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ABSTRACT

A Computer Anxiety Index (CAIN), which uses a six-point Likert scale of agreement, was developed to measure the trait of computer anxiety and to be predictive of the development of the state of computer anxiety. Computer anxiety was defined as the irrational fear or apprehension felt by an individual when using computers or when considering the possibility of computer utilization. College students enrolled in an undergraduate instructional media class at Iowa State University were used to gather validity and reliability measurements. A four-step validation process involved administering the CAIN to subjects two weeks before a scheduled computer lab, administering the State-Trait Anxiety Index as a concurrent measure of computer anxiety, observing subjects while they were using computers, and comparing results of the computer anxiety measures. Normative data were also gathered from computer professionals, other computer users, educators, junior high school and college students, and other adults. The CAIN was found to be reliable and valid, with practical applications in computer anxiety research, career planning, and identification of computer-anxious individuals. (LMM)

DEVELOPMENT AND VALIDATION OF A MEASURE OF COMPUTER ANXIETY

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INTRODUCTION

The rate at which computerization is propagating is constantly accelerating. Thus, the need to understand the effects of computer usage on the individuals involved with computers is important. Many individuals fear computer utilization, and this fear can be very detrimental to their performance in a highly computerized environment.

Before fear of computers, or computer anxiety, can be analyzed, it must first be identified. The state/trait theory of anxiety proposed by Spielberger (1972) was used as a foundation for describing the new phenomenon of computer anxiety identified in this research.

The intent of this study was to develop a measure that could be used to identify individuals who had a tendency to become unusually computer anxious when faced with a situation in which computers were involved. This tendency to become anxious is called the trait of computer anxiety. The actual development of anxiety when the individual is involved with computers is called the state of computer anxiety. The Computer Anxiety Index (CAIN) is intended to measure the trait of computer anxiety, and to be predictive of the development of the state of computer anxiety.

Three goals were identified to insure that the final product of the study would be a usable paper and pencil test of computer anxiety. These three goals were as follows:

1. Develop a general measure of computer anxiety.
2. Gather information to test the reliability and validity of the instrument.
3. Gather data to be used as norm references for the test.

Before the process of developing the actual test could begin, a clear definition of the computer anxiety had to be developed to guide the development process. Computer anxiety was defined as the fear or apprehension felt by an individual when using computers, or when considering the possibility of computer utilization. To further clarify the construct, it was made clear that, although there are rational fears related to computer utilization, (e.g. job displacement, increased exposure to radiation from terminal screens) the fears that were being addressed in this study were fears that could be called "irrational" fears (e.g. impending doom or sure calamity because of contact with computers).

This definition is quite helpful in guiding the development of the computer anxiety measure, but to further assist in the development process, the construct had to be further described in terms of the observable behaviors that suggest the underlying feelings related to computer anxiety. In other words, it was necessary to define how we would know if someone were computer anxious. This is important since the ultimate purpose of the CAIN is to predict the state of computer anxiety. Thus, the behaviors of that state must be identified so that the predictive ability of the test can be validated. The following are the

behaviors that were identified as being indica[illegible]omputer anxiety:

1. Avoidance of computers and the general area where computers are located.
2. Excessive caution with computers.
3. Negative remarks about computers.
4. Attempts to cut short the necessary use of computers.

METHODOLOGY

With computer anxiety clearly defined, and its indicative behaviors enumerated, it was possible to begin the process of developing the actual test of computer anxiety. It was decided that the test would use a six point Likert scale of agreement/disagreement and that the Hennerson, Morris and Fitz-Gibbon (1978) model of psychological test development would be used.

The first step in this development process was to generate numerous test items that would be indicative of an individuals feelings of anxiety toward computers. Rohner (1981) had previously developed a measure of computer anxiety, but it was specifically directed toward prospective teachers, and there were other minor problems identified with it. However, the items of the Rohner test were used to suggest other more appropriate items. College students were also asked to generate statements reflecting how they felt about computers. These statements were used to suggest items that reflected an individual's feelings of anxiety toward computers. Test items were generated that related to the

previously defined construct of computer anxiety. The specific definition and the associated behaviors were used as the initial criterion for an appropriate item.

Once items were developed, they were pilot tested to determine if they were good discriminators. As a result of the pilot test, poor items were identified and eliminated, and questionable items were modified. A second pilot test was completed, and only the best items were kept to make up the final version of the Computer Anxiety Index. This rigorous development and pilot testing procedure accounted for the high level of reliability that was later found to exist.

The next goal of this project was to determine the reliability of the test and to gather information to demonstrate the validity of the test. College students enrolled in an undergraduate instructional media class at Iowa State University were used as subjects in gathering this information. The reliability of the test was measured using two different methods. The internal consistency of the test was checked using Cronbach's (1970) coefficient alpha formula. The students were also tested and retested with an intervening period of three weeks to test the test/retest reliability of the measure.

The establishment of the reliability of the test made it possible to examine the validity of it. The validation portion of the study was done using students in an instructional media class at Iowa State University as subjects. This group was chosen because part of their planned curriculum included a two hour laboratory session in which the students were required to work with a computer.

Four steps were followed to demonstrate the validity of the Computer Anxiety Index (CAIN). The first step was to administer the CAIN to the subjects two weeks before their lab on computers. The CAIN was administered prior to the subject's required use of computers because the CAIN was being developed as a measure of the trait of computer anxiety (rather than the state of computer anxiety) and naturally as a predictor of the development of the state of computer anxiety under the proper conditions (i.e. exposure to computers).

The second step of the validation process was to administer the State-Trait Anxiety Index (STAI) (Spielberger 1970), which was intended as a concurrent measure of computer anxiety. The STAI was chosen as the best measure to use as a concurrent measure of computer anxiety because there was no other appropriate, valid measure of computer anxiety in existence. However, since the STAI is actually a measure of general anxiety, the timing of its administration was considered crucial if it was to be construed as measuring computer anxiety. The state portion of the STAI was administered to the subjects after they were seated in front of their computers. The assumption was made that if an individual had the trait of computer anxiety they would develop a state of anxiety while seated before a computer, and this state of anxiety could be measured by the STAI.

The third step of the validation process was to actually observe subjects while they were using computers. During this observation session, a judgement was made about each individual on his/her observed level of computer anxiety. Subjects were judged on a three point scale, either computer anxious, neutral,

or computer comfortable. The criterion on which the subjects were judged were those behaviors that were stated earlier as being indicative of the state of computer anxiety.

The final evaluation procedure was to compare the results of the three independent measures of computer anxiety. The STAI and the observed measure of computer anxiety were correlated to the results of the CAIN. It should be emphasized that these three measures were each very different. The CAIN was a measure of the trait of computer anxiety, and the portion of the STAI that was used was a measure of the state of anxiety. Both of these measures were administered using self-reports, while the third measure was an observational one. The observation was also measuring the state of computer anxiety, while the test was designed to measure the less transient trait of computer anxiety. Since these three measures were each somewhat different, it was not expected that their correlations would be extremely high. To be demonstrative of the validity of the CAIN however, the correlations of the measures had to be positive and significant.

The collection of normative data was the third and final goal of this study. The intent in collecting this data was to allow a person who might take this test at a later time to be compared to others who had already taken the test.

The following six groups were identified as being important and interesting to those concerned with computer anxiety:

1. Computer professionals
2. Those who use computers on a daily basis, but are not computer users
3. Educators

4. Junior high school students
5. College students
6. Adults who fit none of the above categories

Subjects for the collection of normative data were solicited from across the state of Iowa. They were from schools, businesses and government agencies.

The intent in gathering this data was not to identify scientifically comparable random samples, but to gather a large volume of data. Therefore no scientifically valid comparisons should be made between the groups of subjects.

RESULTS

The computer anxiety index was found to be highly reliable, using two methods of demonstrating reliability. A group of 25 subjects were tested with the CAIN, and retested 3 weeks later. The coefficient of reliability for the test/retest situation was .90 (r=.90).

The internal consistency of the second administration of the test of the above mentioned subjects was checked using Cronbach's coefficient alpha method. The coefficient alpha was found to be .94 (r=.94). The internal consistency was also calculated for a second group of randomly selected from the tests returned as part of the collection of norm data. The coefficient alpha for this group was .96 (r=.96).

The three independent measures of computer anxiety, (the CAIN, STAI and observation) were taken and they all correlated

positively and significantly with each other. The correlation constant of the STAI with the CAIN was .32 (r=.32). With a subject population of 111, this was significant beyond the .01 level ($p \leq .01$).

The observation measure was correlated with the CAIN and the correlation coefficient was .36. This too was significant beyond the .01 level ($p \leq .01$).

The normative data was successfully collected and compiled. Table 1 shows the number of subjects, their means, standard deviations and the range of scores for each of the six groups. The scores were grouped into 2/10 intervals and compiled into a percentile table (Table 2) to allow easy comparison.

ANALYSIS OF RESULTS

The reliability and validity figures give strong evidence that the test is measuring what it was designed to measure. The normative data gives some indication of the normal range of responses that can be expected from the test. The results imply that a necessary measure is now available for future research and evaluation. The stated goal of the project, to develop a usable measure of computer anxiety, was accomplished. The test can be used as a tool in career planning, and as a test to identify individuals in need of special training.

In addition to the accomplishment of the stated goals of the study, this study is significant as an important first step in the scientific examination of the phenomenon of computer anxiety. This study provides a tool to use in that examination.

One avenue of research that is suggested by this study is to determine if the several groups that were inspected are in fact as similar as the normative data would suggest. Four of the six norm groups showed normal distributions skewed to the right (towards the positive). (The group called "other" was not sufficiently large to show a regular distribution, and the teachers had a skewed and elongated distribution.) This is as can be expected for a measure that is examining a phenomenon that is generally identified as a negative one. The distribution shows that most people cluster around the less anxious end of the scale. However, even with a skewed distribution, there were individuals in all of the six norm groups that were separated from the rest of the group by at least one full interval. This seems to indicate that in all groups, including people who use computers on a daily basis, there are those who are critically computer anxious. The examination of this peculiarity in the distribution of the scores of the norm groups could prove to be very interesting and enlightening.

A second area in which this study could be very valuable is in examining the change in computer anxiety following a specific treatment or remediation activity. The CAIN can be used to measure changes in computer anxiety. Since the reason for concern about computer anxiety is that it is generally believed that computer anxiety may interfere with people's functioning, this test can be used to determine which treatments prove to be most effective in reducing computer anxiety.

CONCLUSIONS

The Computer Anxiety Index is a valid and reliable test that can can be used to measure computer anxiety. This test has several practical applications. It can be used effectively in the further study of the phenomenon of computer anxiety. It can also be used as an evaluation tool by guidance counselors to identify students that are either well or poorly suited for careers involving computers. It can also be used by employers and educators to identify individuals who are in need of special curriculum or training programs to help reduce computer anxiety.

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Table 1. Means, standard deviations, and ranges of CAIN scores by norm groups

	College student	Junior high	Teacher	Profes-sional	User	Other	All
N	111	247	42	67	122	25	614
Mean score	2.70	2.21	2.44	1.78	1.99	2.21	2.23
Standard deviation	0.71	0.67	0.92	0.58	0.54	0.72	0.72
Low score (1 = lowest possible)	1.00	1.00	1.00	1.00	1.00	1.12	1.00
High score (6 = highest possible)	5.04	5.04	4.69	3.73	4.28	4.31	5.04

Note - the higher the CAIN score, the higher the individual anxiety

Table 2. Percentile table for CAIN raw scores by norm group

	College student	Junior high	Teacher	Profes-sional	User	Other	All
1.0	0	1	2	4	2	-	1
1.2	-	4	3	14	6	3	5
1.4	1	9	16	30	12	7	11
1.6	4	18	24	45	23	19	20
1.8	8	30	32	59	38	32	31
2.0	14	43	38	72	52	44	42
2.2	24	54	43	80	65	57	53
2.4	35	63	48	86	79	69	63
2.6	47	72	55	-	89	78	72
2.8	59	81	60	91	94	84	79
3.0	69	86	65	-	96	-	85
3.2	78	90	74	95	-	88	89
3.4	86	94	83	97	97	-	93
3.6	91	97	89	-	-	-	95
3.8	92	97	93	98	98	92	96
4.0	94	-	95	-	-	-	97
4.2	-	98	-	-	99	-	98
4.4	96	-	-	-	-	96	98
4.6	97	-	97	-	-	-	99
4.8	-	-	-	-	-	-	-
5.0	99	99	-	-	-	-	99