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1999

## Psychophysiology of positive and negative affect

Kerrie Wilde  
*University of Wollongong*

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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.

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## Chapter 10

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