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### Individual difference & computer user-training behaviour: examination of an empirical model

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# Individual difference & computer user-training behaviour: examination of an empirical model

## Abstract

A model that incorporates both stable and dynamic individual differences to the nomological net of the Technology Acceptance Model (TAM) in the context of computer user training is proposed. A study using 348 completed surveys from University students engaged in computer training found that stable traits (Negative Affects, Trait Anxiety and Personal Innovativeness in IT (PIIT)) explained 35% of variance in Computer Anxiety (CA). Significant support to the model provides evidence that stable individual differences are antecedents to and predict both Computer Self Efficacy and CA. In addition, the model demonstrates the relationship of these determinants to the TAM.

## Keywords

Individual, Difference, Computer, User, Training, Behaviour, Examination, Empirical, Model

## Disciplines

Arts and Humanities | Life Sciences | Medicine and Health Sciences | Social and Behavioral Sciences

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## Individual Difference and Computer User-Training Behaviour: Examination of an Empirical Model

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### Abstract

*A model that incorporates both stable and dynamic individual differences to the nomological net of the Technology Acceptance Model (TAM) in the context of computer user training is proposed. A study using 348 completed surveys from University students engaged in computer training found that stable traits (Negative Affects, Trait Anxiety and Personal Innovativeness in IT (PIIT)) explained 35% of variance in Computer Anxiety (CA). Significant support to the model provides evidence that stable individual differences are antecedents to and predict both Computer Self Efficacy and CA. In addition, the model demonstrates the relationship of these determinants to the TAM.*

### Keywords

Individual differences, user training, technology acceptance model, personality.

### INTRODUCTION

Information technology has permeated all aspects of life and individuals need to learn to use the technology for both work and use at home. However, people have a wide variety of backgrounds, prior experiences and personalities. The notion that individual differences are important in acceptance of technology innovation has been accepted in many disciplines such as marketing, production and information systems. In the domain of information systems, early studies have looked at the impact of individual difference on user acceptance and usage (Zmud, 1979; Harrison and Rainer, 1992). Recent studies have identified the need for computer training programs that enhance computer awareness, computer self efficacy and address computer anxiety (Venkatesh and Davis, 1996; Venkatesh, 2000). There is still a need for further research to understand other aspects of individual difference that explain user behaviour and performance. This study addresses this dearth of information and looks at both stable and dynamic individual differences in the context computer user training.

Research on Information Technology (IT) adoption and user acceptance since the 1980's has drawn on the social psychology theories of Azjen and Fishbein, namely the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and its modifications, to predict user behaviour. In 1989, Davis (1989) replaced TRA's attitudinal determinants with a set of variables (Perceived Usefulness (PU) and Perceived Ease of Use (PEOU)) and proposed

the Technology Acceptance Model (TAM), which has become the most predominant model used in IS acceptance research in the 1990s. However, in order to use TAM to meaningfully design training interventions that foster acceptance, it is necessary to understand the antecedents of the key TAM constructs, PU and PEOU (Venkatesh and Davis, 1996).

Most early studies of TAM did not include external variables and many of the subsequent studies sought variables that influenced PU (see table 5, Legris et al., 2003). Venkatesh and Davis (2000) explored the relationship of external factors to PU by extending the core TAM model to include social influence and cognitive influence processes, thought to impact on PU. They called it TAM2. In contrast, very few researchers have sought antecedents of PEOU, with the exception of Venkatesh and Davis (1996).

In a subsequent study Venkatesh (2000) identified four anchors (Computer Self-Efficacy [CSE]; Computer Anxiety [CA]; Computer Playfulness [CP] and Perceived External Control) and two adjustments (Perceived Enjoyment and Objective Usability) that explained up to 60% of variance in system specific PEOU. During longitudinal tests, CP was found to decrease over time (to non-significance at three months of use). The systems tested were all voluntary and the author called for tests of the model in mandatory conditions. One limitation of the study was that while “dynamic traits” were considered, stable individual differences and factors were not. In addition, the model did not test the influence of the antecedents on PU.

A differentiation between stable situation-specific and dynamic situation-specific individual differences was made by Thatcher and Perrewé (2002). This differentiation concurs with research on motivation, where the relationship of trait-like individual differences and state-like individual differences has been examined on learning performance (Kanfer, 1990). As dynamic situation-specific individual differences have been linked to behaviour, an understanding of how they arise are of value for IS implementation. Thatcher and Perrewé (2002) found that stable traits relate to dynamic traits, and called for future research to examine whether these dynamic traits mediate the effects of stable traits on beliefs (such as perceived ease of use) and behaviours.

Much of the early research on user training has drawn on Bandura’s (1986) Social Cognitive Theory (SCT). The relationship of Computer Self-Efficacy (CSE) to task performance has been well established for computer training (Gist and Mitchell, 1992; Mitchell et al., 1994; Compeau & Higgins, 1995). Others have called for a more refined understanding of the antecedents of CSE and the moderating factors of CSE effect on performance (Marakas et al., 1998). In an extensive review of the construct of CSE, Marakas et al. (1998) pointed to a number of issues in recent research using CSE including insufficient understanding of the role of computer anxiety (and emotional arousal) on CSE and performance. The literature on user computer training, has given limited consideration to stable individual differences on learning behaviour.

Therefore there is a need for an improved understanding of the antecedents to dynamic computer-related constructs of computer self-efficacy (CSE) and computer anxiety (CA), especially stable individual difference traits and dispositions. This would extend the existing knowledge of CSE, CA and the usage of IS by identifying how stable individual differences affect these dynamic constructs. In turn this will allow future research to assess how certain training and intervention programs affect these constructs with specific reference to individual difference profiles.

We bring together these two streams of research to propose and test a model that incorporates both stable and dynamic individual differences to the nomological net of TAM to understand the determinants of both PU and PEOU in the context of computer user training.

### **Research Model and Hypothesis**

We propose a theoretical model to examine user training behaviour that incorporates the role of individual differences characteristics on user acceptance determinants (from the TAM model). In this model we include constructs from Thatcher and Perrewé (2002) and Venkatesh (2000). Our model is illustrated in Figure 1. We explain our rationale for the proposed model and hypotheses for testing next.

### **Stable Individual Differences**

Agarwal and Prasad (1999) define individual differences in the context of IS research to include factors such as personality, demographic variables and circumstantial variables such as user expertise. They investigated the role of stable individual differences such as Personal Innovativeness in IT (PIIT), as well as demographic and situational variables (Agrawal & Prasad, 1998; Agrawal & Prasad, 1999) that influence the adoption of IS. PIIT is “the willingness of an individual to try out new information technology” (Agarwal and Prasad, 1998, p. 206). This

construct has been found to be positively correlated to CSE (Agarwal et al., 2000) and negatively correlated to CA (Thatcher and Perrewe, 2002).

H1: Personal Innovativeness in IT (PIIT) is positively related to CSE [H1a] and negatively related to CA [H1b].

Literature on organizational stress suggests that broad dispositions such as Negative Affectivity (NA) and Trait Anxiety (TA) are predictors of situation specific anxiety (Watson and Clark, 1984; Watson et al., 1989). Negative affect is a broad, stable trait that affects emotions and behaviour. Trait Anxiety is a relatively enduring tendency to experience anxiety over time and in situations when confronted with challenges (Spielberger, Gorsuch, and Lushene, 1970; Tellegen, 1985). Both NA and TA relate to neuroticism, but measure different aspects (Watson and Clarke, 1984). TA has been found to be related to CA (Wiel and Wugalter, 1990). In a study of university students, as expected TA was found to be positively related to CA, but NA was not found to be related (Thatcher and Perrewe, 2002).

H2: Trait Anxiety is positively related to CA [H2a] and negatively related to CSE [H2b].

H3: Negative Affect is positively related to CA [H3a] and negatively related to CSE [H3b].

### **Dynamic Individual Differences**

Another theory that has influenced user acceptance research, and research specific to user training is the Socio-Cognitive Theory (SCT) of Bandura (1986). The SCT has been tested for user acceptance of computer systems by managers (Compeau & Higgins, 1995, Compeau, Higgins and Huff, 1999). These studies have demonstrated the CSE and outcome expectation impact on affect, anxiety and behaviour. Research has found that individuals who have high CSE form more positive perceptions of IT and use IT more (Venkatesh and Davis, 1996; Compeau et al., 1999). Marakas et al. (1998) stated that CSE operates at two distinct levels; at a general level that captures an individual's judgment of efficiency across multiple computer domains and at a specific level, which they called application specific self-efficacy. General self-efficacy was used in research on antecedents to PEOU.

H4: CSE is positively related to PEOU [H4a] and PU [H4b].

The role of computer anxiety (CA) has been researched in the past. A state-trait theory of CA was proposed by Deane et al. (1995), where CA was associated with elevated levels of state anxiety, but more importantly, was found to have a significant effect on task completion latencies independent of computer experience and state anxiety levels (Mahar et al., 1997).

Numerous studies have shown that CSE and CA have a significant impact on computer related task performance (Marakas et al., 2000). The role of computer self-efficacy and computer anxiety in IS adoption and task performance has received more attention than their stable counterparts (Brosnan, 1998; Compeau & Higgins, 1995; Martocchio, 1994). Brosnan (1998) argues for a reciprocal relationship between CSE and CA given that CA increases emotional arousal. In addition there is a connection between this aversive emotional arousal and an individual's judgment of CSE (Marakas et al., 2000).

H5: CA is negatively related to PEOU [H5a] and PU [H5b].

Many previous studies have confirmed the relationships between the "core" TAM variables (PU, PEOU) and Behavioural Intention (BI) (Davis et al, 1989; Venkatesh and Davis, 1996; Venkatesh and Davis, 2000). Most of these have been in voluntary settings. Similar relationships were found in mandatory settings (Brown et al, 2003).

H6: PEOU will be positively related to PU [H6a] and BI [H6b].

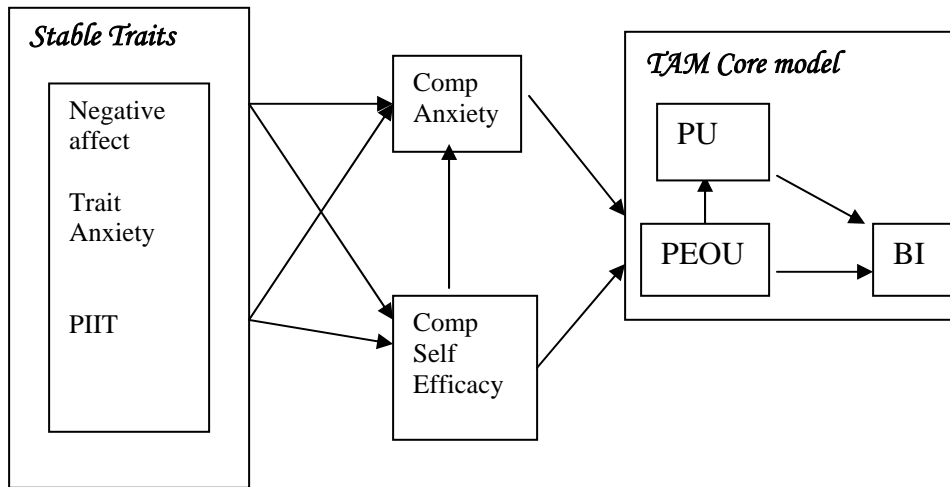
H7: PU will be positively related to BI.

## **METHODOLOGY**

### **Participants**

The participants were undergraduate students from a University in Australia studying an introductory Information Systems subject. This research was conducted over two phases in tutorial class time. In the first phase 381 participants completed the research of which 196 were female, 180 male, and 5 unknown. The mean age of these participants was 19.44 years with a standard deviation of 2.7 years. A total of 348 participants completed the second

phase of research of which 154 were female, 134 male, and 60 unknown. The mean age of these participants was 19.32 years with a standard deviation of 2.6 years.



**Figure 1.** Theoretical Model of Antecedents of Situation Specific Dynamic Individual Differences in Computer Training Behaviour.

### Measures

Most of the measures used were from validated instruments from prior research. The following paper and pencil measures were employed in the first phase of data collection, these constructs are stable in nature. The construct of PIIT was measured by the *Personal Innovativeness in IT Scale* which is a four item measure rating participants' inclinations to try out new IT (Agarwal & Prasad, 1998). Computer Anxiety was measured by 4 items drawn from the *Computer Anxiety Rating Scale* by Heinssen, Glass, and Knight, (1987). These 4 items have been identified by Compeau and Higgins (1995) as best capturing the apprehension connected with computer usage. *Negative Affect* was measured with 10 items from the *Positive and Negative Affect Rating Scale (PANAS)* by Watson, Clark and Tellegen (1988). Negative Affect is a measure of an individual's tendency to experience negative emotions. The *Computer Self-efficacy Scale*, developed by Compeau and Higgins (1995), is a ten item task focused measure that assesses individual's perceptions of their ability to perform certain behaviors. The constructs of Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) were measured using the *TAM Scales* developed by Davis (1989) and Davis, Bagozzi, and Warshaw (1989). The PEOU construct measures the perceived effort required to use a system, and the PU construct measures the degree to which individuals perceive usage of the system to increase their job performance (Davis, 1989). *Intentions* were measured by 3 items drawn from Perugini & Bagozzi, (2001) and adapted for this study. The three items measured planning to pursue the goal, intent to pursue the goal, and effort to be expended in pursuing goal.

### Procedure

In the first phase participants filled out a questionnaire with measures of PIIT, NA, and CA. In the second phase participants were given a brief explanation of the Microsoft Excel Task and measures of CSE, PEOU, and PU were completed. Participants also completed their intentions to study for the tutorial task set for the next week. After the questionnaire were completed participants were instructed to complete a practice Excel Task in preparation for the tutorial exam.

### Data Analysis

The proposed model and hypotheses were tested using the partial least squares (PLS) analysis program PLS-Graph (Chin and Frye, 2003). The PLS approach allows the simultaneous assessment of both measurement and structural

models (Barclay et al., 1995). PLS is also robust to the restrictive assumptions of multivariate normality and the large sample size requirement in covariance based Structured Equation Modeling used in techniques that use the maximum likelihood function to obtain estimators in models (e.g. LISREL) (Fornell, 1982). PLS is generally best suited for predictive research models where the emphasis is more on theory development than on testing in a confirmatory sense, that is, how a model fits the data (Barclay et al., 1995). Statistical tests for significance were conducted using bootstrapping, which allows the testing of the significance of parameter estimates through the examination of the statistical analysis of parameters generated from many sub-samples of the data (Barclay et al., 1995).

The measurement model is PLS was assessed for internal consistency, convergent validity and discriminant validity following the criteria set out in Barclay et al., (1995). Internal consistencies of 0.7 or higher are considered adequate. Convergent and discriminant validity were assessed on the basis: (1) the square root of the average variance extracted (AVE) for the construct from its items be at least 0.707, and should be greater than the construct's correlation with other constructs (Barclay et al., 1995), and (2) each item should load more highly on its intended construct than on other constructs.

Using a bootstrapping procedure *t* statistics and standard errors were generated for each of the paths in the model. The amount of variance explained was calculated by the squared multiple correlation coefficient,  $R^2$ , and is interpreted in a similar fashion to the equivalent statistic in multiple regression (Barclay et al., 1995).

## RESULTS

### Measurement Model

Initial examination of factor loadings on the model constructs revealed a number of issues. Two items on the PANAS scale (NA) were loading lower than expected and were taken out. Two items were also left out by Thatcher and Perrewe (2002). Examination of loadings on TA revealed a number of items that showed cross loading on other constructs. We used a cut off of 0.6 to reduce it to a seven item measure to be more consistent with theory (Barclay et al., 1995). Similarly, we eliminated two items from the CSE scale.

Following these changes to the measures, the data set was re-analyzed. Internal consistency reliability using both Cronbach alpha and composite reliability (Fornell & Larcker, 1981) are adequate. Evidence of adequate discriminant and convergent validity for all scales is apparent (TA and CSE are very close to the cut off of 0.7) (Table 1). This was further confirmed by the factor loadings as all items load more highly on the construct measured than others.

### Structural Model

PIIT demonstrated a positive relationship with CSE ( $p < 0.05$ ) and a negative relationship with CA ( $p < 0.001$ ). These findings support Hypothesis 1. Both TA and NA demonstrated positive relationships to CA ( $p < 0.001$ ) but had no relationship to CSE.

CSE had a significant direct relationship to PU (0.31;  $p < 0.01$ ), PEOU (0.31,  $p < 0.01$ ). This supports hypothesis 4. CA demonstrated significant positive relationships to PU (0.16;  $p < 0.05$ ) and a negative relationship to PEOU (-0.32;  $p < 0.001$ ). Only PU (and not PEOU) had a positive relationship to BI. There was no significant relationship between PEOU and PU.

A measure of the predictive power of the model is the  $R^2$  value for constructs. The results show (see Figure 2) that the stable traits explain 35% of the variance in CA and 16 % of variance in CSE. When the TAM model is considered, while the model explains 27% of variance of PEOU, it explains only 11% of variance in PU.

## DISCUSSION

This study sought to improve the understanding of the antecedents to dynamic computer-related constructs of computer self-efficacy (CSE) and computer anxiety (CA), especially stable individual difference traits and dispositions. Significant support to the theoretical model provides evidence that stable individual differences are antecedents to and predict both CSE and CA. In addition, the model demonstrates the relationship of these determinants to a well supported model of computer acceptance, the TAM.

Significant paths were shown from PIIT, NA and TA to CSE and CA. All three antecedents explained 35% of the variation in PEOU, but only PIIT was seen to be a significant antecedent for CSE. Both NA and TA were shown to have a significant effect on CA, unlike in the study by Thatcher and Perrewe(2002). This concurs with the position that NA and TA, while similar in some aspects, tap different aspect of a disposition. Further work is required to ascertain whether broader personality differences such as neuroticism are better predictors, and whether such scales captures both aspects. Venkatesh (2000) found the inclusion of six antecedents (two used in this model), explained up to 60% of the variation of PEOU. We included PIIT a stable trait, which had by far the highest path correlation with CA. As PIIT shows promise as a good predictor of PEOU, it may have potential as a screening tool. We cannot directly compare our model to earlier work, and there is need for further work on antecedents to PEOU in the context of user training.

Unlike the case of CA, the antecedents tested did not have much predictive value in explaining CSE. We used a well tested measure of CSE (Compeau & Higgins, 1995; Venkatesh, 2000). However, there has been debate in the literature whether an application-specific measure is indicated, since the situation for testing was specific to a single application (Excel) (Agarwal et al., 2000; Yi & Hwang, 2003). We sought a general CSE measure as it would have more stable traits than a situation specific measure and would be valuable as a screening instrument to identify participants with low CSE in different contexts of user training. Further work is indicated to test the value of application specific measures using the same model.

Brown et al., (2002) have argued that in mandatory situations attitude matters more than intention. They found, using the 'core' TAM model, that the relationship between PEOU and BI was over three times the relationship between PU and BI. In our study this was the reverse. We found an insignificant relationship between PEOU and BI. This may be a reflection of the measure of BI we used. Given the mandated situation, we used a measure of intention, used in goal setting that proposed to capture plans and efforts towards the task (of learning Excel). A better potential measure may be task performance. Future studies are required to expand our understanding of how the effects of wider constraints, like mandated action on tasks, influence the applicability of these measures.

There are some limitations in our study. Our study sample was limited to university students. While it can be argued that ecological validity is constrained, studies using student populations provide some advantages, as the university is a naturalistic setting for adult participants, and a useful first step in examining new models for research (Venkatesh & Davis, 1996, 2000).

The value of this study for practice lies in the addition of evidence for the importance to recognize individual differences in computer user training. The relationships of stable traits and situation specific dynamic traits to user perceptions in mandatory user training shows the need to identify groups of employees with different needs. Some measures for screening such individuals have been identified, further research is required to develop and test interventions to decrease anxiety and increase self-efficacy to address participant predispositions.

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**Table 1:** Means, Standard Deviations, Internal Consistencies, Correlations of Constructs (hypothesized model).

	Internal Consistency					Correlation of Constructs							
	No Items	Mean	Std Dev.	Reliability (Cronbach's Alpha)	Composite Reliability (Fornell)	NA	TA	CA	PIIT	CSE	PEOU	PU	BI
Negative Affect (NA)	8	15.77	5.48	.86	.89	<b><u>.71</u></b>							
Trait Anxiety (TA)	7	12.98	3.73	.82	.86	.59	<b><u>.69</u></b>						
Computer Anxiety (CA)	4	10.75	5.29	.81	.88	.32	.29	<b><u>.81</u></b>					
Personal Innovativeness in IT (PIIT)	4	16.48	5.52	.82	.88	-.16	-.09	-.53	<b><u>.80</u></b>				
Computer Self Efficacy (CSE)	8	38.91	19.35	.83	.87	-.19	-.20	-.38	.29	<b><u>.67</u></b>			
Perceived Ease of Use (PEOU)	4	3.27	5.45	.91	.94	-.09	-.07	-.44	.44	.43	<b><u>.89</u></b>		
Perceived Usefulness (PU)	4	5.38	4.86	.94	.96	-.10	-.16	-.01	.17	.29	.18	<b><u>.92</u></b>	
Behavioural Intention (BI)	3	12.56	2.49	.89	.93	.03	-.05	-.02	-.02	.16	-.06	.26	<b><u>.91</u></b>

Composite reliabilities are calculated using factor loadings and residual variances:  $\text{Consistency} = (\sum \lambda_{yi})^2 / \{(\sum \lambda_{yi})^2 + \sum \text{Var}(\epsilon_i)\}$ ,  $\text{Var}(\epsilon_i) = 1 - \lambda_{yi}^2$   
Diagonal elements are the square root of Average Variance Extracted (AVE).

$$\text{AVE} = \text{AVE} = \sum \lambda_{yi}^2 / \{ \sum \lambda_{yi}^2 + \sum \text{Var}(\epsilon_i) \}, \text{Var}(\epsilon_i) = 1 - \lambda_{yi}^2$$

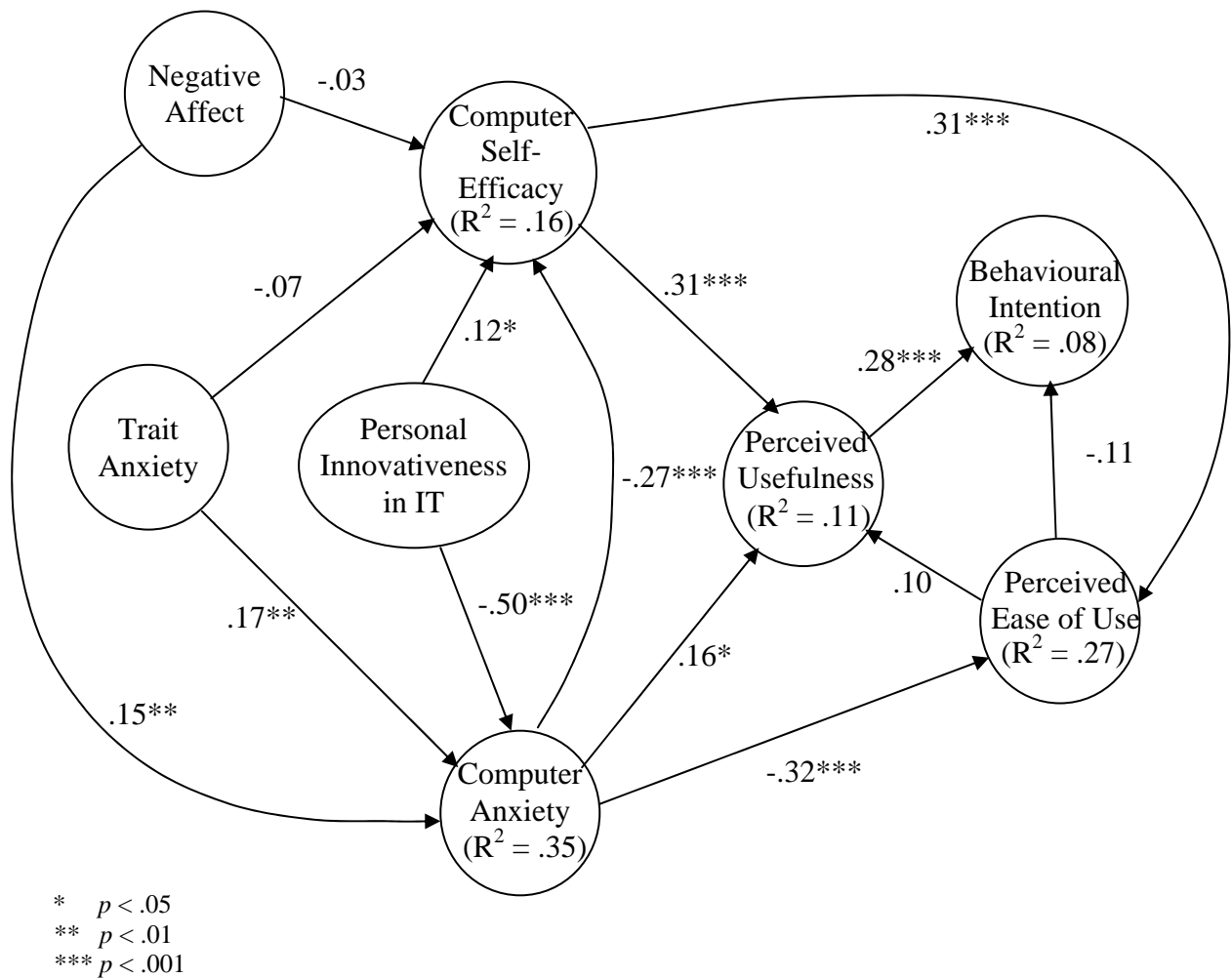


Figure A. Path Coefficients and Squared Multiple Correlations for the Structural Model.

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