Cognitive Therapy and Research, Vol. 12, No. 4, 1988. pp. 351-366

Cognitive Factors in Computer Anxiety[1]

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The recent growth of computer technology has been accompanied by an increasing number of individuals who are anxious or intimidated by computers. The current study was designed to test a cognitive model of computer anxiety, where computer anxiety is seen as a function of internal dialogue, underlying meaning systems, behavioral acts, and behavioral outcomes when working on a computer. The Self-Statements About Computers (SSAC) checklist was empirically developed to assess thoughts or internal dialogue associated with anxiety and computer use, as well as the meaning of those thoughts for the individual. Analyses revealed that high computer-anxious subjects had lower expectations of performance and reported more debilitative thoughts during an actual computer task. They also reported higher levels of anxiety during this computer interaction, had more bodily sensations, and took longer to complete the task. In addition, high computer-anxious individuals reported less computer experience and mechanical interest, and higher levels of math anxiety. These results support the proposed cognitive model of computer anxiety and suggest directions for clinical intervention.

KEY WORDS: computer anxiety; internal dialogue; self-statements; cognitive assessment.

The recent growth of computer technology has been accompanied by an increasing number of individuals who are anxious about, or intimidated by, computers (Glass, Knight, & Baggett, 1985). Surveys of college students and

[1]Portions of this study were presented at the Annual Convention of the Association for Advancement of Behavior Therapy, Houston, November 1985. We would like to thank Kevin Knight, Bob Heinssen, and Kevin Richardson for their assistance in conducting this research.
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0147-5916/88/0800-0351$06.00/0

business people have found that 25% suffered from mild "computerphobia," and another 5% were even more seriously affected by anxiety (Weinberg & Fuerst, 1984). In our own research, 32% of undergraduates and 55% of an adult education sample reported that they felt intimidated by computers, with 50% and 78%, respectively, expressing interest in a workshop designed to reduce feelings of computer anxiety (Heinssen, Glass, & Knight, 1984).

Computer anxiety has been defined and assessed in a variety of ways. Powers (1973) defined computer anxiety as changes on four physiological measures, such as blood pressure and heart rate, which occurred while subjects worked on a computer. Attitudes toward computers have been a more frequent focus (Ahl, 1976; Coovert & Goldstein, 1980; Raub, 1982; Reece & Gable, 1982). Finally, affective factors, such as fear, apprehension, and subjective anxiety, have also been identified (Heinssen, Glass, & Knight, 1987; Jay, 1985; Loyd & Gressard, 1984; Rohner & Simonson, 1981).

Unlike other situation-specific anxieties, however, research on computer anxiety has not been based on clear theories or models. In the area of test anxiety, cognitive theories proposed by Meichenbaum and Butler (1980) and Wine (1971, 1980) have played an important role in guiding research and treatment. For example, studies have found that high test-anxious students have fewer positive and more negative thoughts compared with low-anxious individuals, that high test-anxious people report more task-irrelevant thinking, negative ruminations, and interfering thoughts, and that test anxiety (but not necessarily performance) is correlated with more negative thinking (Bruch, Juster, & Kaflowitz, 1983; Galassi, Frierson, & Sharer, 1981a, 1981b; Hollandsworth, Glazeski, Kirkland, Jones, & Van Norman, 1979; Sarason & Stoops, 1978). In addition, the timing of cognitive assessment appears to be important. Galassi et al. (1981a) found that more negative thoughts were reported just prior to the end of an exam compared with the beginning or midpoint.

The present study was designed to test a proposed model of computer anxiety based on Meichenbaum and Butler's (1980) model of test anxiety. We therefore suggest that computer anxiety is a function of individuals' (1) internal dialogue, (2) underlying meaning systems and cognitive structures, (3) behavioral acts, and (4) behavioral outcomes when working on a computer.

Internal dialogue was assessed in the context of an actual computer interaction using a self-statement checklist developed specifically for this study. Such thoughts may be related to the nature of the anxiety people experience in relation to computers. Expectations for performance relative to others and self-efficacy or confidence in one's ability to complete the tasks were also assessed. The self-statement checklist was additionally used to measure the impact or subjective meaning of thoughts for subjects, thus providing an indication of subjects' underlying meaning systems.

The concept of behavioral acts in Meichenbaum and Butler's (1980) model included such variables as study habits and test-taking behavior. In the area of computer anxiety, skills such as computer experience, scholastic aptitude, and typing ability could be seen as computer-related skills associated with the anxiety a person might feel about using a computer.

The fourth and final component in the model represents the behavioral consequences or events to which one may respond. In this study, specific measures of performance outcome, such as the number of errors made and the time it took to complete the computer tasks, were calculated. According to Meichenbaum and Butler (1980), physiological arousal may also be seen as a behavioral outcome.

Finally, the relationships between computer anxiety and overall trait anxiety, as well as with other situation-specific anxieties (such as math and test anxiety), were of interest. Several authors have suggested that one of the sources of computer anxiety may be the feeling of never having been good at math (Ingram, 1980; Sampson, 1983). Since computer tasks represent a type of evaluative situation, test anxiety was also examined. In addition to assessing these factors, the study also examined the effects of sex differences and the timing of cognitive assessment.

METHOD

Subjects

Subjects were 59 undergraduate students who were selected from a group of 135 on the basis of their scores on the Computer Anxiety Rating Scale (CARS). This 20-item inventory shows evidence of good reliability and validity (Heinssen et al., 1987), with scores ranging from 25 to 93 out of a possible range of 20 to 100 (M = 46.80, SD = 11.58). The CARS has also demonstrated sensitivity to change as part of a therapy outcome study with computer-anxious individuals (Heinssen & Glass, 1986).

In the present study, CARS scores from the larger group were rank-ordered and 30 subjects were randomly selected from both the top and bottom third of the distribution. These 60 individuals were contacted, and all but one subject (high computer-anxious) volunteered to participate in the study. Subjects received points toward a course research requirement for their participation. The mean CARS score for the high computer-anxious group (9 men and 20 women) was 57.38, compared with a mean of 33.43 for the low computer-anxious subjects (17 men and 13 women). This difference was statistically significant, $t(58) = 15.86$, $p < .001$.

Procedure and Measures

Questionnaire Measures. During a group questionnaire session at the beginning of the semester, subjects completed (1) the trait form of the State-Trait Anxiety Inventory (STAI-Trait; Spielberger, Gorsuch, & Lushene, 1970), (2) the 40-item short form of the Math Anxiety Rating Scale (MARS; Richardson & Suinn, 1971), (3) the Computer Attitude Scale (CAS; Loyd & Gressard, 1984), and (4) the Computer Experience Questionnaire (CEQ; Heinssen et al., 1987), in addition to the CARS and measures used by other investigators. The CAS was included as an additional measure of computer anxiety and attitudes; it comprises three 10-item subscales, assessing computer anxiety, computer liking, and computer confidence. Higher scores represent less anxiety and a greater degree of confidence and liking. The CEQ is a checklist of 27 possible experiences a person may have had with computers or word processors. It was developed on the basis of interviews with computer users of varying degrees of expertise and training. The order of questionnaires within these booklets was counterbalanced.

The high and low computer-anxious individuals selected for the study reported for an individual experimental session approximately 4 weeks later in the semester. After reading a description of the research and giving informed consent, they filled out the Test Anxiety Scale (TAS; Sarason, 1978), a measure of mechanical interest from the Kuder Preference Record-Vocational (Kuder, 1934), and reported their SAT scores. Although mechanical interest does not necessarily reflect mechanical or technical skills and abilities, this measure was included to determine whether one's general attitude toward working with machines was related to computer anxiety. Subjects were also asked for self-reported estimates of typing ability on a 5-point scale. It is possible that poor typing skills may make someone feel more intimidated in a computer situation involving use of a terminal or keyboard.

Computer Interaction. Subjects were seated in front of an Apple II plus microcomputer and told that they would soon be given instructions and asked to perform several tasks on the computer. A brief expectations questionnaire was then administered asking subjects to rate, on a scale from 0 to 100, how confident they were that they would be able to perform the operations required to complete the tasks, and how well they thought they would do compared with other students.

In order to examine the influence of when the cognitive measure was administered, half of each group (15 high and 15 low computer-anxious subjects) were then given the Checklist of Bodily Sensations (Galassi et al., 1981a), a Subjective Units of Disturbance Scale (SUDS), and the Self-Statements About Computers checklist. The remaining 29 subjects completed these three measures after the third and final computer task, but they were not aware at that time that the computer interaction was over. The measure of bodily sensations consists of eight physiological reactions, such as hands perspiring and increased heart rate. Subjects were asked to check the sensations they were experiencing more intensely than when they were not in a situation involving a computer. The SUDS scale asked subjects to rate their subjective anxiety on a scale from 0 (totally calm or relaxed) to 100 (extremely anxious or panicked).

During the computer interaction, subjects completed three learning tasks of increasing difficulty that did not require any previous computer experience or knowledge of computers (Robertson & Heinssen, 1984). They were told that the microcomputer was serving as a terminal connected to the university mainframe computer, and they were given a programmer number and password and instructions on how to log on before proceeding. After "logging on," subjects were asked to rate their current level of anxiety on a SUDS scale from 0 to 100 and were informed that their anxiety would be assessed again at a random time in the future. In fact, this scale reappeared on the screen toward the end of the first task, shortly after subjects received a preprogrammed error message and a loud beep from the computer.

After the end of the third task (which for some subjects was also following the completion of the SSAC), the program informed subjects that the session was over and gave them instructions on how to "log off." They then informed the experimenter that they were finished with the tasks, and were debriefed. The program automatically calculated the number of errors made during the tasks and the amount of time taken to complete all three tasks.

SSAC Development

In order to assess the internal dialogue of individuals prior to and during computer interaction, a 40-item thought checklist of Self-Statements About Computers (SSAC) was empirically developed. Four types of self-statements were included, following the work of Hollandsworth et al. (1979) on test anxiety: (1) positive evaluations of oneself or the task, (2) on-task thoughts, (3) negative evaluations, and (4) off-task thoughts. Positive evaluations and on-task thoughts are considered to be facilitative of task performance, while the latter two categories are seen as debilitative.

The method of item generation was consistent with Goldfried and D'Zurilla's (1969) behavioral-analytic strategy, in which they propose that potential responses to situations of interest should be sampled and used as the basis for item content. In the present study, the first step was to give a sample of 199 undergraduate and adult education students descriptions of two frequently occurring situations involving a computer: sitting down at a computer terminal before beginning a project, and having difficulty getting a computer task to work (Heinssen et al., 1984). They were asked to list their thoughts as they imagined the situations.

The ultimate goal of the item-generation process was to identify 40 thoughts that were objectively judged to be facilitative or debilitative to performance. Six judges, all graduate students in clinical psychology, were given extensive training based on the Hollandsworth et al. (1979) instructions to raters. If the thought was judged to be facilitative, raters further classified it as either an evaluative statement about the person or task at hand (positive evaluation: e.g., "It's fun to figure the computer out") or relevant and helpful to the performance of the task (on task: "Take care to hit the right keys"). If the thought was debilitative, raters then decided whether it was a negative evaluation of the person or the task (negative evaluation: "Something will always go wrong when I work on a computer") or irrelevant to the task (off task: "I'm hungry"). At least five of the six raters had to be in agreement for the item to be retained.

Finally, two additional judges selected the most representative and generalizable 10 items from each category for inclusion on the SSAC. These 40 self-statements were presented in the same format as the Galassi et al. (1981a) thought checklist measure, where subjects are instructed to place a check by each of the thoughts they had during the previous 3 to 5 minutes. This checklist format was chosen for the SSAC in order to allow for the later assessment of the meaning of the thoughts for each subject. In order to measure the subjective meaning component in Meichenbaum and Butler's (1980) model, after the completion of the thought checklist, subjects were given a brief description of what is meant by a thought being facilitative or debilitative for performance. They were then asked to go back over the checklist and mark a plus (for facilitative) or a minus (for debilitative), rating the impact of each thought they had previously checked.

RESULTS

Four 2 × 2 multivariate analyses of variance (MANOVAs) were performed to examine sex and group (high vs. low computer anxiety) differences on questionnaire measures of computer anxiety and attitudes, inventories of trait and situation-specific anxiety, variables associated with computer-related skills, and expectations prior to the computer interaction. An additional three 2 × 2 × 2 MANOVAs examined sex, group, and time of cognitive assessment (before vs. during task) with sets of dependent measures related to the computer interaction task: SUDS anxiety scales, self-statements and subjective meaning, and behavioral outcome. Since significant group main effects were found on all MANOVAs, significant univariate ANOVAs on specific measures are also reported.

Questionnaire Measures

Computer Attitudes and Anxiety. A significant multivariate group main effect was found in the analysis of the CARS and CAS subscale scores, $F(4, 52) = 66.03$, $p < .0001$. Univariate ANOVAs revealed that scores on all four measures were consistent with the criteria for group selection, in that the high computer-anxious group indicated significantly more computer anxiety and less computer liking and confidence than did low anxious subjects. No significant interactions or main effects for sex were obtained. Means and *F* values for the high and low computer anxiety groups on these and all other questionnaire measures are shown in Table I.

Trait and Situation-Specific Anxiety. Only the main effect for anxiety level was significant in the MANOVA on trait, math, and test anxiety, $F(3, 53) = 4.97$, $p < .004$. Significant univariate differences were found on both the MARS and the STAI-Trait, where high computer-anxious subjects were more math-anxious and had higher levels of trait anxiety compared with low computer-anxious subjects. These groups did not differ on the TAS, however, although the sex by group interaction was significant, $F(1, 55) = 4.64$, $p < .04$. Post hoc analyses revealed that low computer-anxious men reported significantly lower levels of test anxiety than the other three groups. This same pattern was found in a significant sex by group interaction on the STAI-Trait, $F(1, 55) = 4.03$, $p < .05$.

Computer-Related Skills. Several variables were considered to be examples of skills (behavioral acts) that might potentially be associated with computer anxiety, and the MANOVA confirmed that significant group and sex differences existed, $F(5, 43) = 2.37$ and 3.11, $p < .05$.[3] High computer-anxious subjects reported significantly less computer experience but similar levels of typing ability compared with their low-anxious peers.

Significant group differences were also found for mechanical interest, where low computer-anxious subjects reported greater levels than did high anxious individuals, and men ($M = 48.32$) scored higher than women ($M = 35.90$), $F(1, 47) = 6.78$, $p < .02$. SAT verbal and quantitative scores also appeared to be related to computer anxiety since high computer-anxious subjects had significantly lower scores on both scales compared with low anxious subjects.

[3]Degrees of freedom for these analyses reflect the fact that there were missing data on SAT scores for eight subjects.

Table I. Means and F Values for High and Low Computer-Anxious Subjects

Measure	High computer-anxious (n = 29)	Low computer-anxious (n = 30)	$F(1, 55)$
Questionnaires			
Computer Anxiety Rating Scale	57.38	33.43	223.70[d]
Computer Attitude Scale			
Computer Anxiety	25.93	36.27	94.12[d]
Computer Liking	21.83	31.27	34.95[d]
Computer Confidence	23.34	35.03	85.78[d]
STAI-Trait	41.00	36.07	4.28[b]
Math Anxiety	108.17	82.43	12.02[d]
Test Anxiety	17.55	16.03	0.43
Computer Experience	7.59	11.60	4.02[b]
Mechanical Interest	33.65	48.20	6.38[b]
Typing Ability	2.45	2.53	0.95
SAT-Quantitative	522.08	578.93	4.52[b]
SAT-Verbal	503.33	563.93	4.19[b]
Computer interaction			
Expectations			
Confidence	54.14	64.50	2.38
Relative performance	47.59	58.67	6.48[b]
Bodily sensations	1.07	0.43	4.04[b]
SUDS-Time 1	41.38	19.67	8.71[c]
SUDS-Time 2	51.03	21.67	16.90[d]
SUDS-on SSAC	38.62	20.50	7.28[c]
Performance			
Errors	9.79	4.93	1.03
Time (seconds)	1056.90	721.47	3.78[a]
Self-statements			
Positive evaluations	3.38	4.30	1.45
On task	5.55	4.00	6.85[c]
Negative evaluations	1.79	0.17	7.87[c]
Off task	2.41	1.27	5.50[b]
Subjective meaning			
Facilitative	8.66	7.77	0.95
Debilitative	4.45	2.03	5.68[b]

[a] $p < .10$.
[b] $p < .05$.
[c] $p < .01$.
[d] $p < .001$.

Computer Interaction

Expectations. Both significant multivariate group differences and a group × sex interaction were found on the expectancy variables, $F(2, 54) = 3.20$ and 3.30, $p < .05$. Univariate ANOVAs revealed that high computer-anxious subjects expected to have significantly poorer performance than did the low-anxious subjects. Although the groups did not differ significantly in confidence in their ability to perform the upcoming computer tasks, the confidence of the low computer-anxious women (M = 72.31) showed a near-significant trend to be higher than that of the high-anxious women (M = 51.00), $F(1, 55) = 3.87$, $p < .054$. Means and F values for group differences on all computer interaction variables can also be found in Table I.

SUDS Scales. A 2 × 2 × 2 MANOVA examined sex, group, and time of cognitive assessment differences on the three SUDS scales administered during the computer interaction task. This analysis also found a significant effect for anxiety level, $F(3, 49) = 6.33$, $p < .001$, although other main effects and interactions were not significant. Univariate ANOVAs showed that high computer-anxious subjects experienced significantly higher levels of anxiety than low anxious individuals immediately after beginning the tasks, after being informed of an error in their performance, and on the SUDS scale administered just prior to the SSAC.

Self-Statements. The 2 × 2 × 2 MANOVA on self-statements and subjective meaning ratings for facilitative and debilitative thoughts on the SSAC revealed only a significant group main effect, $F(6, 46) = 2.69$, $p < .03$. A significant main effect for level of computer anxiety was found for on-task thoughts, negative evaluations, and off-task thoughts. In all cases, high computer-anxious subjects reported higher numbers of these thoughts than did low-anxious subjects. In separate ANOVAs, no group differences on overall facilitative thoughts were found, though high computer-anxious individuals had significantly more overall debilitative thoughts than did low anxious persons.

Subjective Meaning. Subjects' ratings of their thoughts on the SSAC as facilitative or debilitative were compared with the empirically derived classification for each self-statement. Few disagreements occurred, as only 7% of all facilitative thoughts checked were reported by subjects to be debilitative, and only 5% of debilitative self-statements were seen by subjects as facilitative. In fact, ANOVAs on subjects' ratings of the meaning or impact of their thoughts revealed exactly the same pattern of results as the SSAC analysis. Although high and low computer-anxious individuals did not differ in the number of thoughts rated facilitative, high computer-anxious subjects had a significantly larger number of thoughts checked that they considered to be debilitative or harmful to their performance on the computer task.

Behavioral Outcome. The measures of behavioral outcome were assessed during the actual computer interaction. Although the multivariate effect for anxiety level was significant, $F(3, 49) = 2.90$, $p < .05$, neither sex, group, nor time of assessment had a significant effect on the number of errors subjects made during the computer tasks. High computer-anxious subjects, however, showed a near-significant trend in taking a longer time to complete the tasks than did low anxious persons, $p < .057$.

Two significant univariate main effects were found for physiological arousal. As predicted, subjects with high levels of computer anxiety reported significantly more bodily sensations. Subjects also reported more physiological arousal when assessed while working on the computer (M = 1.07), compared with those assessed before the computer interaction had begun (M = .43), $F(1, 51) = 4.45$, $p < .04$.

Correlates of Thoughts

The relationship of thoughts on the SSAC with other variables is also pertinent to the evaluation of the proposed cognitive model of computer anxiety. Pearson correlation coefficients were calculated relating the four thought categories and overall facilitative and debilitative thoughts to the questionnaire and computer interaction measures (see Table II). Owing to the large number of correlational analyses performed, more confidence can be placed in findings reaching the .01 level of significance.

The number of positive evaluation thoughts was significantly related only to the Computer Attitude Scale and body sensations, such that the greater

Table II. Correlations of Thoughts on the SSAC with Other Variables

Measure	PosEval	On-Task	NegEval	Off-Task	Facil	Debil
CARS	−.13	.29[a]	.53[c]	.38[b]	.09	.50[c]
CAS-Anxiety	.30[a]	−.16	−.50[c]	−.27[a]	.09	−.45[c]
CAS-Liking	.22[a]	−.11	−.42[c]	−.34[b]	.09	−.42[c]
CAS-Confidence	.28[a]	−.16	−.46[c]	−.22[a]	.09	−.42[c]
STAI-Trait	.00	.07	.22[a]	.22[a]	.05	.24[a]
Math anxiety	.08	.26[a]	.42[b]	.44[c]	.21	.48[c]
Test anxiety	−.03	.01	.25[a]	.35[b]	−.02	.34[b]
Computer experience	.03	.03	−.35[b]	−.13	.03	−.26[a]
Mechanical interest	.01	−.14	−.43[c]	−.26[a]	−.08	−.38[b]
Typing ability	.11	−.15	−.08	−.19	−.01	−.15
SAT-Quantitative	−.06	.03	−.25[a]	−.02	−.04	−.15
SAT-Verbal	.17	.15	−.08	.09	.18	.01
Confidence	−.11	−.30[a]	−.38[b]	−.28[a]	−.25[a]	−.36[b]
Relative performance	.04	−.29[a]	−.47[c]	−.39[c]	−.15	−.48[c]
Bodily sensations	.26[a]	.44[c]	.54[c]	.55[c]	.44[c]	.60[c]
SUDS-Time 1	−.08	.33[b]	.62[c]	.36[b]	.16	.54[c]
SUDS-Time 2	−.06	.40[c]	.61[c]	.32[b]	.19	.51[c]
SUDS-on SSAC	.05	.47[c]	.56[c]	.51[c]	.33[b]	.59[c]
Errors	−.11	.04	.40[c]	.24[a]	−.05	.36[b]
Time (seconds)	.00	−.03	.29[a]	.15	.00	.24[a]

[a] $p < .05$.
[b] $p < .01$.
[c] $p < .001$.

the positive evaluations, the greater the number of physiological sensations, the higher subjects' liking and confidence with computers, and the lower their anxiety. On-task thoughts showed a similar relationship to bodily sensations, and were also positively related to computer anxiety as measured by the CARS, math anxiety, and anxiety reported during the computer interaction. Greater numbers of on-task thoughts were associated with lower levels of confidence and expectations.

The number of negative evaluations, however, was found to correlate with most of the questionnaire measures and all of the computer interaction variables. Specifically, the greater the number of negative thoughts, the lower were subjects' SAT scores (quantitative), mechanical interest, level of computer experience, liking and confidence with computers, and expectations and confidence prior to the computer tasks. More negative evaluations were also associated with higher levels of math, trait, test, and computer anxiety, and with more bodily sensations, higher anxiety levels, and poorer performance on the computer interaction tasks. Off-task thoughts showed exactly the same pattern of significant relationships, with the exception that they were not related to SAT scores, computer experience, or total time to complete the tasks.

Intercorrelations among SSAC scales were also examined. The expected positive relationships were found between positive evaluations and on-task thoughts, and between negative evaluations and off-task thoughts, $r(58) = .27$, $p < .05$, and $.63$, $p < .001$, respectively. Also, as might be expected, positive evaluations were inversely related to negative evaluation thoughts, $r(58) = -.25$, $p < .05$. On-task thoughts, however, showed positive correlations with both debilitative thought categories, $r(58) = .29$ and $.23$, $p < .05$ for negative evaluations and off-task thoughts, respectively.

DISCUSSION

Significant differences were found between high and low computer-anxious subjects across all four factors in the model. In the area of internal dialogue, substantive evidence was found for the role of cognition in computer anxiety. High computer-anxious individuals had more on-task, negative evaluation, off-task, and overall debilitative thoughts associated with an actual computer interaction than did their low anxious peers, although no differences were found on positive evaluations or overall facilitative self-statements. High anxious subjects also expected to do significantly worse on the computer tasks than did low anxious individuals. It was striking that thoughts concerning negative evaluation were significantly correlated with almost all other variables. These included correlations with questionnaire measures of trait and situation-specific anxiety, computer anxiety and experience, and mechanical interest, as well as subjective anxiety, bodily arousal, expectations, and performance during the computer interaction. In contrast, positive evaluation thoughts were correlated with few other variables.

The present study thus contributes to previous research in demonstrating a more crucial role for debilitative thinking compared with facilitative self-statements (Cacioppo, Glass, & Merluzzi, 1979; Kendall et al., 1979). As Kendall (1984; Kendall & Hollon, 1981) has suggested, it may be more the absence of negative thinking that is related to positive adjustment, rather than the presence of positive cognition. In addition, examining the relationships among measures adds support to Meichenbaum's notion of cognitive ethology, where the interaction of the streams of emotion, cognition, and behavior are considered (Meichenbaum & Butler, 1979; Meichenbaum & Cameron, 1981).

Although the greater frequency of off-task thoughts among high computer-anxious subjects is consistent with Wine's (1971, 1980) cognitive-attentional theory and the findings of Hollandsworth et al. (1979), the fact that these subjects also reported a significantly greater number of on-task thoughts was unexpected. Given the moderately high positive correlations among on-task thoughts, bodily sensations, and the three SUDS scales administered at different points during the computer interaction, it may be the case that high computer-anxious individuals were aware of their rising level of anxiety and more often attempted to direct their attention back to the task at hand in order to cope with their anxiety and debilitative arousal.

The findings for SSAC subscales also appear to generalize to questions of the subjective meaning of thoughts, the second factor in our model of computer anxiety. High computer-anxious subjects reported a significantly greater number of thoughts they perceived to be debilitative to their performance compared with low-anxious subjects, although they did not differ in the number of thoughts they reported to be facilitative. In general, subjects' perceptions of the impact or meaning of their thoughts showed considerable overlap with the way such thoughts were classified on the SSAC.

Significant group differences were also found for most variables representing the third factor in the model, behavioral acts or computer-related skills. High computer-anxious subjects had significantly less computer experience and mechanical interest than did low anxious individuals, as well as lower scores on both the quantitative and verbal SAT. It is possible that these higher levels of anxiety act to increase avoidance of computers and technological or mechanical pursuits. However, since these results do not indicate causality, it is also possible that subjects' awareness of their lower levels of aptitude, mechanical interest, and experience with computers leads to greater feelings of intimidation and anxiety as computers become an increasing reality in both school and the workplace.

Finally, significant differences were found for measures of behavioral outcome, the fourth factor in the model. High computer-anxious subjects reported more signs of physiological arousal and higher subjective anxiety during the computer interaction compared with law anxious subjects. Although they made a similar number of errors, they tended to demonstrate poorer performance by taking longer to complete the tasks. Experiences such as these may serve to strengthen and reinforce people's anxiety about working with computers.

Treatments for computer anxiety might therefore choose to intervene at a number of different points. Research by Heinssen and Glass (1986) supports the efficacy of both cognitive restructuring and applied relaxation treatments that focus on changing the factors of internal dialogue and subjective meaning, and the behavioral outcomes of physiological arousal and subjective anxiety, respectively. In addition, there is some evidence that giving individuals hands-on success experience and instruction in computer skills, thus altering behavioral acts and behavioral outcomes, may also be influential in reducing levels of computer anxiety (Anderson, Klassen, Hansen, & Johnson, 1980-1981; Raub, 1982). The nature and treatment of computer anxiety appears to be a promising area for research in both educational and workplace settings.

Sex differences in computer anxiety were not found, in contrast to the significant relationship between gender and computer anxiety obtained by Jay (1985) and Jordan and Stroup (1982). However, our findings are consistent with the work of Gressard and Loyd (1984) and Jones (1983), who also failed to show higher levels of computer anxiety in women. In fact, in the present study, women differed significantly from men only in lower levels of mechanical interest and higher self-reported typing ability. The distribution of women across the two groups did differ significantly, though, since 69% of the high computer-anxious subjects were women, compared with 43% of the low anxious group.

In addition to testing the proposed model of computer anxiety, we wanted to examine the effects of the time of assessment on thoughts, performance and bodily arousal, and subjective anxiety. No multivariate effects for time of assessment were significant, although, as with Galassi et al. (1981a), subjects assessed close to the end of the interaction reported higher levels of bodily sensations compared with those assessed at the beginning of the tasks. There were also no interactions between the time of assessment and level of computer anxiety. Administering the SSAC later on in the interaction just before subjects realized that all tasks were completed allowed for a more immediate measure of thoughts during the computer interaction that helped to avoid reconstruction or delayed recall. This timing also appears to circumvent the concerns suggested by Arnkoff and Smith (1987) that cognitive assessment measures presented during a task may have negative effects on high anxious subjects' performance.

In conclusion, the results of the present study offer strong support for the proposed cognitive model of computer anxiety. It thus adds to our understanding of the role of thoughts in anxiety responses, and suggests that Meichenbaum and Butler's (1980) conceptualization may be generalizable to other types of situation-specific anxiety.

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