Available online at www.sciencedirect.com
ScienceDirect
Computers in Human Behavior 23 (2007) 2851–2862
Computers in Human Behavior
www.elsevier.com/locate/comphumbeh

Computer Anxiety: "Trait" or "State"?

John J. Beckers [a,*], Jelte M. Wicherts [b], Henk G. Schmidt [c]

[a] *Central Office, Maastricht University, The Netherlands*
[b] *Department of Psychology, University of Amsterdam, The Netherlands*
[c] *Department of Psychology, Erasmus University, Rotterdam, The Netherlands*

Available online 31 July 2006

Abstract

A recurring question in the study of computer anxiety is whether computer anxiety is a relatively stable personality trait or a mutable, temporary state. The two studies reported examined this question in two groups of first year psychology students. These students were requested to complete a computer anxiety test, a trait anxiety test, and a state anxiety test. Some groups were administered the tests in a pen and paper format, while others were tested using computerized tests. In the first study, a Dutch version of the Profile of Mood States (POMS) was used; in the second study, a Dutch adaptation of the State-Trait Anxiety Inventory (STAI). The data were analyzed using structural equation modeling. In both studies, computer anxiety turned out to be related more strongly to trait anxiety than to state anxiety. In fact, there was no relationship between computer anxiety and state anxiety in the pen and paper format. In the computerized versions however, computer anxiety and state anxiety were related, suggesting that state anxiety in situations involving a computer is caused by pre-existing computer anxiety.
© 2006 Elsevier Ltd. All rights reserved.

Keywords: Computer anxiety; Trait anxiety; State anxiety; Structural equation modeling

1. Introduction

The DSM IV of the American Psychiatric Association[1] describes anxiety as a mood state in which a subject experiences fear, apprehension, nervousness, worry, tension.

* Corresponding author.
E-mail address: j.beckers@bu.unimaas.nl (J.J. Beckers).

[1] See: http://www.psych.org/public_info/pdf/anxiety.pdf.

0747-5632/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.chb.2006.06.001

Well-known anxiety disorders include fear of appearing in public, fear of closed spaces, or constant fear of close others being hurt. In everyday life, anxiety functions as a warning signal for often unspecified pending danger and serves as a prime for developing an adequate coping response. When anxiety becomes abnormally intense and/or prolonged, it may assume a pathological form, resulting in repressed thoughts, negative conditioned responses, counterproductive thought patterns, poor coping strategies, and increased sympathetic tone of the autonomic nervous system (Craig, Brown, & Baum, 2000). Nowadays, computer anxiety can be added to a list of common anxiety disorders. It can be defined as a feeling of fear and apprehension felt by individuals when using computers or even considering the use of a computer (Simonson, Maurer, Montag Torardi, & Whitaker, 1987). Computer anxiety should be viewed as a potentially serious affliction, as it satisfies the defining aspects of fear as set out in the DSM IV.

Extensive study of computer anxiety over the past three decades has shown that it is a not a simple one-dimensional phenomenon. Most scales used to measure computer anxiety cover various factors, such as lack of confidence in learning to use a computer, aversion of computers, avoidance of computers (Loyd & Gressard, 1984), anxiety aroused by computer-related behaviors, such as looking at computer printers and printouts (Marcoulides & Wang, 1990), or anticipatory anxiety caused by knowing that one has to use the computer (Brosnan, 1998). Summing up previous research, Beckers and Schmidt (2001) suggested that at least six dimensions are involved in the construct of computer anxiety: Computer illiteracy, lack of self-efficacy, heightened physical arousal, feelings of dislike, and two sets of beliefs about the role of computers in every-day life.

Validity studies have demonstrated that computer anxiety, while a robust phenomenon, is not clearly defined (LaLomia & Sidowski, 1993). An important issue that remains to be settled is whether computer anxiety is to be considered predominantly a temporary state, emerging while being confronted with a computer, or whether it is a stable trait of an individual, which is part of a broader anxiety disorder (Harrington, McElroy, & Morrow, 1990). This distinction has an important bearing on the treatment of computer anxiety. By definition, a temporary anxiety will subside, and special training or mere exposure to computers may reduce this type of anxiety. A trait-like anxiety will be more difficult to treat as the source of the anxiety is more deep-seated.

Several authors consider computer anxiety as a state anxiety, which is linked exclusively to the actual or symbolic presence of a computer (Bohlin & Hunt, 1995; Laguna & Babcock, 1997; Rosen & Maguire, 1990; Simonson et al., 1987). These authors emphasize that computer anxiety is open to modification by means of training, social support, and/or better software (e.g., Rosen, Sears, & Weil, 1993; Yaghi & Bentley Abu Saba, 1998). However, there is some support for the hypothesis that highly anxious computer users do not benefit from such treatment, which suggests that their anxiety has deeper roots (Rosen, Sears, & Weil, 1987). Endler, Parker, Bagby, and Cox (1991) propose that a specific dimension of trait anxiety (such as fear to be socially evaluated) interacts with a congruent situational threat: The subject perceives the situation in which he or she has to work with a computer as a situation in which he or she might be socially evaluated. Therefore, subjects who are highly trait anxious, experience a higher state anxiety in the presence of a computer than subjects who do not suffer high levels of anxiety. In this account, computer anxiety is an aspect of a more general trait, which is manifested only in the (anticipated) presence of a computer. When trait anxiety and situational stressor are not congruent, there will be no relation between trait and state anxiety. Deane, Heinssen, Barrelle, Saliba, and Mahar (2000) also argued that computer anxiety is part of a trait anxiety that manifests itself as a heightened state anxiety only in the presence of relevant stressors. Gaudron and Vignoli (2002) found that "students who have high levels of computer trait anxiety show a greater increase in state anxiety than those who have low levels, only when trait anxiety and type of situational stress (e.g., interacting with a computer) are congruent" (p. 320). In summary, some of the literature suggests that treatment of computer anxiety as a transitory mood state falls short of the true nature of computer anxiety. Rather, computer anxiety is an enduring characteristic of a person.

The present study addressed the question whether computer anxiety is a permanent attribute of a person, i.e., a manifestation of general anxiety affecting all aspects of life, or an anxiety that is specific to a particular situational stressor, viz. computer use. To this end, two studies were conducted in which levels of computer anxiety among groups of participants were compared which their responses on various measures of trait anxiety and measures of state anxiety. In the first study, half of the participants completed a computerized version of the state anxiety questionnaire, whereas the other half had its state anxiety measured through a pen and paper procedure. It was hypothesized that, if computer anxiety is predominantly trait-related, its relationship with the measures of trait anxiety should be stronger than its relationship with state anxiety in both conditions. If computer anxiety is largely situational, one would expect its relationship with state anxiety to be stronger in the computerized condition compared to the pencil and paper condition. These hypotheses were tested using a structural equation modeling approach.

Study 2 served to replicate the findings of Study 1, using different measures of state and trait anxiety. In addition, in Study 2 all participants underwent both computerized and pen and paper testing.

2. Study 1

2.1. Method

Participants. Participants were 459 first year psychology students (146 males and 313 females) at the University of Amsterdam. Average age was 21.24 years (SD = 5.05).

Measurements. General mood disturbance was measured by a shortened version of the *Profile of Mood States* (Ark, Marburger, Mellenbergh, Vorst, & Wald, 2003; Wald & Mellenbergh, 1990; Wicherts & Vorst, 2004). This questionnaire measures the following mood states: depression, tension, vigor, fatigue, and anger. The various moods states are described by means of a list of 32 mood descriptions, such as "feeling attractive", "feeling active", "feeling scared", "feeling tired", "feeling patient." The respondent indicates whether these moods apply to his or her mood using a five-point scale (0 = absolutely not, to 4 = very well). In this study we used two versions of the POMS: the trait version and the state version. These versions differ only with respect to the instructions given. In the trait version, the respondent is asked to indicate the extent to which he or she finds the description to apply to his or her mood state over the *last few days including today*. These ratings reflect the extent of negative mood based on a longer period of time, and thus indicated negative mood trait. In the state version, the respondent indicates whether the mood description apply to him or her *at the moment* of administration. The ratings indicate the person's state mood.

The validity of the (Dutch shortened) POMS has been established in various studies (Guadagnoli & Mor, 1989; McNair, Lorr, & Droppleman, 1971, 1981, 1992; Shacham, 1983).

The *Beckers and Schmidt Computer Anxiety Scale* (BSCAS) measures six latent factors underlying computer anxiety. These are: (1) computer literacy (in terms of acquired computer skills), (2) self-efficacy (confidence in one's capacity to learn to use computers), (3) physical arousal in the presence of computers (such as sweaty hand palms, shortness of breath), (4) affective feelings towards computers (like or dislike of computers), (5) positive beliefs about the benefits for society of using computers, and (6) negative beliefs about the dehumanizing impact of computers. The scale contains 32 Likert-type items, consisting of statements on computers that could be scored between 1 (entirely disagree) and 5 (entirely agree). Computer literacy was referred to by items such as "I find it easy to make computers do what I want", "I have difficulty in understanding the technical aspects of computers". Self-efficacy was referred to by items such as "Everyone can learn to use a computer, as long as one is patient and motivated", and "I am confident that I can learn computer skills". Affective feelings toward the computer were measured by items such as "Life will be easier and faster with computers" and "Computers are nice to work with". Examples of physical arousal items are "I feel suffocated when I am in front of the computer", "My heart beats faster when I think about working with a computer". Beliefs on the dehumanizing power of computers were measured using items such as "Soon our lives will be controlled by computers", and "People are becoming slaves to computers". Beliefs on the benefits of personal computers especially for the good of society, were measured by items such as "Computers are bringing us into a bright new era", "Computers create economic stability".

The BSCAS is a shortened version of a computer anxiety scale developed by Beckers and Schmidt (2001). The reliability coefficient of the BSCAS will be reported below. Validity of the BSCAS has not been studied extensively, but studies reported by Beckers (2003) and Wicherts (2002) support its validity.

Procedure. All tests were part of an overall testing program for first-year students. During the first week, students received the paper and pencil versions of the computer anxiety questionnaire and the trait version of the Profile of Mood States. In week 4 the Profile of Mood States test was again presented, this time in the state version. To be able to investigate the effect of a computer induced stressor, the state version of the POMS was administered under one of two conditions: one group ($N = 222$) took the test in pen and paper format (Sample PP), the other group ($N = 237$) took the test in a computerized format (Sample C).

Analyses. We conducted a multi-group confirmatory analysis using LISREL 8.54 (Jöreskog & Sörbom, 2002). This analysis enables one to evaluate the model fit of pre-described models. More importantly, with this analysis it is possible to statistically test for differences and similarities in parameter estimates between groups. Because both samples differ with respect to the stressor (i.e., computer vs. paper and pencil administration), this allows for a statistical test of the important path between computer anxiety and negative state mood during an encounter with a computer.

The fitted model contains three common factors: the computer anxiety factor, a factor representing negative (trait) mood, and a factor representing negative (state) mood with (i.e., C sample) or without (i.e., PP sample) exposure to the computer. Fig. 1 displays the factor model. Because of the fact that the same items are administered twice, we allowed for the residuals of each of the POMS scales to be correlated over time.

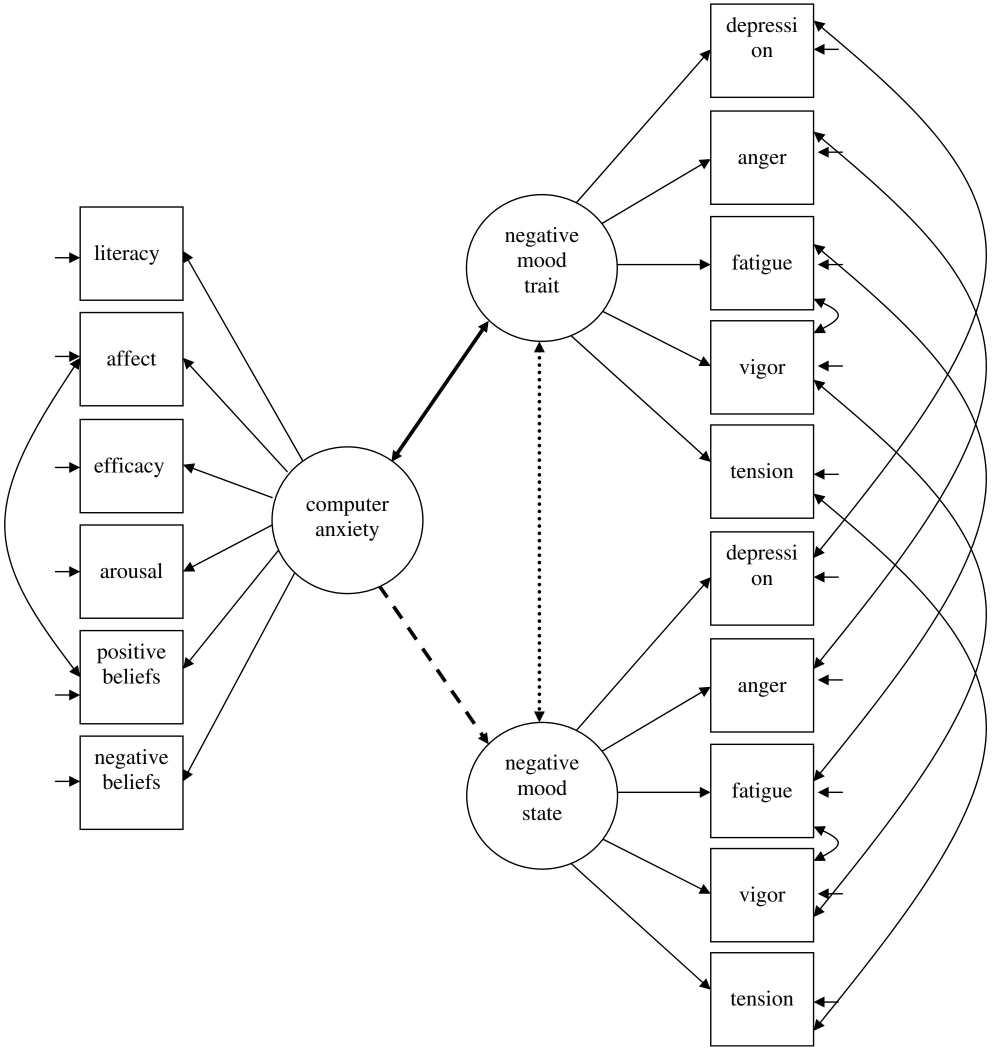

Fig. 1. Path model relating computer anxiety, negative mood trait, and negative mood state.

2.2. Results

Reliability of the scales. The Cronbach's α reliability for the BSCAS was 0.91. The reliabilities of the POMS scales were 0.80 for tension, 0.78 for vigor, 0.88 for fatigue, 0.85 for anger, and 0.89 for depression. These reliabilities are sufficiently high for the purpose of this study.

Model adjustments and equivalence tests. The hypothesized model did not fit the data very well. Allowing the residuals of Positive Beliefs and Affect in the BSCAS to covary improved the fit considerably in both groups ($\chi^2(\mathrm{df} = 1) = 37.8$, $p < 0.001$ and $\chi^2(\mathrm{df} = 1) = 34.6$, $p < 0.001$ in samples C and PP, respectively). In addition, the residuals of the Fatigue and Vigor scales of the POMS were allowed to covary. This again considerably improved model fit in both samples ($\chi^2(\text{df} = 2) = 126.6$, $p < 0.001$ and $\chi^2(\text{df} = 2) = 86.5$, $p < 0.001$ in sample C and PP, respectively). Note that the latter residual covariance is consistent with the finding by Wicherts and Vorst (2004) that the shortened POMS is not strictly unidimensional.

To ensure that the POMS measurements are equivalent over time and across both groups, we restricted factor loadings estimates to be equal over time and across groups. Both the restrictions with respect to measurement occasion ($\Delta\chi^2(\text{df} = 13) = 19.4$, $p = 0.11$), and the restrictions over groups ($\Delta\chi^2(\text{df} = 4) = 3.70$, $p = 0.45$) proved tenable, indicating equivalence (of factor loadings) over time and group, respectively.

Main analyses. Table 1 contains fit indices of the models tested. In the first step, we investigated the overall fit of the model presented in Fig. 1. As judged by the CFI, and RMSEA, the fit appears to be acceptable. Moreover, the standardized root mean residual (SRMR) is 0.061 in the C sample and 0.078 in the PP sample, which indicates that the model fit is good according to Hu and Bentler's (1999) rules-of-thumb for good model fit.

In Step 2, we tested whether the all-important correlation between negative trait mood and computer anxiety (i.e., the solid two-way arrow in Fig. 1) is significant in both groups by fixing this parameter to zero. Because of nesting, we may compare the model fit of Step 2 to the model fit of Step 1. It is clear that the model with this path (i.e., Step 1) fits better than the model without this path (i.e., Step 2). That is, if we subtract the χ^2's for a likelihood ratio test, we get the following result: $\chi^2(\text{df} = 2) = 21.58$, $p < 0.001$. This clearly indicates that negative mood trait and computer anxiety are interrelated.

Now consider the fit measures of Step 3a, in which we restricted the path between computer anxiety and negative state mood (i.e., dashed arrow in Fig. 1) to be zero in the PP sample only. If we again compare this model to the model in Step 1 by means of a likelihood ratio test, we get the following test result: $\chi^2(\text{df} = 1) = 1.02$, $p = 0.31$. Thus, in the PP sample this path is non-significant, as expected. If we follow the same procedure in the C sample (Step 3b), the results are considerably different: $\chi^2(\text{df} = 1) = 12.77$, $p < 0.001$. Therefore, in the C sample, the path between computer anxiety and negative state mood is significantly different from zero.

2.3. Conclusion

Negative mood as a trait is positively correlated with computer anxiety, regardless of the presence or absence of the stressor. In addition, when confronted with a computer (C sample only), computer anxiety is also positively related to negative mood as a state. In the absence of the computer (sample PP), negative mood state and computer anxiety are unrelated.

Table 1
Fit indices Study 1

Step	Description	df	χ^2	RMSEA	CFI
1	Baseline model	203	395.6	0.062	0.96
2	CA ↔ Trait mood zero both samples	205	418.2	0.064	0.95
3a	Path CA → State mood zero sample PP	204	396.6	0.061	0.96
3b	Path CA → State mood zero sample C	204	408.4	0.063	0.95

Note: RMSEA: Root Mean Square Error of Approximation; CFI: Comparative Fit Index; CA: computer anxiety; PP: paper and pencil; C: computer.

3. Study 2

A potential problem of the measures used in Study 1 is that participants may not have perceived the trait and state versions of the POMS as sufficiently different. Not only were the items similar but also the time frame over which the level of one's own anxiety had to be judged (''now'' versus ''the last few days including today'') may not have been perceived as really different. One could at least interpret the fact that the trait and state version of the POMS correlate quite highly as an indication that both instruments measured largely the same underlying trait. Therefore, to study the generality of our findings, a second study was carried out, using other instruments to measure trait and state anxiety. In addition, all participants in this study were exposed to both paper and pencil and computerized versions of the tests to exclude the possibility of systematic differences between groups influencing the findings.

3.1. Method

Participants. Participants were 366 first year psychology students at the University of Amsterdam. Of these students, 103 students were male and 263 were female. The average age was 21.62 years (SD = 5.68).

Measurements. The Dutch version of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1983) was used to measure state and trait anxiety. Each mode of anxiety is measured by using 20 items containing statements such as ''I feel calm'',

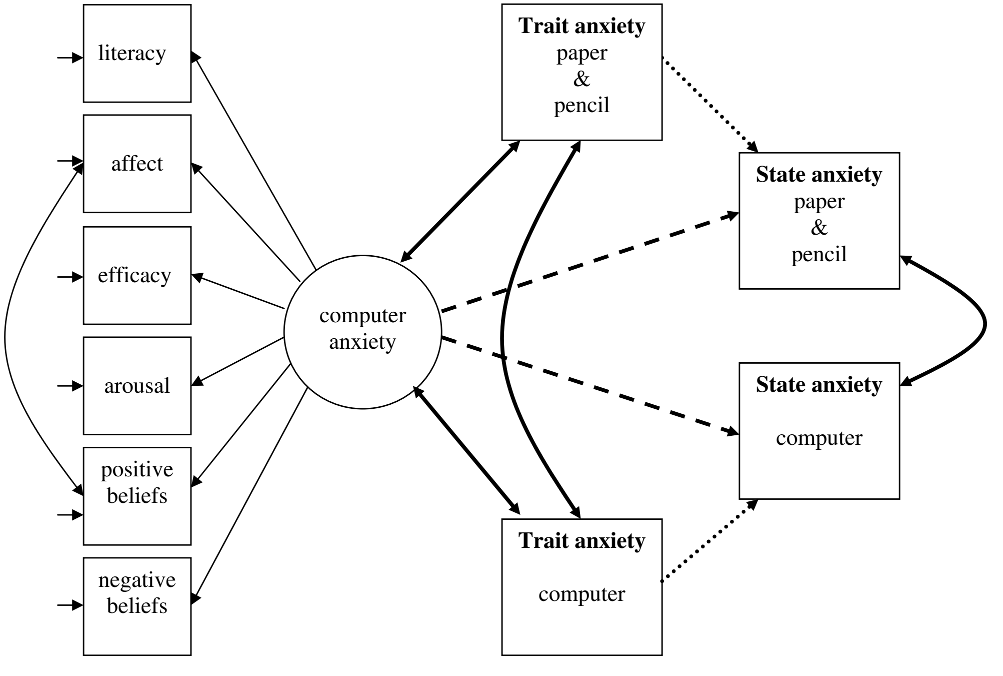

Fig. 2. Path model relating computer anxiety, state anxiety and trait anxiety administered by computer or by paper and pencil.

"I feel comfortable", "I feel restless", "I feel tense". These Likert type items range from 1 (not at all) to 4 (very much so). Respondents are asked to indicate extent to which a statement applies at this very moment (state) or in general (trait). The validity of the STAI has been established in various studies (Mook, van der Ploeg, & Kleyn, 1990; van der Ploeg, 1989, 2000; Rombouts, Gazendam, & Nijholt, 1990; Spielberger et al., 1983).

Computer anxiety was again measured using the Beckers & Schmidt Computer Anxiety Scale (Beckers & Schmidt, 2001).

Procedure. Participants were administered the tests during three sessions which were all part of a general testing program for first-year students. The data were collected in a two-group counterbalanced design. In both groups, the computer anxiety questionnaire was administered during the first session using a paper and pencil format. Participants in the first group ($N = 183$) were given the STAI in paper and pencil format in the third session and the STAI in the computerized format during the fourth session. In the second group ($N = 183$), the format order of the STAI was reversed (i.e., computer version first, paper and pencil version second). Because of the design was fully counterbalanced, we pooled both groups in a single-group analysis.

Analyses. The data were analyzed using the structural equations modeling program LISREL 8.54. Again, we compared the fit of models that differ in the relevant paths between computer anxiety on the one hand and state and trait anxiety on the other hand. Fig. 2 displays the path model.

3.2. Results

Reliability of the scales. Cronbach's α reliability for the BSCAS and the STAI were 0.90 for the BSCAS, 0.92 for the state anxiety scale, and 0.93 for the trait anxiety scale. The reliability of the scales is good.

Preliminary analyses. Table 2 contains the model fit of different models. Like in Study 1, we started with a baseline model incorporating all paths. In this model, the residuals of Positive Beliefs and Affect in the BSCAS were again allowed to covary. According to Hu and Bentler's (1999) guidelines, the baseline model fits well in terms of SRMR and CFI. As a check for measurement equivalence between computerized and paper and pencil administration of the STAI, we tested in Step 2 whether the path from trait anxiety to state anxiety (i.e., the dotted lines in Fig. 2) is invariant across administration modes. The increase in chi-square is non-significant ($\chi^2(\text{df} = 1) = 1.15$, $p = 0.28$), indicating that this restriction is tenable. We also checked whether the correlation between computer anxiety and trait anxiety was insensitive to the format in which the STAI was administered. This restriction (i.e., Step 3) again did not result in a significant increase in χ^2 ($\chi^2(\text{df} = 1) = 3.24$, $p = 0.07$). Together the tenability of the restrictions in Steps 2 and 3 suggest that the STAI functions equivalently across administration modes.

Main analyses. In Step 4, we fixed the path between computer anxiety and trait anxiety to be zero in order to test whether this is relationship is significant. As can be seen, this restriction leads to a clear and significant deterioration in model fit: $\chi^2(\text{df} = 1) = 18.34$, $p < 0.001$. This clearly indicates a positive relation between computer anxiety and trait anxiety. This estimate of this correlation is 0.25 (SE = 0.056, $Z = 4.43$, $p < 0.001$).

In Step 5a, we fixed the path from computer anxiety to state anxiety when the STAI was administered in paper and pencil format (i.e., the top dashed line in Fig. 2). As expected, this restriction did not result in a significant increase in chi-square ($\chi^2(\text{df} = 1) = 0.63$,

Table 2
Fit indices Study 2

Step	Description	df	χ^2	RMSEA	CFI	SRMR
1	Baseline model	30	84.6	0.073	0.96	0.056
2	COTR → COST equal to PPTR → PPST	31	85.7	0.073	0.96	0.056
3	CA ↔ COTR equal to CA ↔ PPTR	32	89.0	0.073	0.96	0.057
4	CA ↔ COTR and CA ↔ PPTR fixed at 0	33	107.3	0.081	0.95	0.098
5a	CA → PPST fixed at 0	33	89.6	0.072	0.96	0.057
5b	CA → COST fixed at 0	33	94.9	0.074	0.96	0.064

Note: RMSEA: Root Mean Square Error of Approximation; CFI: Comparative Fit Index; SRMR: Standardized Root Mean Square Residual; CA: computer anxiety; COTR: trait anxiety measured by computer; COST: state anxiety measured by computer; PPTR: trait anxiety measured by paper & pencil; PPST: state anxiety measured by paper and pencil.

$p = 0.43$), indicating the non-significance of this path. On the other hand, we did expect this path to be significant when the STAI was administered through the computer. This was tested in Step 5b by fixing this parameter (i.e., the bottom dashed line in Fig. 2). As can be seen in Table 2, this restriction did result in a clear deterioration in model fit. ($\chi^2(\text{df} = 1) = 5.96$, $p = 0.01$). This path is estimated as 0.10 ($\text{SE} = 0.043$, $Z = 2.38$, $p < 0.01$). This finding suggests that computer anxiety only influences state anxiety in the presence of a computer, while under other conditions the relationship between the two is absent.

3.3. Conclusion

The results of Study 2 corroborate the results of Study 1 as computer anxiety is clearly correlated with trait anxiety. Moreover, in the presence of the computer, computer anxiety also has a clear effect on state anxiety.

4. General discussion

The literature presented in Section 1 of this article suggested two mutually exclusive conceptions of the nature of computer anxiety: computer anxiety predominantly as a variable mood state and computer anxiety seen as a stable trait. This study was designed to clarify the nature of the relationships between computer anxiety, trait anxiety, and state anxiety, and to study the effect on these measures of introducing a stressor in the form of a computer event. To this end students completed computerized and paper and pencil versions of the trait and state anxiety scales. In the first study, trait and state anxiety were measured by the Dutch Profiles of Mood States test. In the second study trait and state anxiety were measured by the Dutch version of the STAI. The major finding in this study is that computer anxiety is more strongly related to trait anxiety than to state anxiety. In fact, computer anxiety and state anxiety are only related when the computer is used for filling in the tests, and even under this condition state anxiety is less related to computer anxiety than to trait anxiety. Gaudron and Vignoli (2002) referred to the work of Endler et al. (1991), who suggested that trait anxiety is multidimensional, and that individuals are more prone to anxiety in situations of ambiguity, social evaluation and physical danger. So the question arises whether computer anxiety is derived from a fear for any of these situations or a combination. Ambiguity is often present in working with computers. In addition, working with a computer is open to judgment by colleagues and superiors (Weil, Rosen, & Wugalter, 1990). The threat that a computer poses in terms of a physical danger is debatable, but the rising numbers of people suffering from RSI and eyesight fatigue indicate that working with computers is not risk free. It is interesting to note that in colloquial terms computer users often use descriptive terms that refer to physical damages, e.g. viruses, crashes, "the blue screen of death", etc.

Therefore, a case could be made that computer anxiety is composed of all these three elements of a trait anxiety. However, Gaudron and Vignoli (2002) questioned whether the existence of computer anxiety would suggest that a fourth factor should be added to the concept of trait anxiety, viz. a fear for modern technology in itself. This view is supported by Worthington and Zhao (1999), who point out that computer anxiety has an existential component that deals with conceptions of self, society and culture. Introducing computer technology into a social setting may be seen as a cognitive and emotional disturbance that may force people to radically rethink their beliefs and practices, and that may lead to the conclusion that their self-concept and world view are inadequate to cope with these changes. If people become overwhelmed by the uncertainty of life and the reasons for their existence, they may face an existential crisis. This theory is partly supported by the findings of this study. Conceptions of self, society and culture are to some extent represented in the latent factors of computer anxiety measured in this study such as self-efficacy – denoting a sense of self-worth – and beliefs on the positive aspects of computers on society and beliefs on the dehumanizing aspects of computers.

The main conclusions that can be drawn from this study is that computer anxiety has a base in trait anxiety, which will negatively influence the success of treatments that are solely focused on teaching computer users the intricacies of various applications. Computer anxiety remains a complex phenomenon with no quick fix solutions. Computer anxiety appears to harbor components of trait anxiety. This may affect the perspective of those who try to alleviate the negative emotional, cognitive and behavioral effects of working with computers.

References

Ark, L. A. van der, Marburger, D., Mellenbergh, G. J., Vorst, H. C. M. & Wald, F. D. M. (2003). Verkorte PROFILE OF MOODS STATES (Verkorte POMS); Handleiding en verantwoording. [Shortened POMS Technical Manual]. Lisse: Swets Testing Services.

Beckers, J. J. (2003). Computer anxiety. Determinants and consequences. Unpublished doctoral dissertation, Erasmus University, Rotterdam, The Netherlands.

Beckers, J. J., & Schmidt, H. G. (2001). The structure of computer anxiety: a six-factor model. *Computers in Human Behavior, 17*(1), 35–49.

Bohlin, R. M., & Hunt, N. P. (1995). Course structure effects on students' computer anxiety, confidence and attitudes. *Journal of Educational Computing Research, 13*(3), 263–270.

Brosnan, M. J. (1998). The impact of psychological gender, gender-related perceptions, significant others, and the introducer of technology upon computer anxiety in students. *Journal of Educational Computing Research, 18*(1), 63–78.

Craig, K. J., Brown, K. J., & Baum, A. (2000). Environmental factors in the etiology of anxiety., retrieved from http://www.acnp.org/G4/GN401000127/CH125.html.

Deane, F. P., Heinssen, R. K., Barrelle, K., Saliba, A., & Mahar, D. (Eds.). (2000). *Construct validity of computer anxiety measured by the computer attitudes scale*. Amsterdam: Elsevier Science.

Endler, N. S., Parker, J. D., Bagby, R. M., & Cox, B. J. (1991). Multidimensionality of stait and trait anxiety: factor structure of the Endler multidimensional anxiety scales. *Journal of Personality and Social Psychology, 60*, 912–926.

Guadagnoli, E., & Mor, V. (1989). Measuring cancer patients' affect: Revision and psychometric properties of the Profile of Mood States (POMS). *Psychological Assessment, 1*, 150–154.

Gaudron, J.-P., & Vignoli, E. (2002). Assessing computer anxiety with the interaction model of anxiety: development and validation of the computer anxiety trait subscale. *Computers in Human Behavior, 18*, 315–325.

Harrington, K. V., McElroy, J. C., & Morrow, P. C. (1990). Computer anxiety and computer-based training: A laboratory experiment. *Journal of Educational Computing Research, 6*(3), 343–358.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55.

Jöreskog, K. G., & Sörbom, D. (2002). *LISREL 8: Structural Equation Modeling with the SIMPLIS command language*. Chicago: Scientific Software International.

Laguna, K., & Babcock, R. L. (1997). Computer anxiety in young and older adults: Implications for human–computer interactions in older populations. *Computers in Human Behavior, 13*(3), 317–326.

LaLomia, M. J., & Sidowski, J. B. (1993). Measurements of computer anxiety: A review. *International Journal of Human Computer Interaction, 5*(3), 239–266.

Loyd, B. H., & Gressard, C. (1984). Reliability and factorial validity of Computer Attitude scales. *Educational and Psychological Measurement, 44*(2), 501–505.

McNair, D. M., Lorr, M., & Droppleman, L. F. (1992). *Manual for the Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Service.

Mook, J., van der Ploeg, H. M., & Kleyn, W. C. (1990). Anxiety, anger, and depression: Relationships at the trait level. *Anxiety Research, 3*, 17–31.

Marcoulides, G. A., & Wang, X. b. (1990). A cross-cultural comparison of computer anxiety in college students. *Journal of Educational Computing Research, 6*(3), 251–263.

van der Ploeg, H. M. (1989). In *A cross-cultural study of the dimensionality of the State-Trait Anxiety Inventory*. In R. Schwarzer, H. M. van der Ploeg, & C. D. Spielberger (Eds.). *Advances in test anxiety research* (Vol. 6, pp. 195–202). Lisse, The Netherlands: Swets & Zeitlinger.

van der Ploeg, H. M. (2000). *Handleiding bij de Zelf Beoordelings Vragenlijst (ZBV) [Test Manual Dutch State Trait Anxiety Inventory]*. Lisse, The Netherlands: Swets & Zeitlinger.

Rombouts, R., Gazendam, A., & Nijholt, N. J. (1990). Onderzoek naar de equivalentie van computer- en papier-potlood versies van enkele psychologische vragenlijsten. *[A study of equivalence of computerized and paper-and-pencil versions of various psychological questionnaires] Nederlands Tijdschrift voor de Psychologie, 44*, 88–93.

Rosen, L. D., & Maguire, P. (1990). Myths and realities of computerphobia: A meta-analysis. *Anxiety Research, 3*, 175–191.

Rosen, L. D., Sears, D. C., & Weil, M. M. (1987). Computerphobia. *Behavior Research Methods, Instruments and Computers, 19*(2), 167–179.

Rosen, L. D., Sears, D. C., & Weil, M. M. (1993). Treating technophobia: A longitudinal evaluation of the computerphobia reduction program. *Computers in Human Behavior, 9*(1), 27–50.

Shacham, S. (1983). A shortened version of the profile of mood states. *Journal of Personality Assessment, 47*, 305–306.

Simonson, M. R., Maurer, M., Montag Torardi, M., & Whitaker, M. (1987). Development of a standardized test of computer literacy and a computer anxiety index. *Journal of Educational Computing Research, 3*(2), 231–247.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. (1983). *Manual for the state-trait anxiety inventory STAI (Form Y)*. Palo Alto: Consulting Psychologists Press.

Wald, F. D. M., & Mellenbergh, G. J. (1990). De verkorte versie van de Nederlandse vertaling van de Profile of Mood States (POMS). *[The shorthened version of the Dutch Profile of Mood States (POMS)] Nederlands Tijdschrift voor de Psychologie, 45*, 86–90.

Weil, M. M., Rosen, L. D., & Wugalter, S. E. (1990). The etiology of computerphobia. *Computers in Human Behavior, 6*, 361–379.

Wicherts, J. M. (2002). Meetequivalentie tussen pen & papier en computerafname van vragenlijsten: Alexithymie, sociale wenselijkheid en angst [Measurement equivalence of paper-and-pencil and computerized administration of questionnaires: Alexithymia, social desirability, and anxiety]. Unpublished master's thesis, University of Amsterdam.

Wicherts, J. M., & Vorst, H. C. M. (2004). Modelpassing van de Verkorte Profile of Mood States en meetinvariantie over mannen en vrouwen. *[Model fit of the Shorthened Profile of Mood States and measurement invariance over gender] Nederlands Tijdschrift voor de Psychologie, 59*, 12–21.
Worthington, V. L., & Zhao, Y. (1999). Existential computer anxiety and changes in computer technology: What past research on computer anxiety has missed. *Journal of Educational Computer Research, 20*, 299–315.
Yaghi, H. M., & Bentley Abu Saba, M. (1998). Teachers' computer anxiety: An international perspective. *Computers in Human Behavior, 14*(2), 321–336.