18	109.19	104.88	108.66	
84.3	88.72	84.99	87.04	87.04	80.6	86.53	86.07	89.17	87.95	86.59	87.48	87.95	86.59	87.48	87.95	87.95	91.53	89.32	90.03	86.2	88.55	88.7	82.76	86.06	88.36	88.21	
72.85	76.43	87.52	81.57	87.78	76.62	77.3	83.85	83.85	74.92	68.43	72.65	74.25	75.5	74.23	77.58	80.06	79.99	77.38	75.52	77.44	77.44	71.57	76.06	75.45	84.72	88.58	
92.44	89.29	82.54	88.91	86.64	84.04	85.24	81.01	81.01	84.11	82.77	80.17	80.19	83.69	78.08	77.9	83.97	80.33	83.72	89.18	91.6	81.89	87.07	76.06	76.61	94.39	84.31	
77.52	69	75.01	74.09	83.37	72.3	70.32	57.66	56.29	60.26	60.26	58.82	63.18	63.71	56.17	56.06	59.96	61.64	64.95	59.9	54.83	58.67	66.88	67.17	68.19	69.53	54.29	
54.52	64.63	82.54	83.37	73.6	73.6	73.6	77.63	77.63	57.9	60.26	58.82	63.18	63.71	56.17	56.06	59.96	61.64	64.95	59.9	54.83	58.67	66.88	67.17	68.19	69.53	54.29	
81.85	75.72	79.25	80.14	78.66	78.66	78.66	77.63	77.63	79.02	79.02	78.8	79.61	78.63	83.53	80.91	78.19	82.05	80.49	78.31	80.67	81	87.78	88.15	94.37	89.23	87.35	
92.46	97.38	98.79	90.25	87.82	87.82	87.82	84.59	89.37	88.41	90.12	83.96	98.2	88.92	96.11	87.96	92.39	88.42	89.55	87.81	89	90.74	92.28	91.34	92.28	94.78	114.52	
98.86	103.32	98.68	96.51	99.61	99.61	99.61	97.23	99.07	97.23	98.39	99.48	97.29	95.85	94.55	97.95	96.36	90.95	89.45	93.45	92.06	92.28	91.34	92.28	94.78	95.12	85.43	
70.33	57.4	61.9	72.56	77.16	91.37	67.29	67.29	77.72	62.71	66.2	62.42	79.4	81.03	78.25	84.2	77.05	79.58	82.77	71.17	74.88	68.35	67.68	72.8	74.12	75.89	74.92	
86.52	78.06	70.06	71.5	78.43	73.72	75.5	78.44	74.51	74.1	73.71	74.86	66.77	68.49	87.44	73.94	73.13	73.94	74.7	79.76	72.26	69.82	67.94	68.32	71.61	71.16	68.66	
69.99	68.87	70.06	81.29	84.73	82.3	82.47	83.6	73.62	66.36	67.98	77.43	71.64	76.43	72.09	76.31	73.13	73.94	74.7	79.76	72.26	69.82	67.94	68.32	71.61	71.16	68.66	
102.73	95.68	92.15	86.67	84.73	82.3	82.47	83.6	73.62	66.36	67.98	77.43	71.64	76.43	72.09	76.31	73.13	73.94	74.7	79.76	72.26	69.82	67.94	68.32	71.61	71.16	68.66	
68.34	70	74.5	80.29	81.29	72.84	72.08	71.28	68.75	68.02	70.16	68.82	68.02	68.15	95.67	98.17	93.67	95.28	91.6	92.16	92.15	89.63	92.27	88.53	91.82	89.92	92.72	
100.98	104.93	84.15	90.73	85.99	70.84	75.69	71.28	68.75	68.02	70.16	68.82	68.02	68.15	95.67	98.17	93.67	95.28	91.6	92.16	92.15	89.63	92.27	88.53	91.82	89.92	92.72	
67.84	69.41	76.65	72.97	70.84	75.69	71.28	68.75	68.02	68.02	70.16	68.82	68.02	68.15	95.67	98.17	93.67	95.28	91.6	92.16	92.15	89.63	92.27	88.53	91.82	89.92	92.72	
106.17	105.48	108.75	112.88	109.61	104.5	100.9	90.41	102.66	101.58	101.24	102.43	105.86	106.29	108.9	104.29	101.88	95.77	93.49	96.71	106.74	101.15	99.39	101.58	102.54	105.11	107.07	
98.33	91.74	89.18	84.8	84.19	89.4	89.4	77.1	73.39	76.46	81.49	81.45	82.82	99.18	110.37	101.49	101.88	95.77	93.49	96.71	106.74	101.15	99.39	101.58	102.54	105.11	107.07	
84.06	70.72	86.91	89.89	85.27	76.54	77.1	73.39	76.46	81.49	81.45	81.45	82.82	99.18	110.37	101.49	101.88	95.77	93.49	96.71	106.74	101.15	99.39	101.58	102.54	105.11	107.07	
65.91	69.31	76.93	73.77	70.73	71.04	65.58	67.34	66.23	66.23	68.23	69.82	66.33	69.28	61.64	73.88	70.25	77.61	66.88	68.27	65.09	68.16	67.73	70.79	74.33	75.16	69.35	
79.53	71.09	74.03	69.25	72.85	74.41	70.99	70.99	76.34	70.52	72.57	66.89	66.96	76.05	75.33	80.88	80.88	74.76	74.76	68.34	75.28	79.15	88.37	67.31	65.48	77.42	74.92	
85.35	80.52	83.91	80.13	84.91	94.77	90.61	84.62	81.31	67.42	75.04	85.93	85.93	73.13	85.8	89.72	86.8	84.92	93.9	98.03	82.46	79.15	88.37	67.31	65.48	77.42	74.92	
89.45	71.81	73.15	77.2	87.66	82.67	76.53	78.92	78.92	73.96	75.34	77.34	80.38	80.85	86.83	44.74	47.69	44.99	48.79	51.65	46.08	46.16	45.61	46.6	45.53	48.17	44.6	48.2
81.61	83.14	83.15	79.06	99.38	48.58	46.93	49.15	48.21	47.39	46.67	46.19	46.19	62.73	44.74	47.69	44.99	48.79	51.65	46.08	46.16	45.61	46.6	45.53	48.17	44.6	48.2	
45.72	46.67	44.91	47.09	52.46	48.58	46.93	49.15	48.21	47.39	46.67	46.19	46.19	62.73	44.74	47.69	44.99	48.79	51.65	46.08	46.16	45.61	46.6	45.53	48.17	44.6	48.2	
79.74	83.2	78.51	78.83	87.68	96.02	91.76	75	92.5	66.02	76.33	79.26	79.26	79.32	75.01	76.79	80.16	73.98	75.34	82.68	73.71	75.66	80.23	69.92	73.29	70.46	76.26	
79.77	67.15	81.06	75.73	70.54	71.91	93.62	94.38	91.59	95.51	84.86	82.52	89.3	88.41	86.91	86.58	84.92	86.75	86.34	87.81	88.94	88.77	88.8	88.45	89.93	90.58	90.88	
85.52	87.47	96.18	99.69	91.77	93.62	94.38	91.59	95.51	95.51	84.86	82.52	89.3	88.41	86.91	86.58	84.92	86.75	86.34	87.81	88.94	88.77	88.8	88.45	89.93	90.58	90.88	
88.87	90.14	83.3	84.9	85.56	88.09	84.51	81.83	81.83	78.89	82.02	77.46	75.74	78.28	76.65	76.27	77.21	80.62	80.62	80.62	85.9	85.37	85.96	83.18	81.81	74.83	74.42	78.48
77.08	83.21	87.17	84.04	77.9	81.56	79.03	88.23	74.94	74.66	78.61	75.55	120.51	107.52	113.13	111.7	120	81.82	85.31	85.31	77.5	77.09	74.67	74.03	73.04	78.78	77.97	76.97
96.45	84.21	89.72	107.07	106.37	90.38	85.8	88.23	74.94	74.66	78.61	75.55	120.51	107.52	113.13	111.7	120	81.82	85.31	85.31	77.5	77.09	74.67	74.03	73.04	78.78	77.97	76.97
76.68	89.77	88.16	83.89	79.98	88.3	87.9	91.26	73.53	93.06	91.64	95.65	96.96	93.18	92.77	100.93	91.66	89.37	86.3	95.4	92.2	96.16	94.44	88.31	94.38	83.38	76.61	86.09
72.88	70.12	85.07	79.22	81.29	84.28	94.91	73.53	67.75	69.44	65.89	81.25	96.96	93.18	92.77	100.93	91.66	89.37	86.3	95.4	92.2	96.16	94.44	88.31	94.38	83.38	76.61	86.09
83.79	83.79	79.73	77.97	74.54	77.97	69.1	77.99	70.86	72.83	68.91	76.81	75.71	80.8	87.7	81.8	73.99	71.99	68.32	70.71	69.89	74.68	71.57	77.61	65.78	78.32	64.41	79.6
54.87	56.04	55.84	61.7	56.94	59.77	56.11	55.52	53.74	53.33	53.75	55.52	54.15	55.76	55.62	56.79	55.31	58.85	62.2	56.19	57.28	58.05	55.7	54.8	55.97	59.21	55.59	58
101.83	108.81	106.46	103.95	104.7																							

	h1u3	h1u4	h1u5	h1u6	h1u7	h1u8	h1u9	h1u10	h1u11	h1u12	hex0	hex1	hex2	hex3	hex4	hex5	hex6	hex7	hex8	hex9	hex10	hex11	hex12
	117.7	101.06	107.12	88.07	92.61	99.74	92.84	96.5	92.15	99.68	80.8	93.82	98.75	106.5	101.36	94.94	89.93	92.76	89.83	93.12	82.16	81.34	86.31
	76.22	74.17	77.03	77.92	76	75.61	77.72	76.39	75.87	77.39	84.46	79.27	87.66	74.19	69.07	68.48	69.17	74.42	73.78	74.62	72.13	72.16	70.7
	59.23	58.27	56.38	55.7	56.1	55.92	58.68	58.5	64.13	56.54	58.49	61.24	57.99	63.91	67.53	60.32	60.13	67.69	65.16	64.98	58.8	59.08	58.67
	80.43	83.21	76.43	77.88	78.34	79.39	80.08	80.57	81.89	78.96	67.67	83.35	86.69	78.01	79.28	89.53	70.43	81.52	79.38	77.43	77.78	77.43	77.57
	74.73	87.34	78.6	77.84	76.74	72.44	73.86	73.04	71.76	72.92	75.83	73.34	76.65	73.44	74.85	80.75	87.69	80.88	77.6	75.12	73.3	73.96	75.55
	68.91	70.86	70.72	67.97	72.84	66.15	65.25	68.77	67.27	68.49	77.34	67	63.97	68.05	73.39	68.52	74.66	71.48	71.6	67.82	69.98	67.2	69.48
	68.68	66.67	67.25	60.86	62.9	62.05	62.15	61.22	65.62	59.94	62.54	67.67	62.79	63.62	65.09	66.67	64.91	67.36	60.05	59.52	61.74	59.65	
	89.74	84.89	80.68	79.01	85.41	91.53	89.19	87.03	85.79	79.73	87.19	84.91	88.06	81.12	92.89	98.41	95.03	79.6	83.35	73.67	86.13	84.13	87.65
	50.24	67.11	55.02	52.98	48.97	48.26	49.34	49.29	50.95	50.12	54.17	51.32	51.37	52.43	63.95	60.18	102.3	46.56	102.81	49.34	47.92	49.52	
	94.61	90.36	93.69	102.05	97.66	96.01	97.72	97.37	96.21	97.68	103.31	98.35	100.16	95.44	122.42	97.86	100.09	98.24	102.3	101.41	103.92	105.66	
	88.95	88.71	89.69	87.19	89.1	90.43	90.6	88.21	90.94	87.79	78.91	82.64	90.16	99.92	98.72	94.6	97.11	87	86.51	85.2	89.72	93.74	
	87.65	82.09	82.09	79.58	88.85	77.41	72.95	74.85	74.86	73.72	78.91	82.64	92.34	92.3	87.38	77.43	73.5	74.29	75.11	73.09	73.66	74.96	
	89.88	89.27	97.92	90.99	85.45	88.31	88.07	91.42	89.6	90.21	93.84	76.96	81.14	74.93	67.84	92.74	98.47	90.8	93.14	93.15	92.86	92.32	
	67.04	67.84	79.25	74.52	71.01	72.53	65.22	67.24	67.42	68.82	75.17	76.96	81.14	74.93	60.87	69.31	80.46	72.87	72.09	66.35	69.58	69.34	
	55	56.3	63.84	63.32	60.74	61.26	60.94	58.93	62.01	63.18	61.46	60.64	60.58	59.88	60.87	63.01	62.31	59.92	60.28	58.65	60.11	59.55	
	92.94	85.54	85.45	84.95	80.44	82.17	82.84	82.78	82.24	83.27	78.98	72.38	73.39	73.98	74.26	77.29	80.22	75.34	81.06	84.41	80.19	78.5	
	86.68	83.86	86.86	86.55	88.66	88.66	86.16	88.11	84.44	85	91.83	90.28	100.21	93.25	91.25	84.28	87.2	86.17	80.59	78.53	81.96	86.14	
	97.31	90.03	91.18	86.17	90.95	89.75	91.04	89.5	90.34	90.19	97.16	97.08	94.4	100.45	94.68	96.15	94.45	92.77	93	94.24	93.53	94.92	
	61.87	67.08	63.27	76.36	69.24	87.95	76.9	89.5	65.37	73.97	92.67	97.25	84.46	72.25	67.4	70.84	78.4	81.6	77.88	75.66	77.17	70.05	
	76.53	66.87	67.77	67.23	69.4	70.62	70.22	72.17	72.17	69.98	72.33	81.95	81.05	76.56	78.61	82.59	76.65	75.24	76.09	76.05	74.98	77.61	
	76.76	79.25	70.85	65.75	75.57	82.15	79.57	81.62	73.01	73.75	79.79	74.64	76.66	86.75	87.89	74.29	78.94	75.55	77.28	79	78.2	90.97	
	88.75	81.62	88.97	79.19	76.05	81.04	85.58	78.28	78.04	77.45	76.99	78.64	76.42	74.59	77.31	74.85	73.05	73.14	70.49	68.11	71.09	71.23	
	66.65	69.53	71.74	73.26	76.05	75.03	69.5	65.63	77.64	72.45	76.99	77.42	78.64	110.55	104.25	92.67	94.77	94.31	94.04	94.53	92.99	94.27	
	101.48	97.17	86.5	86.36	85.25	86.13	87.82	82.96	85.77	86.23	71.13	71.94	72.2	76.78	82.81	80.22	70.85	73.77	70.79	68.54	69.26	69.22	
	70.63	77.28	69.1	68.28	67.45	64.67	64.43	65.27	67.07	63.52	101.25	101.98	107.45	75.63	78.48	105.66	108.46	103.66	110.84	107.86	108.1	103.59	
	106.52	95.9	98.84	97.86	104.63	102.21	101.33	101.25	101.98	102.13	107.04	85.38	85.02	82.5	76.48	78.01	91.88	90.6	82.46	66.16	73.95	74.73	
	92.38	91.4	86.67	97.96	96.3	105.4	96.94	100.28	123.27	97.5	85.73	80.48	74.48	82.5	87.39	67.95	89.86	73.75	83.84	63.87	76.55	72.38	
	87.05	88.12	92.81	97.18	67	74.81	78.5	80.15	82.69	68.85	81.79	69.27	66.49	67.95	71.53	66.46	64.17	58.02	63.24	64.89	69.18	67.14	
	68.37	74.99	65.54	61.59	63.2	64.38	66.35	69.66	75.52	74.25	73.68	71.66	77.78	75.87	70.5	75.33	72.18	72.14	74.9	73.49	73.3	73.79	
	77.72	77.28	74.2	86.24	91.24	87.31	90.2	68.9	64.99	88.35	82.6	86.69	75.73	78.68	82.04	87.04	95.83	76.26	85.37	66.71	68.68	88.66	
	81.3	83.7	74.2	86.24	91.24	87.31	90.2	68.9	64.99	88.35	82.6	86.69	75.73	78.68	82.04	87.04	95.83	76.26	85.37	66.71	68.68	88.66	
	77.28	74.47	75.59	89.59	82.97	77.35	78.17	68.92	73.75	76.67	78.24	78.06	73.08	71.32	78.77	78.03	89.91	82.65	80.48	77.04	74.52	77.68	
	45.11	47.14	48.7	48.99	45.29	46.38	42.36	47.5	46.83	44.73	49.41	44.87	47.46	45.66	48.97	48.08	52.23	46.34	44.8	43.26	46.95	48.76	
	45.11	47.14	48.7	48.99	45.29	46.38	42.36	47.5	46.83	44.73	49.41	44.87	47.46	45.66	48.97	48.08	52.23	46.34	44.8	43.26	46.95	48.76	
	80.85	82	77.18	89.03	84.77	79.37	80.32	75.83	73.12	75.31	86.12	93.06	94.58	93.67	92.4	98.48	100.38	97.3	96.07	90.49	82.2	86.83	
	77.63	79.86	73.01	81.74	72.15	80.91	85.36	73.84	74.29	74.56	75.89	81.58	77.38	69.35	80.89	61.98	68.11	65.8	67.12	70.49	66.41	70.6	
	90.59	100.97	92.7	91.46	91.67	90.39	88.32	88.34	94.23	88.04	80.31	90.9	96.6	93.85	93.42	95.59	87.93	87.64	87.88	90.69	86.12	85.88	
	78.63	89.04	78.55	79.02	75.03	76.81	78.37	82.57	83.17	83.19	91.79	92.88	102.57	102.69	101.84	93.61	98.09	89.93	89.22	87.03	85.66	87.62	
	77.88	89.96	83.56	73.89	73.43	78.48	72.28	77.51	74.11	75.72	92.11	93.11	76.32	76.95	76.13	73.29	88.92	86.45	81.93	81.22	79.24	80.22	
	98.78	115	111.74	101.66	108.19	102.35	104.18	106.59	107.74	98.94	106.55	116.52	94.19	105.88	108.27	108.2	100.44	101.04	101.56	98	100.34	99.03	
	80.9	83.19	77.18	85.86	91.88	89.51	90.63	79.73	82.35	82.68	104.31	101.11	100.43	91.74	102.67	93.48	97.01	89.54	93.86	93.24	94.87	95.15	
	98.14	100.24	86.57	81.74	71.11	73	74.86	77.66	73.21	76.03	81.4	72.82	68.59	73.39	78.99	78.74	75.72	74.57	78.96	74.81	76.78	74.66	
	79.3	69.27	68.15	69.19	67.44	68.47	70.52	71.47	70.75	71.24	78.02	74.82	68.39	81.77	70.3	71.3	70.33	72.61	69.33	71.3	74.06	69.43	
	56.5	56.36	60.92	58.52	58.26	57.21	56.5	55.81	55.35	56.67	56.73	57.45	55.9	56.44	57.84	57.37	55.82	54.8	55.38	54.8	55.38	55.93	
	103.74	104.29	104.01	102.48	102.53	101.36	99.6	95.86	100.24	100.13	104.9	123.06	103.53	101.29	102.12	104.58	103.53	107.58	106.93	98.77	96.7	96.51	
	77.66	80.77	77.49	84.74	70.51	77.44	77.48	68.01	64.81	68.41	87.1	86.36	73.41	71.96	78.38	77.88	84.17	70.61	75.23	75.23	67.53	65.13	
	85.17	82.04	81.38	78.72	78.86	80.84	81.74	81.12	77.56	76.45	86.19	80.76	82.24	80.86	80.42	82.8	82.48	80.99	83.02	79.26	82.88	81.17	

Appendix 17
Study 6 SCL data

subject	sC0	sC1	sC2	sC3	sC4	sC5	sC6	sC7	sC8	sC9	sC10	sC11	sC12	sN0	sN1	sN2	sN3	sN4	sN5	sN6	sN7	sN8	sN9	sN10	sN11	sN12
1	10.53	10.51	10.59	10.57	10.53	10.51	10.48	10.46	10.44	10.42	10.4	10.38	10.36	10.38	10.43	10.54	10.52	10.41	10.34	10.3	10.3	10.28	10.26	10.24	10.22	10.2
2	8.2	8.34	8.39	8.64	8.38	8.27	8.17	8.11	8.15	8.08	8.01	7.89	7.89	8.29	8.36	8.39	9.63	9.61	9.32	9.51	9.47	9.19	9.07	8.97	8.91	8.84
3	8.52	8.5	8.51	8.57	8.72	8.87	8.98	8.67	8.87	8.8	8.67	8.63	8.06	8.04	7.93	8.05	8.23	8.23	8.12	7.99	7.92	7.91	7.92	7.91	7.91	7.91
4	8.46	8.67	8.54	8.37	8.24	8.15	8.14	8.26	8.21	8.15	8.11	8.03	8	9.41	9.45	11.84	11.05	10.61	10.03	9.79	9.55	9.4	9.18	9.17	9.11	9.06
5	6.39	6.31	6.26	6.27	6.27	6.8	8.02	8.1	7.66	7.46	7.29	7.15	7.04	4.71	4.66	4.58	4.51	4.45	4.43	4.6	4.61	4.58	4.58	4.48	4.42	4.38
6	5.91	6.59	5.38	5.21	5.08	5.48	5.34	5.16	5.03	5	4.88	4.79	4.69	5.39	5.33	5.16	5.06	5.18	5.82	5.86	6.02	5.69	5.47	5.31	5.18	5.06
7	8.49	8.44	8.88	8.83	9.01	9.1	8.79	8.87	8.66	8.33	8.45	8.4	8.36	8.16	8.1	8.37	8.36	8.24	8.35	8.35	8.18	8.08	8.02	7.97	8.17	8.24
8	7.3	7.05	6.93	6.52	7.53	7.96	7.23	6.66	6.7	6.46	6.74	6.96	6.47	5.23	5.35	5.64	5.74	5.69	5.91	5.76	5.59	5.53	5.48	5.39	5.43	5.97
9	8.15	8.14	8.17	8.23	8.19	8.68	8.66	8.43	8.33	8.24	8.17	8.11	8.09	8.58	8.23	8.82	8.9	9.01	8.97	8.92	8.74	8.7	8.68	8.69	8.66	8.66
10	11.61	11.76	11.73	11.66	11.19	11.82	11.71	11.85	11.59	11.43	11.42	11.5	11.45	12.45	12.43	13.82	13.37	12.82	12.85	12.53	12.64	12.66	12.4	12.14	12.12	12.02
11	8.45	8.31	8.22	8.66	9.86	8.98	8.66	8.46	8.31	8.14	7.96	8.71	8.45	7.8	7.66	8.08	8.32	8.04	8.09	7.91	7.78	7.69	7.82	7.61	7.57	7.57
12	6.44	6.4	6.37	6.47	7.45	7.25	7.03	6.89	6.8	6.74	6.68	6.64	6.59	6.44	6.38	6.34	6.42	7.04	6.89	6.76	6.67	6.6	6.59	6.54	6.49	6.43
13	12.14	12.07	12.31	12.27	15.39	14.88	13.82	14.63	13.78	13.3	13.03	12.82	12.72	12.5	13.24	12.81	12.65	13.53	13.34	13.94	13.43	13.05	12.63	12.32	12.08	12.34
14	11.61	11.98	11.74	11.49	11.43	11.96	12.76	12.01	11.7	11.57	11.47	11.38	11.31	13.11	12.92	12.61	12.51	12.77	14.12	13.6	13.2	12.85	12.77	12.64	12.68	12.44
15	6.94	6.9	6.86	6.82	6.79	7.4	8.32	7.65	7.43	7.3	7.22	7.15	7.13	8.19	8.28	8.04	7.94	7.97	9.1	9.31	8.65	8.35	8.17	8.06	7.98	7.92
16	8.7	8.51	8.41	8.34	8.32	8.32	8.23	8.17	8.12	8.08	8.03	7.98	7.93	8.95	8.8	8.74	8.66	8.61	8.74	8.67	8.62	8.57	8.53	8.49	8.47	8.46
17	11.75	11.68	12.13	12.59	12.57	12.08	11.73	11.56	11.79	11.82	11.63	11.51	11.35	12.85	11.89	12.47	11.87	11.61	11.4	11.27	11.2	11.13	11.07	10.99	10.92	10.86
18	7.02	7.43	7	7.12	7.43	7.07	6.86	6.93	6.91	6.93	6.88	6.86	6.87	6.9	6.94	6.83	7.25	7.55	7.12	6.94	6.84	6.88	6.89	6.88	6.92	6.9
19	9.24	9.21	9.18	9.19	9.18	9.25	9.28	9.28	9.26	9.24	9.22	9.26	9.24	9.25	9.19	9.18	9.17	9.15	9.18	9.2	9.28	9.23	9.19	9.16	9.15	9.16
20	11.8	13.54	14.18	13.25	12.47	12.07	12.09	11.86	12.02	11.79	11.71	11.84	11.72	12.18	12.93	14.61	14.1	13.29	12.66	12.34	12.49	12.34	12.27	12.17	12.14	12.34
21	8.31	9.02	8.88	8.63	8.68	8.62	8.51	8.61	8.71	8.61	8.52	8.46	8.41	8.48	8.71	8.47	8.34	8.48	8.77	8.78	8.79	8.71	8.53	8.4	8.32	8.26
22	7.38	7.43	7.46	7.52	7.51	7.41	7.32	7.28	7.22	7.18	7.15	7.13	7.09	7.15	7.19	7.12	7.1	7.08	7.02	6.97	6.93	6.9	6.89	6.87	6.86	6.84
23	8.38	8.3	8.23	8.23	8.67	8.71	8.51	8.23	8.41	8.33	8.27	8.23	8.19	9	8.87	8.78	8.93	9.32	9.6	9.25	9.11	9.01	8.94	8.94	8.87	8.82
24	7.79	7.8	8.08	9.26	9.03	8.67	8.58	8.44	8.4	8.16	8.14	8.1	7.96	6.47	7.42	7.45	7.15	6.99	6.82	6.75	6.69	6.64	6.61	6.6	6.59	6.57
25	9.03	9.05	9.05	9.07	9.06	9.07	9.02	8.99	8.97	8.97	8.96	8.97	8.99	8.73	8.71	8.66	8.78	8.78	8.84	8.86	8.73	8.68	8.64	8.69	8.67	8.64
26	6.73	6.69	6.87	6.83	6.75	6.67	6.63	6.62	6.57	6.54	6.51	6.48	6.46	6.39	6.39	6.76	6.65	6.55	6.78	6.64	6.57	6.52	6.49	6.46	6.43	6.42
27	9.38	9.27	9.52	9.55	9.42	9.29	9.21	9.17	9.15	9.12	9.1	9.08	9.07	10.1	9.92	10.27	10.23	10.08	9.87	9.82	9.77	9.7	9.64	9.61	9.3	9.74
28	13.54	13.36	13.46	13.07	13.89	14.05	13.12	12.71	12.81	13	12.76	12.48	12.86	11.99	11.72	11.69	11.8	13.57	13.1	12.75	13.74	12.68	12.25	12.96	12.85	12.69
29	5.37	5.36	5.34	5.63	5.63	5.84	5.57	5.47	5.42	5.38	5.36	5.34	5.31	5.59	5.56	5.56	5.54	5.81	6.64	6.16	6.36	5.79	5.55	5.61	5.55	5.61
30	4.74	4.71	4.82	5.23	5.01	4.9	4.84	4.8	4.73	4.7	4.67	4.64	4.6	4.3	4.33	4.8	4.82	4.89	4.82	4.73	4.69	4.64	4.6	4.56	4.53	4.5
31	9.85	9.84	9.98	9.84	9.66	9.69	10.85	10.16	9.9	9.66	9.48	9.35	9.4	8.34	8.33	8.31	8.42	8.69	9.11	8.99	8.98	8.98	8.65	8.5	8.41	8.34
32	6.77	6.72	6.72	7.51	7.59	7.39	7.46	7.31	7.16	7.04	6.94	6.87	6.8	7.52	7.39	7.29	7.22	7.24	7.31	7.31	7.36	7.71	7.51	7.38	7.27	7.2
33	5.66	5.53	5.51	5.66	5.84	5.77	5.75	5.77	5.76	5.71	5.68	5.64	5.61	6.05	6.05	6.2	6.25	6.27	6.2	6.33	6.55	6.57	6.49	6.42	6.37	6.33
34	4.04	4	3.97	3.84	3.91	3.88	4.5	4.86	4.91	4.84	4.96	4.98	4.99	4.2	4.16	4.12	4.08	4.04	4	4.06	4.1	4.07	4.05	4.03	4	3.97
35	5.99	5.98	5.98	5.87	5.79	5.73	5.81	5.93	5.81	5.86	5.81	5.77	5.73	5.85	6.13	6.33	6.53	6.28	6.17	6.36	6.54	6.33	6.28	6.2	6.12	6.07
36	5.92	5.92	6.46	6.62	6.53	7.36	7.13	6.73	6.76	6.53	6.38	6.28	6.32	8.46	8.65	8.4	8.21	8.27	8.15	9.02	9.46	8.82	8.73	8.45	8.27	8.16
37	10.38	10.09	10.03	10.87	10.9	10.53	10.25	10.26	10.08	9.98	13.64	13.53	13.45	13.33	13.26	13.3	13.68	14.35	14.07	13.98	13.78	13.64	13.54	14.06	15.09	15.43
38	15.72	14.49	14.73	15.81	14.58	14.27	13.98	14.02	13.98	13.75	13.59	13.5	13.41	14.58	13.76	13.81	15.7	14.18	13.35	13.05	12.91	12.82	12.77	12.74	12.81	12.69
39	3.49	3.65	3.56	3.5	3.47	3.43	3.42	3.42	3.53	3.48	3.43	3.4	3.4	3.71	3.63	3.58	3.54	3.54	3.53	3.61	3.72	3.64	3.58	3.54	3.52	3.59
40	8.98	9.47	9.05	8.86	9.23	9.55	10.22	9.62	9.22	9.03	8.91	8.9	9.29	13.08	12.13	11.37	12.14	13.05	13.16	12.86	11.52	11.17	11.35	10.98	10.86	10.78
41	6.37	6.59	6.86	7.66	7.33	7.02	6.81	6.66	6.57	6.5	6.46	6.44	6.44	7.05	6.98	6.89	6.85	7.68	7.39	7.21	7.21	7.09	7	6.93	6.87	6.83
42	5.26	4.68	4.79	5.02	5.43	5.58	5.3	5	4.8	5.19	5	4.76	4.49	5.22	5.15	5.41	5.3	6.01	5.61	5.11	4.88	4.72	4.9	4.97	4.75	4.62
43	5.91	5.92	6.13	6.06	6.04	6.19	6.16	6.09	6.04	6.01	5.97	5.93	5.89	5.44	5.4	5.36	5.32	5.33	5.58	5.56	5.51	5.47	5.44	5.42	5.39	5.35
44	13.44	13.38	13.61	13.61	14.22	13.94	13.92	13.68	13.87	13.64	13.53	13.45	13.41	13.33	13.26	13.3	13.68	14.35	14.07	13.98	13.78	13.64	13.54	14.06	15.09	15.43
45	10.66	10.7	10.71	10.72	10.71	10.69	10.68	10.71	10.75	10.78	10.78	10.85	10.83	8.99	8.96	8.92	8.89	8.84	8.8	8.77	8.74	8.7	8.66	8.64	8.62	8.6
46	8.17	7.96	7.88	7.78	7.7	8.31	8.74	8.35	8.03	7.87	7.76	7.68	7.61	7.5	7.42	7.42	7.41	7.41	8.09	8.71	8.35	7.96	7.75	7.64	7.53	7.44
47	3.77	3.78	3.78	3.76	3.78	3.79	3.77	3.79	3.78	3.77	3.76	3.74	3.73	3.76	3.76	3.75	3.75	3.75	3.76	3.81	4.18	4.22	4.11	4.04	3.99	3.97
48	4.38	3.9	3.7	3.56	4.06	4.67	4.48	4.68	4.75	4.41	4.65	4.37	4.1	9.58	10.29	9.25	9.47	10.55	9.75	10.23	9.36	9.52	10.49	10.49	9.53	9.37
49	12.14	12.05	12	12.1	12.15	12.13	12.59	12.6	12.41	12.26	12.16	12.11	12.09	12.51	12.5	12.4	12.38	12.33	12.3	12.						

SW0	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11	SW12	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S10	S11	S12	S60
10.02	10.23	10.71	10.4	10.2	10.13	10.1	10.08	10.05	10.11	10.47	10.1	10.04	10.36	10.35	10.46	10.51	10.49	10.44	10.41	10.38	10.37	10.34	10.33	10.31	10.3	10.41
7.8	7.81	8.03	9.55	9.38	9.1	8.91	8.81	8.61	8.49	8.4	8.3	8.19	8.22	8.18	8.08	8.85	8.73	8.52	8.36	8.21	8.13	8.04	7.95	7.86	7.77	8.14
8.11	8.05	8.01	8.06	8.14	8.11	8.05	8.05	8.06	8.02	8.01	7.98	7.99	9.02	9.1	8.99	9.11	9.16	9.19	9.11	8.97	8.88	8.83	8.76	8.72	8.7	8.26
9.38	9.81	10.1	9.82	9.57	9.36	9.2	9.06	8.96	8.86	8.77	8.69	8.63	10.44	10.74	10.42	10.76	10.13	9.82	9.6	9.49	9.38	9.24	9.11	9.01	8.92	10.21
4.41	4.46	4.58	4.63	4.6	4.72	5.36	5.18	5.06	5.02	4.99	4.97	4.94	5.61	5.54	5.48	5.42	5.37	5.34	5.5	5.67	5.57	5.5	5.45	5.41	5.38	3.93
4.73	4.92	6.2	5.7	5.53	7.04	6.78	6.23	5.92	5.67	5.49	5.32	5.22	2.21	2.23	2.22	2.21	2.2	2.22	2.22	2.21	2.2	2.19	2.18	2.17	3.42	
8.19	8.23	8.6	8.48	8.29	8.17	8.08	8.04	8.02	8	7.99	7.97	7.96	8.14	8.2	8.06	8.71	8.39	8.2	8.09	8.04	8	7.98	8	7.97	8.04	
5.23	5.15	5.12	5.1	5.16	5.45	5.77	5.78	5.59	5.55	5.44	5.34	5.27	5.16	5.22	5.34	5.34	5.45	5.87	5.76	5.55	5.42	5.33	5.25	5.19	5.81	
8.12	8.1	8.06	8.04	8.25	9.4	9.58	8.95	8.7	8.58	8.5	8.47	8.43	8.65	8.6	8.52	8.58	8.9	9.34	8.94	8.72	8.63	8.6	8.56	8.55	8.5	
10.9	10.88	10.88	10.55	10.34	10.8	10.7	10.54	10.36	10.36	10.2	10.07	9.97	12.19	12.31	12.25	12.21	13.0	12.43	12.55	12.44	12.06	12.09	11.87	11.79	11.69	10.76
7.81	7.73	7.74	8.11	9.38	8.78	8.54	8.37	8.23	8.12	8.03	7.97	7.89	7.95	7.89	7.84	8.64	10	9.21	9.79	9.25	9.07	8.86	8.76	8.64	8.53	8.44
5.96	5.98	6	6.61	7.74	7.38	7.06	6.84	6.7	6.63	6.55	6.5	6.44	6.76	6.67	6.64	6.79	7.33	7.26	7.07	6.95	6.88	6.83	6.78	6.73	6.69	
12.72	12.67	13.01	12.83	13.82	14.76	14.3	13.64	13.25	13	12.84	12.71	12.59	11.42	11.32	11.25	11.17	10.74	15.25	14.55	14.24	13.99	13.15	12.66	12.33	12.09	
10.39	10.31	10.28	10.28	10.33	11.31	11.22	10.48	10.48	10.36	10.3	10.26	10.23	11.45	10.99	10.95	10.8	10.74	11.8	11.65	11.31	11.29	11.44	11.08	11	10.81	
6.51	6.44	6.38	6.34	6.3	6.75	6.78	6.53	6.41	6.34	6.28	6.23	6.18	10.61	9.4	8.89	8.45	8.5	10.42	9.81	9.09	8.76	8.56	8.41	8.3	8.3	
10.15	9.97	9.83	9.74	9.9	10.72	10.36	10.18	9.99	9.87	9.77	9.7	9.61	9.67	9.57	9.49	9.49	9.4	10.14	10.22	9.94	9.79	9.68	9.6	9.52	9.46	8.26
11.42	11.5	12.11	11.79	11.43	11.22	11.07	11.01	10.92	10.82	10.74	10.93	11.03	11.99	11.51	12.34	12.13	11.67	11.52	11.34	11.23	11.18	11.08	10.98	10.92	10.83	10.75
6.74	6.71	6.82	6.67	7.32	7	6.87	6.74	6.67	6.65	6.62	6.61	6.66	7.01	6.94	6.95	7.42	7.22	7.22	7.04	6.96	6.91	6.86	6.85	6.82	6.86	7.15
9.86	9.86	9.82	9.79	9.75	9.76	9.8	9.78	9.73	9.76	9.73	9.72	9.71	9.61	9.63	9.57	9.54	9.52	9.53	9.64	9.62	9.58	9.53	9.51	9.5	9.5	10.05
13.13	13.18	13.98	13.46	12.62	12.39	11.91	11.57	11.31	11.22	11.25	11.11	11.26	12.25	12.26	13.79	13.59	12.61	12.2	12.29	12	11.89	11.82	11.69	11.65	11.64	11.93
8.44	8.36	8.34	8.3	8.28	8.26	8.39	8.76	8.99	8.67	8.48	8.39	8.32	8.17	8.27	8.2	8.2	8.48	8.55	8.43	8.69	8.66	8.35	8.19	8.03	7.94	8.6
7.03	6.98	7.22	7.55	7.37	7.14	6.98	6.94	6.89	6.84	6.81	6.78	6.78	7.3	7.37	7.31	7.24	7.18	7.14	7.1	7.07	7.07	7.2	7.41	7.41	7.33	6.95
9.07	9.51	9.2	9.07	9.72	9.9	9.62	9.52	9.57	9.29	9.24	9.2	9.16	8.32	8.22	8.15	8.1	8.29	8.66	8.53	8.37	8.48	8.4	8.29	8.22	8.16	7.63
7.64	7.74	7.88	8.52	8.33	8.19	8.18	7.75	7.67	7.62	7.57	7.53	7.5	8.86	9.05	9.02	9.11	9.14	9.09	9.06	8.23	8.12	8.04	7.96	7.89	7.82	7.78
8.02	7.9	7.88	8.21	8.28	8.19	8.11	8.18	8.46	8.31	8.19	8.15	8.17	9.08	9.05	9.08	9.02	9.14	9.09	9.06	9.03	9	8.97	8.95	8.93	9.14	8.93
6.96	6.84	6.93	6.83	6.69	6.65	6.63	6.54	6.5	6.46	6.42	6.4	6.37	7.07	7.04	7.54	7.66	7.49	7.36	7.23	7.15	7.09	7.04	7.04	7	6.97	6.95
10.1	10.05	10.02	9.99	10	9.99	9.96	10	10.17	10.1	10.02	10.02	10.21	9.4	9.36	9.52	9.69	9.66	9.55	9.53	9.47	9.41	9.37	9.38	9.47	9.51	9.44
12.56	12.51	12.62	12.37	13.85	13.02	12.49	12.31	12.28	12.16	12.02	11.91	12.12	13.25	13.59	12.75	12.47	13.3	12.96	12.57	12.33	12.19	12.07	11.98	12.12	12.15	13.86
5.54	5.52	5.5	5.49	5.55	5.52	5.48	5.46	5.46	5.45	5.44	5.44	5.44	6.09	5.99	5.92	5.84	6.08	5.99	5.95	5.95	5.9	5.84	5.78	5.75	5.71	6.48
4.13	4.1	4.09	4.16	4.14	4.1	4.08	4.06	4.05	4.03	4.01	4	3.98	4.76	4.7	4.82	5.41	5.09	4.99	4.89	4.8	4.74	4.7	4.66	4.65	4.55	4.72
8.49	8.57	8.46	8.41	8.62	8.59	8.59	8.59	8.59	8.59	9.26	9.05	8.93	9.61	12.55	11.8	11.62	11.18	10.98	12.59	11.77	10.99	10.54	10.31	10.02	9.79	9.43
7.36	7.31	7.22	7.15	7.1	7.05	7.81	8.14	7.78	7.59	7.48	7.34	7.25	7	6.99	7.11	6.99	6.92	7.3	7.4	7.36	7.2	7.1	7.05	6.98	6.91	7.47
6.58	6.55	6.57	7.34	7.34	7.24	7.75	7.95	7.69	7.57	7.48	7.43	7.39	6.2	6.13	6.09	6.05	6.02	6.03	6.06	6.13	6.11	6.04	5.99	5.96	5.94	4.97
3.41	3.39	3.36	3.34	3.3	3.28	3.25	3.23	3.2	3.18	3.15	3.12	3.1	2.91	2.9	2.88	2.86	2.85	2.83	2.81	2.81	2.78	2.77	2.75	2.74	2.72	2.62
6.24	6.78	6.39	6.2	6.06	5.94	6.8	6.87	7.05	6.69	6.42	6.21	6.09	5.35	5.32	5.3	5.27	5.28	5.29	5.5	5.99	5.85	5.77	5.7	5.65	5.6	5.62
8.32	8.71	9.03	8.81	8.68	8.49	8.66	8.98	8.7	8.48	8.36	8.28	8.2	8.73	8.33	8.44	9.15	8.96	8.52	9.24	9.52	8.97	8.8	9.23	8.66	8.45	6.84
15.4	14.21	15.25	15.8	14.32	13.83	13.61	13.44	13.31	13.27	13.18	13.1	13.08	15.44	14.61	14.7	14.7	14.08	13.71	13.52	13.4	13.49	13.57	13.41	13.34	13.35	13.93
4.01	3.93	3.87	3.82	3.94	3.94	3.96	3.94	3.87	3.82	3.78	3.76	3.95	3.69	3.69	3.88	3.88	3.78	3.72	3.82	3.78	3.72	3.68	3.65	3.62	3.61	4.59
13.19	13.04	12.36	12.02	11.27	11.99	11.47	11.49	11.25	10.91	10.94	10.63	11.41	10.36	10.19	10.18	10.63	12.51	14.75	13.94	12.37	11.54	11.45	11.61	11.14	10.98	10.43
6.87	6.82	6.79	7.18	7.76	7.41	7.22	7.1	7.16	7.02	6.94	6.87	6.8	7.35	7.19	6.96	7.05	7.27	7.01	6.9	6.81	6.75	6.71	6.67	6.64	6.62	6.9
5.47	5.55	5.59	5.94	7.08	6.17	5.88	5.73	5.6	5.47	5.2	5.69	5.23	2.28	2.19	2.36	2.42	2.71	2.79	2.46	2.32	2.25	2.2	2.14	2.16	2.1	3.2
5.4	5.42	5.41	5.34	5.33	5.49	5.54	5.48	5.46	5.44	5.41	5.38	5.34	5.55	5.5	5.46	5.53	5.47	5.45	5.35	5.67	5.94	5.85	5.79	5.74	5.71	6.49
14.01	13.96	14.39	14.65	14.8	14.85	14.52	14.31	14.18	14.07	13.97	13.88	13.95	14.06	14.21	14.4	15.22	15.24	15.71	15.4	15.14	15.28	14.96	14.81	14.83	14.62	14.42
9.75	9.33	9.85	10.13	10.11	9.97	9.88	9.8	9.72	9.67	10.02	10.13	13.95	11.22	11.28	11.63	12.06	11.84	11.73	11.65	11.59	11.59	11.55	11.5	11.44	11.39	10.83
7.64	7.51	7.38	7.31	7.26	8.13	8.56	8.03	7.69	7.53	7.42	7.33	7.25	8.17	8.1	8.04	8.08	7.99	8.73	9.47	8.73	8.47	8.31	8.2	8.11	8.04	8.82
2.94	2.94	2.93	2.92	2.9	2.9	3.24	3.22	3.22	3.24	3.1	3.08	3.05	3.97	3.94	3.93	3.99	3.95	3.92	3.93	3.94	3.99	3.94	3.91	3.9	3.89	3.72
8.89	9.08	9.43	8.56	10.41	11.12	10.27	10.13	9.64	10.28	10.61	11.26	10.5	4.53	5.4	5.59	5.01	5.21	4.87	5.19	6.08	5.19	5.01	4.84	4.84	5.14	5.48
12.82	12.81	12.61	12.85	13.31	13.12	12.89	12.77	12.55	12.58	12.55	12.56	12.52	12.57	12.52	13.07	13.03	12.67	12.5	13.21	13.16	12.81	12.59	12.45	12.4	12.38	12.36
8.07	8.05	8.03	8	8.21	8.18	8.12	8.55	9.17	9.03	8.66	8.39	8.27	8.18	8.14	8.16	8.16	8.45	8.96								

	se1	se2	se3	se4	se5	se6	se7	se8	se9	se10	se11	se12	sch0	sch1	sch2	sch3	sch4	sch5	sch6	sch7	sch8	sch9	sch10	sch11	sch12	shd0	shd1
	10.42	10.59	10.58	10.52	10.47	10.44	10.42	10.4	10.38	10.37	10.37	10.36	10.24	10.25	10.41	10.36	10.3	10.29	10.27	10.23	10.2	10.18	10.18	10.16	10.16	9.93	9.98
8.25	8.71	9.39	9.09	8.93	8.79	8.68	8.57	8.48	8.36	8.27	8.25	8.18	8.24	8.01	8	8.13	8.48	8.34	8.18	8.07	8.03	8.87	8.77	8.71	8.71	8.55	8.41
8.34	8.39	8.47	8.53	8.45	8.36	8.36	8.33	8.29	8.32	8.32	8.58	8.08	8.01	8	8	8.13	8.48	8.34	8.18	8.08	8.08	8.09	8.77	8.71	8.71	8.55	8.41
10.85	10.51	10.49	10.31	9.88	9.68	9.48	9.33	9.21	9.15	9.05	8.95	8.95	10.05	10.62	10.62	9.99	9.39	9.08	8.76	8.68	8.8	8.52	8.57	8.69	8.64	9.28	9.68
3.88	3.82	3.78	3.75	3.89	4.48	4.48	4.64	4.64	4.65	4.66	4.69	4.76	4.36	4.36	4.39	4.27	4.32	4.31	4.45	4.48	4.44	4.41	4.38	4.34	4.3	6.23	6.23
3.51	3.48	3.41	3.36	3.42	3.4	3.37	3.32	3.32	3.3	3.28	3.25	3.22	4.18	4.26	4.17	4.09	4.03	4.43	4.35	4.27	4.21	4.14	4.1	4.04	3.99	3.05	3.01
8.01	8.25	8.39	8.28	8.15	8.05	8.06	8.04	8	7.96	7.93	7.91	8.2	8.26	8.26	8.53	8.58	8.48	8.73	8.18	8.1	8.05	8.02	8	8.08	8.12	8.04	8.05
5.88	5.69	5.59	5.95	6.06	6.07	5.9	5.87	5.84	5.95	5.76	5.64	5.59	5.52	5.44	5.53	5.58	5.49	5.73	6.31	6.16	5.66	5.68	5.57	5.79	6.01	5.2	5.14
8.53	8.65	8.64	8.87	8.82	8.84	8.48	8.44	8.4	8.36	8.43	8.57	8.33	8.55	8.51	8.47	8.38	8.65	9.03	8.89	8.73	8.63	8.56	8.49	8.43	8.39	8.12	8.09
10.71	10.67	10.47	11.09	11.32	11.45	11.03	10.83	10.71	10.55	10.43	10.34	10.34	11.89	12.64	12.4	12.38	12.78	12.59	12.59	12.23	12	11.82	11.71	11.66	11.52	11.31	11.39
6.37	8.22	8.54	8.95	8.48	8.3	8.2	8.31	8.2	8.43	8.57	8.34	8.45	9.13	9.13	8.95	9.18	9.34	8.92	8.77	8.61	8.49	8.41	8.39	8.27	8.26	9.63	8.4
6.83	6.76	6.95	7.65	7.37	7.15	7.02	6.93	6.88	6.82	6.78	6.75	7.06	6.95	6.95	6.85	7	7.8	7.57	7.31	7.31	7.04	6.97	6.89	6.83	6.78	6.79	6.71
11.82	11.74	11.62	12.95	16.7	16.7	14.97	16.73	15.64	12.48	12.39	12.09	12	13.05	12.58	12.32	12.39	13.41	13.73	13.13	12.7	12.43	12.24	12.15	12.11	11.98	12.43	12.52
12.56	12.5	12.39	12.47	13.07	12.93	12.87	12.57	12.48	12.25	12.13	12.08	12	10.73	10.45	10.33	10.54	10.71	10.71	10.55	10.33	10.43	10.26	10.16	10.09	10.07	10.78	11.07
7.47	7.42	7.61	7.47	8.71	9.52	9.1	8.53	8.34	8.2	8.09	8.01	8.01	6.09	5.93	5.88	5.85	5.82	6.24	6.44	6.2	6.09	6.02	5.96	5.92	5.87	5.65	5.6
8.22	8.28	8.24	8.25	8.6	8.45	8.36	8.29	8.24	8.19	8.13	8.08	9.58	9.52	9.46	9.42	9.42	9.45	10.03	9.9	9.74	9.63	9.56	9.51	9.48	9.46	8.77	8.71
10.71	12.19	12.45	11.66	11.36	11.16	11.06	10.94	10.87	10.67	10.67	10.58	11.11	10.86	11.12	11.67	11.29	11.29	11.05	10.94	10.85	10.78	10.73	10.67	10.63	10.58	10.78	11.02
7.09	6.98	7.49	7.21	7.04	6.96	6.87	6.87	6.89	6.87	6.87	6.84	6.46	6.45	6.43	6.43	6.68	7.03	6.78	6.61	6.53	6.46	6.41	6.4	6.43	6.45	7.16	7.01
10.06	10.03	10	9.94	9.96	9.99	9.99	9.88	9.95	9.91	9.89	9.88	9.78	9.78	9.78	9.79	9.78	9.75	9.8	9.84	9.8	9.77	9.78	9.76	9.76	9.85	9.53	9.52
11.92	13.36	12.48	12.9	12.08	11.87	11.81	11.82	11.69	11.67	11.61	11.57	12.45	12.45	13.99	13.77	13.66	12.68	12.47	12.19	12.04	11.93	11.83	11.77	11.72	11.67	12.18	12.45
8.48	8.47	8.39	8.35	8.3	8.36	8.43	8.48	8.68	8.57	8.43	8.35	8.44	8.6	8.6	8.33	8.18	8.08	8.32	8.45	8.28	8.16	8.09	8.05	8.03	8.01	8.31	8.54
6.97	7.02	7.18	7.12	7.08	7.02	7.02	6.98	6.96	6.94	6.96	6.97	6.93	6.89	6.89	6.93	7.5	7.49	7.27	7.1	7.03	6.99	6.95	6.92	6.9	6.88	6.66	6.53
7.79	7.7	7.64	7.92	8.02	7.89	7.83	7.91	8.09	7.9	7.57	7.49	7.66	7.75	7.7	7.67	8.85	9.48	10.31	9.67	9.27	8.97	8.81	8.7	8.64	8.57	7.71	7.67
7.82	8.36	9.41	8.65	8.26	8.04	7.91	8.09	7.9	7.7	7.57	7.49	9.22	8.71	9.17	9.48	8.94	8.46	10.31	8.21	8.03	7.89	7.78	8.11	7.8	7.65	6.31	6.32
9.15	9.11	9.25	9.36	9.24	9.14	9.08	9.05	9.03	9.01	9.01	9.01	9.18	9.2	9.25	9.25	9.32	9.32	9.2	9.12	9.06	9.1	9.09	9.06	9.04	9.05	8.79	8.75
7.12	7.86	8.34	7.81	7.68	7.5	7.38	7.3	7.25	7.22	7.21	7.16	5.86	5.81	5.99	6.14	6.11	6.01	5.89	5.82	5.77	5.74	5.71	5.71	5.68	5.67	7.29	7.13
9.47	9.57	9.76	10.06	9.95	9.76	9.69	9.65	9.63	9.62	9.61	9.6	9.14	9.29	9.55	9.59	9.59	9.49	9.4	9.31	9.28	9.28	9.25	9.27	9.32	9.3	9.61	9.59
13.09	12.65	12.41	13.26	13.96	13.06	12.69	12.43	12.31	12.6	12.45	12.39	13.39	13.14	13.14	13.58	13.14	13.31	12.9	12.48	12.28	12.22	12.16	12.06	11.94	11.96	13.69	13.84
6.46	6.65	6.55	7.03	6.88	6.67	6.55	6.48	6.48	6.43	6.39	6.37	7.61	8.32	8.32	8.19	8.23	7.79	7.66	7.52	7.38	7.28	7.21	7.14	7.09	7.14	6.34	6.29
4.67	4.74	4.85	4.75	4.7	4.65	4.61	4.57	4.55	4.53	4.5	4.46	3.68	3.67	3.67	3.67	3.7	3.69	3.67	3.66	3.64	3.62	3.6	3.6	3.58	3.56	3.89	3.87
9.38	9.09	9.2	9.64	9.94	10.01	9.66	9.36	9.25	9.13	9.02	8.92	8.76	8.65	8.56	8.56	8.59	8.42	8.41	8.78	8.65	9.3	8.89	8.71	8.7	8.64	8.75	8.76
7.4	7.55	7.47	7.36	7.29	8.3	8.12	7.77	7.58	7.44	7.34	7.27	7.52	7.39	7.3	7.21	7.16	7.19	7.19	8.06	7.85	7.61	7.45	7.33	7.23	7.15	8.1	8.17
4.98	5.02	5.1	5.07	5.03	5.01	5.05	5.01	4.98	4.95	4.92	4.9	6.39	6.41	6.53	6.48	6.48	6.44	6.37	6.73	6.94	6.85	6.77	6.72	6.67	6.66	7.02	6.97
2.64	2.65	2.66	2.66	2.67	2.73	2.88	2.94	2.96	3	3.02	3.05	2.67	2.67	2.67	2.67	2.67	2.65	2.64	2.64	2.64	2.63	2.62	2.61	2.6	2.6	2.24	2.3
5.71	5.62	5.57	5.53	5.49	5.68	5.85	5.73	5.66	5.6	5.56	5.51	5.58	5.55	5.55	5.52	5.52	5.59	5.55	5.53	5.97	5.87	5.82	5.77	5.73	5.69	5.49	5.78
6.83	6.95	7.68	7.67	8.46	8.02	7.64	7.41	7.29	7.43	7.31	7.32	8.94	8.96	8.93	9	9.89	9.81	9.53	9.14	9.43	9.29	9.24	9.25	9.61	9.52	9.13	8.77
11.13	11.12	11.44	11.2	11.27	11.22	11.52	10.98	10.84	10.79	10.97	10.71	14.56	13.87	14.3	14.3	14.83	14.41	13.69	13.43	13.33	13.26	13.25	13.24	13.52	13.55	12.34	10.36
13.9	14.1	13.08	12.81	12.04	11.94	11.84	11.75	11.89	11.8	11.67	11.71	14.58	13.87	14.53	14.53	14.32	4.18	4.09	4.19	4.13	4.06	4	3.96	3.96	3.92	3.68	10.4
4.65	4.7	4.47	4.33	4.26	4.36	4.56	4.45	4.32	4.24	4.18	4.13	4.19	4.44	4.44	4.53	4.32	4.18	4.09	3.95	3.92	3.92	3.92	3.92	3.96	3.92	3.68	10.36
8.6	8.97	9.7	9.24	9.82	9.85	9.47	9.19	9.23	9.12	8.99	9.02	8.9	8.84	8.77	8.74	8.74	8.71	8.95	10.34	9.69	9.39	9.23	9.06	8.95	8.88	6.96	6.92
3.76	3.75	3.7	3.74	3.81	3.92	3.92	3.86	3.82	3.8	3.78	3.77	3.55	3.57	3.57	3.57	3.57	3.57	3.57	3.57	3.57	3.57	3.57	3.57	3.57	3.57	3.17	3.19
5.61	5.57	5.19	5.66	5.56	5.95	5.62	5.62	5.36	5.45	5.25	5.36	4.38	4.27	3.98	3.98	3.66	4.45	4.9	4.82	4.34	4.09	4.17	4.06	3.97	3.95	7.3	6.49
12.22	12.27	12.36	12.27	12.21	12.65	12.62	12.41	12.24	12.14	12.08	12.03	12.19	12.24	12.24	12.22	12.15	12.09	12.04	12.21	12.21	12.12	12.04	11.97	11.91	11.87	13.42	13.29
8.2	8.18	8.16	8.39	8.27	8.81	8.81	8.8	8.52	8.3	8.22	8.32	8.68	8.73	8.6	8.47	8.47	8.5	8.47	8.45	8.97	8.92	8.81	8.5	8.5	8.47	8.1	8.11

	sh2	sh3	sh4	sh5	sh6	sh7	sh8	sh9	sh10	sh11	sh12	sw0	sw1	sw2	sw3	sw4	sw5	sw6	sw7	sw8	sw9	sw10	sw11	sw12	sl0	sl1	sl2
10.3	10.3	10.2	10.11	10.03	9.88	9.98	8.95	9.94	9.95	8.24	9.41	10.64	10.48	10.72	10.69	10.37	9.8	10.72	10.7	10.66	10.59	10.56	10.53	10.51	10.23	10.33	10.66
8.47	9.81	9.37	9.11	8.93	8.78	8.65	8.54	8.43	8.32	8.24	9.41	9.41	9.65	9.65	9.65	9.37	9.8	9.76	9.9	9.86	9.6	9.48	9.35	9.23	8.94	8.73	8.62
8.07	8.11	8.18	8.1	8.03	7.96	7.96	7.95	7.91	7.93	8.04	8.66	8.7	8.69	8.64	8.73	8.73	8.73	8.68	8.69	8.65	8.69	8.69	8.65	8.6	8.27	8.26	8.22
9.73	9.33	9.12	9.15	8.92	8.79	8.79	8.72	8.7	8.64	8.57	5.04	8.61	8.89	8.7	8.63	8.47	8.63	8.58	8.44	8.36	8.48	8.59	8.73	9.23	9.2	9.6	
6.17	6.16	6.22	6.28	6.28	6.29	6.29	6.25	6.29	6.26	3.01	2.46	2.44	4.96	4.87	4.79	4.7	4.63	4.93	5.19	5.15	5.12	5.11	5.09	5.04	6.79	6.89	6.83
3	2.98	2.96	2.99	3.01	2.95	2.96	2.95	3.09	3.06	3.01	2.46	2.44	2.43	2.43	2.42	2.4	2.39	2.38	2.56	2.36	2.34	2.32	2.31	2.32	2.15	2.13	2.12
8.41	8.42	8.27	8.16	8.1	8.05	7.99	7.95	8.1	8.65	8.6	8.25	8.22	8.74	8.72	8.5	8.31	8.2	8.13	8.11	8.07	8.05	8.03	8.05	8.94	8.95	9.48	
5.11	5.14	5.18	5.19	5.07	5.74	5.52	5.38	5.29	5.23	5.17	5.47	5.62	5.51	5.48	5.35	5.25	5.22	5.64	5.52	5.45	5.4	5.35	5.34	5.31	4.95	4.92	4.95
8.05	8.04	8.67	9.56	9.74	8.76	8.52	8.5	8.42	8.35	8.29	9.91	9.73	9.68	9.61	9.91	9.77	9.54	9.41	9.33	9.27	9.23	9.19	9.15	9.62	9.49	9.19	
11.35	11.49	11.49	11.74	11.42	11.27	11.12	11.02	10.99	11.02	10.91	10.32	10.55	10.97	10.86	11.17	11.17	10.94	10.74	10.54	10.41	10.34	10.25	10.39	10.45	11.28	11.39	11.18
8.68	8.68	10.26	9.48	9.61	9.66	9.14	8.93	8.78	8.67	8.59	8.8	8.8	4.92	4.87	4.96	5.93	5.95	5.78	5.63	5.54	5.48	5.56	5.48	5.42	7.01	6.92	7.55
6.55	6.33	7.46	7.35	7.38	7.15	7.03	6.94	6.87	6.81	6.75	12.23	12.13	13.06	13.02	12.67	13.69	13.57	13.04	13.35	13.73	13.24	13.24	11.71	11.6	11.61	11.66	11.4
13.42	12.81	12.44	12.14	11.99	11.9	11.84	11.81	11.75	11.7	11.66	12.34	12.54	12.54	14.55	13.78	12.77	12.99	12.16	12.02	12.03	11.89	11.78	11.89	11.71	7.36	6.19	6.15
8.55	8.47	8.43	8.41	8.68	8.96	8.79	8.81	8.68	8.59	8.52	9.12	9.12	8.03	8.03	8.1	8.04	7.98	8.36	8.53	8.37	8.15	8.04	8.34	8.32	8.32	8.34	7.02
6.58	7.38	7.4	7.39	7.04	7.82	7.77	7.73	7.7	7.67	7.65	6.77	6.76	8.94	8.89	7.37	7.28	7.07	6.89	6.79	6.74	6.71	6.88	6.67	6.65	6.67	6.65	8.62
7.64	7.61	7.98	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04	8.04
6.57	6.67	6.73	6.53	6.42	6.38	6.34	6.31	6.29	6.27	6.25	8.52	8.52	9.25	9.67	9.35	9.29	9.26	9.25	9.25	9.22	9.2	9.18	9.21	9.21	9.21	9.21	9.21
8.72	9.04	9.21	9.06	8.89	8.81	8.78	8.78	8.75	8.72	8.75	6.16	6.13	6.27	6.52	6.34	6.24	6.18	6.18	6.13	6.1	6.07	6.05	6.02	6	6.59	6.35	6.53
7.23	7.19	7.05	7.04	6.98	6.91	6.87	6.82	6.79	6.76	6.73	10.22	10.22	10.59	10.91	10.7	10.77	10.71	10.67	10.67	10.67	10.67	10.67	10.67	10.67	10.67	10.67	10.67
9.76	10	9.89	9.77	9.72	9.7	9.67	9.62	9.59	9.59	9.57	12.85	12.85	12.66	12.66	12.55	12.97	12.71	12.53	12.22	12.09	11.98	11.88	11.83	11.83	12.2	12.34	13.61
14.19	14.17	14.16	13.98	13.32	12.94	12.79	13.1	13.46	13	12.65	12.84	12.61	12.61	12.66	12.65	12.97	12.71	12.53	12.22	12.09	11.98	11.88	11.83	11.83	12.2	12.34	13.61
6.27	6.26	6.82	6.54	6.65	6.45	6.35	6.29	6.26	6.22	6.2	7.05	6.94	6.86	6.83	6.43	7.22	7.04	6.85	6.76	6.71	6.67	6.63	6.6	6.5	6.5	6.5	6.5
3.86	3.88	3.86	3.84	3.82	3.81	3.79	3.78	3.78	3.76	3.74	4.36	4.33	4.33	4.33	4.33	4.33	4.35	4.33	4.3	4.29	4.27	4.24	4.23	4.2	4.23	4.2	4.23
8.61	8.62	9.16	8.9	8.76	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58
8.18	7.75	7.61	7.77	8.14	8.16	7.98	8.02	7.86	7.74	7.66	5.16	5.23	5.5	5.49	5.51	5.47	5.47	5.47	5.46	5.46	5.42	5.44	5.57	5.5	5.57	5.5	5.57
7.36	7.69	8.28	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14
2.36	2.41	2.46	2.52	2.9	3.14	3.21	3.28	3.36	3.42	3.48	2.44	2.43	2.43	2.46	2.48	2.49	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52
5.66	5.58	5.52	5.51	5.94	6.05	6.05	5.84	5.73	5.65	5.59	5.67	5.63	5.61	5.59	5.57	5.54	5.97	6.37	6.2	6.09	6.01	5.95	5.9	5.95	5.9	5.95	5.95
8.94	8.65	8.44	8.31	8.91	9.51	9.69	9.19	8.92	9.33	8.8	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26	8.26
10.96	11.55	11.16	10.72	10.48	10.37	10.29	10.23	10.18	10.12	10.06	9	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67	14.67
12.88	12.77	13.42	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86	12.86
3.8	3.88	3.79	3.71	3.83	3.86	3.98	3.93	3.96	3.98	3.92	5.03	4.84	4.67	4.56	4.62	4.55	4.87	4.77	4.58	4.37	4.34	4.34	4.34	4.34	4.34	4.34	4.34
9.58	9.2	9.26	10.38	11.14	10.02	9.63	9.53	9.56	9.28	6.83	6.43	6.59	6.31	6.29	6.92	6.54	6.66	6.48	6.31	6.24	6.16	6.12	6.08	6.12	6.08	6.12	6.08
7.18	7.17	7.56	7.42	7.25	7.14	7.08	7	5.46	5.6	5.55	5.76	5.72	5.68	5.63	5.61	5.54	5.95	6.19	6.05	5.98	5.93	5.9	5.86	5.81	5.86	5.81	5.86
5.65	5.75	6.94	6.17	5.79	5.38	5.44	5.41	5.46	5.46	5.46	14.42	12.21	12.18	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12
5.34	5.3	5.26	5.27	5.45	5.49	5.45	5.41	5.46	5.46	5.46	14.42	12.21	12.18	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12	12.12
15.04	15.04	15.05	15.29	15.24	14.97	15.19	14.88	14.69	14.54	14.42	9.21	9.17	9.15	9.14	9.11	9.08	8.98	8.4	8.13	8.09	8.04	7.96	7.86	7.77	7.69	7.51	7.42
12.33	12.3	12.08	11.95	11.84	11.77	11.71	11.65	11.61	11.58	11.54	7.86	7.81	7.76	7.75	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
6.89	6.86	6.83	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42	7.42
3.17	3.15	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17
6.52	7	6.71	6.5	6.19	5.93	5.33	5.64	5.36	5.57	5.33	7.92	7.38	3.85	3.88	3.85	3.82	3.81	3.8	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81
13.26	13.08	13.1	13.15	13.13	13.06	12.84	12.83	12.77	12.78	12.78	12.54	12.54	12.5	12.31	12.44	12.37	12.36	12.57	12.6	12.61	12.54	12.44	12.37	12.32	12.34	12.02	12.14
8.16	8.41	8.38	8.15	8.14	8.39	8.93	8.94	8.89	8.63	8.55	7.92	7.93	7.93	7.93	7.96	7.92	7.89	7.85	8.08	8.25	8.03	7.95	7.9	7.94	8.02	8	7.97

	slu3	slu4	slu5	slu6	slu7	slu8	slu9	slu10	slu11	slu12	sex0	sex1	sex2	sex3	sex4	sex5	sex6	sex7	sex8	sex9	sex10	sex11	sex12
	10.46	10.28	10.22	10.25	10.23	10.2	10.18	10.14	10.13	10.1	10.49	10.51	10.7	10.68	10.6	10.55	10.51	10.48	10.46	10.44	10.42	10.41	10.39
8.85	8.61	8.48	8.34	8.25	8.15	8.06	7.99	7.91	7.82	7.67	8.67	8.82	8.74	9.23	9.05	8.9	8.78	8.68	8.57	8.47	8.38	8.28	8.18
8.25	8.33	8.28	8.21	8.13	8.09	8.06	8.05	8.11	8.11	8.98	8.92	8.95	9.25	9.05	9.15	9.08	9.03	8.96	8.95	9.02	8.99	9	8.42
9	8.91	8.68	8.55	8.44	8.3	8.25	8.42	8.28	8.22	8.87	9.18	9.32	9.3	9.14	8.66	8.9	9.05	8.8	8.71	8.6	8.5	8.42	8.1
6.73	6.66	6.73	6.77	6.71	6.65	6.53	6.44	6.37	6.3	4.39	4.35	4.3	4.26	4.22	4.22	4.2	4.36	4.32	4.27	2.68	2.66	2.65	2.63
2.11	2.11	2.16	2.19	2.21	2.15	2.17	2.15	2.15	2.14	2.79	2.75	2.73	2.73	2.71	2.68	2.76	2.76	2.73	2.7	2.7	2.68	2.66	2.63
9.1	8.66	8.43	8.32	8.24	8.21	8.21	8.22	8.2	8.18	6.59	8.07	8.04	8.47	8.75	8.55	8.46	8.59	8.58	8.34	8.19	8.1	8.04	8
4.93	4.91	4.96	4.96	4.92	4.94	5.13	5.08	5.02	4.98	9.1	9.07	9.04	9.04	9.04	9.38	9.66	9.33	9.17	9.1	9.04	8.99	8.95	8.91
9.13	9.28	9.4	9.21	9.13	9.08	9.05	9.02	9.01	9	10.87	10.87	10.75	10.73	10.66	10.94	11.15	10.83	10.69	10.65	10.51	10.41	10.33	10.26
10.97	11.67	12.44	11.93	11.57	11.34	11.16	11.02	10.99	10.99	8.21	8.12	7.91	7.91	8.37	10.16	9.28	8.86	8.63	8.45	8.31	8.24	8.29	8.25
9.14	9.19	8.88	8.68	8.55	8.45	8.42	8.36	8.27	8.27	7.02	6.97	6.97	6.9	7.01	7.55	7.26	7.13	7.01	6.92	6.86	6.79	6.72	6.66
7.47	8.6	8.07	7.71	7.48	7.32	7.19	7.11	7.02	6.97	11.46	11.22	11.43	11.86	11.91	13.37	12.66	12.43	11.93	11.67	11.33	11.15	11.07	10.86
11.73	13.19	13.29	12.48	12.1	11.76	11.49	11.41	11.82	11.62	10.57	11.39	11.49	11.69	11.48	11.79	12.34	11.79	11.48	11.33	11.23	11.15	11.08	11.02
10.72	10.75	11.96	11.61	11.07	10.91	10.79	10.7	10.63	10.43	6.43	6.39	6.35	6.32	6.28	6.28	7.36	7.36	7.04	6.9	6.81	6.74	6.68	6.62
6.88	6.62	6.66	6.54	6.66	6.58	6.54	6.51	6.47	6.47	8.24	8.2	8.17	8.14	8.14	8.14	8.43	8.34	8.28	8.23	8.19	8.15	8.12	8.08
9.45	9.58	10.32	9.98	9.81	9.7	9.64	9.6	9.58	9.56	10.58	10.58	10.77	11.44	11.49	11.28	11.31	11.21	11.17	10.9	10.84	10.76	10.68	10.58
11.78	11.86	11.28	11.05	10.92	10.83	10.77	10.71	10.66	10.61	6.72	6.72	6.67	6.81	7.16	7.02	6.82	6.75	6.7	6.66	6.63	6.62	6.61	6.6
6.85	7.02	6.73	6.55	6.45	6.39	6.34	6.31	6.28	6.27	12.26	12.26	12.89	14.33	13.28	12.7	12.76	12.67	12.43	12.3	12.4	12.46	12.45	12.13
9.58	9.59	9.57	9.61	9.58	9.55	9.52	9.55	9.51	9.49	8.4	8.63	8.67	8.55	8.48	8.42	8.42	8.42	8.55	8.65	8.56	8.48	8.43	8.37
13.04	12.38	12.09	11.9	11.78	11.7	11.63	11.6	11.57	11.52	7.29	7.3	7.3	7.3	7.72	7.9	7.84	7.63	7.44	7.33	7.26	7.22	7.19	7.22
8.29	8.35	8.36	8.32	8.35	8.41	8.41	8.53	8.66	8.66	8.43	8.43	8.43	8.69	8.98	9.2	9	8.78	8.68	8.64	8.61	8.61	8.61	8.61
7.18	6.97	6.78	6.7	6.65	6.62	6.59	6.63	6.62	6.59	8.38	8.43	8.43	8.69	7.34	7.27	6.89	6.49	6.25	6.17	6.16	6.12	6.06	6.02
8.64	8.82	8.9	8.72	8.62	8.56	8.51	8.46	8.41	7.34	7.28	7.28	7.28	7.28	7.34	7.27	6.89	6.49	6.25	6.17	6.16	6.12	6.06	6.02
8.6	8.31	7.93	7.76	7.64	7.55	7.47	7.4	7.34	7.34	8.55	8.55	8.55	8.55	8.55	8.55	8.55	8.55	8.55	8.55	8.55	8.55	8.55	8.55
6.49	6.47	6.3	6.21	6.15	6.1	6.05	6.03	5.98	5.98	6.44	6.44	6.61	6.97	7.45	7.46	7.17	6.98	6.87	6.85	6.88	6.78	6.73	6.69
9.62	9.42	9.27	9.28	9.45	9.38	9.34	9.38	9.39	9.39	10.16	10.16	10.14	10.15	10.11	10.11	10.19	10.41	10.38	10.33	10.22	10.13	10.14	10.28
12.98	14.33	13.23	13.17	12.99	12.48	12.47	12.25	12.17	12.16	12.88	12.88	12.82	12.38	12.74	13.67	13.07	12.65	12.44	12.33	12.67	13.4	12.69	12.38
8.27	9.5	8.76	8.17	7.9	7.74	7.63	7.64	7.55	7.46	6.34	6.31	6.16	6.14	6.61	6.4	4.17	4.15	4.11	4.09	4.06	4.05	4.03	4.01
3.74	3.71	3.69	3.68	3.66	3.65	3.64	3.62	3.61	3.6	4.18	4.17	4.16	4.16	4.25	4.22	4.17	4.15	4.11	4.09	4.06	4.05	4.03	4.01
8.77	8.7	8.74	8.74	8.8	9.67	9.18	8.94	8.81	8.7	9.32	9.35	9.35	10.16	9.83	9.64	10.24	10.28	10.18	9.74	9.52	9.34	9.28	9.26
7.64	7.47	7.35	7.08	7.3	7.14	7.05	6.98	7.28	7.28	7.78	7.64	7.53	7.47	7.4	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.34	7.34
7.08	7.04	6.99	7.08	7.08	7.3	7.05	6.98	6.94	6.9	5.35	5.32	5.33	5.3	5.28	5	4.97	5.44	5.02	4.98	4.95	4.91	4.87	4.83
2.64	2.63	2.6	2.59	2.57	2.55	2.53	2.52	2.5	2.48	5.11	5.14	5.09	5.04	5.04	5.28	5.24	5.44	5.02	4.98	4.95	4.91	4.87	4.83
5.65	5.58	5.51	5.53	5.57	5.55	5.6	5.63	5.94	5.94	8.38	8.32	8.34	8.22	8.18	8.18	8.16	8.95	8.82	8.67	8.67	8.66	8.72	8.5
6.27	6.11	6.06	6.44	6.85	6.86	6.49	6.25	6.12	6.04	8.88	8.83	9.02	9.08	9.26	9.09	8.95	9.12	9.5	9.3	9.12	9.11	8.78	8.63
9.66	9.44	9.06	8.91	8.83	8.84	8.89	8.97	9.05	8.86	13.38	13.39	14.92	14.6	14.8	13.85	13.94	13.44	13.44	13.13	12.96	12.88	12.94	12.84
15.5	14.12	13.31	13.24	13.18	13.33	13.13	13.16	14.29	13.34	4.4	4.35	4.89	5.21	4.91	4.76	5.3	5.01	4.72	4.55	4.47	4.46	4.46	4.35
3.92	3.86	3.84	3.91	3.95	3.95	3.91	3.86	3.83	3.87	11.99	11.86	10.68	10.62	10.68	6.8	6.41	6.25	5.99	5.83	5.74	5.69	5.66	5.63
10	10.15	10.42	10.4	10.19	9.74	9.57	9.52	9.47	9.42	6.01	6.27	6.08	6.11	6.11	6.8	6.41	6.25	5.99	5.83	5.74	5.69	5.66	5.63
6.9	7.3	7.13	6.94	6.84	6.79	6.75	6.69	6.64	6.6	4.72	4.45	4.54	4.54	4.64	5.1	4.88	4.36	4.21	4.17	4.21	4.08	4.07	4.1
5.48	5.46	5.71	5.84	5.72	5.67	5.65	5.61	5.56	5.53	6.11	6.06	6.08	6.08	6	5.96	6.15	6.06	5.98	5.96	5.96	5.91	5.87	5.83
13.11	14.12	14.17	14.02	13.88	13.74	13.61	13.52	13.45	13.33	13.41	13.27	13.07	13.15	13.51	13.11	11.07	11.04	12.87	12.75	12.66	12.57	12.51	12.42
9.52	9.42	11.04	12.46	12.58	12.36	12.24	12.19	12.17	12.12	8.45	8.4	8.37	8.39	8.38	8.31	8.78	9.01	8.63	8.48	8.42	8.34	8.28	8.23
10.13	10.18	11.08	10.26	10.2	9.6	9.38	9.36	9.35	9.35	5.96	6.85	6.85	6.49	6.31	6.88	6.77	6.83	3.96	3.92	3.94	3.86	3.85	3.84
12.47	12.37	12.26	12.17	12.17	12.13	12.08	12.03	11.98	11.88	11.94	12.61	12.76	13.15	13.03	12.74	12.83	13.21	13.1	6.32	6.21	6.46	6.27	6.13
8.07	8.1	8.02	7.98	8.28	8.43	8.25	8.12	8.07	8.02	7.98	7.96	7.96	7.91	7.87	7.91	7.9	7.86	8.1	8.88	8.68	8.41	8.14	8.03

APPENDIX 18

Study 6 Statistical Outcomes

STUDY 6 ANALYSES SET 1 HR E0 to E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	11256.10	49	229.72		
CONSTANT	1516.21	1	1516.21	6.60	.013

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	3336.05	49	68.08		
LEVEL	293.96	1	293.96	4.32	.043

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	2298.06	49	46.90		
VALENCE	1.51	1	1.51	.03	.858

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	3149.58063	2702.97961	3149.58063	55.16285	57.09605	.000
T5	630.89260	1854.74741	630.89260	37.85199	16.66736	.000
T6	366.82332	1953.73996	366.82332	39.87224	9.19997	.004

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T16 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	8342.62	49	170.26		
LEVEL BY VALENCE	124.46	1	124.46	.73	.397

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T17	46.01058	497.14758	46.01058	10.14587	4.53491	.038
T18	17.35322	354.90554	17.35322	7.24297	2.39587	.128
T19	3.14142	317.31234	3.14142	6.47576	.48510	.489

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T29	.52536	344.81317	.52536	7.03700	.07466	.786
T30	.19279	188.63233	.19279	3.84964	.05008	.824
T31	.43779	176.74290	.43779	3.60700	.12137	.729

EFFECT .. LEVEL BY VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T41	135.44194	996.41210	135.44194	20.33494	6.66055	.013
T42	1.48587	604.53560	1.48587	12.33746	.12044	.730
T43	29.39331	456.60417	29.39331	9.31845	3.15431	.082

STUDY 6 HR ANALYSES SET 1 E0 TO E4

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	3898.41	49	79.56			
CONSTANT	96.86	1	96.86	1.22	.275	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	1027.90	49	20.98			
LEVEL	29.28	1	29.28	1.40	.243	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	634.50	49	12.95			
VALENCE	.09	1	.09	.01	.935	

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	151.12857	1933.28302	151.12857	39.45476	3.83043	.056
T5	40.59402	1695.84559	40.59402	34.60909	1.17293	.284
T6	.14599	726.69512	.14599	14.83051	.00984	.921

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T8 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	2196.64	49	44.83			
LEVEL BY VALENCE	2.13	1	2.13	.05	.828	

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T9	25.17188	346.83153	25.17188	7.07819	3.55626	.065
T10	.18544	185.23520	.18544	3.78031	.04905	.826
T11	2.43445	118.90508	2.43445	2.42663	1.00322	.321

EFFECT .. VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T13	.32732	253.96694	.32732	5.18300	.06315	.803
T14	.01249	147.24113	.01249	3.00492	.00416	.949
T15	2.44948	109.69715	2.44948	2.23872	1.09414	.301

EFFECT .. LEVEL BY VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T17	.91853	784.35007	.91853	16.00714	.05738	.812
T18	5.68187	431.41299	5.68187	8.80435	.64535	.426
T19	6.09601	343.74330	6.09601	7.01517	.86898	.356

STUDY 6 ANALYSES SET 1 HR E4 TO E12
Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	10671.03	49	217.78			
CONSTANT	2388.28	1	2388.28	10.97	.002	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	3085.50	49	62.97			
LEVEL	337.08	1	337.08	5.35	.025	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	2181.64	49	44.52			
VALENCE	1.81	1	1.81	.04	.841	

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	3320.10393	3572.65240	3320.10393	72.91127	45.53622	.000
T5	148.63749	2804.67194	148.63749	57.23820	2.59682	.114
T6	60.33423	1977.43935	60.33423	40.35591	1.49505	.227

Tests involving
'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T12 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	8288.67	49	169.16			
LEVEL BY VALENCE	213.53	1	213.53	1.26	.267	

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T13	.16655	396.90688	.16655	8.10014	.02056	.887
T14	.20198	257.31884	.20198	5.25140	.03846	.845
T15	.03720	155.13750	.03720	3.16607	.01175	.914

EFFECT .. LEVEL BY VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T29	57.24462	498.12406	57.24462	10.16580	5.63110	.022
T30	10.68232	438.80736	10.68232	8.95525	1.19285	.280
T31	1.37812	271.30994	1.37812	5.53694	.24890	.620

STUDY 6 ANALYSES SET SCL E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	133.53	49	2.73		
CONSTANT	6.18	1	6.18	2.27	.139

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	26.25	49	.54		
LEVEL	.69	1	.69	1.29	.262

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	12.71	49	.26		
VALENCE	.00	1	.00	.02	.893

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	16.05035	48.95761	16.05035	.99913	16.06425	.000
T5	31.43879	30.69783	31.43879	.62649	50.18272	.000
T6	2.66727	17.57264	2.66727	.35863	7.43749	.009

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T16 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	46.83	49	.96		
LEVEL BY VALENCE	.17	1	.17	.18	.676

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T17	.16178	5.00943	.16178	.10223	1.58243	.214
T18	.24565	2.88145	.24565	.05881	4.17741	.046
T19	.03768	1.82664	.03768	.03728	1.01086	.320

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T29	.00240	2.69800	.00240	.05506	.04358	.835
T30	.02404	1.54939	.02404	.03162	.76019	.388
T31	.00568	1.18562	.00568	.02420	.23466	.630

EFFECT .. LEVEL BY VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T41	.10964	9.07610	.10964	.18523	.59191	.445
T42	.05645	5.60834	.05645	.11446	.49320	.486
T43	.02580	1.73750	.02580	.03546	.72758	.398

STUDY 6 ANALYSES SET 1 SCL E0 TO E5
Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	37.02	49	.76		
CONSTANT	18.38	1	18.38	24.33	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	7.19	49	.15		
LEVEL	.06	1	.06	.39	.536

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	3.80	49	.08		
VALENCE	.00	1	.00	.00	.995

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	13.47656	29.86804	13.47656	.60955	22.10896	.000
T5	.06848	28.29550	.06848	.57746	.11858	.732
T6	.47995	9.82386	.47995	.20049	2.39394	.128

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T9 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	12.67	49	.26		
LEVEL BY VALENCE	.02	1	.02	.08	.773

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.19055	3.73656	.19055	.07626	2.49880	.120
T11	.12476	2.24343	.12476	.04578	2.72504	.105
T12	.00008	.52858	.00008	.01079	.00739	.932

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.01678	2.27090	.01678	.04634	.36203	.550
T16	.02589	1.03614	.02589	.02115	1.22460	.274
T17	.00557	.64547	.00557	.01317	.42294	.519

EFFECT .. LEVEL BY VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T20	.00147	6.80543	.00147	.13889	.01060	.918
T21	.01861	2.91877	.01861	.05957	.31245	.579
T22	.00899	1.19940	.00899	.02448	.36732	.547

STUDY 6 SCL ANALYSES SET 1 E5 to E12
Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig. of F	
WITHIN CELLS	178.68	49	3.65			
CONSTANT	.66	1	.66	.18	.673	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig. of F	
WITHIN CELLS	28.15	49	.57			
LEVEL	1.10	1	1.10	1.91	.173	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig. of F	
WITHIN CELLS	14.34	49	.29			
VALENCE	.03	1	.03	.09	.765	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	42.44413	33.92537	42.44413	.69235	61.30405	.000
T5	.56382	9.06861	.56382	.18507	3.04648	.087
T6	.36208	3.75071	.36208	.07655	4.73025	.034

EFFECT 'LEVEL BY VALENCE'.

Tests of Significance for T11 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig. of F	
WITHIN CELLS	49.28	49	1.01			
LEVEL BY VALENCE	.15	1	.15	.15	.704	

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T12	.12692	2.06827	.12692	.04221	3.00686	.089
T13	.00116	.84269	.00116	.01720	.06765	.796
T14	.00398	.38858	.00398	.00793	.50213	.482

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T19	.03621	.75955	.03621	.01550	2.33604	.133
T20	.00088	.45092	.00088	.00920	.09557	.759
T21	.00110	.32915	.00110	.00672	.16422	.687

EFFECT .. LEVEL BY VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T26	.19920	2.90118	.19920	.05921	3.36448	.073
T27	.00480	1.13405	.00480	.02314	.20750	.651
T28	.00121	.83049	.00121	.01695	.07125	.791

Tests of Between-Subjects Effects.

Tests involving 'LEVEL' Within-Subject Effect.

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

STUDY 6 ANALYSES SET 2 HR FE CLUSTERS E0 TO E4

Tests of Between-Subjects Effects.

Tests involving 'LEVEL' Within-Subject Effect.

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T7	17.85364	537.26242	17.85364	10.96454	1.62831	.208
T8	1.90718	368.05068	1.90718	7.51124	.25391	.617
T9	8.11756	199.12895	8.11756	4.06386	1.99750	.164

STUDY 6 ANALYSES SET 2 HR FE CLUSTERS E4 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	7915.23	49	161.54			
CONSTANT	1260.72	1	1260.72	7.80	.007	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	4050.85	49	82.67			
LEVEL	7.02	1	7.02	.08	.772	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T3	1702.23754	2201.90549	1702.23754	44.93685	37.88066	.000	
T4	81.17648	1604.93930	81.17648	32.75386	2.47838	.122	
T5	24.70188	1051.67053	24.70188	21.46266	1.15092	.289	

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T11	25.61785	530.61535	25.61785	10.82888	2.36570	.130	
T12	6.91101	409.28917	6.91101	8.35284	.82738	.367	
T13	.93408	244.37416	.93408	4.98723	.18729	.667	

STUDY 6 ANALYSES SET 2 HR CHW CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	5380.68	49	109.81			
CONSTANT	711.05	1	711.05	6.48	.014	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	7222.82	49	147.40			
LEVEL	400.49	1	400.49	2.72	.106	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T3	1534.37529	1171.51300	1534.37529	23.90843	64.17717	.000	
T4	304.51418	932.28362	304.51418	19.02620	16.00500	.000	
T5	170.95812	974.75734	170.95812	19.89301	8.59388	.005	

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T15	169.66777	852.11874	169.66777	17.39018	9.75653	.003	
T16	4.34169	533.96044	4.34169	10.89715	.39842	.531	
T17	6.65816	297.38513	6.65816	6.06908	1.09706	.300	

STUDY 6 HR ANALYSES SET 2 CHW clusters e0 to e4

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	2038.52	49	41.60		
CONSTANT	51.38	1	51.38	1.24	.272

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	1560.85	49	31.85		
LEVEL	7.81	1	7.81	.25	.623

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	68.69466	927.56039	68.69466	18.92980	3.62892	.063
T4	21.01545	817.00871	21.01545	16.67365	1.26040	.267
T5	1.89573	335.34570	1.89573	6.84379	.27700	.601

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T7	8.23677	593.91918	8.23677	12.12080	.67956	.414
T8	3.96014	248.59751	3.96014	5.07342	.78057	.381
T9	.41290	263.51943	.41290	5.37795	.07678	.783

STUDY 6 ANALYSES SET 2 HR CHW CLUSTERS E4 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	4937.43	49	100.76		
CONSTANT	1129.36	1	1129.36	11.21	.002

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	7323.32	49	149.46		
LEVEL	543.59	1	543.59	3.64	.062

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	1618.39570	1614.98537	1618.39570	32.95889	49.10347	.000
T4	67.76360	1379.13337	67.76360	28.14558	2.40761	.127
T5	36.17808	1054.59959	36.17808	21.52244	1.68095	.201

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T11	31.79331	364.41558	31.79331	7.43705	4.27499	.044
T12	3.97328	286.83703	3.97328	5.85382	.67875	.414
T13	.48124	182.07329	.48124	3.71578	.12951	.720

STUDY 6 SCL ANALYSES SET 2 FE clusters e0 to e12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	97.27	49	1.99		
CONSTANT	3.26	1	3.26	1.64	.206

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	44.88	49	.92		
LEVEL	.09	1	.09	.10	.758

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	7.83012	28.76739	7.83012	.58709	13.33718	.001
T4	16.60073	20.66561	16.60073	.42175	39.36181	.000
T5	1.21341	9.24519	1.21341	.18868	6.43115	.014

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.00253	7.81486	.00253	.15949	.01585	.900
T16	.26881	6.17905	.26881	.12610	2.13167	.151
T17	.06292	2.64854	.06292	.05405	1.16409	.286

STUDY 6 ANALYSES SET 2 SCL FE CLUSTERS E0 TO E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	23.53	49	.48		
CONSTANT	9.20	1	9.20	19.16	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	13.39	49	.27		
LEVEL	.00	1	.00	.02	.902

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	7.22218	20.28957	7.22218	.41407	17.44181	.000
T4	.08929	17.05417	.08929	.34804	.25656	.615
T5	.19105	4.94129	.19105	.10084	1.89456	.175

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	.07926	8.04977	.07926	.16428	.48248	.491
T9	.11988	3.97088	.11988	.08104	1.47924	.230
T10	.00538	.97358	.00538	.01987	.27087	.605

STUDY 6 ANALYSES SET 2 SCL FE CLUSTERS E5 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	127.14	49	2.59		
CONSTANT	.47	1	.47	.18	.671

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	47.04	49	.96		
LEVEL	.22	1	.22	.23	.634

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	22.47991	19.89426	22.47991	.40601	55.36851	.000
T4	.30462	4.50290	.30462	.09190	3.31484	.075
T5	.16161	1.78708	.16161	.03647	4.43106	.040

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.32207	2.88128	.32207	.05880	5.47716	.023
T11	.00535	1.42566	.00535	.02910	.18376	.670
T12	.00479	.95429	.00479	.01948	.24583	.622

STUDY 6 ANALYSES SET 2 SCL CHW CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	48.97	49	1.00		
CONSTANT	2.92	1	2.92	2.92	.094

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	28.20	49	.58		
LEVEL	.77	1	.77	1.34	.252

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	8.22263	22.88822	8.22263	.46711	17.60333	.000
T4	14.86210	11.58162	14.86210	.23636	62.87922	.000
T5	1.45954	9.51307	1.45954	.19414	7.51780	.009

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.26889	6.27068	.26889	.12797	2.10112	.154
T16	.03329	2.31073	.03329	.04716	.70598	.405
T17	.00056	.91561	.00056	.01869	.03003	.863

STUDY 6 ANALYSES SET 2 SCL CHW CLUSTERS E0 TO E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	17.30	49	.35		
CONSTANT	9.18	1	9.18	26.01	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	6.47	49	.13		
LEVEL	.07	1	.07	.56	.456

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	6.27115	11.84936	6.27115	.24182	25.93275	.000
T4	.00508	12.27747	.00508	.25056	.02026	.887
T5	.29447	5.52805	.29447	.11282	2.61018	.113

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	.11276	2.49221	.11276	.05086	2.21697	.143
T9	.02350	1.19132	.02350	.02431	.96659	.330
T10	.00369	.75441	.00369	.01540	.23960	.627

STUDY 6 ANALYSES SET 2 SCL CHW CLUSTERS E5 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	65.88	49	1.34		
CONSTANT	.21	1	.21	.16	.694

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	30.39	49	.62		
LEVEL	1.02	1	1.02	1.65	.205

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	20.00043	14.79066	20.00043	.30185	66.25945	.000
T4	.26008	5.01664	.26008	.10238	2.54036	.117
T5	.20158	2.29278	.20158	.04679	4.30796	.043

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.00406	2.08817	.00406	.04262	.09517	.759
T11	.00062	.55107	.00062	.01125	.05506	.815
T12	.00040	.26478	.00040	.00540	.07438	.786

STUDY 6 ANALYSES SET 3 HR E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	12416.35	49	253.39		
CONSTANT	994.52	1	994.52	3.92	.053

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	3901.86	49	79.63		
LEVEL	366.67	1	366.67	4.60	.037

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	115.02	49	2.35		
VALENCE	.14	1	.14	.06	.809

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	2856.02873	2811.51663	2856.02873	57.37789	49.77577	.000
T5	720.69699	1815.70915	720.69699	37.05529	19.44923	.000
T6	387.91890	1907.80325	387.91890	38.93476	9.96331	.003

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T16 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	5635.99	49	115.02		
LEVEL BY VALENCE	6.79	1	6.79	.06	.809

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T17	67.36816	370.25682	67.36816	7.55626	8.91554	.004
T18	14.71513	355.91520	14.71513	7.26358	2.02588	.161
T19	.12625	234.06615	.12625	4.77686	.02643	.872

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T29	1.06574	14.21045	1.06574	.29001	3.67485	.061
T30	.14598	9.28637	.14598	.18952	.77026	.384
T31	.42399	8.76639	.42399	.17891	2.36989	.130

EFFECT 'LEVEL BY VALENCE BY TIME'

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T41	52.22123	696.31194	52.22123	14.21045	3.67485	.061
T42	7.15296	455.03192	7.15296	9.28637	.77026	.384
T43	20.77540	429.55297	20.77540	8.76639	2.36989	.130

STUDY 6 ANALYSES SET 3 HR E0 TO E4

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig. of F	
WITHIN CELLS	4168.06	49	85.06			
CONSTANT	153.09	1	153.09	1.80	.186	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig. of F	
WITHIN CELLS	1096.40	49	22.38			
LEVEL	37.61	1	37.61	1.68	.201	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig. of F	
WITHIN CELLS	34.82	49	.71			
VALENCE	.30	1	.30	.43	.516	

EFFECT...TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T4	199.67671	1808.64758	199.67671	36.91118	5.40965	.024	
T5	40.22306	1806.39104	40.22306	36.86512	1.09109	.301	
T6	.04614	713.67177	.04614	14.56473	.00317	.955	

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T8 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig. of F	
WITHIN CELLS	1706.40	49	34.82			
LEVEL BY VALENCE	14.94	1	14.94	.43	.516	

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T9	25.93940	347.55576	25.93940	7.09297	3.65705	.062	
T10	.15408	160.20084	.15408	3.26940	.04713	.829	
T11	.93456	138.05274	.93456	2.81740	.33171	.567	

Tests involving 'VALENCE BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T13	.18530	12.24347	.18530	.24987	.74158	.393	
T14	.10262	7.48895	.10262	.15284	.67143	.417	
T15	.20338	4.71425	.20338	.09621	2.11395	.152	

EFFECT .. LEVEL BY VALENCE BY TIME (Cont.)

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T17	9.07957	599.93016	9.07957	12.24347	.74158	.393	
T18	5.02829	366.95876	5.02829	7.48895	.67143	.417	
T19	9.96566	230.99813	9.96566	4.71425	2.11395	.152	

STUDY 6 ANALYSES SET 3 HR E4 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
---------------------	----	----	----	---	-----------

WITHIN CELLS	11611.68	49	236.97		
CONSTANT	1690.89	1	1690.89	7.14	.010

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
---------------------	----	----	----	---	-----------

WITHIN CELLS	3564.53	49	72.75		
LEVEL	415.60	1	415.60	5.71	.021

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
---------------------	----	----	----	---	-----------

WITHIN CELLS	111.20	49	2.27		
VALENCE	.60	1	.60	.26	.610

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	3289.82034	3518.77648	3289.82034	71.81176	45.81172	.000
T5	140.11641	2772.09706	140.11641	56.57341	2.47672	.122
T6	75.77927	1970.53911	75.77927	40.21508	1.88435	.176

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T12 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
---------------------	----	----	----	---	-----------

WITHIN CELLS	5448.82	49	111.20		
LEVEL BY VALENCE	29.24	1	29.24	.26	.610

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T13	4.00136	283.39636	4.00136	5.78360	.69185	.410
T14	.78360	213.68097	.78360	4.36084	.17969	.673
T15	1.03664	163.36972	1.03664	3.33408	.31092	.580

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T21	.64761	8.07780	.64761	.16485	3.92840	.053
T22	.07084	9.64781	.07084	.19689	.35977	.551
T23	.00041	5.05400	.00041	.10314	.00397	.950

EFFECT .. LEVEL BY VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T29	31.73282	395.81209	31.73282	8.07780	3.92840	.053
T30	3.47101	472.74272	3.47101	9.64781	.35977	.551
T31	.02004	247.64602	.02004	5.05400	.00397	.950

STUDY 6 ANALYSES SET 3 SCL E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	155.00	49	3.16		
CONSTANT	7.59	1	7.59	2.40	.128

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	13.28	49	.27		
LEVEL	.53	1	.53	1.96	.168

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	1.02	49	.02		
VALENCE	.00	1	.00	.12	.735

Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	14.31104	51.86100	14.31104	1.05839	13.52155	.001
T5	32.60454	32.02003	32.60454	.65347	49.89448	.000
T6	2.28589	17.00879	2.28589	.34712	6.58534	.013

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T16 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	47.13	49	.96		
LEVEL BY VALENCE	.02	1	.02	.02	.899

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T17	.09995	2.58145	.09995	.05268	1.89711	.175
T18	.08874	1.27536	.08874	.02603	3.40935	.071
T19	.00806	.81679	.00806	.01667	.48346	.490

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T29	.00012	.19213	.00012	.00392	.03073	.862
T30	.00173	.11154	.00173	.00228	.76107	.387
T31	.00316	.05981	.00316	.00122	2.58987	.114

EFFECT .. LEVEL BY VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T41	.02430	9.29619	.02430	.18972	.12808	.722
T42	.06568	5.59006	.06568	.11408	.57569	.452
T43	.03868	2.10754	.03868	.04301	.89920	.348

STUDY 6 ANALYSES SET 3 SCL E0 TO E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	41.71	49	.85		
CONSTANT	18.43	1	18.43	21.65	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	3.91	49	.08		
LEVEL	.07	1	.07	.85	.360

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	.31	49	.01		
VALENCE	.00	1	.00	.48	.493

Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	14.17662	31.51154	14.17662	.64309	22.04444	.000
T5	.14343	27.75513	.14343	.56643	.25321	.617
T6	.54023	9.89543	.54023	.20195	2.67508	.108

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T9 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	12.05	49	.25		
LEVEL BY VALENCE	.00	1	.00	.02	.900

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.08379	1.64301	.08379	.03353	2.49900	.120
T11	.02101	.83736	.02101	.01709	1.22928	.273
T12	.00005	.30143	.00005	.00615	.00791	.929

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.00027	.13820	.00027	.00282	.09663	.757
T16	.00470	.06345	.00470	.00129	3.63231	.063
T17	.00024	.03534	.00024	.00072	.32594	.571

Tests involving 'LEVEL BY VALENCE BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T20	.00047	7.13752	.00047	.14566	.00325	.955
T21	.01891	2.11587	.01891	.04318	.43794	.511
T22	.01605	1.13132	.01605	.02309	.69506	.408

STUDY 6 ANALYSES SET 3 SCL E5 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	199.88	49	4.08			
CONSTANT	1.40	1	1.40	.34	.561	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	13.45	49	.27			
LEVEL	.68	1	.68	2.48	.121	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	1.04	49	.02			
VALENCE	.00	1	.00	.00	.952	

Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	42.55080	33.68237	42.55080	.68740	61.90150	.000
T5	.46442	8.76664	.46442	.17891	2.59582	.114
T6	.39512	3.76878	.39512	.07691	5.13721	.028

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T11 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	50.92	49	1.04			
LEVEL BY VALENCE	.00	1	.00	.00	.952	

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T12	.01901	1.06251	.01901	.02168	.87691	.354
T13	.00277	.49725	.00277	.01015	.27282	.604
T14	.00110	.27843	.00110	.00568	.19361	.662

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T19	.00284	.04725	.00284	.00096	2.94674	.092
T20	.00025	.02754	.00025	.00056	.45222	.504
T21	.00000	.01578	.00000	.00032	.00011	.991

EFFECT .. LEVEL BY VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T26	.13923	2.31512	.13923	.04725	2.94674	.092
T27	.01246	1.34963	.01246	.02754	.45222	.504
T28	.00000	.77320	.00000	.01578	.00011	.991

STUDY 6 ANALYSES SET 4 HR PA clusters E0 TO E12
Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	6114.96	49	124.80		
CONSTANT	509.07	1	509.07	4.08	.049

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	3773.55	49	77.01		
LEVEL	136.83	1	136.83	1.78	.189

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	1483.71772	1455.38588	1483.71772	29.70175	49.95388	.000
T4	370.67851	875.74302	370.67851	17.87231	20.74038	.000
T5	206.99614	939.47283	206.99614	19.17291	10.79628	.002

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.48156	381.94237	.48156	7.79474	.06178	.805
T16	21.19351	354.78519	21.19351	7.24051	2.92707	.093
T17	12.07034	419.56807	12.07034	8.56261	1.40966	.241

STUDY 6 ANALYSES SET 4 HR PA CLUSTERS E0 TO E4

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	2062.91	49	42.10		
CONSTANT	83.53	1	83.53	1.98	.165

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares					
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	1473.16	49	30.06		
LEVEL	49.97	1	49.97	1.66	.203

Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	106.01373	897.87161	106.01373	18.32391	5.78554	.020
T4	18.13119	956.78170	18.13119	19.52616	.92856	.340
T5	.02789	365.88519	.02789	7.46704	.00373	.952

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T7	32.85609	420.74422	32.85609	8.58662	3.82643	.056
T8	1.71098	285.94947	1.71098	5.83570	.29319	.591
T9	8.50192	150.99555	8.50192	3.08154	2.75898	.103

STUDY 6 ANALYSES SET 4 HR PA CLUSTERS E4 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	5725.69	49	116.85		
CONSTANT	877.51	1	877.51	7.51	.009

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	3200.81	49	65.32		
LEVEL	112.18	1	112.18	1.72	.196

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	1691.39149	1793.42510	1691.39149	36.60051	46.21224	.000
T4	73.24409	1362.21388	73.24409	27.80028	2.63465	.111
T5	38.06589	991.63304	38.06589	20.23741	1.88097	.176

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T11	6.59880	332.46210	6.59880	6.78494	.97256	.329
T12	.47810	407.28510	.47810	8.31194	.05752	.811
T13	.38420	229.41230	.38420	4.68188	.08206	.776

STUDY 6 ANALYSES SET 4 HR NA CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	6416.41	49	130.95		
CONSTANT	485.59	1	485.59	3.71	.060

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	5764.30	49	117.64		
LEVEL	236.63	1	236.63	2.01	.162

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	1373.37675	1370.34119	1373.37675	27.96615	49.10854	.000
T4	350.16446	949.25250	350.16446	19.37250	18.07534	.000
T5	181.34675	977.09681	181.34675	19.94075	9.09428	.004

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	119.10783	684.62640	119.10783	13.97197	8.52477	.005
T16	.67457	456.16192	.67457	9.30943	.07246	.789
T17	8.83130	244.05105	8.83130	4.98063	1.77313	.189

STUDY 6 ANALYSES SET 4 HR NA CLUSTERS E0 TO E4

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	2139.97	49	43.67		
CONSTANT	69.87	1	69.87	1.60	.212

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	1329.64	49	27.14		
LEVEL	2.57	1	2.57	.09	.760

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	93.84828	923.01944	93.84828	18.83713	4.98209	.030
T4	22.19449	857.09829	22.19449	17.49180	1.26885	.265
T5	.22164	352.50083	.22164	7.19389	.03081	.861

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T7	2.16287	526.74170	2.16287	10.74983	.20120	.656
T8	3.47139	241.21013	3.47139	4.92266	.70519	.405
T9	2.39831	218.05532	2.39831	4.45011	.53893	.466

STUDY 6 ANALYSES SET 4 HR NA CLUSTERS E4 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	5997.19	49	122.39		
CONSTANT	813.98	1	813.98	6.65	.013

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig. of F
WITHIN CELLS	5812.54	49	118.62		
LEVEL	332.67	1	332.67	2.80	.100

Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	1599.07646	1733.42917	1599.07646	35.37611	45.20216	.000
T4	66.94316	1419.53100	66.94316	28.97002	2.31077	.135
T5	37.71379	983.96007	37.71379	20.08082	1.87810	.177

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T11	29.13539	346.74634	29.13539	7.07646	4.11723	.048
T12	3.77651	279.13859	3.77651	5.69671	.66293	.419
T13	.67248	181.60343	.67248	3.70619	.18145	.672

STUDY 6 ANALYSES SET 4 SCL PA CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	80.51	49	1.64			
CONSTANT	3.66	1	3.66	2.23	.142	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	34.21	49	.70			
LEVEL	.18	1	.18	.26	.612	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	7.11406	25.65751	7.11406	.52362	13.58623	.001
T4	16.54080	16.97416	16.54080	.34641	47.74900	.000
T5	1.05952	8.15665	1.05952	.16646	6.36493	.015

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.01284	6.39850	.01284	.13058	.09834	.755
T16	.15355	4.14116	.15355	.08451	1.81685	.184
T17	.04102	2.05176	.04102	.04187	.97968	.327

STUDY 6 ANALYSES SET 4 SCL PA CLUSTERS E0 TO E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	21.10	49	.43			
CONSTANT	8.98	1	8.98	20.86	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	9.51	49	.19			
LEVEL	.02	1	.02	.10	.752	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	7.15060	16.53038	7.15060	.33735	21.19610	.000
T4	.10004	13.88003	.10004	.28327	.35316	.555
T5	.28150	4.86194	.28150	.09922	2.83703	.098

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	.04843	5.78286	.04843	.11802	.41035	.525
T9	.03989	1.99267	.03989	.04067	.98091	.327
T10	.00716	.55400	.00716	.01131	.63370	.430

STUDY 6 ANALYSES SET 4 SCL PA CLUSTERS E5 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	103.46	49	2.11		
CONSTANT	.69	1	.69	.33	.570

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	36.41	49	.74		
LEVEL	.29	1	.29	.39	.534

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	21.62453	17.21913	21.62453	.35141	61.53631	.000
T4	.22147	4.21019	.22147	.08592	2.57759	.115
T5	.19744	1.85679	.19744	.03789	5.21037	.027

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.13057	1.50968	.13057	.03081	4.23803	.045
T11	.01348	1.27717	.01348	.02606	.51734	.475
T12	.00051	.70301	.00051	.01435	.03529	.852

STUDY 6 ANALYSIS SET 4 SCL NA E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	75.50	49	1.54		
CONSTANT	3.93	1	3.93	2.55	.117

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	26.21	49	.53		
LEVEL	.37	1	.37	.68	.413

Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	7.19710	26.39562	7.19710	.53869	13.36048	.001
T4	16.06547	15.15740	16.06547	.30933	51.93556	.000
T5	1.22953	8.91195	1.22953	.18188	6.76026	.012

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.11140	5.47913	.11140	.11182	.99629	.323
T16	.00087	2.72427	.00087	.05560	.01558	.901
T17	.00571	.87257	.00571	.01781	.32080	.574

STUDY 6 ANALYSES SET 4 SCL NA CLUSTERS E0 TO E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	20.92	49	.43			
CONSTANT	9.45	1	9.45	22.14	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	6.44	49	.13			
LEVEL	.05	1	.05	.40	.531	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	7.02629	15.11936	7.02629	.30856	22.77134	.000
T4	.04809	13.93855	.04809	.28446	.16906	.683
T5	.25896	5.06883	.25896	.10345	2.50335	.120

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	.03584	2.99768	.03584	.06118	.58580	.448
T9	.00003	.96056	.00003	.01960	.00141	.970
T10	.00893	.87875	.00893	.01793	.49805	.484

STUDY 6 SCL ANALYSES SET 4 NA clusters e5 to e12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	97.46	49	1.99			
CONSTANT	.71	1	.71	.36	.553	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	27.96	49	.57			
LEVEL	.39	1	.39	.69	.410	

Tests involving 'TIME' Within-Subject Effect.

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	20.92911	16.51048	20.92911	.33695	62.11365	.000
T4	.24320	4.58399	.24320	.09355	2.59969	.113
T5	.19768	1.92777	.19768	.03934	5.02469	.030

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.02767	1.86795	.02767	.03812	.72578	.398
T11	.00174	.56970	.00174	.01163	.14964	.701
T12	.00060	.34862	.00060	.00711	.08371	.774

APPENDIX 19

Bett's Questionnaire Upon Mental Imagery (QMI) (Sheehan, 1967)

Please see print copy for image



APPENDIX 20

Study 7a Ratings, PANAS and QMI Scores

V35	V36	V37	V38	V39	V40	V41	V42	V43	V44	V45	V46	V47	V48	V49	V50	V51	V52	V53	V54	V55	V56	V57	V58	V59	V60	V61	V62	V63	V64	V65	V66	V67	V68
2	2	3	2	4	3	4	4	3	4	2	3	4	3	4	1	1	2	3	4	2	1	3	3	2	1	2	3	3	4	3	1	1	1
3	3	2	2	4	3	4	4	3	4	2	3	4	3	4	2	1	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
4	4	3	4	4	3	4	4	3	4	2	3	4	3	4	2	1	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
5	5	4	4	4	3	4	4	3	4	2	3	4	3	4	2	1	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
6	6	5	4	4	3	4	4	3	4	2	3	4	3	4	2	1	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
7	7	6	5	4	3	4	4	3	4	2	3	4	3	4	2	1	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
8	8	7	6	5	4	3	4	3	4	2	3	4	3	4	2	1	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
9	9	8	7	6	5	4	3	4	3	4	2	3	4	3	4	2	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
10	10	9	8	7	6	5	4	3	4	2	3	4	3	4	2	1	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
11	11	10	9	8	7	6	5	4	3	4	2	3	4	3	4	2	1	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
12	12	11	10	9	8	7	6	5	4	3	4	2	3	4	3	4	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	1	
13	13	12	11	10	9	8	7	6	5	4	3	4	2	3	4	3	4	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	
14	14	13	12	11	10	9	8	7	6	5	4	3	4	2	3	4	3	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	
15	15	14	13	12	11	10	9	8	7	6	5	4	3	4	2	3	4	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	
16	16	15	14	13	12	11	10	9	8	7	6	5	4	3	4	2	3	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	
17	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	4	2	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	
18	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	4	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	
19	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	
20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	2	2	3	4	3	3	2	1	2	3	3	4	3	1	1	

[illegible]

[illegible]

[illegible]

v175	v176	v177	v178	v179	v180	v181	v182	v183	v184	v185	v186	v187	v188	v189	v190	v191	v192	v193	v194	v195	v196	v197	v198	v199	v200
3	4	4	5	2	4	3	2	1	1	2	1	1	3	3	3	1	4	4	4	3	1	3	3	3	2
4	3	4	4	3	3	3	3	2	5	1	2	1	3	3	3	1	4	1	1	1	3	3	3	3	
3	3	1	3	3	3	3	3	2	1	2	1	1	5	2	3	1	4	1	1	2	4	4	4	1	
3	1	4	4	3	6	4	1	3	1	3	1	1	5	1	1	1	5	1	1	3	3	5	1	3	
2	5	5	5	2	2	5	1	4	1	1	1	1	4	4	5	1	3	1	4	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	2	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	
1	3	3	3	3	1	4	3	1	3	3	1	1	4	4	4	1	4	1	1	1	3	3	4	1	

[illegible]

	b17	b18	b19	b20	b1	b2	b3	b4	b5	b6	b7	b8	b9	b10	b11	b12	b13	b14	b15	b16	b17	b18	b19	b20
3	3	3	3	1	2	2	2	1	4	2	1	1	1	2	1	3	1	3	2	3	3	2	1	2
3	3	2	2	2	3	2	2	1	2	2	1	1	2	1	2	2	1	2	1	1	3	2	2	2
3	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1						

APPENDIX 21

Study 7a HR and SCL raw data

h=11		h=12		h=0		h=1		h=2		h=3		h=4		h=5		h=6		h=7		h=8		h=9		h=10		h=11		h=12		h=0		h=1	
73.24	73.67	80.05	74.77	71.2	74.52	73.88	78.75	70.58	74.05	65.93	69.78	70.49	72.53	72.23	74.68	77.69	72.65	71.77	73.9	77.23	77.24	73.52	76.26	73.34	70.98	74.73	71.76	72.54	73.93				
80.3	79.18	84.17	81.09	84.78	85.87	83.54	85.88	81.93	80.98	79.81	81.41	80.46	81.7	42.29	87.02	89.76	91.8	93.97	94.57	91.64	91.37	94.95	93.99	94.56	93.56	95.51	93.81	73.62	76.89				
48.53	41.66	40.08	45.17	38.72	38.84	43.96	38.95	38.56	38.56	40.05	39.17	39.95	41.17	78.53	87.02	40.98	41.52	48.7	41.85	44.44	41.37	38.97	38.32	38.08	37.28	39.95	40	38.53	36.69				
60.76	63.94	70.21	73.96	75.07	61.54	65.76	68.36	66.55	78.5	79.88	65.63	62.38	61.7	69.53	71.5	57.07	71.02	72.14	60.67	59.6	61.11	81.82	78.88	65.68	67.58	65.69	64.8	72.68	70.15				
57.92	61.88	59.8	65.54	57.18	62.23	64.4	58.56	60.79	58.81	60.58	58.66	58.55	55.6	62.73	59.12	59.82	102.3	102.3	59.6	61.11	63.2	61.33	63.77	62.58	63.92	64.17	56.42	73.47					
52.8	52.69	53.91	52.92	55.26	54.69	59.33	65.09	73.54	58.84	59.73	58.84	60.73	58.07	64.48	55	53.07	100.64	53.89	58.28	63.59	66.88	64.09	56.87	59.52	56.08	60.43	57.48	53.5	53.41				
103.83	101.89	101.51	97.02	100.12	100.8	100.8	100.75	94.29	102.33	102.33	84.98	60.73	58.07	64.48	55	53.07	100.64	53.89	58.28	63.59	66.88	64.09	56.87	59.52	56.08	60.43	57.48	53.5	53.41				
78.37	73.45	74.43	74.02	73.95	81.34	89.77	89.64	87.86	83.43	89.25	82.51	81.38	82.38	87.05	98.9	100.5	95.72	104.54	100.64	99.72	102.35	84.88	80.47	82.48	122.49	88.95	106.76	103.32	100.86				
109.19	109.68	99.08	100.98	99.51	106.58	93.74	105.09	116.61	103.36	102.33	84.98	60.73	58.07	64.48	55	53.07	100.64	53.89	58.28	63.59	66.88	64.09	56.87	59.52	56.08	60.43	57.48	53.5	53.41				
58.91	58.1	61.87	63.84	67.66	65.8	62.62	59.15	58.45	60.21	60.86	83.66	58.64	52.95	59.56	63.91	65.95	70.82	101.04	124.84	121.27	121.62	126.3	122.66	123.01	122.48	120.15	119.82	104.16	102.18				
90.05	88.87	81.95	83.05	80.74	82.28	81.86	88.23	84.6	84.04	80.86	83.66	58.64	52.95	59.56	63.91	65.95	70.82	101.04	124.84	121.27	121.62	126.3	122.66	123.01	122.48	120.15	119.82	104.16	102.18				
74.22	75.1	72.86	71.88	74.82	76.22	72.11	80.26	86.42	82.43	79.73	72.85	76.61	74.35	73.28	75.13	73.88	74.03	73.23	72.25	83.39	78.92	79.85	75.28	73.46	75.24	75	72.83	76.31	82.31				
81.57	65.1	69.84	80.14	69.27	80.23	84.78	90.08	89.09	81.05	88.25	84.19	83.33	85.62	78.48	76.72	74.33	80.93	69.27	71.6	89.23	93.01	86.5	75.25	74.14	85.6	98.66	95.29	91.08	66.89				
64.91	66.57	77.17	78.33	79.46	78.61	71.05	77.51	66.97	73.51	68.99	68.21	64.55	60.65	61.38	61.47	62.99	64.74	63.33	68.04	67.47	70.47	67.83	79.05	94.66	92.09	95.29	91.08	66.89					
56.19	60.23	62.87	62.47	66.35	61.57	66.07	73.51	66.97	73.51	68.99	68.21	64.55	60.65	61.38	61.47	62.99	64.74	63.33	68.04	67.47	70.47	67.83	79.05	94.66	92.09	95.29	91.08	66.89					
50.51	49.31	47.4	51.99	50.21	58.51	58.51	48.09	48.67	48.12	58.51	48.09	48.67	48.12	58.51	48.09	48.67	48.12	58.51	48.09	48.67	48.12	58.51	48.09	48.67	48.12	58.51	48.09	48.67					
81.97	83.56	81.47	78.12	78.49	80.32	79.86	86.56	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16	85.16					
95.19	103.89	111.51	110.9	106.21	101.3	118.86	121.24	95.15	112.95	111.13	114.89	111.13	116.98	105.94	115.92	105.13	111.96	107.34	115.92	120.46	107.63	116.66	117.37	114.03	122.93	112.5	106.64	88.7					
67.97	66.33	77.74	78.25	77.54	91.06	81.12	69.56	71.04	70.84	76.08	70.95	73.2	72.83	73.09	72.72	82.64	88.63	85.34	82.95	81.91	75.85	79.03	78.73	80.06	78.34	79.67	81.72	80.45					
77.85	83.95	78.47	79.31	77.63	77.54	76.64	73.8	69.21	71.04	70.84	76.08	70.95	73.2	72.83	73.09	72.72	82.64	88.63	85.34	82.95	81.91	75.85	79.03	78.73	80.06	78.34	79.67	81.72	80.45				
55.11	51.16	46.93	48.69	49.6	50.27	56.27	55.39	65.26	68.54	65.92	62.43	61.31	61.69	59.44	50.69	51.39	52.57	51.73	51.6	60.82	65.49	59.13	62.77	58.64	57.24	59.55	55.47	49.11	50.61				
97.08	80.59	103.5	98.67	103.06	98.34	104.18	97.51	105.83	106.57	109.17	114.48	116.36	106.35	106.09	101.24	101.23	102.69	103.35	103.91	106.83	116.07	113.43	116.76	113.17	107.89	107.89	107.89	107.89	107.89				
75.4	78.03	77.02	76.87	74.38	81.16	80.69	81.66	88.27	84.66	77.93	84.43	81.94	81.42	80.08	81.24	81.49	73.95	81.09	77.4	78.9	84.12	84.12	74.86	76.84	78.04	81.74	77.9	78.73	72.86				
104.91	104.75	120.47	106.84	104.84	109.08	108.01	107	103.98	109.3	111.56	111.88	106	108.52	114.85	104.7	104.9	105.19	106.65	106.67	107.43	106.46	105.94	109.03	102.61	95.57	99.99	97.14	106.94	105.45				
83.83	83.18	84.1	88.84	97.91	89.01	97.15	91.17	87.39	83.86	84.28	86.55	85.88	84.26	85.93	89.43	89.26	89.63	89.63	89.63	89.63	89.63	89.63	89.63	89.63	89.63	89.63	89.63	89.63					
70.39	64.57	64.04	65.22	61.43	64.77	60.83	60.34	59.33	67.63	66.11	66.09	68.46	62.99	64.11	71.91	76.32	71.78	74.59	75.77	70.09	69.44	76.08	84.73	75.34	73.39	61.65	72.99	62.79	63.65				
73.68	73.86	68.96	70.33	74.29	97.02	93.87	88.34	90.24	98.33	93.91	94.06	95.94	90.9	90.76	76.2	68.09	77.2	78.37	72.96	79.59	70.1	73.23	74.44	76.24	72.21	77.34	83.42	82.46	80.84				
84.34	83.57	67.89	68.22	67.86	78.03	79.4	74.39	70.86	81.58	73.75	71.94	71.28	83.36	87.7	73.41	73.41	73.41	73.41	73.41	73.41	73.41	73.41	73.41	73.41	73.41	73.41	73.41	73.41					
70.12	66.77	75.06	75.66	76.74	81.76	91.4	72.87	80.11	78.51	77.75	79.7	82.23	81.39	82.23	81.39	82.23	81.39	82.23	81.39	82.23	81.39	82.23	81.39	82.23	81.39	82.23	81.39	82.23					
82.67	78.91	60.62	66.46	78.83	81.76	81.74	77.98	75.55	76.15	73.52	79.7	76.26	88.01	70.64	79.31	72.28	86.3	78.01	109.87	111.53	109.87	111.53	109.87	111.53	109.87	111.53	109.87	111.53					
77.15	70.39	60.62	72.03	99.88	101.63	104.05	95.05	100.59	104.09	106.12	100.24	74.53	73.8	76.56	95.43	78.63	80.2	84.41	87.94	89.52	90.45	90.82	88.62	85.72	84.06	83.3	80.58	81.84					
64.2	77.76	97.86	84.31	83.1	92.01	81.72	82.78	78.28	81.38	81.31	76.92	74.53	73.8	76.56	95.43	78.63	80.2	84.41	87.94	89.52	90.45	90.82	88.62	85.72	84.06	83.3	80.58	81.84					
81.06	78.66	101.67	102.21	99.09	92.83	91.82	91.15	91.54	91.74	88.69	94.72	74.63	73.8	76.56	95.43	78.63	80.2	84.41	87.94	89.52	90.45	90.82	88.62	85.72	84.06	83.3	80.58	81.84					
97.04	94.64	67.72	71.53	73.15	71.18	67.5	71.86	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24						
66.17	67.72	70.39	70.28	66.99	78.49	73.33	66.59	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24	68.24						
69.99	65.67	73.57	75.48	81.82	83.88	83.16	70.36	71.58	76.51	61.37	62.57	65	74.59	68.86	74.27	73.6	80.8	80.54	73.88	79.51	78.36	77.18	81.56	71.15	79.34	79.79	81.56	72.8					
63.38	67.03	73.78	74.20																														

hm2	hm3	hm4	hm5	hm6	hm7	hm8	hm9	hm10	hm11	hm12
72.49	76.24	74.19	77.07	74.37	74.24	77.98	72.97	74.44	70.31	72.1
84.63	84.77	83.51	82.43	90.63	79.98	76.87	79.11	75.35	84.69	87.11
46.73	38.94	51.52	42.36	48.33	39.16	38.2	37.5	38.82	41.14	38.86
80.41	68.11	66.02	65.56	68.45	70.64	64.22	64.41	63.59	63.36	65.98
52.58	56.58	63.11	60.39	58.59	58.47	60.83	60.68	59.09	59.17	62.26
52.55	52.06	53.66	62.58	63.23	61.8	61.98	57.65	60.26	60.56	57.64
80.11	105.66	105.13	112.9	101.91	102.25	103.47	103.48	103.81	104.96	
73.51	83.25	92.36	91.72	83.53	87.16	80.39	81.55	79.74	77.22	79.24
104.59	111.02	102.33	119.51	106.61	110.8	103.86	107.88	106.42	107.38	106.96
67.43	81.22	77.27	71.06	64.78	63.94	58.08	60.22	62.43	57.65	58.64
93.6	82.86	94.51	94.68	99.88	103.62	102.91	104.69	99.69	99.32	99.66
77.71	85.23	82.27	89.1	95.75	78.68	72.07	72.51	72.4	73.29	71.25
86.08	83.66	76.69	92.56	77.84	78.68	78.1	81.66	83.42	85.07	84.31
88.92	80.05	74.88	70.58	83.18	80.78	81.3	79.46	78.51	77.24	77.04
66.1	86.43	67.32	73.45	80.69	70.48	66.77	71.29	50.12	64.64	65.46
48.66	50.	59.81	55.27	50.76	55.15	48.93	55.07	50.76	57.64	54.52
76.7	80.66	83.12	87.21	91.65	100.68	101.7	95.07	87.03	82.51	89.06
100.92	109.45	121.65	107.52	110.53	115.8	108.88	114.18	110.32	110.07	111.31
77.07	87.28	80.03	75.13	67.83	75.15	72.71	73.81	73.81	73.81	70.95
83.81	91.38	85.21	83.14	78.61	80.04	74.61	76.16	77.34	77.34	79.81
52.8	47.17	51.61	58.9	65.82	63.43	55.04	56.92	57.35	54	52.64
106.44	105.12	105.09	112.65	121	122.32	116.57	106.79	110.79	110.03	104.57
75.12	79.79	78.47	80.9	82.75	80.1	78.18	76.96	77.76	75.29	79
78.85	78.42	76.7	74.33	80.68	82.18	86.88	71.93	78.28	74.52	81.34
107.58	103.97	97.86	101.62	105.56	106.8	108.01	110.7	112.48	108.58	107.74
90.31	97.06	93.2	89.47	89.41	87.03	88.02	89.24	89.02	87.75	85.3
67.38	61.38	62.25	73.67	67.37	71.86	88.63	77.45	76.58	85.21	65.48
73.58	78.16	69.75	74.32	76.69	82.16	84.86	89.5	84.58	85.47	77.05
95.55	103.5	101.62	89.41	78.8	77.46	79.37	81.47	82.72	80.36	78.08
71.53	77.38	86.19	75.84	72.76	73.2	70.4	74.66	66.22	66.25	68.38
94.19	91.02	93.96	106.81	106.65	108.28	105.36	107.67	101.17	101.17	101.42
81.98	77.5	93.28	81.11	82.58	80.7	79.58	83.75	86.07	93.09	83.82
82.19	73.07	82.43	75.06	80.69	70.11	79.04	67.82	79.21	77.43	72.94
100.95	98.46	104.53	98.18	91.39	99.25	97.1	97.74	99.33	96.41	99.99
79.16	82.9	84.32	89.99	95.13	91.27	88.68	84.02	82.42	82.15	81.42
94.04	102.35	102.19	97.9	87.58	84.6	86.91	86.94	90.6	89.7	90.65
74.97	77.55	76.8	66.64	70.42	67.65	66.66	67.74	67.02	68.91	72.25
71.39	79.95	78.68	72.22	70.28	72.65	66.09	69.86	66.26	67.55	68.36
81.78	89.45	77.38	75.71	59.93	65.31	66.02	72.19	76.67	73.98	78.12
69.67	77.43	77.43	73.94	73.44	84.55	74.31	87.77	79.8	80.21	83.56
105.26	105.08	108.12	105.36	105.8	96.88	100.45	101.39	98.48	107.44	107.36
64.76	82.54	82.2	77.22	62.57	64.74	57.73	49.72	55.93	55.79	49.17
95.19	97.28	97.65	103.5	100.07	98.54	94.89	97.24	96.15	95.92	96.16
84	91.32	99.39	99.39	89.57	100.14	101.5	99	95.92	96.3	95.57
86.27	88.2	85.99	96.87	97.72	88.07	83.86	85.47	84.23	79.21	82.96
90.75	82.11	89.14	90.07	85.97	91.82	72.98	86.93	89.94	84.88	91.2
100.75	97.87	93.99	96.32	87.65	100.45	96.59	103.1	89.44	97.08	95.85
86.61	89.4	99.37	95.93	92.97	94.28	87.88	88.08	82.77	89.55	88.83
78.92	79.66	78.16	80.4	80.85	86.41	86.29	93.1	82.95	80.14	81.21
73.22	83.5	80.85	81.46	79.15	75.27	78.91	82	74.38	72.64	73.04

Study 7a SCL data

[illegible]

	scn2	scn3	scn4	scn5	scn6	scn7	scn8	scn9	scn10	scn11	scn12
	8.41	9.34	12.24	14.88	13.15	11.88	11.14	10.69	10.4	10.17	9.97
	5.65	5.59	5.56	5.53	5.49	5.45	5.4	5.36	5.32	5.35	5.38
	2.58	2.99	3.96	3.99	3.64	3.48	3.38	3.3	3.26	3.21	3.18
	6.37	5.96	5.79	5.67	5.63	5.78	5.62	5.55	5.48	5.44	5.42
	6.1	6.1	6.47	6.49	6.38	6.32	6.28	6.22	6.18	6.14	6.1
	7.29	7.23	7.38	8.2	6.3	8.19	7.88	7.73	7.62	7.61	7.53
	5.7	5.59	5.55	5.87	5.66	5.72	5.67	5.6	5.59	5.58	5.55
	6.65	7.36	9.23	8.75	8.25	6.12	7.77	7.44	7.38	7.19	7.03
	8.77	10.18	9.39	8.77	8.64	8.55	8.38	8.27	8.2	8.13	8.08
	5.78	8.65	6.22	6.01	5.81	5.65	5.56	5.38	5.25	5.14	5.08
	7.13	6.97	7.64	12.1	10.62	9.82	9.69	8.96	8.64	8.28	7.96
	4.71	4.71	4.85	4.95	4.84	4.76	4.73	4.7	4.68	4.67	4.65
	8.37	8.23	8.72	10.02	9.48	8.92	8.57	8.31	8.52	8.71	8.05
	7.38	7.25	7.15	7.86	13.44	10.45	9.47	8.9	8.53	8.31	8.15
	10.67	10.61	10.71	12.93	12.77	11.94	11.57	11.37	11.28	11.14	11.05
	4.74	4.71	4.69	4.73	4.73	4.7	4.68	4.65	4.64	4.62	4.6
	8.74	8.65	8.6	8.6	8.68	9.24	9.12	8.83	8.67	8.58	8.52
	6.68	6.68	6.82	6.88	6.81	6.76	6.73	6.72	6.67	6.64	6.66
	14.93	13.31	11.41	10.59	10.03	9.59	9.23	9.1	8.82	8.58	8.36
	7.3	7.81	7.9	7.51	7.4	7.28	7.25	7.21	7.17	7.15	7.16
	6.26	6.24	6.22	6.22	6.27	6.39	6.38	6.29	6.22	6.18	6.15
	6.82	6.97	7.29	9.17	10.69	9.32	8.53	8.13	7.87	7.85	7.47
	9.01	11.83	12.61	11.31	10.74	10.34	10.06	9.84	9.65	9.48	9.34
	8.44	8.43	8.43	8.42	8.66	9.03	8.61	8.5	8.57	8.41	8.36
	7.09	7.01	6.94	6.84	6.76	7.66	7.89	7.67	7.5	7.37	7.27
	5	5.09	5.02	4.87	4.82	4.73	4.67	4.64	4.61	4.59	4.56
	15.49	15.24	15.07	16.17	16.41	15.74	16.37	16.06	15.78	15.7	15.62
	8.84	8.57	8.59	8.54	9.14	10.84	9.72	10.39	9.68	10.38	10.08
	5.78	5.74	6.04	6.1	6.01	5.93	5.96	5.8	5.74	5.68	5.63
	13.88	15.47	15.2	14.13	13.96	13.8	13.89	13.69	13.81	13.69	13.56
	5.06	5.03	5.07	5.37	5.47	5.38	5.3	5.23	5.18	5.15	5.12
	6.42	6.62	6.87	6.76	6.59	6.52	6.47	6.44	6.43	6.41	6.39
	13.9	14.52	14.33	14.83	14.27	14.05	13.87	13.78	13.65	13.55	13.58
	8.56	8.41	8.95	9.85	9.43	9.43	9.12	8.79	8.64	8.54	8.55
	15.38	16.22	16.37	15.99	16.42	16.12	15.78	15.59	15.46	15.33	15.26
	14.31	15.06	15.29	14.93	14.79	14.56	14.52	14.39	14.45	14.45	14.46
	10.26	10.61	10.83	10.53	10.43	10.36	10.24	10.22	10.14	10.07	10
	10.55	10.53	12.65	12.05	11.79	11.62	11.58	11.45	11.36	11.24	11.16
	9.88	10.24	9.88	9.72	9.66	9.54	9.44	9.35	9.28	9.22	9.16
	6.41	6.38	6.35	6.4	6.36	6.88	7.05	6.78	6.7	6.53	6.58
	10.18	10	9.95	11.71	11.64	10.98	10.68	10.49	10.36	10.47	10.41
	11.09	11.33	11.13	10.94	10.81	10.72	10.64	10.6	10.54	10.47	10.41
	6.74	6.71	6.86	7.4	7.12	6.97	6.87	6.8	6.76	6.71	6.68
	6.92	6.72	7.22	8.1	7.78	7.47	7.18	6.99	6.85	6.74	6.65
	10.59	10.58	10.51	10.64	12.18	12.29	12.4	12.59	12.19	11.95	11.15
	12.57	13.05	12.7	12.45	12.45	12.29	12.5	13.06	13.01	12.09	12.96
	13.26	13.17	13.19	13.04	12.95	13.12	13.14	13.06	13.01	13.12	12.96
	9.69	9.75	9.6	9.44	9.56	9.54	9.54	9.55	9.44	9.37	9.31
	7.88	7.96	7.89	7.81	7.85	9.75	9.84	9.22	8.8	8.53	8.35
	12.88	13.46	12.74	12.51	12.41	12.34	12.3	12.35	12.46	12.27	12.13

APPENDIX 22

Study 7a Statistical Outcomes

STUDY 7 ANALYSES SET 1 HR E0 to E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	18396.68	49	375.44			
CONSTANT	6620.74	1	6620.74	17.63	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	2950.59	49	60.22			
LEVEL	310.17	1	310.17	5.15	.028	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	1526.31	49	31.15			
VALENCE	172.72	1	172.72	5.54	.023	

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T4	1.17117	6560.04500	1.17117	133.87847	.00875	.926	
T5	2262.09408	2713.80219	2262.09408	55.38372	40.84403	.000	
T6	146.63260	3820.10053	146.63260	77.96124	1.88084	.176	

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T16 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	6117.46	49	124.85			
LEVEL BY VALENCE	64.98	1	64.98	.52	.474	

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T17	283.21108	513.44371	283.21108	10.47844	27.02797	.000	
T18	.68138	349.00666	.68138	7.12258	.09566	.758	
T19	20.29144	303.47495	20.29144	6.19337	3.27632	.076	

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T29	127.51385	277.48535	127.51385	5.66297	22.51715	.000	
T30	13.65981	174.45298	13.65981	3.56026	3.83674	.056	
T31	6.29861	174.82569	6.29861	3.56787	1.76537	.190	

EFFECT .. LEVEL BY VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T41	64.37925	776.79696	64.37925	15.85300	4.06101	.049
T42	15.35640	339.14028	15.35640	6.92123	2.21874	.143
T43	28.65386	602.92595	28.65386	12.30461	2.32871	.133

STUDY 7 ANALYSES SET 1 HR E0 TO E3

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	4521.14	49	92.27		
CONSTANT	836.21	1	836.21	9.06	.004

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	578.64	49	11.81		
LEVEL	4.73	1	4.73	.40	.530

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	335.10	49	6.84		
VALENCE	7.39	1	7.39	1.08	.304

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	882.52685	2075.45681	882.52685	42.35626	20.83581	.000
T5	101.71040	840.82295	101.71040	17.15965	5.92730	.019
T6	3.64739	552.44200	3.64739	11.27433	.32351	.572

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T7 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	1454.90	49	29.69		
LEVEL BY VALENCE	1.79	1	1.79	.06	.807

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	3.06720	332.33098	3.06720	6.78226	.45224	.504
T9	.30013	324.56949	.30013	6.62387	.04531	.832
T10	2.60307	219.77633	2.60307	4.48523	.58037	.450

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T11	.03667	157.18945	.03667	3.20795	.01143	.915
T12	3.77181	151.86768	3.77181	3.09934	1.21697	.275
T13	5.33976	231.38175	5.33976	4.72208	1.13081	.293

EFFECT .. LEVEL BY VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T14	6.46271	443.08201	6.46271	9.04249	.71471	.402
T15	8.49860	622.23260	8.49860	12.69862	.66925	.417
T16	16.82200	371.27215	16.82200	7.57698	2.22015	.143

STUDY 7 ANALYSES SET 1 HR E3 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	21104.52	49	430.70		
CONSTANT	7537.44	1	7537.44	17.50	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	2958.14	49	60.37		
LEVEL	438.55	1	438.55	7.26	.010

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	1484.85	49	30.30		
VALENCE	270.87	1	270.87	8.94	.004

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	1244.28034	4452.43690	1244.28034	90.86606	13.69357	.001
T5	125.17215	5079.31561	125.17215	103.65950	1.20753	.277
T6	27.83742	2481.49832	27.83742	50.64282	.54968	.462

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T13 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	5616.84	49	114.63		
LEVEL BY VALENCE	61.55	1	61.55	.54	.467

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T14	165.68939	529.68797	165.68939	10.80996	15.32748	.000
T15	11.40309	293.89131	11.40309	5.99778	1.90122	.174
T16	.23751	303.24895	.23751	6.18875	.03838	.845

EFFECT .. VALENCE BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T23	32.40619	335.80240	32.40619	6.85311	4.72868	.035
T24	16.62728	165.01408	16.62728	3.36763	4.93738	.031
T25	4.51179	106.33515	4.51179	2.17011	2.07907	.156

EFFECT .. LEVEL BY VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T32	105.95283	605.35476	105.95283	12.35418	8.57627	.005
T33	10.89328	627.28601	10.89328	12.80176	.85092	.361
T34	4.80070	356.37513	4.80070	7.27296	.66008	.420

STUDY 7 ANALYSES SET 1 SCL E0 TO E12
Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	289.26	49	5.90			
CONSTANT	261.46	1	261.46	44.29	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	19.13	49	.39			
LEVEL	.73	1	.73	1.86	.179	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	9.09	49	.19			
VALENCE	.31	1	.31	1.69	.200	

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	.53179	68.47929	.53179	1.39754	.38052	.540
T5	132.11824	92.34677	132.11824	1.88463	70.10308	.000
T6	3.82801	90.57016	3.82801	1.84837	2.07102	.156

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T16 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	65.39	49	1.33			
LEVEL BY VALENCE	1.63	1	1.63	1.22	.275	

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T17	.49511	3.36760	.49511	.06873	7.20408	.010
T18	.00385	4.90122	.00385	.10002	.03846	.845
T19	.01092	1.90872	.01092	.03895	.28039	.599

Tests involving 'VALENCE BY TIME' Within-Subject Effect.

EFFECT .. VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T29	.01601	2.35244	.01601	.04801	.33347	.566
T30	.19438	2.14140	.19438	.04370	4.44791	.040
T31	.00004	.81756	.00004	.01668	.00259	.960

EFFECT .. LEVEL BY VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T41	.06247	14.23956	.06247	.29060	.21495	.645
T42	.04385	10.04567	.04385	.20501	.21388	.646
T43	.02007	3.55805	.02007	.07261	.27634	.601

STUDY 7 ANALYSES SET 1 SCL E0 TO E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	217.11	49	4.43			
CONSTANT	125.06	1	125.06	28.22	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	7.56	49	.15			
LEVEL	.02	1	.02	.14	.708	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	3.72	49	.08			
VALENCE	.16	1	.16	2.14	.150	

Tests involving 'TIME' Within-Subject Effect.

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	79.02810	90.11961	79.02810	1.83918	42.96930	.000
T5	.08149	96.65487	.08149	1.97255	.04131	.840
T6	1.02748	44.53288	1.02748	.90883	1.13055	.293

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T9 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	17.97	49	.37			
LEVEL BY VALENCE	.60	1	.60	1.63	.208	

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

EFFECT .. LEVEL BY TIME (Cont.)
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.11850	3.25631	.11850	.06646	1.78317	.188
T11	.14916	1.85439	.14916	.03784	3.94135	.053
T12	.01193	1.07661	.01193	.02197	.54308	.465

Tests involving 'VALENCE BY TIME' Within-Subject Effect.

EFFECT .. VALENCE BY TIME (Cont.)
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.03620	1.53809	.03620	.03139	1.15313	.288
T16	.01822	1.24644	.01822	.02544	.71619	.402
T17	.00005	.55085	.00005	.01124	.00421	.949

EFFECT .. LEVEL BY VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T20	.09718	8.78209	.09718	.17923	.54223	.465
T21	.04201	4.01478	.04201	.08193	.51269	.477
T22	.04801	1.73828	.04801	.03548	1.35337	.250

STUDY 7 ANALYSES SET 1 SCL E5 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	255.24	49	5.21			
CONSTANT	208.43	1	208.43	40.01	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	18.14	49	.37			
LEVEL	1.27	1	1.27	3.43	.070	

Tests involving 'VALENCE' Within-Subject Effect.

Tests of Significance for T3 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	8.71	49	.18			
VALENCE	.20	1	.20	1.13	.293	

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T4	94.99909	97.86525	94.99909	1.99725	47.56494	.000
T5	.00846	33.79953	.00846	.68979	.01227	.912
T6	.97200	17.01766	.97200	.34730	2.79875	.101

Tests involving 'LEVEL BY VALENCE' Within-Subject Effect.

Tests of Significance for T11 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	70.02	49	1.43			
LEVEL BY VALENCE	1.30	1	1.30	.91	.344	

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T12	.01793	3.41993	.01793	.06979	.25690	.615
T13	.02162	1.08869	.02162	.02222	.97288	.329
T14	.00548	.89180	.00548	.01820	.30120	.586

EFFECT .. VALENCE BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T19	.14316	1.85132	.14316	.03778	3.78905	.057
T20	.02686	.71758	.02686	.01464	1.83440	.182
T21	.00438	.39741	.00438	.00811	.54002	.466

EFFECT .. LEVEL BY VALENCE BY TIME						
Univariate F-tests with (1,49) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T26	.00019	6.23897	.00019	.12733	.00148	.969
T27	.00088	1.91223	.00088	.03903	.02246	.881
T28	.02128	2.34209	.02128	.04780	.44513	.508

STUDY 7 ANALYSES SET 2 HR FE CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	8713.70	49	177.83			
CONSTANT	4466.07	1	4466.07	25.11	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	4521.88	49	92.28			
LEVEL	45.61	1	45.61	.49	.485	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	76.56299	3755.53660	76.56299	76.64360	.99895	.322
T4	1313.66027	1163.47041	1313.66027	23.74429	55.32530	.000
T5	46.07512	2169.50684	46.07512	44.27565	1.04064	.313

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	38.76585	709.78525	38.76585	14.48541	2.67620	.108
T16	4.78415	244.37496	4.78415	4.98724	.95928	.332
T17	.35983	397.11342	.35983	8.10436	.04440	.834

STUDY 7 ANALYSES SET 2 HR FE CLUSTERS E0 TO E3

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	2174.10	49	44.37			
CONSTANT	343.19	1	343.19	7.73	.008	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	1006.79	49	20.55			
LEVEL	6.18	1	6.18	.30	.586	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	446.97063	1093.87971	446.97063	22.32408	20.02191	.000
T4	72.32765	465.97877	72.32765	9.50977	7.60561	.008
T5	8.90676	299.51260	8.90676	6.11250	1.45714	.233

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T6	.31272	294.32818	.31272	6.00670	.05206	.820
T7	5.99646	347.91934	5.99646	7.10039	.84452	.363
T8	3.09522	258.07693	3.09522	5.26688	.58768	.447

STUDY 7 ANALYSES SET 2 HR FE CLUSTERS E3 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	10101.36	49	206.15		
CONSTANT	5333.03	1	5333.03	25.87	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	4250.48	49	86.74		
LEVEL	85.75	1	85.75	.99	.325

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	437.53891	2543.79438	437.53891	51.91417	8.42812	.006
T4	116.52067	2754.94897	116.52067	56.22345	2.07246	.156
T5	27.38160	1225.93146	27.38160	25.01901	1.09443	.301

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T12	3.32485	608.46792	3.32485	12.41771	.26775	.607
T13	.00291	270.97445	.00291	5.53009	.00053	.982
T14	3.58691	242.32317	3.58691	4.94537	.72531	.399

STUDY 7 ANALYSES SET 2 HR CHW CLUSTERS E0 to E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	11209.29	49	228.76		
CONSTANT	2327.38	1	2327.38	10.17	.002

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	4546.18	49	92.78		
LEVEL	329.53	1	329.53	3.55	.065

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	52.12202	3081.99375	52.12202	62.89783	.82868	.367
T4	962.09362	1724.78476	962.09362	35.19969	27.33245	.000
T5	106.85609	1825.41939	106.85609	37.25346	2.86835	.097

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	308.82449	580.45541	308.82449	11.84603	26.06988	.000
T16	11.25363	443.77199	11.25363	9.05657	1.24259	.270
T17	48.58547	509.28748	48.58547	10.39362	4.67455	.036

STUDY 7 ANALYSES SET 2 HR CHW CLUSTERS E0 TO E3

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	2682.13	49	54.74			
CONSTANT	500.42	1	500.42	9.14	.004	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	1026.74	49	20.95			
LEVEL	.35	1	.35	.02	.898	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	435.59289	1138.76655	435.59289	23.24013	18.74313	.000
T4	33.15456	526.71186	33.15456	10.74922	3.08437	.085
T5	.08039	484.31116	.08039	9.88390	.00813	.929

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T6	9.21720	481.08480	9.21720	9.81806	.93880	.337
T7	2.80228	598.88274	2.80228	12.22210	.22928	.634
T8	16.32986	332.97155	16.32986	6.79534	2.40310	.128

STUDY 7 ANALYSES SET 7 HR CHW CLUSTERS E3 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	12488.01	49	254.86			
CONSTANT	2475.28	1	2475.28	9.71	.003	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	4324.51	49	88.26			
LEVEL	414.35	1	414.35	4.69	.035	

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	839.14762	2244.44491	839.14762	45.80500	18.32000	.000
T4	25.27875	2489.38071	25.27875	50.80369	.49758	.484
T5	4.96762	1361.90201	4.96762	27.79392	.17873	.674

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T12	268.31737	526.57481	268.31737	10.74642	24.96806	.000
T13	22.29346	650.20287	22.29346	13.26945	1.68006	.201
T14	1.45130	417.30091	1.45130	8.51635	.17041	.682

STUDY 7 ANALYSES SET 2 SCL FE CLUSTERS E0 to E12
Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	145.52	49	2.97			
CONSTANT	121.84	1	121.84	41.02	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	28.26	49	.58			
LEVEL	.09	1	.09	.16	.695	

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	.18163	39.50422	.18163	.80621	.22529	.637
T4	61.08862	46.44071	61.08862	.94777	64.45514	.000
T5	1.92688	47.18562	1.92688	.96297	2.00097	.164

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.10293	6.93220	.10293	.14147	.72754	.398
T16	.01086	3.90487	.01086	.07969	.13627	.714
T17	.03030	1.26445	.03030	.02581	1.17412	.284

STUDY 7 ANALYSES SET 2 SCL FE CLUSTERS E0 to E5
Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	109.18	49	2.23			
CONSTANT	58.10	1	58.10	26.08	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	7.43	49	.15			
LEVEL	.19	1	.19	1.29	.262	

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	37.84084	46.42585	37.84084	.94747	39.93898	.000
T4	.08839	52.22838	.08839	1.06589	.08292	.775
T5	.52074	24.29319	.52074	.49578	1.05035	.310

Tests involving 'LEVEL BY TIME' Within-Subject Effect.

EFFECT .. LEVEL BY TIME (Cont.)

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	.00053	3.41400	.00053	.06967	.00758	.931
T9	.17474	1.99636	.17474	.04074	4.28891	.044
T10	.00604	.63636	.00604	.01299	.46482	.499

STUDY 7 ANALYSES SET 2 SCL FE CLUSTERS E5 to E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	134.74	49	2.75		
CONSTANT	97.85	1	97.85	35.58	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	29.66	49	.61		
LEVEL	.00	1	.00	.00	.989

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	43.88332	48.90032	43.88332	.99797	43.97277	.000
T4	.03274	18.65415	.03274	.38070	.08599	.771
T5	.42294	9.11492	.42294	.18602	2.27366	.138

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.00722	4.03565	.00722	.08236	.08766	.768
T11	.01560	1.41951	.01560	.02897	.53844	.467
T12	.00258	.59911	.00258	.01223	.21096	.648

STUDY 7 ANALYSES SET 2 SCL CHW CLUSTERS E0 to E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	152.82	49	3.12		
CONSTANT	139.93	1	139.93	44.87	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	56.26	49	1.15		
LEVEL	2.26	1	2.26	1.97	.167

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	.36617	31.32751	.36617	.63934	.57273	.453
T4	71.22400	48.04747	71.22400	.98056	72.63600	.000
T5	1.90117	44.20210	1.90117	.90208	2.10754	.153

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.45465	10.67496	.45465	.21786	2.08693	.155
T16	.03684	11.04202	.03684	.22535	.16346	.688
T17	.00069	4.20232	.00069	.08576	.00804	.929

STUDY 7 ANALYSES SET 2 SCL CHW CLUSTERS E0 to E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	111.65	49	2.28		
CONSTANT	67.12	1	67.12	29.45	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	18.09	49	.37		
LEVEL	.42	1	.42	1.15	.289

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	41.22345	45.23184	41.22345	.92310	44.65768	.000
T4	.01132	45.67293	.01132	.93210	.01215	.913
T5	.50679	20.79053	.50679	.42430	1.19442	.280

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	.21516	8.62439	.21516	.17601	1.22242	.274
T9	.01643	3.87281	.01643	.07904	.20784	.650
T10	.05391	2.17853	.05391	.04446	1.21248	.276

STUDY 7 ANALYSES SET 2 SCL CHW CLUSTERS E5 to E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	129.21	49	2.64		
CONSTANT	110.78	1	110.78	42.01	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	58.51	49	1.19		
LEVEL	2.58	1	2.58	2.16	.148

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	51.25893	50.81626	51.25893	1.03707	49.42685	.000
T4	.00259	15.86296	.00259	.32373	.00799	.929
T5	.55344	8.30015	.55344	.16939	3.26723	.077

EFFECT .. LEVEL BY TIME						
Univariate F-tests with (1,49) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.01090	5.62325	.01090	.11476	.09497	.759
T11	.00689	1.58140	.00689	.03227	.21360	.646
T12	.02418	2.63479	.02418	.05377	.44966	.506

STUDY 7 ANALYSES SET 3 HR PA CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	10993.43	49	224.36			
CONSTANT	1700.53	1	1700.53	7.58	.008	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	10433.05	49	212.92			
LEVEL	668.60	1	668.60	3.14	.083	

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	195.66583	3226.19102	195.66583	65.84063	2.97181	.091
T4	1469.97999	1724.99875	1469.97999	35.20406	41.75598	.000
T5	211.62477	2932.42082	211.62477	59.84532	3.53620	.066

EFFECT .. LEVEL BY TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	728.32304	1901.61289	728.32304	38.80843	18.76714	.000
T16	.37857	1056.90061	.37857	21.56940	.01755	.895
T17	76.66566	1065.07297	76.66566	21.73618	3.52710	.066

STUDY 7 ANALYSES SET 3 HR PA CLUSTERS E0 TO E3

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	3178.76	49	64.87			
CONSTANT	373.89	1	373.89	5.76	.020	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	2118.79	49	43.24			
LEVEL	26.14	1	26.14	.60	.441	

EFFECT .. TIME
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	549.37210	2291.46309	549.37210	46.76455	11.74762	.001
T4	110.80194	849.24625	110.80194	17.33156	6.39308	.015
T5	12.54211	468.77139	12.54211	9.56676	1.31101	.258

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T6	9.78461	1018.41952	9.78461	20.78407	.47077	.496
T7	.00305	665.96808	.00305	13.59119	.00022	.988
T8	3.70488	477.02963	3.70488	9.73530	.38056	.540

STUDY 7 ANALYSES SET 3 HR PA CLUSTERS E3 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	11994.66	49	244.79			
CONSTANT	1956.47	1	1956.47	7.99	.007	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	10691.30	49	218.19			
LEVEL	968.22	1	968.22	4.44	.040	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	1628.07741	3173.86367	1628.07741	64.77273	25.13523	.000
T4	25.12037	3858.03105	25.12037	78.73533	.31905	.575
T5	60.98216	1981.37797	60.98216	40.43629	1.50810	.225

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T12	449.80156	1777.30593	449.80156	36.27155	12.40095	.001
T13	52.86278	964.34584	52.86278	19.68053	2.68605	.108
T14	.38854	766.78744	.38854	15.64872	.02483	.875

STUDY 7 ANALYSES SET 3 HR NA CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	12221.15	49	249.41			
CONSTANT	1513.84	1	1513.84	6.07	.017	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	8583.41	49	175.17			
LEVEL	1045.94	1	1045.94	5.97	.018	

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	269.28140	2930.96997	269.28140	59.81571	4.50185	.039
T4	1015.60369	2536.59671	1015.60369	51.76728	19.61864	.000
T5	191.19172	2001.50023	191.19172	40.84694	4.68069	.035

EFFECT .. LEVEL BY TIME							
Univariate F-tests with (1,49) D. F.							
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T15	888.54269	1224.32486	888.54269	24.98622	35.56131	.000	
T16	.92937	673.39161	.92937	13.74269	.06763	.796	
T17	142.03887	620.15825	142.03887	12.65629	11.22279	.002	

STUDY 7 ANALYSES SET 3 HR NA CLUSTERS E0 TO E3

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	3301.12	49	67.37			
CONSTANT	569.16	1	569.16	8.45	.005	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	1912.19	49	39.02			
LEVEL	13.73	1	13.73	.35	.556	

EFFECT .. TIME							
Univariate F-tests with (1,49) D. F.							
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T3	542.37675	1509.11591	542.37675	30.79828	17.61062	.000	
T4	31.59002	616.82266	31.59002	12.58822	2.50949	.120	
T5	15.62824	479.33609	15.62824	9.78237	1.59759	.212	

EFFECT .. LEVEL BY TIME							
Univariate F-tests with (1,49) D. F.							
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T6	17.66166	632.07395	17.66166	12.89947	1.36918	.248	
T7	.44689	607.20428	.44689	12.39192	.03606	.850	
T8	7.98658	510.02777	7.98658	10.40873	.76730	.385	

STUDY 7 ANALYSES SET 3 HR NA CLUSTERS E3 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	13427.92	49	274.04			
CONSTANT	1489.58	1	1489.58	5.44	.024	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	8215.51	49	167.66			
LEVEL	1431.48	1	1431.48	8.54	.005	

EFFECT .. TIME							
Univariate F-tests with (1,49) D. F.							
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F	
T3	1321.98675	2731.30821	1321.98675	55.74098	23.71660	.000	
T4	5.89789	3108.02360	5.89789	63.42905	.09298	.762	
T5	1.54461	1622.54501	1.54461	33.11316	.04665	.830	

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T12	543.94221	1057.13654	543.94221	21.57422	25.21261	.000
T13	133.67327	736.62419	133.67327	15.03315	8.89190	.004
T14	.67668	563.51280	.67668	11.50026	.05884	.809

STUDY 7 SCL ANALYSES SET 3 PA CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	137.26	49	2.80		
CONSTANT	95.62	1	95.62	34.13	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	83.19	49	1.70		
LEVEL	3.79	1	3.79	2.23	.141

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	1.11365	45.95380	1.11365	.93783	1.18748	.281
T4	59.21315	51.02207	59.21315	1.04127	56.86646	.000
T5	1.72135	44.44583	1.72135	.90706	1.89773	.175

TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	1.18331	12.32675	1.18331	.25157	4.70378	.035
T16	.23929	8.42994	.23929	.17204	1.39088	.244
T17	.00182	6.94520	.00182	.14174	.01282	.910

STUDY 7 SCL ANALYSES SET 3 PA CLUSTERS E0 TO E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	96.12	49	1.96		
CONSTANT	50.04	1	50.04	25.51	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	30.33	49	.62		
LEVEL	.40	1	.40	.65	.424

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	32.31226	45.77958	32.31226	.93428	34.58531	.000
T4	.01472	49.46684	.01472	1.00953	.01458	.904
T5	.67418	22.96253	.67418	.46862	1.43864	.236

EFFECT .. LEVEL BY TIME						
Univariate F-tests with (1,49) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	.66388	11.06137	.66388	.22574	2.94087	.093
T9	.23553	5.63482	.23553	.11500	2.04817	.159
T10	.00112	2.49025	.00112	.05082	.02194	.883

STUDY 7 ANALYSES SET3 SCL PA CLUSTERS E5 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	149.99	49	3.06			
CONSTANT	72.98	1	72.98	23.84	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	71.36	49	1.46			
LEVEL	5.15	1	5.15	3.54	.066	

EFFECT .. TIME						
Univariate F-tests with (1,49) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	46.11384	66.28604	46.11384	1.35278	34.08829	.000
T4	.00225	18.24816	.00225	.37241	.00603	.938
T5	.59620	17.80431	.59620	.36335	1.64082	.206

EFFECT .. LEVEL BY TIME						
Univariate F-tests with (1,49) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.00204	5.54816	.00204	.11323	.01804	.894
T11	.03254	3.42926	.03254	.06998	.46502	.498
T12	.00058	1.63579	.00058	.03338	.01724	.896

STUDY 7 ANALYSES SET 3 SCL NA CLUSTERS E0 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	195.84	49	4.00			
CONSTANT	156.11	1	156.11	39.06	.000	

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares						
Source of Variation	SS	DF	MS	F	Sig of F	
WITHIN CELLS	82.54	49	1.68			
LEVEL	.08	1	.08	.05	.830	

EFFECT .. TIME						
Univariate F-tests with (1,49) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	.43733	35.74992	.43733	.72959	.59941	.443
T4	77.20861	53.41140	77.20861	1.09003	70.83173	.000
T5	2.98147	55.07418	2.98147	1.12396	2.65264	.110

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T15	.06934	11.73788	.06934	.23955	.28947	.593
T16	.47354	11.78083	.47354	.24043	1.96959	.167
T17	.01268	5.43228	.01268	.11086	.11441	.737

STUDY 7 ANALYSES SET 3 SCL NA CLUSTERS E0 TO E5

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	147.24	49	3.00		
CONSTANT	75.75	1	75.75	25.21	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	28.61	49	.58		
LEVEL	.05	1	.05	.09	.762

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	45.99020	53.44049	45.99020	1.09062	42.16877	.000
T4	.00046	53.22382	.00046	1.08620	.00042	.984
T5	.67816	22.23475	.67816	.45377	1.49451	.227

EFFECT .. LEVEL BY TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T8	.11449	14.63216	.11449	.29862	.38342	.539
T9	.00660	9.79885	.00660	.19998	.03300	.857
T10	.04645	3.85066	.04645	.07858	.59106	.446

STUDY 7 ANALYSES SET 3 SCL PA CLUSTERS E5 TO E12

Tests of Between-Subjects Effects.

Tests of Significance for T1 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	153.38	49	3.13		
CONSTANT	122.35	1	122.35	39.09	.000

Tests involving 'LEVEL' Within-Subject Effect.

Tests of Significance for T2 using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN CELLS	77.86	49	1.59		
LEVEL	.06	1	.06	.04	.843

EFFECT .. TIME

Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T3	55.87958	47.91592	55.87958	.97788	57.14384	.000
T4	.04163	16.04491	.04163	.32745	.12713	.723
T5	.82880	8.71592	.82880	.17788	4.65943	.036

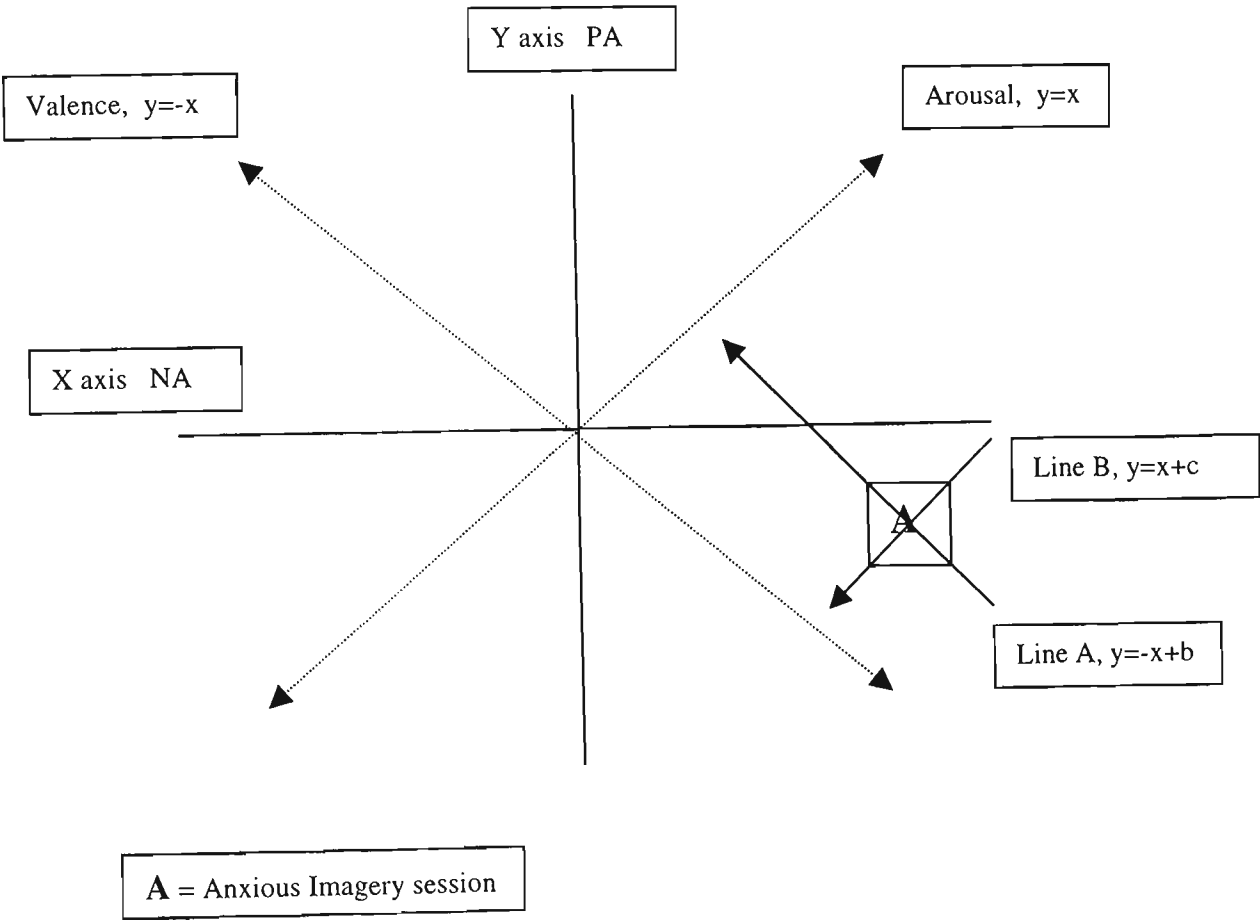
Univariate F-tests with (1,49) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
T10	.60043	9.77124	.60043	.19941	3.01098	.089
T11	.01014	3.97473	.01014	.08112	.12506	.725
T12	.12109	2.75282	.12109	.05618	2.15539	.148

APPENDIX 23

Arousal, Valence and Emotion Intensity scores for Anxious

Table 9.2 shows the PA and NA scores for the 10 imagery sessions (Study 7a).
Arousal, valence and *emotion intensity* calculations are tabulated in Table 10.2.



Anxious (NA 15.27; PA 13.77) **Experiment average** (9.77, 15.88)

AROUSAL SCORE: Need to calculate projection of **A** on arousal dimension $y=x$.

VALENCE SCORE: Need to calculate projection of **A** on valence dimension $y=-x$.

EMOTION INTENSITY : Take modulus of valence score

Note: need to translate co-ordinates so that experiment average = (0,0)

STEP 1 Translate x,y co-ordinates

Anxious = (5.5, -2,11)

STEP 2 Calculate line A going through point A and parallel to y=-x

Line, $y=-x + b$
 $-2.11= -5.5+b$
 $b=3.39$

$y=-x +3.39$

STEP 3 Calculate intersection (x2,y2) for line A and arousal dimension using simultaneous equations

$$\begin{array}{r} y=x \\ y=-x+3.39 \\ \hline 2y=3.39 \end{array}$$

#(x2,y2) = (1.69, 1.69)

STEP 4 Calculate distance along arousal dimension from (0,0) using the distance formula

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

arousal score = +2.39

STEP 5 Calculate line B going through point A and parallel to y=x

Line, $y=x + c$
 $-2.11= 5.5+b$
 $b=-7.61$

$y=x -7.61$

STEP 6 Calculate intersection (x2,y2) of line B and valence dimension using simultaneous equations

$$\begin{array}{r} y=-x \\ y=x-7.61 \\ \hline 2y=-7.61 \end{array}$$

#(x2,y2) = (-3.81, -3.81)

STEP 7 Calculate distance along arousal dimension from (0,0) using the distance formula

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

valence score = -5.39 #emotion intensity = 5.39

APPENDIX 24

Study 7b Statistical Outcomes

STUDY 7b ANALYSES SET 1 Regression n=50

HR

Model Summary^{a,b}

Model	Variables		R	R Square	Adjusted R Square	Std. Error of the Estimate
	Entered	Removed				
1	V,INTEN S ^c	.	.825	.681	.641	.5230
2	V,INTEN S ^{c,d}	.	.825	.681	.641	.5230

- a. Dependent Variable: HRAVG
- b. Method: Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
- c. Independent Variables: (Constant), V.INTENS
- d. Probability of F-to-enter = .050 limits reached.

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.673	1	4.673	17.082	.003 ^b
	Residual	2.189	8	.274		
	Total	6.862	9			
2	Regression	4.673	1	4.673	17.082	.003 ^b
	Residual	2.189	8	.274		
	Total	6.862	9			

- a. Dependent Variable: HRAVG
- b. Independent Variables: (Constant), V.INTENS

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-7.7E-02	.437		-.175	.865
	V.INTENS	.298	.072	.825	4.133	.003
2	(Constant)	-7.7E-02	.437		-.175	.865
	V.INTENS	.298	.072	.825	4.133	.003

a. Dependent Variable: HRAVG

Excluded Variables^a

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	AROUSAL1	.440 ^b	2.160	.068	.632	.660
	VALENCE1	-.116 ^b	-.553	.597	-.205	.987
2	AROUSAL1	.440 ^b	2.160	.068	.632	.660
	VALENCE1	-.116 ^b	-.553	.597	-.205	.987 ^c

a. Dependent Variable: HRAVG

b. Independent Variables in the Model: (Constant), V.INTENS

c. This variable is not added to the model because PIN = .050 limits reached.

Correlations

Correlations

		AROUSAL	E.INTENS	VALENCE
Pearson Correlation	AROUSAL	1.000	.583	.066
	E.INTENS	.583	1.000	.115
	VALENCE	.066	.115	1.000
Sig. (2-tailed)	AROUSAL	.	.077	.857
	E.INTENS	.077	.	.752
	VALENCE	.857	.752	.
N	AROUSAL	10	10	10
	E.INTENS	10	10	10
	VALENCE	10	10	10

STUDY 7b ANALYSES SET 2 Regression n=25

HR

Model Summary^{a,b}

Model	Variables		R	R Square	Adjusted R Square	Std. Error of the Estimate
	Entered	Removed				
1	AROUSL25 ^c	.	.808	.652	.609	.8482
2	VAINT25 ^d	.	.920	.847	.803	.6022
3	VAINT25 ^{d,e}	.	.920	.847	.803	.6022

- a. Dependent Variable: HRAVG25
- b. Method: Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
- c. Independent Variables: (Constant), AROUSL25
- d. Independent Variables: (Constant), AROUSL25, VAINT25
- e. Probability of F-to-enter = .050 limits reached.

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.788	1	10.788	14.996	.005 ^b
	Residual	5.756	8	.719		
	Total	16.544	9			
2	Regression	14.005	2	7.003	19.309	.001 ^c
	Residual	2.539	7	.363		
	Total	16.544	9			
3	Regression	14.005	2	7.003	19.309	.001 ^c
	Residual	2.539	7	.363		
	Total	16.544	9			

- a. Dependent Variable: HRAVG25
- b. Independent Variables: (Constant), AROUSL25
- c. Independent Variables: (Constant), AROUSL25, VAINT25

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.693	.268		6.308	.000
	AROUSL25	.276	.071	.808	3.872	.005
2	(Constant)	6.8E-02	.578		.118	.909
	AROUSL25	.182	.060	.531	3.041	.019
	VAINT25	.300	.101	.520	2.978	.021
3	(Constant)	6.8E-02	.578		.118	.909
	AROUSL25	.182	.060	.531	3.041	.019
	VAINT25	.300	.101	.520	2.978	.021

a. Dependent Variable: HRAVG25

Excluded Variables^a

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	VAINT25	.520 ^b	2.978	.021	.748	.718
	VALENC25	.109 ^b	.498	.634	.185	.998
2	VALENC25	.133 ^c	.880	.413	.338	.995
3	VALENC25	.133 ^c	.880	.413	.338	.995 ^d

a. Dependent Variable: HRAVG25

b. Independent Variables in the Model: (Constant), AROUSL25

c. Independent Variables in the Model: (Constant), AROUSL25, VAIN25

d. This variable is not added to the model because PIN = .050 limits reached.

Correlations

Correlations

		VAINT25	VALENC25	AROUSL25
Pearson Correlation	VAINT25	1.000	-.019	.531
	VALENC25	-.019	1.000	.048
	AROUSL25	.531	.048	1.000
Sig. (2-tailed)	VAINT25	.	.958	.114
	VALENC25	.958	.	.895
	AROUSL25	.114	.895	.
N	VAINT25	10	10	10
	VALENC25	10	10	10
	AROUSL25	10	10	10

Study 7b raw data analysis 1									
IMAG	arousal 1	arousal 2	valence 1	valence	emot int	hr avg	sc avg	pa	na
A	2.39	2.39	-5.39	-1	5.39	2.74	0.35	13.77	15.27
H	0.6	0.6	-3.15	-1	3.15	0.94	0.39	14.06	12.39
W	2.64	2.64	-7.1	-1	7.1	1.81	0.3	12.24	17.16
S	1.61	1.61	-8.43	-1	8.43	2.41	0.31	11.07	16.86
C	2.55	2.55	3.76	1	3.76	1.32	0.41	20.34	8.91
D	-8.44	8.44	-3.59	-1	3.59	0.42	0.22	7.38	6.34
M	-5.19	5.19	1.65	1	1.65	0.17	0.35	13.39	4.94
F	0.32	0.32	7.37	1	7.37	1.89	0.29	21.33	4.78
E	1.8	1.8	7.3	1	7.3	1.73	0.27	22.32	5.88
N	1.74	1.74	8.3	1	8.3	2.5	0.33	22.98	5.13

study 7b raw data analysis 2									
IMAG	arous25 1	arous25 2	valen25 1	valence25	emot int25	hr avg25	sc avg25	pa25	na25
A	2.54	2.54	-5.13	-1	5.13	2.79	0.31	14.64	14.88
H	0.58	0.58	-2.12	-1	2.12	0.18	0.27	15.38	11.37
W	3.66	3.66	-7.26	-1	7.26	2.56	0.24	13.92	17.18
S	1.82	1.82	-8.58	-1	8.58	2.5	0.27	11.69	16.81
C	2.51	2.51	4.32	1	4.32	1.89	0.34	21.3	8.18
D	-8.87	8.87	-4.14	-1	4.14	-0.41	0.3	7.27	4.64
M	-5.12	5.12	1.7	1	1.7	-0.29	0.4	14.05	6.12
F	0.33	0.33	6.82	1	6.82	2.88	0.27	21.53	4.87
E	1.53	1.53	6.66	1	6.66	3.02	0.37	22.26	5.83
N	2.05	2.05	7.69	1	7.69	2.14	0.34	22.63	4.75