The structure of computer anxiety: a six-factor model

J.J. Beckers a,*, H.G. Schmidt b

aMaastricht McLuhan Institute, Maastricht University, PO Box 616, 6200 MD, Maastricht, The Netherlands
bDepartment of Psychology, Maastricht University, PO Box 616, 6200 MD, Maastricht, The Netherlands

Abstract

A six-factor model of computer anxiety was tested in two samples of university students. The dimensions involved were: computer literacy, self-efficacy, physical arousal caused by computers, affective feelings about them, beliefs about the beneficial effects of computers, and beliefs about their dehumanizing aspects. Confirmatory factor analyses showed that, compared to a number of alternative models proposed in the literature, the data fitted this six-factor model relatively well. In addition, it was demonstrated that computer literacy has a strong directional influence on both physical arousal and affects. Beliefs about computers, in turn, were shown to be dependent on affects and physical arousal. Self-efficacy mainly contributed to increased computer literacy. These findings suggest that training programs that enhance self-efficacy and computer literacy may in principle reduce computer anxiety. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Computer anxiety; Computer literacy; Structural equations model

1. Introduction

Computer anxiety as a psychological phenomenon has been well-researched over the past three decades. Gradually, a better insight has been acquired into its nature. The construct is still defined in various ways, but terms recurring in most of these definitions are aversion, fear or apprehension towards interacting with computers or thinking about computers, intimidation by, resistance to, hostility, or aggression towards computers (Jay, 1981; Meier, 1986; Glass & Knight, 1988). Sometimes,
Computer anxiety is manifested by physiological reactions such as sweaty palms, dizziness, and shortness of breath, and often these behaviors are accompanied by self-critical internal dialogue (Hemby, 1998; Weil, Rosen & Wugalter, 1990; Lalomia & Sidowski, 1993).

Rosen and Weil (1995, 1996) found computer anxiety to be endemic among groups such as public school teachers, students, and psychologists. They estimated that as many as 40% of the population in the United States experience computer anxiety to a degree. In a large sample of first year university students from 23 countries, Rosen and Weil (1995) found the occurrence of computer anxiety to vary widely, e.g. Israeli students had a low of 12% and Indonesian students a high of 100% computer-related anxiety. Bozionelos (1996) showed that more than 20% of a sample of British managers and professionals had scores above the midpoint on a computer anxiety scale. With the increasing penetration of personal computers in business, education, and the home, the problem of computer anxiety has become more pertinent. It is an unsolved issue whether blooming Internet use and the emergence of technologies such as digital telephony will decrease the occurrence of computer anxiety or will enhance it.

Computer anxiety has been studied in a number of different ways. Of relevance to the present article is a subset of studies that has employed factor analysis to explore dimensions underlying this phenomenon. These studies have demonstrated that computer anxiety may not be a one-dimensional construct. The computer-anxiety model of Loyd and Gressard (1984) for instance, identifies three separate factors: self-confidence in dealing with computers, fear of, and liking of computers. Other researchers have concentrated on various aspects of interacting with computers, e.g. whether anxiety was generalized or just related to specific aspects of computer use such as manipulating the keyboard or dealing with errors and crashes (Marcoulides & Wang, 1990; Brosnan & Lee, 1998). Other studies focused on the circumstances under which computer anxiety emerges, i.e. does anxiety only appear when actually dealing with a computer, or does it already emerge while thinking about using it or seeing others use it? (Weil & Rosen, 1995; Rosen & Weil, 1995; Dyck, Gee & Smither, 1998). Table 1 reviews the major findings of these factor-analytic studies. For each study the relevant factors are reported and where needed further explained. In addition, an attempt is made to establish common themes.

The table suggests that computer anxiety is comprised of at least the following elements: (1) low confidence in one’s own ability to use computers; (2) negative affective responses to them; (3) becoming aroused while using a computer or thinking about it; and (4) negative beliefs about the role of the computer in our lives. It is presently unclear, however, how these factors interact. For instance, is low confidence a precursor of negative affect, or is it the other way around? Do beliefs about the role of computers cause people to become aroused in the presence of these machines, or are beliefs by-products of these aversive responses? In addition, the studies reviewed are not very clear about the role of actual experience with computers in the emergence of anxiety. One can, however, hardly imagine people suffering from computer anxiety without ever having tried to use one. Various studies have found the relationship between computer experience and computer anxiety to be
Table 1
Overview of factor models of computer anxiety published in the literature

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Confidence in learning to use the computer</td>
<td>Confidence, enthusiasm, and positive anticipation toward computer use</td>
<td>Equipment anxiety: anxiety aroused by watching others work with personal computer and looking at printers and printouts</td>
<td>Observational computer learning anxiety</td>
<td>Indirect involvement: anxiety in response to observing others working with computers, or talking about computers</td>
<td>Vicarious computer anxiety: anxiety aroused by watching personal computers or watching others use personal computers</td>
<td></td>
</tr>
<tr>
<td>Liking of computers</td>
<td>Positive feelings towards computers, negative feelings towards computers</td>
<td>Anxiety related to fear, lack of understanding, intimidation</td>
<td></td>
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</tr>
<tr>
<td>Fear of computers</td>
<td>Lack of understanding computers with resultant feelings of being intimidated</td>
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</tr>
</tbody>
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(continued overleaf)
<table>
<thead>
<tr>
<th>Study</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Loyd and Gressard (1984)</td>
<td>General computer anxiety related to actual computer use, beliefs about the role of computers in society and its impact on the worker</td>
</tr>
<tr>
<td>Nickell and Pinto (1986)</td>
<td>Interactive computer learning anxiety</td>
</tr>
<tr>
<td>Heinsen, Glass and Knight (1987)</td>
<td>Direct involvement: anxiety related to actively using the computer, including learning to program a computer and taking computer classes</td>
</tr>
<tr>
<td>Marcoulides and Wang (1990)</td>
<td>Enactive computer anxiety: anxiety aroused by actually using personal computers, including fear for errors</td>
</tr>
<tr>
<td>Dyck, Gee and Smither (1998)</td>
<td></td>
</tr>
<tr>
<td>Brosnan and Lee (1998)</td>
<td>Lack of typing skills</td>
</tr>
</tbody>
</table>

**Table 1 (continued)**

Consumer technology anxiety
negative, but it remains unclear if there is a causal relationship and if so: what causes what (Lee, 1986; Rosen et al., 1990; Maurer, 1994; Todman & Monaghan, 1994; Anderson, 1996; Chua, Chen & Wong, 1999, Smith, 1999). The present studies were carried out to clarify these issues.

Before turning to the main findings, two issues need further discussion. Following Murphy, Cover and Owen (1989) we will distinguish between the (lack of) confidence that one may have in one’s ability to learn to use a computer — or computer self-efficacy — and actual experience with computers — or computer literacy (Watt, 1980). Computer literacy manifests itself in such diverse things as the number of hours that one spends at a computer, the range of applications that one is able to use successfully, one’s knowledge of computer jargon, or one’s subscription to computer magazines. In short, it comprises the perception that one has of one’s level of mastery of relevant computer knowledge and skills. Computer self-efficacy, on the other hand, describes the expectation of mastery. Based on previous successes or failures in learning situations in general, or with technology in particular, people develop expectations of future success or failure (Igbaria & Ilvari, 1995; Torkzadeh & Koufteros, 1994; Rosen & Garner, 1999). The assumption is that computer self-efficacy will help a person to persevere in his endeavors as he expects a positive outcome. High self-efficacy may be effective in reducing feelings of anxiety or even keep these feelings from developing.

The second issue to be clarified concerns the relationship between beliefs about computers and affectstoward them. Affects are evaluative responses towards computers (“I dislike computers”, “Computers make me crazy”), whereas beliefs are cognitive constructions of experience that a person holds to be true and that guide his or her behavior. These experiences are often condensed and integrated into schemata (Levine & Donitsa-Schmidt, 1998). These beliefs may pertain to what a computer may do for me as an individual, or what they may do for society (Igbaria & Parasuraman, 1989; Simonson, Maurer, Montag Torardi & Whitaker, 1987; Levine & Donitsa-Schmidt, 1998). They can be positive or negative (Turnipseed & Burns, 1995).

Based on these deliberations, we propose here a six-factor model of computer anxiety. These six factors are: computer literacy, self-efficacy, physical arousal in response to computers, affective feelings about them, beliefs about the beneficial effects of computers, and beliefs about their purported dehumanizing aspects. In addition, we propose a set of directional influences among these factors. Fig. 1 summarizes our position. It can be read as follows: computer literacy or lack of it and computer self-efficacy are independent contributors to the level of physical arousal that people experience while confronted with computers, and their affects towards the machine. These factors in turn influence beliefs about computers, both negative and positive.

This model was tested in a sample of Dutch university students. First, six sets of items measuring the different dimensions were taken from the literature or written for that purpose. These sets were subjected to confirmatory factor analysis in an attempt to validate these dimensions as distinct from each other. Second, the model and some of its competitors were tested against the data. Subsequently, the results were cross-validated in a new sample.
2. Method

2.1. Participants

Participants were 184 first-year psychology students of Maastricht University, the Netherlands, 138 females and 46 males. Mean age was 20.34 years with a standard deviation of 2.79. The range was 19–39 years. 179 of these participants indicated use of a computer once in a while; 112 owned one. In response to a question inquiring about their level of expertise with computers, 25% described themselves as “highly unskilled” or “unskilled;” another 38% considered themselves “neither skilled nor unskilled.” Participants received a small compensation for their involvement in the study. The study was conducted in February 1999. A second sample of psychology students was tested 1 year later. This sample consisted of 225 participants: 149 first-year and 76 third-year students, 177 females and 48 males. Mean age was 21.17 years with a standard deviation of 2.55. The range was 19–41 years. This group had similar characteristics with regard to computer ownership and skills level.
2.2. Measures and procedure

Three existing scales were used to provide an initial pool of items for measuring the dimensions of computer anxiety. These scales were the Computer Anxiety Rating Scale (CARS) constructed by Heinssen et al. (1987), the Computer Attitude Scale (CAS) created by Nickell and Pinto (1986), and a composite scale of self-efficacy (SE) used by Igbaria and Ilivari (1995). The composite scale of self-efficacy contains sub-scales dealing with anxiety, perceived usefulness, perceived ease of use, self-efficacy, and organizational support. The items of the CAS (20), the CARS (19) and SE (14) were originally in the English language and were translated in Dutch. To complement the scales, a set of 58 five-point Likert-scale items was constructed for each of the factors mentioned above with an emphasis on items that referred to physiological avoidance responses and affect. Here, some examples are given of the items included in the questionnaire. Computer literacy was referred to by items such as “I find it easy to make computers do what I want”. “I find it difficult to understand the technical aspects of a computer”. Self-efficacy was referred to by items such as “Nowadays, everyone can learn to use a computer”, and “I am confident that I can learn computer skills”. Affective feelings toward the computer were measured by items such as “The computer has simplified my life” and “I dislike computers”. Examples of physical arousal items are “I feel like I am short of breath when I am in front of the computer”, “I have sweaty hand palms when I work with the computer”. Beliefs on the dehumanizing power of computers contains items such as “Computers make people become isolated”, and “Computers destroy human creativity”. Beliefs on the benefits of personal computers especially for the good of society, was measured by items such as “Computers bridge the information gap between rich and poor countries”, “Computers help to effectively fight the large world problems, such as poverty”. The scales ranged from 1 (“entirely disagree”) to 5 (“entirely agree”). The final pool of 111 items was filled in by the participants at the end of a lecture on an unrelated topic.

2.3. Statistical analysis

The data were submitted to confirmatory factor analysis, using EQS, a program that implements Bentler’s approach to Structural Equations Modeling (SEM) (Bentler, 1989). EQS provides a number of relevant statistics, among them a Chi-square statistic that can be used to test whether the empirical data sufficiently fit the theoretical model. In addition, other statistics have been developed for the evaluation of a particular model. Since theories of social science phenomena, such as computer anxiety, are not yet sufficiently developed to allow for all-or-none decisions regarding the acceptability of a certain model, often a number of reasonable alternative models are tested, each less stringent than its precursor. Confirmatory factor analysis, in particular, enables the investigator to test the extent to which observations (e.g. responses to items) can be considered manifestations of underlying “latent” factors. The six-dimensions model was tested first. Subsequently, a number of simpler models were tested to find out the extent to which these simpler
models could adequately account for the data. After completion of these construct validity studies, a modeling study was carried out testing the causal model outlined in the introduction section. Again, SEM was used to test the model and some of its competitors. Finally, the model was tested against new data to provide cross-validation information.

3. Results and discussion

3.1. Confirmatory factor analyses

Table 2 contains the summary data of the confirmatory factor analyses. Model 1 assumed that the six dimensions discussed in the introduction section were independent latent measures of the hypothesized aspects of computer anxiety. In addition, it assumed that items each would only load on one of these factors. The Chi-square for this model indicates that the observed covariances significantly differed from the covariances predicted by the model. Removal of items showing relatively high residuals did not further improve the fit. These findings suggest that the model does not adequately represent the data. A problem, however, with analyses using Chi-square for the evaluation of model adequacy is, that this statistic is quite sensitive to violations of its distribution, in particular, in relatively small samples (Hu & Bentler, 1995). In addition, Chi-square statistics of fit only allow for acceptation or rejection of a particular model; they do not provide information of the extent to which a model fits the data. Therefore, other statistics of fit have been developed. These statistics tend to be less sensitive to violation of assumptions underlying the Chi-square distribution and provide information on the extent of model fit. One of these statistics is the Comparative Fit Index (CFI). CFI takes into account attributes of the unrestricted model relative to the model under test. CFI is smaller than 0.90, indicating poor fit. The Average of Absolute Standardized Residuals (AASR) is

<table>
<thead>
<tr>
<th>Model</th>
<th>Model description</th>
<th>Chi-square</th>
<th>d.f.</th>
<th>P</th>
<th>Chi-square/ d.f.</th>
<th>AASR</th>
<th>CFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Six-factor model, uncorrelated factors, items load uniquely on factors</td>
<td>6305.58</td>
<td>3159</td>
<td>0.001</td>
<td>1.99</td>
<td>0.13</td>
<td>0.59</td>
</tr>
<tr>
<td>2</td>
<td>Six-factor model, correlated factors, items load uniquely on factors</td>
<td>5441.64</td>
<td>2916</td>
<td>0.001</td>
<td>1.87</td>
<td>0.08</td>
<td>0.64</td>
</tr>
<tr>
<td>3</td>
<td>Six-factor model, correlated factors, items are allowed to load on more than one factor</td>
<td>1486.93</td>
<td>1120</td>
<td>0.001</td>
<td>1.32</td>
<td>0.04</td>
<td>0.91</td>
</tr>
<tr>
<td>4</td>
<td>Four-factor model</td>
<td>1957.62</td>
<td>1132</td>
<td>0.001</td>
<td>1.73</td>
<td>0.06</td>
<td>0.80</td>
</tr>
<tr>
<td>5</td>
<td>Three-factor model</td>
<td>2138.69</td>
<td>1140</td>
<td>0.001</td>
<td>1.88</td>
<td>0.06</td>
<td>0.76</td>
</tr>
<tr>
<td>6</td>
<td>Two-factor model</td>
<td>2798.83</td>
<td>1157</td>
<td>0.001</td>
<td>2.42</td>
<td>0.08</td>
<td>0.60</td>
</tr>
<tr>
<td>7</td>
<td>One-factor model</td>
<td>2270.30</td>
<td>1019</td>
<td>0.001</td>
<td>2.22</td>
<td>0.07</td>
<td>0.69</td>
</tr>
</tbody>
</table>
higher than 0.05, also indicating that the amount of residual covariance not explained by the model is unacceptably high. The ratio of Chi-square and its degrees of freedom, however, is smaller than 5, indicating some fit.

Model 2 assumed that the factors involved in computer anxiety are correlated. This assumption seems reasonable, because it is not unlikely, for instance, that those who consider themselves less computer literate, also show lower levels of self-efficacy related to computers, and may consider the computer a threat to humankind. The fit indices presented for this model however suggest that fit of Model 2 to the data is again poor.

Model 3 is similar to Model 2, but accepts that some items load on more than one factor. In this model, items are not necessarily “pure” indicators of a factor but may measure aspects of other factors as well. For instance, the item “I always try to get the newest of the newest with respect to computers”, indicates an element of computer literacy, only those who are computer literate will tend to buy or otherwise acquire the latest gadgets. This item also reflects a positive affective feeling towards computers and, therefore, can be considered an indicator of affect as well. Model 3 fared much better than its two alternatives. Both AASR and CFI are within the desired limits. The Chi-square measure is still significantly different from zero, but it is possible that this is because of the relatively small sample involved.

Models 4, 5, 6, and 7 were tested to check whether the data could be explained by simpler solutions as well, or even better. The four-factor model considered literacy and self-efficacy as one factor, the positive and negative beliefs with regard to computers as one factor and affective feelings and physical arousal as the other two factors. The three-factor model considered literacy and self-efficacy as one factor, and affective feelings and physical arousal as two others. This solution was roughly in line with the three-factor solution proposed by Loyd and Gressard (1984), who distinguished between confidence in learning to use the computer, liking of computers and fear of computers. The two-factor model distinguished between cognitive aspects on the one hand and affective-emotional aspects on the other. None of these models came close to fit however.

In conclusion, the six-factor model seems to be a good approximation of the data, indicating that computer anxiety can be described a conglomerate of six correlated dimensions.

3.2. Modeling of directional influences

Table 3 displays the correlation matrix, means and standard deviations of the variables of interest.

Although the structural equations modeling program analyzes covariances among variables rather than correlations, the correlation matrix is given for readability purposes.

The causal model outlined in the introduction section was tested against these data. The results are: Chi-square = 15.17, d.f. = 6, \( P < 0.02 \); AASR = 0.02; CFI = 0.96. Although these outcomes suggest reasonable fit (as do other indices of fit not reported here), the path coefficients between self-efficacy, affect, and physical
arousal turned out to be non-significantly different from zero. The same applied to the path between affect and negative beliefs about computers. Removing these paths leads to the model displayed in Fig. 2. The results for this model are: Chi-square = 16.76, d.f. = 9, $P > 0.05$; AASR = 0.02; CFI = 0.98, indicating slightly better fit with the data.

The findings presented here confirm the importance of computer literacy, or better lack thereof, in the emergence of computer anxiety. Computer literacy has a strong negative directional influence on aversive physical arousal such as being short of breath or developing sweaty hand palms when confronted with a computer. Affect, on the other hand, is positively influenced by literacy. Not surprisingly, people who are computer literate like these machines and vice versa. These two emotions influence, in turn, positive and negative beliefs related to the role of computers in our lives. To check the possibility that beliefs influence emotions rather than the other way around, we tested a model according to which literacy and self-efficacy would influence both beliefs, that, in turn, would influence the emotional responses. The results for this model are: Chi-square = 170.50, d.f. = 6, $P < 0.001$; AASR = 0.09; CFI = 0.53, suggesting that indeed beliefs are a consequence of the emotions rather than the other way around.

A third finding is that computer literacy and self-efficacy are related. It may well be that there is a directional influence of self-efficacy on computer literacy, for instance because a positive idea about one’s ability to learn in general may be a necessary precursor of computer literacy. The level of expertise one reaches in a domain is clearly influenced by the motivation and effort one puts into acquiring the necessary skills, the latter being part of the make up of self-efficacy. The present study design however does not allow for the testing of such a hypothesis.

A fourth finding is that self-efficacy has no direct relationship with physical arousal and affective feelings. This finding diverts from the hypothesized relationship as it was expected that a person’s beliefs in one’s capabilities of dealing with an object would effect the amount of physical arousal or affection a person has towards an object. This indicates that raising levels of self-efficacy might influence physical arousal and affective feelings only to the extent that it raises computer literacy.

Table 3
Correlations, means and standard deviations of six variables included in path analysis

<table>
<thead>
<tr>
<th></th>
<th>Literacy</th>
<th>Self-efficacy</th>
<th>Physical arousal</th>
<th>Affective feelings</th>
<th>Positive beliefs</th>
<th>Negative beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Efficacy</td>
<td>0.46</td>
<td></td>
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<td></td>
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<tr>
<td>Physical arousal</td>
<td>−0.70</td>
<td>−0.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affective feelings</td>
<td>0.57</td>
<td>0.29</td>
<td>−0.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive beliefs</td>
<td>0.30</td>
<td>0.22</td>
<td>−0.29</td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative beliefs</td>
<td>−0.29</td>
<td>−0.07</td>
<td>0.41</td>
<td>−0.11</td>
<td>−0.22</td>
<td></td>
</tr>
<tr>
<td>Means</td>
<td>3.28</td>
<td>4.04</td>
<td>1.73</td>
<td>2.61</td>
<td>3.21</td>
<td>2.67</td>
</tr>
<tr>
<td>Standard deviations</td>
<td>0.60</td>
<td>0.53</td>
<td>0.58</td>
<td>0.48</td>
<td>0.50</td>
<td>0.62</td>
</tr>
</tbody>
</table>

44

When comparing the six-factor model with the other multi-factor models summarized in Table 1, the resemblance with the three-factor model by Loyd and Gressard (1984) seems relatively straightforward. Lack of confidence in using computers, disliking these machines, and displaying high levels of arousal seem to be at the core of the computer anxiety phenomenon. The self-efficacy dimension is also clearly represented in one of the factors of the Computer Anxiety Rating Scale, whereas the experiential dimension occurs in the models of Marcoulides and Wang (1990), Rosen and Weil (1995), Dyck, Gee and Smither (1998) and Brosnan and Lee (1998). The present model however may be considered more specific in that it predicts directional influences among these variables, based on theory, and that these directional influences were confirmed through structural equations modeling.

3.3. Generalizability of six-factor model

To check for the cross-sample stability of the six factor solution proposed, it was tested against a second sample of 225 participants. The six-factor model fitted this
new set of data equally well: Chi-square = 1620.06; d.f. = 1120; \( P < 0.01 \); Chi-square/d.f. = 1.45; AASR < 0.05; CFI = 0.91. The directional model outlined above, was also tested against the new data set. The results for this model are: Chi-square = 26.33, d.f. = 9, \( P < 0.01 \); AASR < 0.04; CFI = 0.96, indicating slightly smaller but still sufficient fit.

4. General discussion

The present study suggests that computer anxiety is a multidimensional construct rather than a unitary one. The six-factor model outlined seems to describe the data reasonably well, although it proved not always possible to find dimensionally “pure” items. The six-factor model fared better than simpler solutions, in some cases based on published models (e.g. Loyd & Gressard, 1984). In addition, most of the hypothesized directional influences among factors were confirmed in the path analyses conducted and the findings proved generalizable to a new sample. A major finding is that computer literacy has a strong negative directive influence on aversive physical arousal and a positive influence on affect. The results further indicate that emotions influences beliefs, rather than the other way around. Computer literacy and self-efficacy are related. Furthermore, self-efficacy has no direct influence on physical arousal and affective feelings. The reader should however bear in mind that these conclusions only apply to the population at hand: students of higher education in their twenties. It may be possible that, for instance, older persons or persons with less formal education would display a different pattern of computer anxiety. On the other hand, the samples studied were not particularly computer literate; 63% described themselves as either unskilled or not particularly skilled. Further research in different populations is, however, recommended.

The finding that computer literacy has a directional influence on other factors suggests that a person must have some experience, directly by working with, or indirectly by observing people working with personal computers, to develop a fear of computers. These experiences seem to lay the basis for physical arousal in response to personal computers and the beliefs one holds. This view finds support in the literature. Rosen and Maguire (1990), for instance, refer to the cumulative aspect of negative reinforcement that occurs when computer anxious individuals are forced to interact with computers. Todman and Monaghan (1994) mention the positive or negative influence of early experiences with computers on later tendencies to seek or avoid interaction with computers.

The perception of one’s ability to enact successfully on one’s environment, to master difficult skills, and to transfer this ability to new situations and new challenges, relates fairly strong to computer literacy. It is suggested that the process of becoming a digital literate person is a step-by-step process of accumulating rewarding experiences that can and should be managed to maximize optimal positive results. This view finds also support in the development of programs to reduce computerphobia. Rosen, Sears and Weil (1993) report positive results with programs that employ systematic desensitization or thought-stopping replacing negative
self-statements with positive statements. Gist, Schwoerer and Rosen (1989) found behavioral modeling by video-taped models to yield higher self-efficacy scores, higher performance and less frustration on an objective software task than a tutorial approach. In the beginning of this article, it has already been pointed out that personal computers are becoming all-pervasive in our society, and a person’s experience will not be restricted uniquely to the home, the educational setting, or the working environment. More and more, and at an increasingly younger age, people will be exposed to personal computers in widely varying settings. This provides a great challenge to parents, educators, instructors, software developers, and manufacturers to create learning experiences that enable users to master these complex skills incrementally based on their own needs, and dividing the learning process in steps designed to build success on success.

In summary, computer anxiety seems to be part of a process of cumulating experiences and it appears that its occurrence and its magnitude can be manipulated by altering the conditions under which these experiences are acquired and by guiding the perception of this experiences. Seeing computer anxiety as a potential by-product of a necessary learning experience may help us to gain new insights in what variables are conducive in enhancing and supporting learning. One can think of learning styles, learning methods, individual versus group-learning, interface design, ergonomic aspects, and so on. Already, there are intriguing new views on the difference between factually observed computer experience and subjectively interpreted computer experience, which stresses the point that the user’s own evaluation of his performance is a more relevant yardstick than the number of hours spent in front of a computer (Smith, Caputi, Cittenden, Jayasuriya & Rawstorne, 1999). Self-directedness, the ability to take charge and be goal-oriented (Hemby, 1998) seems to be related to self-efficacy and may prove to be an interesting addition to the model of computer anxiety and its precursors. Some people feel that it will only be a matter of time before computers and their applications have become so simplified that the phenomenon of computer anxiety will become extinct. Though entrance barriers seem to go down, authors like Norman in his book the Invisible Computer (Norman, 1999) and Brosnan in his book, Technophobia: The Psychological Impact of Information Technology (Brosnan, 1998) signal the increased impact of modern technology on society, which will not grow lesser but will become even more. For instance, the effects of global viral attacks on personal computer files will fuel in many people the aversion already held against computers. Especially now, with the rapid advance of Internet and the increasing number of personal computers available worldwide, more effort should be put into identifying whether a person suffers from computer anxiety and the development of appropriate training programs that help overcome this anxiety. The present study points at those elements that may be influenced by such programs.

Acknowledgements

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