SESSION VII COMPUTERPHOBIA

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Computerphobia

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Five studies of over 450 university students presented a comprehensive picture of computerphobia. Three research and clinically based self-report instruments were developed to measure three nearly independent dimensions of computerphobia—computer anxiety, computer attitudes, and computer cognitions and feelings. Results indicated that older students were more computer anxious, but did not have more negative attitudes, cognitions, or feelings, than did younger students. Women had more negative attitudes than did men. Feminine-identity students showed more anxiety and negative attitudes than did masculine-identity students, regardless of gender. White students had more anxiety and more positive attitudes than did nonwhite students. Computerphobia was related to other anxiety measures (mathematics, state, and trait), but was a separate construct. Experience with computer interaction did not reduce anxiety or improve attitudes. Finally, regardless of academic major, computer-anxious students showed less computer aptitude, literacy, and interest. Implications for treating computerphobia are discussed.

For many people, the computer represents a barrier to both educational and employment opportunities, and they see it as a threatening intruder into their lives. These people are known as “cyberphobes,” “technophobes,” or, more commonly, “computerphobics.” For them, actual or imagined interaction with computers may cause disabling levels of anxiety or trigger an internal dialogue that belittles their ability and undermines their confidence. Some have such high levels of computerphobia that they are unable to approach computers at all. One 4-year study of over 500 college students and corporate managers (Weinberg, 1982; Weinberg & English, 1983) concluded that nearly a third of this population was cyberphobic. The president of Mattel Corporation’s Electronics Division characterized the extent of this phobia in the general

population: “The very word ‘computer’ scares most consumers, so we deliberately avoid using it as much as possible” (Sansweet, 1980).

What is computerphobia? What is known about it to date? Can it be documented and measured? Who are computerphobics? What are their characteristics? Can they be helped? In this paper, we present an overview of past attempts to define and measure computerphobia and identify computerphobics. We then describe a series of empirical studies undertaken to create instruments to measure computerphobia and to examine its correlates in college students.

Overview of Past Research

Computerphobia is becoming a commonly used term, but its definition is still evolving, and little is known about its extent or causes. In a pioneering work, Jay (1981) defined computerphobia as (1) a resistance to talking about computers or even thinking about computers, (2) fear or anxiety toward computers, and (3) hostile or aggressive thoughts about computers. The behavioral, emotional, and attitudinal components he identified have influenced others conducting research in this area, although some may em-

Preparation of this article was supported in part by U.S. Department of Education Grant G008541203 to Larry D. Rosen. We gratefully acknowledge the assistance of Lorinda Camparo, Margaret Franco, Janice Kawaminami, Ethel Moore, Dee Pearson, Elvira Quesada, John Sarko, Eric Satow, Shawn Trammell, Glen White, and Patricia Williams in data collection and analysis. Address correspondence to: Larry D. Rosen, Department of Psychology, California State University, Dominguez Hills, Carson, CA 90747.

phasize one more than another. Some empirical work has been done to investigate the attitudes people have about computers. Less effort has been directed toward understanding the widespread fears about computers and their impact on society.

Empirical Studies of Computer Attitudes

As computers become increasingly pervasive in our lives, investigators have attempted to assess public attitudes about computers. These studies reveal that the general population holds both negative and positive attitudes simultaneously.

In a nationwide study conducted in 1963, Lee (1970) reported that the public held two independent beliefs: that computers are useful tools of mankind, and that computers are relatively autonomous and eventually will control society.

In a later study, Ahl (1975) compared the attitudes found in a *Time* magazine survey in 1971 with those reported by readers of *Creative Computing* in 1975. He noted that substantial percentages of the population felt that computers took more jobs than they created and that they were dehumanizing society. On the more positive side, Ahl indicated that compared to the data collected in 1971, "people have become more optimistic about the use of computers in most areas with the notable exception of credit data banks" (Ahl, 1971, p. 77).

However, a different picture emerged in a recent Harris poll of 1,256 randomly selected members of the adult public "Latest Harris Poll," 1983; Shaw, 1984). Nearly 9 out of 10 respondents in the large-sample phone poll agreed that computers would "improve the quality of life" in the future. But 71% also felt that computer technology would cost jobs, and over half felt that computers were a threat to personal privacy. Although 83% felt that technology had done "more good than bad" in the past, only 68% predicted the same for the future.

As part of his survey of computer attitudes, Harris also collected data on self-rated computer literacy. He found that those reporting themselves to be even moderately computer literate tended to be younger, professional workers with college degrees. Only a small percentage of low-income, unskilled, or uneducated people claimed to know anything about computers. Based on these disturbing trends, pollster Harris said, "The penetration of computers into the lives of the adult public who claim they know how to use them suggests the real prospect of a new 'have' and 'have-not' division in our society" (Shaw, 1984).

Computer attitudes have been measured across such diverse groups as office secretaries (Ardnt, Feltes, & Hanak, 1983); nurses (Rosenberg, Reznikoff, Stroebel, & Ericson, 1967); CPAs, pharmacists, lawyers, and physicians (Zoltan & Chapanis, 1982); college students (Cohen, 1983-84; Ellsworth & Bowman, 1982; Griswold, 1983; Mathis, Smith, & Hansen, 1970; Raub, 1981); secondary education students (Collis, 1985); and educators (Lichtman, 1979; Norris & Lumsden, 1984). These

studies reveal a range of positive and negative attitudes across the various groups.

Research on Computer Anxiety

Computer anxiety has received even less attention than computer attitudes. However, a review of the literature identified three instruments developed to measure computer anxiety. Maurer and Simonson's (1984) Computer Anxiety Index (CAIN), developed in conjunction with the Standardized Test of Computer Literacy (STCL), examines avoidance of, caution with, negative attitudes toward, and disinterest in computers. Similarly, Loyd and Gressard's (1984) Computer Attitude Scale (CAS) assesses computer liking, confidence, and anxiety through a Likert attitude-measurement format. Finally, Raub's (1981) Attitudes Toward Computers Questionnaire measures three factors: computer appreciation, usage, and societal impact. Each of these instruments also measures the attitudes associated with computer anxiety, allowing us to gain some insight into the correlates of computer-phobia.

At Iowa State University, Simonson and his colleagues (Montag, Simonson, & Maurer, 1984) demonstrated that the CAIN is correlated with both state anxiety and independent observations of computer comfort.

In an unpublished study, Gressard and Loyd (1984), found computer anxiety to be highly related to both computer confidence and computer liking, and moderately related to mathematics anxiety. These results suggest that the three subscales of the CAS may not be independent and may, indeed, measure aspects of computer anxiety.

In her dissertation, Raub (1981) defined computer anxiety as a form of "state anxiety" (Spielberger, 1972), with the computer providing the "personally threatening" stimulus. On the basis of a series of studies, she conceptualized computer anxiety as a multidimensional construct composed of (1) appreciation of computers, (2) computer usage anxiety, and (3) anxiety concerning the negative impact of computers on society.

In a correlational study of computer anxiety, computer experience, trait anxiety, and mathematics anxiety, Raub (1981) found that experience, academic major, and gender were correlates of computer anxiety. Age was not related to computer anxiety, although the limited age range in her sample may have been responsible for this finding. Based on the gender difference, all additional correlative analyses were performed separately for males and females. For males, computer experience, trait anxiety, and math anxiety were all related to computer anxiety, with experience and trait anxiety proving the best predictive combination. In contrast, for females, only experience and math anxiety were correlated with computer anxiety.

Anderson (quoted in "Computerphobia Study," 1981) surveyed business-school students enrolled in a beginning computer literacy course. The survey was administered both before and after the course, during which students were not forced to obtain any hands-on computer experience. Anderson found that males and females did not differ

in their levels of anxiety, either before or after the course. Older students did show less anxiety than did younger students. Surprisingly, students did not change their attitudes toward computers over the duration of the course.

Howard and Smith (1986), using an extensive battery of questionnaires, studied 111 managers from both manufacturing and service organizations. Using Raub's (1981) computer-anxiety measure and their own measure of attitudes toward microcomputers, they concluded that (1) only a small number of managers were actually computerphobic; (2) neither age nor sex was related to computer anxiety or computer attitudes; (3) math anxiety was related to computer anxiety; (4) computer anxiety was not related to locus of control, cognitive style, or trait anxiety; (5) computer anxiety was not related to computer knowledge, but was related to computer experience; and (6) computer anxiety was negatively correlated with computer attitudes toward microcomputers and the impact of computers on society.

Finally, in a recent attempt to synthesize the literature in this area, Meier (1985) presented a comprehensive review and a social-learning-theory analysis of "computer aversion" (defined as "a negative affective reaction of concomitant behaviors and cognitions").

The remainder of this report describes the results of a series of studies conducted by the authors and designed to provide a better understanding of computerphobia. Study 1 examined the measurement of computerphobia and provided comparative and correlative data for college students. Study 2 investigated a variety of potential correlates of computerphobia as part of a larger study that examined the role of hands-on experience in producing change in level of computerphobia. Studies 3 and 4 examined the relationship between computerphobia and computer aptitude, interest, and literacy in two separate populations. Finally, Study 5 described the creation and validation of a measure of negative and positive "computer thoughts."

STUDY 1

As discussed above, past research on computerphobia has been limited to a study of computer attitudes, which are assumed to be directly linked to computer anxiety. However, this assumption had not been tested. This provided the impetus for the creation of two new instruments, one to measure self-reported computer anxiety and one to assess computer attitudes. The use of two separate measures makes it possible to determine the true relationship between the two constructs and to provide comparative and correlative data for each.

Method

Instrumentation. The Computer Anxiety Rating Scale (CARS) was designed along the lines of the Mathematics Anxiety Rating Scale (MARS; Richardson & Suinn, 1972). A pool of statements was created to reflect a variety of aspects and features of computer anxiety, includ-

ing anxiety about the machines themselves, their role in society, computer programming, computer games, consumer use of computers, and future computer impact. These statements were presented to professors who regularly taught courses using computers. The final list included 54 statements. Each statement was to be rated on a 5-point scale (designed to mimic the MARS) indicating how anxious the item expressed in the statement made the person feel "at this point in time" (1 = *not at all*, 2 = *a little*, 3 = *a fair amount*, 4 = *much*, and 5 = *very much*).

The Attitudes Toward Computers Scale (ATCS) was created in the same manner as the CARS. Features and aspects of attitudes toward computers were generated, and from these features, individual statements were created. In all, 26 statements were created and judged to be face and content valid by the same people who had judged the CARS. Responses were presented in a 5-point Likert format from *strongly agree* to *strongly disagree*. To avoid response biases, nine items were presented in reverse format, with higher scores indicating more positive attitudes toward computers.

A third questionnaire (Computer Experience Demographics Questionnaire; CEDQ) was included to assess demographic characteristics of the sample, including age, ethnic identification, gender, class level, major, computer experience (both in coursework and at home), computer ownership, plans to own a computer, video game experience, and calculator ownership and experience. Two additional self-report questions were included. One asked whether the person exhibited physical symptoms of discomfort (sweaty palms, queasy stomach, racing heart, headache and/or blank mind) when sitting at a computer terminal. Those who had never done so were asked to imagine themselves sitting in front of a computer. A final question asked the person to assess his/her knowledge of computers on a 7-point scale from *no knowledge* (1) to *knowledgeable* (7). With the exception of the question about physical symptoms, questions were analyzed separately. For these five symptoms, a total score was calculated, ranging from 0 (no real or imagined symptoms) to 5 (all of the listed symptoms).

Research design. The initial study was designed to assess the reliability and validity of the two newly created measures—the CARS and the ATCS—in addition to providing comparative data across gender, ethnic group, and college major.

Subjects. Two psychology courses were selected to provide the sample. One, an introductory psychology course, had an enrollment of 62 students, whereas the other, an upper-division course in the psychology of the black experience, had 22 students. Participation was voluntary. The students in the introductory course received credit for research participation.

Procedure. All subjects signed an informed consent form and were tested in their classroom by a research assistant. To avoid the problem of order effects, all questionnaires were completely counterbalanced, with each

questionnaire appearing equally often first, second, and third in the packet.

Results

Sample description. Several characteristics of the sample are worth noting. The study was performed at a state university that caters to returning students by offering a full complement of coursework after work hours. Thus, the sample was considerably older than the typical college population (mean = 28.90, range = 18 to 55). The ethnic composition of the sample (black = 52%, white = 34%, Hispanic = 6%, Asian = 6%, other nonwhite = 2%) closely matched that of the general university population (the university is a minority institution), as did the class-level distribution (10% graduate, 55% upper-division, and 35% lower-division). The sample was well over half female (69%), which matches the social science population at most universities. The academic majors were obviously weighted toward the social sciences (44%), due to the selection of students enrolled in psychology courses for the sample. However, 12% of the students were majoring in the sciences, 11% in the humanities, 10% in business, 7% in liberal studies, and 17% had not declared a major.

More than one third of the sample (37%) had already taken a computer course, and half of these students

planned to take another. Of those who had not taken a computer course, 46% intended to do so in the future. This left about 34% who had little computer experience and did not intend to get that experience at school. In terms of computer ownership, only 16% of the sample currently owned a home computer, but another 17% intended to purchase one in the future.

Factorial validity and reliability. The 54 items of the CARS were subjected to a principal-factors analysis with varimax rotation. On the basis of a preliminary analysis, one item was dropped due to a preponderance of negative correlations with other items. Twelve factors with a minimum eigenvalue criterion of 1.0 were selected. Table 1 summarizes these factors, along with the percentage of variance explained by each.

Overall, the results of the factor analysis seem very clear and easily explicable. Eleven of the 12 factors had identifiable common themes and all 12 accounted for 80% of the variance. It is interesting to note that these factors appear to further expand the factor-analytic subscales of both Loyd and Gressard (1984) and Raub (1981).

The 26 ATCS items were factor analyzed in the same manner as the CARS items. Nine factors were identified and are summarized in Table 1. These factors accounted for 69.4% of the total variance and yielded a solution in which all but two of the communalities were above .61.

Table 1
Factors of the Computer Anxiety Rating Scale (CARS) and Attitudes Toward Computer Scale (ATCS), With Percentage of Variance Explained, Number of Items per Factor, and Alpha Coefficients

Factors	Percentage of Variance Explained	Items	Alpha
Computer Anxiety Rating Scale			
1 General Computer Anxiety	40.3	19	.95
2 Use of Computers in Society	7.8	5	.86
3 Computer Equipment	5.5	7	.90
4 Computers in Media/Society	4.8	9	.89
5 Computer Games	4.0	5	.87
6 Unnamed	3.2	3	.82
7 Computers in the Future	2.9	4	.79
8 Calculators and Personal Computers	2.7	3	.77
9 Calculators and Typewriters	2.5	3	.76
10 Computer Errors	2.1	3	.72
11 Computer Mail	2.0	2	
12 Computer Error Messages	1.9	1	
Total Percentage of Variance Explained	79.7		
Attitudes Toward Computers Scale			
1 Societal Threats & Computer Control	18.4	5	.76
2 Inequality in Computer Ability	11.1	4	.78
3 Future Personal Use	8.4	4	.62
4 Learning to Use a Computer	7.4	2	
5 Harming Computers	5.7	3	.55
6 Computer Intelligence	5.2	3	.49
7 Computers and Jobs	4.8	2	
8 Computers Creating Jobs	4.3	1	
9 Privacy Invasion	3.9	2	
Total Percentage of Variance Explained	69.4		

Note—Alpha coefficients cannot be calculated for factors with fewer than three items. CARS: mean = 94.63; SD = 34.75; skewness = 1.30; range = 54-226. ATCS: mean = 84.16; SD = 10.21; skewness = 0.31; range = 60-111.

Overall, while the factor structure of the ATCS was less apparent than that of the CARS, it was clear enough to provide reasonable explanations for eight of the nine factors. Furthermore, many of these subscales appear to capture various subcomponents of Raub's (1981) motivation-to-learn and societal-fears subscales.

Cronbach alpha coefficients, a measure of internal consistency, were calculated for each of the factored subscales of the CARS and the ATCS. These are summarized in Table 1. All CARS subscales have alpha coefficients exceeding .72. Furthermore, the alpha for the entire scale (.97) indicates a high degree of internal consistency for the total CARS score. The ATCS total score has an alpha of .76, showing that the ATCS is a less consistent measurement instrument than the CARS. Individual ATCS scale alphas ranged from .49 to .78.

Relationship of subscales and demographics. The CARS and the ATCS were correlated with each other as well as with the subscales and demographic information. The CARS and the ATCS correlated negatively ($r = -.29, p < .01$), indicating that students who had more positive attitudes toward computers also had the least anxiety. Furthermore, the negative relationship between anxiety and attitudes held for all CARS factors. However, only 6 of the 12 correlations were significant at the $p < .05$ level. The relationship between anxiety and attitude subscales was less clear. Of the nine ATCS factors, only two correlated significantly (negatively) with the CARS. These two were the most important ATCS factors (Societal Threats and Computer Control, and Inequalities in Computer Ability) in terms of accountable variance.

The ATCS, but not the CARS, correlated significantly ($r = .31, p < .01$) with self-rated knowledge. This indicates that the way in which a person rates his/her knowledge about computers is positively related to his/her computer attitudes, but is not related to his/her amount of anxiety. In contrast, age was significantly related to the CARS ($r = .34, p < .001$) but not to the ATCS. Older students had more anxiety, but did not have more negative attitudes, than younger students. This relationship held for 8 of the 12 CARS factors. Despite the lack of an age correlate for the total ATCS score, age was significantly negatively related to two subscales—Inequality in Computer Ability and Privacy Invasion. It is interesting to note that the older the student, the more he/she believed that certain groups were better than other groups at computer use and that computers invade privacy.

Of the remaining demographic information, perhaps the most interesting relationships were captured by three questions. Whether the student had taken a computer programming course or planned to take one in the future was not related to either attitudes or anxiety. However, those students who had taken a course that used computers for purposes other than programming had both lower anxiety and more positive attitudes. Finally, although more than four fifths of the sample owned a calculator, those who did not appeared to have more anxiety and a less positive at-

titude than those who did, suggesting a more general "technophobia."

Analyses of covariance across gender, ethnic group, and academic major. The subjects in the first study were partitioned into eight groups in a $2 \times 2 \times 2$ analysis of variance design examining the effects of gender, ethnic group (white vs. nonwhite), and academic major (science and business vs. social science and humanities). The latter grouping combined the "hard" majors for comparison with the "soft" majors, following preliminary analyses to establish their within-group similarity. These three variables were selected based on evidence from previous studies that they contribute to computer anxiety.

Examination of demographic differences between groups, in addition to previous research, suggested several potential covariates. Thus, for each computer anxiety and attitude scale, an analysis of covariance (ANCOVA) was performed with four covariates: age, class level, computer course taken, and course taken in which computers were used.

The pattern of significant F scores reflected several striking differences. First, social science/humanities majors were significantly more anxious and had less positive attitudes than did science and business majors. Second, although women exhibited no more computer anxiety than did men, they did have a significantly more negative attitude toward computers than did men. This difference was manifested on the full ATCS scale as well as on the Harming Computers subscale. That is, women had a generally less positive attitude than did men, and, additionally, felt that the user could harm a computer if he/she did not know how to use it.

When the effect of ethnicity was examined, it was found that white students had significantly more anxiety than did nonwhite students on one CARS subscale (Computer Errors). In contrast, white students had a more positive attitude than did nonwhite students on four of the nine ATCS subscales (Societal Threats, Learning to Use Computers, Harming Computers, and Computers Creating Jobs).

Only two interactions were significant at the $p < .05$ level, both for the Computers and Jobs subscale. Of the social science majors, male, female, white, and nonwhite students had about the same attitudes. Of the science majors, nonwhite males and females had essentially the same attitudes, whereas white males had a much more positive attitude than did white females.

Individual item comparisons. The ANCOVA results indicated that differences existed between genders, ethnic groups, and majors on some of the scales and subscales. Further t tests were done to compare these groups on individual items from the CARS and the ATCS.

Females showed more anxiety than did males when watching someone working at a computer terminal and when thinking about prepackaged programs for computers. These two items suggest that females would be more anxious than males when taking a course in which

working at a terminal with other students is required, and in which students have to use programs such as CAI packages. Females in this study showed less positive attitudes than did males on 11 of the 26 ATCS items, indicating that their total-score difference was not limited to a few items. Rather, females seemed to have a pervasive negative attitude toward the computer.

White and nonwhite students differed on many of the CARS items. Unlike the gender differences, however, some items showed white students with more anxiety than nonwhite students, and some showed the reverse. White students were more anxious about items that dealt with taking a computer course or writing computer programs, whereas nonwhite students were more anxious about the appearance of computers in consumer areas such as grocery stores and department stores, about taking a test with a computer score sheet, and about using a typewriter. In terms of attitudes, nonwhite students had more positive attitudes than did white students about the difficulty of learning to program, the necessity for a logical approach to programming, and the necessity of knowing how to use computers to get a good job. In contrast, white students had more positive attitudes about harming a computer, societal threats posed by computers, gender differences in computer ability, and computer effects on mental health.

Social science majors had significantly more anxiety than did other students about 24 of the 53 items on the CARS, spanning all factors of anxiety. Social science students showed less positive attitudes for only 7 of the 26 ATCS items, including computer effects on society, computer effects on individual mental health, gender differences in computer ability, difficulty in correcting computer mistakes, and the effects computers have on jobs.

Examination of high-anxiety and negative-attitude students. The distributional picture of the CARS indicated that 14% of the students formed a high-anxiety tail of the frequency distribution. These 12 students were examined to determine their demographics. Not surprisingly, given the earlier results, this subgroup included students who were older than average (mean = 37), but who ranged in age from 22 to 53. They were predominantly nonwhite females who were senior or graduate students in the social sciences. Furthermore, nearly half had taken a computer course (and were still anxious), 2 owned a computer, and 2 more intended to buy one within a year. Their self-rated knowledge was low (3.16 on a 7-point scale) and they averaged two of the five physical discomfort signs.

As a comparison, the students who scored in the bottom (negative attitudes) 14% of the ATCS were examined. Interestingly, only 3 of these students were also in the highly computer-anxious group. The negative-attitude students were nonwhite female social science majors, about average age for the entire sample. Again, half had taken a computer course. As a group, they rated their computer knowledge as very low (2.46) and experienced just under two of the possible five physical discomfort symptoms.

Summary. Overall, the results of the first study present a fairly clear picture. First, both new scales appear to have respectable reliability and internal structure, as evidenced by the alpha coefficients and the factor analyses. Second, there appears to be strong evidence that computer anxiety and computer attitudes are related, but are not identical. Third, age is related to anxiety, with older students displaying more anxiety than younger students. Fourth, both anxiety and attitudes toward the computer are affected by having taken a course that uses a computer, but not by having taken a computer programming course. Fifth, although males and females did not differ in anxiety (except for three items), females did display a less positive attitude toward the computer. Sixth, although white students showed more anxiety than did nonwhite students, they also had more positive attitudes toward the computer. On individual items, however, there were differences in both directions, with each group showing more anxiety on some items and more positive attitudes on some items than the other group. Seventh, social science and humanities students had much higher anxiety and much less positive attitudes than did science and business students.

STUDY 2

Study 2 served several purposes. First, it was designed to further study personality correlates of computerphobia. Looking at the contributing influence of other types of anxiety would enable us to better understand whether this was a unique anxiety state, or simply part of a more global anxiety. Additionally, Study 2 allowed for further investigation of the gender differences revealed in Study 1, by moving beyond male-female differences to culturally induced sex-role differences. Finally, this study allowed a test of the notion that computerphobia is simply the result of lack of exposure to computers and will disappear once some computer experience is obtained.

Method

Subjects. The sample included students from three lower-division general-education courses in problem solving and logical reasoning ($n = 85$), two upper-division courses in psychological testing and measurement ($n = 23$), and an introductory business course in computers ($n = 37$). Each course required extensive computer interaction.

Instrumentation. The instrument battery included the CARS, the ATCS, and the CEDQ used in Study 1 and described above. Additional instruments included the Bem Sex Role Inventory (BSRI; Bem, 1974), the state and trait portions of the State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), and the MARS (Richardson & Suinn, 1972). These measures were selected as the best measurement tools for the constructs of sex-role identity, state and trait anxiety, and mathematics anxiety.

The BSRI (Bem, 1974) includes 60 personality characteristics, 20 of which are stereotypically feminine and 20

stereotypically masculine. An additional 20 items serve as fillers to disguise the purpose of the measurement tool. A person is asked to indicate on a 7-point scale how well each characteristic describes him/her (1 = *never or almost never true*; 7 = *always or almost always true*). The BSRI yields two sets of scores, with separate total scores generated from the 20 feminine items and the 20 masculine items. Furthermore, based on comparison with normative data, each person is classified as belonging to one of four sex-role categories (masculine, feminine, androgynous, or undifferentiated).

Spielberger (1972) differentiated between state and trait anxiety. State anxiety is aroused by specific objects or situations, exists at a particular moment in time, and can recur in the presence of the stimulus situation. In contrast, trait anxiety is a relatively stable individual tendency to respond to most situations with anxiety. The STAI (Spielberger et al., 1970) includes two questionnaires designed to measure state and trait anxiety. Each instrument contains 20 items responded to on a 4-point Likert-type scale (*almost never, sometimes, often, almost always*). The instructions direct the respondent to answer either how he/she feels at the particular moment (state) or how he/she generally feels (trait).

The MARS (Richardson & Suinn, 1972) is a 98-item scale composed of brief descriptions of ordinary life and academic situations involving numerical manipulation or mathematical problem solving. The respondent indicates his/her discomfort with each item on a 5-point scale (*not at all, a little, a fair amount, much, very much*). A total score is calculated from all 98 responses.

Procedure. The entire instrument battery was administered during the first week of a 10-week quarter. All subjects were tested in the classroom and participation was voluntary. To avoid the problem of order effects, all questionnaires were completely counterbalanced, with the CEDQ always appearing last.

The battery (except the BSRI) was readministered during the 10th week in the classroom. The CEDQ was modified to include amount of time spent working on the computer and expected course grade. As before, the measures were counterbalanced, with the demographic questions asked last.

Results

Overview. This section presents the results of both the pretest and the posttest. Results of the pretest were examined including correlates, predictive models, and between-group differences for all computerphobia measures. Based on the posttest data, pretest-posttest comparisons were made and additional analyses examined expected course grades and computer preference.

Sample description. The sample in this study was similar to that of Study 1. Thirty-three students (23%) did not complete the courses. Demographically, these dropouts were identical to the students who completed the courses in age, gender, major, and computer experience. The one notable difference was that 79% of the dropouts were

black or Hispanic. In terms of the independent variables, dropouts did not differ on computer anxiety, math anxiety, state or trait anxiety, masculinity or femininity. They did, however, report nearly twice as much physical discomfort. They also felt less positive than nondropouts about Future Personal Use of Computers and more positive that humans are smarter than computers (Computer Intelligence). These opposite trends, plus nonsignificant differences on the remaining factors, yielded comparable total attitude scores for the two groups.

Reliability. Study 2 provided further information on the reliability of the CARS and the ATCS. Overall, performance on the computerphobia measures matched that of the sample in Study 1, with the means of both the CARS (mean = 94.63) and the ATCS (mean = 84.16) matching estimates in that study. The pretest-posttest design of Study 2 afforded an examination of test-retest reliability. For the CARS, the entire scale had a significant test-retest correlation of .62, with subscales ranging from .39 to .68 (mean = .55) and individual items ranging from .27 to .61 (mean = .47). The ATCS total score had a significant test-retest correlation of .58, with the subscales ranging from .30 to .71 (mean = .52) and individual items ranging from .19 to .72 (mean = .47).

Correlates. Table 2 displays the partial correlations of each of the independent variables with three measures of computerphobia (computer anxiety, computer attitudes, and physical discomfort) plus self-rated computer knowledge. Based on the results of Study 1, each partial correlation covaried the effects of age, computer experience, sex, ethnic background, academic major, and class level.

From the data in Table 2, it is clear that computer anxiety and computer attitudes are correlated, but are not identical constructs. Although both measures are correlated with physical discomfort during computer interaction, computer anxiety is also related to math anxiety and to feminine sex-role identity. In contrast, computer attitudes are related to computer knowledge, state and trait anxiety, and masculine sex-role identity.

Table 2
Partial Correlates of Computer Anxiety, Computer Attitudes,
Self-Reported Physical Discomfort, and
Self-Reported Computer Knowledge

Independent Variables	Computer Anxiety	Computer Attitudes	Physical Discomfort	Computer Knowledge
Computer Anxiety		-.31*	.30*	n.s.
Computer Attitudes	-.31*		-.22†	.16‡
Physical Discomfort	.30*	-.22†		-.24†
Computer Knowledge	n.s.	.16‡	-.24†	
Math Anxiety	.33*	n.s.	.20*	-.30*
State Anxiety	n.s.	-.17‡	n.s.	n.s.
Trait Anxiety	n.s.	.22‡	n.s.	n.s.
Masculinity	n.s.	.28†	n.s.	n.s.
Femininity	.17‡	n.s.	n.s.	n.s.

Note—n.s. means not significant at the .05 level. Partial correlation has removed effects of age, gender, ethnic background, academic major, class level, and computer experience. * $p < .001$. † $p < .01$. ‡ $p < .05$.

Similar correlative patterns are evident for the two self-ratings. Self-rated discomfort and computer knowledge are both related to computer attitudes and math anxiety, while discomfort is also related to computer anxiety. Neither measure is related to state or trait anxiety or to sex-role identity.

Predictive models. Based on these correlative data, two hierarchical standard multiple-regression analyses were computed, one with computer anxiety and one with computer attitudes as the dependent variable. Each analysis tested the hypothesis that even after removing the variance accounted for by age, sex, ethnic background, academic major, class level, and computer experience, both computerphobia measures would be predictable by some combination of anxiety measures, self-reported discomfort and computer knowledge, and sex-role identity. Furthermore, a standard regression was chosen to highlight the unique contributions of each of the predictors.

The predictive model for computer anxiety demonstrated that physical discomfort, computer attitudes, and feminine sex-role identity all provided significant unique contributions, with all predictors yielding a total contribution of nearly 18% after the covariate set was removed.

For the computer attitudes scale, the results indicated that only computer anxiety and masculine sex-role identity provided significant unique contributions (total = 17.4% after covariate removal).

Group comparisons. As in Study 1, three-way ANCOVAs were examined to determine the interactive qualities of gender, academic major, and ethnic background. For computer anxiety, the total score and five factors (1-4, 6) all demonstrated a sex $\times$ major interaction: male science or business majors showed more anxiety than did male social science or humanities majors, and females showed the opposite trend. Females showed more anxiety than did males on the Computer Errors subscale.

Several significant effects were evident for computer attitudes. The total score and three subscales (Societal Threats and Computer Control, Inequality in Computer Ability, and Privacy Invasion) showed that nonwhite students did a more negative attitude than did white students. The Inequality subscale also showed a main effect of sex, with males having less positive attitudes than did women. The attitudes toward Learning to Use the Computer and Computers Creating Jobs showed a main effect of major (social science majors had more positive attitudes).

Two other subscales were highlighted by interactions between academic major and ethnic background. For attitudes about Future Personal Use, among science majors nonwhites had a more positive attitude than did whites, while the opposite was true for social science majors. For attitude toward Harming Computers, among science majors white students had the more positive attitude; among social science majors, the white and nonwhite students did not differ.

Gender, major, and ethnic background demonstrated no main effects of interactions for math anxiety, trait and state anxiety, and self-rated knowledge. For self-rated physical discomfort, however, there was a significant three-way interaction. For all majors, nonwhite males and nonwhite females did not differ, but for social science majors, white females had more discomfort than did white males. In contrast, among science majors, white males had more discomfort than did white females.

One final group comparison was done for the sex-role identity groupings produced by the BSRI. When all four groups (androgynous, masculine, feminine, and undifferentiated) were considered, comparisons revealed few differences. However, when masculine sex-role students were compared with feminine sex-role students clear differences were evident. Feminine-identity students had more computer anxiety (total CARS score and seven subscales) and more negative computer attitudes (total ATCS score and three subscales) than did masculine-identity students.

Pretest-posttest changes. Both pretest and posttest questionnaires were completed by 112 students. On the posttest questionnaire, half the students indicated that they used the computer 1-2 h per week. An additional 27% used it 3-5 h per week, 11% used it 6-8 h per week, and 12% used it more than 9 h per week. As expected, self-rated computer knowledge increased significantly from pre- to posttest. However, students showed no significant changes in math anxiety, state anxiety, or trait anxiety, nor did they show any significant drop in physical discomfort.

No significant changes occurred in computer anxiety or computer attitudes, as measured by the total scale scores. However, several subscales did demonstrate change. Students showed reduced anxiety concerning Computers in the Media and Society, Computers in the Future, and Computer Mail. Students showed an improved attitude toward Future Personal Use, but also demonstrated a more negative attitude concerning Learning to Use a Computer.

Grade expectations. On the posttest students were asked to indicate the grade they expected to achieve in the course. Students who expected to achieve worse grades experienced substantially more discomfort during computer interaction than those who expected higher grades. "A" students showed little discomfort; "B" students showed nearly twice as much, and "C" students five times as much. Poorer students also had more negative computer attitudes, more math anxiety, and more trait and state anxiety. Poorer students did not, however, show more computer anxiety.

Computer preference. When asked, 21% of the students said they would have preferred to take the course without the computer. This group is characterized by two major differences from other students: (1) extremely low self-rated computer knowledge, both at the beginning of

the course (2.33 on a 7-point scale) and at the end (2.88); and (2) a preponderance of females (87%). Otherwise, these students did not differ on any anxiety measure or in any other demographic characteristic from those who would choose to use a computer.

Summary. Study 2 showed some striking results concerning computer anxiety and attitudes. First, students who withdrew from a course requiring computer interaction showed more self-reported physical discomfort at the computer terminal. Although they did not differ from nondropouts in computer anxiety, they did have a more negative attitude about Future Personal Use.

Second, computer anxiety and computer attitudes appear to be correlated with different variables. Computer anxiety is related to math anxiety, physical discomfort, and feminine sex-role identity, whereas computer attitudes are related to physical discomfort, computer knowledge, state and trait anxiety, and masculine sex-role identity. Further hierarchical multiple-regression models indicated that even after removal of age, sex, ethnic background, academic major, class level, and computer experience as covariates, computer anxiety can be predicted by a combination of physical discomfort, computer attitudes, and feminine sex-role identity. Computer attitudes can be predicted by computer anxiety and masculine sex-role identity.

Third, computer anxiety scores differed across sex and major, with male science majors and female social science majors showing the most anxiety. For computer attitudes, subscale scores showed both main effects and interactions between academic major and ethnic background. For self-rated discomfort, all three variables interacted, with white social science females and white science males showing the most discomfort.

Fourth, most students used the computer 1–5 h per week and felt more computer knowledgeable after the course. Although there were no changes in math anxiety, state or trait anxiety, physical discomfort, computer anxiety, or computer attitudes across the 10 weeks, there were changes in several CARS and ATCS subscales. Students felt less anxious about Computers in the Media and Society, Computers in the Future, and Computer Mail, and showed an improved attitude toward Future Personal Use, but also showed a more negative attitude about Learning to Use a Computer.

Fifth, students who expected to get worse grades (at the end of the course) experienced more discomfort during computer interaction and had more negative attitudes and more math, trait, and state anxiety. Finally, females with lower self-rated computer knowledge were more likely to prefer taking the same course without the computer interaction.

STUDY 3 AND STUDY 4

This section reports the results of two separate but related studies designed to investigate the relationship between computerphobia and computer literacy. Study 3 examined these relationships in a group of students with lit-

tle computer experience or literacy. In Study 4, these variables were examined in students high in computer literacy. Along with literacy, the contributions of computer aptitude and interest were also measured. These two groups were studied separately, and the results were compared to reveal similarities and differences.

Method

Subjects. The sample for Study 3 included 105 volunteer students from introductory biology, introductory English, an upper-division art course, and two psychology courses (an introductory course and an upper-division course). The sample for Study 4 included 60 volunteer students from a lower-division computer science course and a lower-division computer information systems course. Both of these courses were required for the major, but included students majoring in other subjects.

Instrumentation. The instrument battery included the CARS, the ATCS, and a revised CEDQ. In addition to the demographic information collected in the first two studies, students were asked to rate the following: (1) "How important is it that you be computer literate?" (1 = *not important*, 7 = *very important*); (2) "How much computer ability do you have?" (1 = *no ability*, 7 = *high ability*); and (3) "What role do you expect computers to play in your career?" and "What role do you expect computers to play in your personal life?" (for both, 1 = *no role*, 7 = *important role*).

All students were administered the Computer Aptitude, Literacy, and Interest Profile (CALIP; Poplin, Drew, & Gable, 1984). The CALIP is a standardized instrument designed to measure three distinct but overlapping aspects of computer literacy. The CALIP includes six sections, four designed to measure aptitude for computer programming (estimation, graphic patterns, series, and logical structures), one to measure interest in activities that require logical, computer-like skills, and one to measure computer knowledge (literacy). Each subtest produces a standard score and the four aptitude sections are combined to yield a Computer Aptitude Quotient (CAQ).

The CALIP, which takes approximately 1 h, was created through extensive item analysis to ensure that each item represented a range of abilities mentioned in the literature as being related to computer abilities. The CALIP was administered nationwide to 1,236 individuals between the ages of 12 and 60, and was proportionally allocated to geographic, sex, ethnic, and age demographics. Several studies support the reliability and validity of all scales (Poplin et al., 1984).

Procedure. The battery was administered in a single class period during the first 2 weeks of the quarter. Because the first subtest of the CALIP required timed administration, the CALIP was always administered first. The order of the CARS and ATCS was counterbalanced, with the demographic questionnaire appearing last.

Results

Sample demographics. The demographic characteristics of the sample for Studies 3 and 4 were similar in some

areas and different in others. Both studies included students who were slightly younger than those in Study 1, and both included a majority of nonwhite female students. Differences between the studies are evident when past and future computer experience is examined. A much larger percentage of computer and business students (Study 4) had taken a programming course and expected to take one in the future. Although only 25% owned a computer, nearly 50% more intended to purchase one in the future. The general students (Study 3) matched the samples in the previous two studies in their computer experience and demographic characteristics.

Between-study comparisons. Students in both studies completed the same measures. Table 3 presents the means. On the CALIP, the aptitude score (CAQ) is scaled to a mean of 100 ($SD = 15$). Thus, both groups scored nearly one standard deviation above the mean and did not differ in their computer aptitude. The remaining CALIP scores are scaled to a mean of 10 ($SD = 3$). The general students scored slightly below the mean on both literacy and interest, and, as might be expected, showed significantly lower scores than did the computer and business students.

Although some differences were evident, both groups showed statistically equivalent levels of computer attitudes and self-rated computer discomfort. In contrast, the general students showed significantly higher computer anxiety, lower self-rated computer knowledge, lower literacy importance, lower self-rating of computer ability, and lower computer technology importance in their careers and personal lives. Thus it appears that the two studies were investigating two different populations, one reasonably experienced with computer technology and the other showing only limited experience, literacy, and interest in computers and computer careers.

Table 3
Comparison of General (Study 3) and Computer and Business Students (Study 4) on Computer Aptitude, Literacy, and Interest; Computer Anxiety, Computer Attitudes, and Self-Ratings of Discomfort, Knowledge, and Future Importance

Measure	General Students ($n = 105$)	Computer & Business Students ($n = 60$)	t Score
CALIP*			
Aptitude	110.07	112.52	-1.27
Literacy	8.89	11.93	-6.33†
Interest	9.78	10.33	-1.06
Computer Anxiety	108.10	96.81	1.91‡
Computer Attitudes	85.28	86.12	-0.73
Self-Ratings			
Knowledge	2.86	3.50	-2.86§
Discomfort	1.01	.78	1.16
Literacy Importance	4.47	5.12	2.60§
Ability	3.50	4.02	-2.08‡
Career Importance	4.81	5.68	-3.62§
Personal Importance	3.82	4.44	-2.25‡

*Computer Aptitude, Literacy, and Interest Profile (Poplin, Drew, & Gable, 1984). † $p < .001$. ‡ $p < .05$. § $p < .01$.

Table 4
Correlations Between Computer Anxiety Scale (CARS), Attitude Toward Computer Scale (ATCS), and the Computer, Aptitude, Literacy, and Interest Profile (CALIP; Poplin, Drew, & Gable, 1984) Subscales and Self-Ratings

	General Students		Computer & Business Students	
	CARS	ATCS	CARS	ATCS
CALIP Scales (No Covariates)				
Aptitude (CAQ)	-.20*	.18*	-.43†	.27*
Literacy	n.s.	.27‡	-.53†	.36‡
Interest	-.23‡	.31†	-.31‡	.42†
CALIP Scales (Partial Correlations)				
Aptitude	-.21*	n.s.	-.39†	n.s.
Literacy	n.s.	.20*	-.51†	n.s.
Interest	-.23‡	.26‡	-.24*	.30*
Self-Ratings				
Knowledge	n.s.	.26‡	-.34‡	.39†
Discomfort	.29†	-.18*	n.s.	n.s.
Literacy Importance	n.s.	.25‡	n.s.	.32‡
Ability	n.s.	n.s.	n.s.	.31‡
Career Role	n.s.	.18*	n.s.	.33‡
Personal Role	n.s.	n.s.	n.s.	n.s.

Note—n.s. means not significant at the .05 level. Partial correlations covary age and computer experience. * $p < .05$. † $p < .001$. ‡ $p < .01$.

Correlates. The top half of Table 4 displays the correlations between the CARS and ATCS and each of the CALIP subscales for each study. Two sets of correlations are displayed, one without covariates and one with age and computer experience covaried (partial correlations). A separate definition of computer experience was used for each study. For Study 3, the best experience measure was whether the student had taken a programming course. For Study 4, students were divided into two experience groups, one with limited programming experience (1 or 2 courses) and one with extensive computer programming experience (3 or more courses).

It is interesting to note that the computerphobia measures are correlated with computer aptitude, literacy, and interest for both groups. When no covariates are accounted for, the only nonsignificant correlation is for the relationship between computer anxiety and computer literacy for general majors. Even after age and experience have been covaried, the general students show a negative relationship between computer anxiety and computer aptitude and a positive relationship between computer attitudes and computer interest. Those with the least aptitude have the most anxiety, whereas those with the least interest have the most negative attitude.

For the computer and business majors, removing experience does not remove the strong relationships between computer anxiety and computer aptitude, literacy, and interest. The most anxious students have the least aptitude, the least interest, and the least literacy. The least interested have the most negative attitude.

The bottom half of Table 4 indicates that many of the self-ratings are related to computer attitudes, including

knowledge, importance of being computer literate, and career role importance for both groups of students, self-rated discomfort for general students, and self-rated ability for computer and business students.

Gender comparisons. One consistent finding with the CALIP has been that although women and men do not differ either in computer aptitude or in computer literacy, women do show significantly less computer interest, even after computer experience has been covaried (Poplin et al., 1984). This pattern was supported for the general students. For the computer and business students, however, women showed significantly lower computer aptitude (both on the CAQ and on the individual logic and series scales) and computer interest than did men (after computer experience was removed).

Summary. Overall, Studies 3 and 4 demonstrated that computer anxiety and computer attitudes are correlated with computer aptitude, literacy, and interest, even when students whose majors required extensive computer contact are analyzed separately and computer experience is covaried out. Furthermore, although the results from Study 3 (general students) supported the lack of relationship between gender and computer aptitude, Study 4 disputed that finding. Female computer and business majors appeared to have lower computer aptitude than did male computer and business majors. In both studies, women had significantly less interest than men.

STUDY 5

On the basis of the results of the preceding studies, the authors received a 3-year grant from the U.S. Department of Education's Fund For the Improvement of Postsecondary Education to develop, test, and disseminate a computerphobia reduction program. Although the actual program is described elsewhere (see Weil, Rosen, & Sears, 1987), one research issue that arose from the program's development merits mention here. On the basis of the research results, programs were developed to aid students with anxiety about computers (measured by the CARS scale) and negative attitudes about computers (measured by ATCS scale). When the program began treating students, it was evident that a third area of discomfort was not being assessed by either measurement instrument. Many students had negative cognitions and feelings about their computer abilities. These students would covertly repeat a litany of negative messages, such as "I'll never be able to figure this out," or "I'll probably damage the machine by pushing the wrong button." Study 5 was designed to create and validate a measure of these thoughts and feelings.

Method

Subjects. A total of 69 subjects were recruited from two introductory psychology courses and one introductory computer information systems course. The subject population was similar to that of the previous studies.

Instrumentation. Both the CARS and the modified demographic questionnaire were administered to all students. In addition, a third measure, the Computer Thoughts Survey (CTS), was created. The CTS presented 28 self-statements about student-computer interaction, 12 of which were negative (e.g., "I am going to make a mistake," "People will notice that I am nervous") and 18 positive ("This will be fun"). For each item the student indicated how often he/she had the thought when using a computer or thinking about using a computer, on the same scale as the CARS (*not at all, a little, a fair amount, much, very much*). Each item was scored in such a way that lower scores indicated more negative thoughts. Presentation orders of the CARS and CTS were counter-balanced.

Results

Scores on the CTS ranged from a low of 58 (possible low score 28) to a high of 139 (possible high score 140), with a mean of 105.46 ($SD = 18.37$). Unlike the CARS, the CTS was not skewed and, in fact, was nearly normally distributed. The mean interitem correlation was .35 with an alpha of .93.

As expected, the CARS and the CTS were significantly related, but were not identical constructs ($r = -.35$). In addition, the CTS was also related to all self-ratings, including computer knowledge ($r = .30$), computer literacy importance ($r = .20$), computer ability ($r = .37$), career role ($r = .23$), and personal role ($r = .42$). Demographically, the CTS was unrelated to age, sex, ethnic background, academic major, or computer experience (including computer ownership).

DISCUSSION

Taken together, the five studies reported above present a comprehensive picture of computerphobia and the computerphobic. On the basis of these results, it appears that computerphobia can take at least three forms. Computerphobics may display anxiety about computers, may have negative attitudes about computers, or may engage in disabling internal self-critical dialogues when interacting with computers. The data indicate some overlap between these three forms, but to a great extent they are independent of one another.

These studies also have helped us learn what computerphobia is not. It is not math anxiety in disguise. It is not state anxiety or trait anxiety alone. It is not the result of lack of exposure to computers. It is not completely explained by computer illiteracy.

Computerphobia Measurement

The CARS scale has been demonstrated to be a valid and reliable measure of computer anxiety. Its 12 factors together explain nearly 80% of the variance, and each is internally consistent. The factors themselves appear to capture the elements of computer anxiety that have been

suggested by other researchers and to further extend our understanding of computer anxiety beyond that of any existing scale.

The ATCS represents an advance in the assessment of computerphobia. By obtaining a separate measure of computer attitudes, we can more clearly understand and respond to the needs of the computerphobic (see Weil et al., 1987). Although the ATCS factor structure is less internally consistent than that of the CARS, its nine factors provide a comprehensive view of general computer attitudes.

A third dimension of computerphobia, negative computer thoughts, became evident when we worked with computerphobics. The CTS has proved useful in reliably measuring both positive and negative computer thoughts. Additional research on its factor structure may provide added clinical insight into the private thoughts of computerphobics.

This research has provided us with a wealth of information about the characteristics of computerphobics. One of the more interesting findings is that people tend to have one form of computerphobia or another. Rarely is there significant overlap; that is, a person with high computer anxiety rarely has negative attitudes or negative thoughts. Data accumulated from over 1,000 students in the reported studies plus unreported clinical and research studies illustrate this trend. Nearly 12% of the students can be categorized as "high risk" for developing computerphobia on the computer anxiety dimension, another 2% on the attitudes dimension, and 6% on the thoughts dimension. However, less than .5% of the entire sample were high risk on more than one dimension.

Computerphobia Correlates

Age and computerphobia. One advantage of conducting research using a nontraditional student population is that a typical classroom includes a wide age range. The relationship between age and computerphobia may have been overlooked in some prior research (e.g., Howard & Smith, 1986; Raub, 1981) because of the truncated age range in the samples. In the present studies, an interesting age-computerphobia connection was revealed. Older students did not differ from younger students in their computer attitudes or computer thoughts. However, they did show significantly more anxiety about computers. This partially supports the popular notion that older people are more computerphobic due to lack of exposure or negative experiences with computers. It is interesting to note that *not* belonging to the "computer generation" did not adversely affect attitudes or cognitions about interacting with computers. Indeed, Anderson (quoted in "Computerphobia Study," 1981) reported that in her sample, older business students showed less anxiety than did younger students.

Gender, sex-role identity, and computerphobia. The prior literature on computerphobia presented conflicting

results about the relationship of gender and computer anxiety. Raub (1981) found that gender was significantly related to computer anxiety, but Anderson (quoted in "Computerphobia Study," 1981) and Howard and Smith (1986) reported that gender was not related. Our results revealed a fairly complex relationship between gender and computerphobia. Gender was not related to computer anxiety or computer thoughts, but was significantly related to computer attitudes, with women having more negative attitudes. However, in more detailed analyses, gender interacted with both academic major and ethnicity on the anxiety and attitude scales. In an attempt to clarify this issue, we tested the possibility that sex-role identity may explain more than does gender. The data revealed that feminine-identity students had more computer anxiety and more negative computer attitudes than did masculine-identity students, regardless of gender. Future research should address the cultural roots of sex-role identity as an aid to understanding and treating the computerphobic.

Ethnicity and computerphobia. A continuing concern of the authors is equal access to computer technology by both sexes and all ethnic groups. No data were available in the literature about the relationship of ethnicity and computerphobia, and the results of the ethnicity analyses were somewhat surprising. The nonwhite students in Study 1 had less anxiety than did white students, but this was not evident in Study 2. However, white students had more positive attitudes in both studies. The negative attitudes of nonwhite students may reflect a sociocultural reality. As Harris's recent nationwide poll (Shaw, 1984) suggested, computer technology may further polarize society and limit minority participation.

Academic major and computerphobia. The rationale and motivation students have for selecting a particular academic major are complex. There is no reason to believe that feelings about involvement with computers consciously affect that selection process, but academic major is consistently related to both computer anxiety and computer attitudes. In the near future, it is likely that computer interaction will be an integral part of most academic majors, leaving the computerphobic with limited options.

Computer experience and computerphobia. Our most direct evidence about the role of computer experience comes from the pretest-posttest comparisons in Study 2. If mere interaction with computers reduces anxiety and improves attitudes, working with a computer 4 h per week for 10 weeks should eliminate computerphobia. However, no significant changes were found in computer anxiety or computer attitudes, and in fact, a number of students became more anxious and developed more negative attitudes after working with computers.

Computer aptitude, literacy and interest, and computerphobia. Correlating our measures of computer anxiety and computer attitudes with the CALIP (Poplin et al., 1984), which measures computer aptitude, literacy, and interest, revealed what appears to be a logical and under-

standable relationship. Overall, regardless of major, age, or computer experience, the computer-anxious student shows less aptitude, less literacy, and less interest. Not surprisingly, the student with negative computer attitudes also has less interest in computer-related activities. The computerphobic student, with reduced computer skills and low computer interest, may find it difficult to navigate through the present and future technological society.

CONCLUSION

The research reported here and that of others has shown that nearly every segment of society is at risk for computerphobia. Our computerphobic students were both old and young; Asian, black, Hispanic, and white; social science, humanities, business, and science majors; experienced and inexperienced programmers. These students were less interested than nonphobic students in any form of computer interaction, both in their personal lives and in their academic careers.

These computerphobic students are unlikely to pursue a career that involves computing technology. We can hardly afford to lose the input of one third of our population as we face a maze of technological choices.

One step toward assisting the computerphobic has already begun. The Computerphobia Reduction Program (Weil, et al., 1987), currently in its second year of a 3-year grant, provides individualized computerphobia reduction through skills acquisition training. Based on psychological principles rather than computer training, the computerphobia program has been extremely effective in treating computerphobics whose discomfort arises from computer anxiety, negative attitudes, or negative thoughts.

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