IOWA STATE UNIVERSITY
Digital Repository

1983

Development and validation of a measure of computer anxiety

Matthew M. Maurer
Iowa State University

Development and validation of a

measure of computer anxiety

by

Matthew M. Maurer

A Thesis Submitted to the

Graduate Faculty in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE

Department: Professional Studies
Major: Education (Curriculum
and Instructional Media)

Iowa State University
Ames, Iowa

1983

14326·17

TABLE OF CONTENTS

INTRODUCTION

Background

(Electronic) computing is little more than 30 years old,
however the advent of the last few years of developments
in micro-electronics, stimulated by the needs of U.S.
defense and space programmes have made it possible for many
computing components and sub assemblies to be mass produced
very cheaply. These micro-electronic products are minute,
inherently very reliable and consume very little power.

This trend is moving computing from an expensive specialized
activity, the preserve of large companies and computer
professionals to an everyday affair. It is difficult to
anticipate the range of applications and products human
ingenuity will produce from this enormous potential
(Firnberg, 1979, p. 149).

Introduction and Definition of Terms

The potential of the computer is very high; however, a computer

is only a servant to those using it, and beyond that, it has little

value. To obtain the benefits of this powerful machine, lay individuals

in the society are probably going to have to consciously choose to use

computers. Superficially, this may seem very simple, but there is at

least one major impediment that prevents many from making the choice

to use computers. Many have a sense of anxiety approaching fear when

they interact with machines, especially computers.

Defining anxiety is a difficult semantic problem. Most people

have an understanding of what is meant by anxiety, but its definition

is complex. The dictionary defines anxiety as:

1. Worry or uneasiness about what may happen
2. An eager desire (Davies, 1970).

A possibly more useful statement concerning anxiety was made by Levitt

(1967, p. 8).

> Various theorists have proposed that the term "anxiety"
> should be reserved for fear stemming from a source that
> is unknown to the stricken individual.... The person who
> is beset with free-floating anxiety is afraid that
> 'something terrible is going to happen,' but he does
> not know what it is.

For the purpose of this study, computer anxiety is defined as the
fear and apprehension felt by an individual when considering the implica-
tions of utilizing computer technology, or when actually using computer
technology. The individual is in this state (of computer anxiety)
because of the fear of interaction with the computer, even though the
computer posses no immediate or real threat.

It is hypothesized that a person who is computer anxious will act
differently than a person who is not computer anxious. It is further
hypothesized that computer anxious individuals can be identified by
means of a paper and pencil test. The person who is computer anxious
will attempt to avoid computer utilization. When forced to use a
computer, this person will voice dissatisfaction towards or disapproval
of computers. If forced into a situation where computer utilization
is occurring, the computer anxious person will avoid the physical area
of the computer if this is possible. When forced to actually use a
computer, the computer anxious person will attempt to minimize the time
spent using the computer, and the person who is computer anxious will
show signs of excessive caution and hesitation when forced to use a
computer. It is also hypothesized that people who have a tendency to
be computer anxious can be identified when they are not involved with
computers.

The Need for a Measure of Computer Anxiety

> Computers are seen by many as a part of that application of
> science to advance industrialization which threatens to make
> our lives unpleasant, empty or brief (Laver, 1980, p. 47).

Many persons allow computer anxiety to interfere with their use of

computer technology, and thus they handicap themselves in today's

sophisticated society. Because of the rapid growth of use of computers

in many areas, including business, education, government, and the home,

people who allow their anxiety to prevent them from using computers may

be hampered in much the same way a person who does not drive a car is

hampered. On the other hand, people who do not have a fear of the

computer, and who are making extensive use of it, are likely to become

more efficient and possibly even more effective individuals. The need

for individuals who can and will use computers is heightened by the

present economic status of most of the world. Budgets are being cut

in many organizations and because of this, a method of increasing

efficiency and lowering costs is being sought. Computers, if used

correctly, can help.

There is very little direct mention or evidence of computer anxiety

in the existing literature; however, the number of indirect references

to this problem clearly indicates that this problem does exist. An

article by Rivizzigno (1980), offers one example. It is titled "Over-

coming the Fear of Using the Computer and Basic Statistical Methods."

A second example written by Nickerson (1981) is titled "Why Interactive

Computer Systems are Sometimes not Used by People who Might Benefit

from Them." A third example deals with the education field. It was

written by Anastasio (1972) and was titled "The Study of Factors Inhibiting the Use of Computers in Instruction." Although only one of these examples directly mentions fear, all of them discuss why individuals seem to refuse to get directly involved with computers when computer usage would seem a rational course of action. It is proposed in this study that the reasons may not be all rational, but may consist of both a rational component and an irrational component. Useful analogies would be the fear of heights, or the fear of snakes. It is indeed true that a fall from a substantial height could be dangerous. Some snakes are indeed very dangerous. These are the rational components of that fear; however, it is commonly known that many individuals take these categories of fear far past that rational point. The same could be true of computer usage. Computers can cause job displacement. Computer crimes do occur. However, as with other kinds of fear, many individuals take fear of computers past the point of reason.

In today's society, very few individuals are completely free from the effects of computer anxiety. People in business, industry, and government are involved as major users of computer services and as leaders in the computer field. Educators are also involved in several ways. Computer assisted instruction and computer managed instruction (the use of the computer as a teaching aid and in assisting with school and classroom record keeping) have brought the computer into the classroom. School managers and administrators also make extensive use of computers.

Additionally, schools have traditionally been concerned with the integration of their students into the existing society, and that society has now become heavily computerized. The attitude of students toward the computer may be crucial if computer related skills are to be integrated into the student's value system. Since schools are one of the major leaders in the development of the public's attitudes, the anxiety felt by many toward computers is a concern schools must probably examine.

Programs, classes, workshops, and possibly even entire courses of study need to be developed to aid in reducing computer anxiety. However, before solutions to the problem of computer anxiety can be proposed or developed, this phenomenon must be made more easily identifiable. In other words, there is a need to be able to diagnose those who experience an extreme and possibly handicapping degree of computer anxiety. It is often easy to spot someone who is computer anxious when they are forced to use a computer because they exhibit obviously fearful reactions. In most cases, however, it would be preferable to determine if an individual is computer anxious before that person is forced to use a computer so that the anxiety might be lowered prior to the time when the individual is required to interact with the computer. It is also relatively inconvenient to determine computer anxiety by observing actual computer utilization, because a computer is required. A testing environment including a computer would be much more difficult to set up than it would be to administer the kind of paper and pencil test proposed in this study.

Summary and Statement of Problems

An instrument that can identify a person who is computer anxious without requiring the exposure of the individual to the use of a computer is needed. This would allow early and non-threatening identification of those who are either highly computer anxious, or those who show very low levels of computer anxiety. A measure of this sort could be used in business and government (since these groups make heavy use of computer services) as an indication of job aptitude, or as an indication for the need for computer anxiety reduction training. Similar uses could be made of the instrument in education as a step in the process of preparing students to use the computer. Computer training will become a growing concern of educators because in the next few years a larger percentage of the population will be required to use the computer in their professions.

A measure of computer anxiety was developed at Iowa State University by Rohner (1981). Unfortunately, problems were identified with the measure that needed to be rectified before it could be generally used. The measure, as it was developed, was aimed specifically at teachers and prospective teachers. The measure was not formally validated, but was shown to be highly reliable ($r = 0.86$). A third problem with Rohner's measure was that while its results were reported as a single number, this number had little meaning or value because there was little normative information with which to compare it. Normative information is needed so the results of a measure can be interpreted intelligently

by comparing the individual's score with the scores obtained from a large group of test takers.

In this study, these three problems will be addressed. First, Rohner's instrument will be modified to be more generic so that it can be used on a wider, more diverse population. Next, an attempt will be made to validate this revised measure by correlating it with other related, but much more difficult and unwieldy, methods of measuring computer anxiety. Finally, in this study, normative data from five groups, data processing professionals, data processing users, educators, young students, and a cross-section of the general population, will be compiled.

Problems

1. Modification of an existing computer anxiety instrument.

2. Validation of this instrument.

3. Collection of normative data using this instrument.

LITERATURE REVIEW

General Introduction

This chapter will focus on three major areas that are pertinent to the proposed study on computer anxiety. These areas are (1) anxiety and anxiety theory, (2) attitude test construction techniques, and (3) computer anxiety and associated topics. In the first section, three aspects of anxiety will be investigated. A definition of anxiety will be formed from the opinions and findings of experts in the field of anxiety, a current unifying theory of anxiety will be discussed, and anxiety research results that are related to this study will be presented in a brief review.

In the second section of this chapter, an accepted method for developing and testing a psychological measure will be presented, and information on validation of such an instrument will be discussed. The chapter's final section will cover the area of computer anxiety. Since specific research in the area of computer anxiety is limited, associated research that indirectly deals with computer anxiety will be discussed.

Anxiety and Anxiety Theory

Definition

The definition of anxiety and this definition's relationship to anxiety theory has been the basis for a significant amount of controversy in the literature. One, single definition is difficult to propose because of the widely varying connotations of the term, made

both by experts in the field and by the general public. The same term is used to define a range of feelings from mild uneasiness and discomfort to a physically debilitating state of panic (Hanfmann, 1950). To further complicate the situation, according to May (1977), there are no fewer than five distinct groups of individuals involved with defining and developing theories dealing with anxiety. These groups are:

1. Philosophers

2. Biologists

3. Psychologists

4. Psychotherapists

5. The general culture.

There is often quite a bit of disagreement not only between these groups, but also within them. Because of the amount of disagreement among the experts in the field, a brief overview of the more significant opinions about, and theories of, anxiety is necessary.

Anxiety can be identified in terms of anxiety causing objects, but often anxiety is experienced independently from such objects (Hanfmann, 1950). This object versus objectless dichotomy gives rise to one of the major controversies in the study of anxiety, that of distinguishing between fear and anxiety. Some experts insist that fear and anxiety are distinct emotions. Freud claims that anxiety is the manifestation of unreleased tensions (mainly sexual) and has no relation to fear (Strachey, 1971). "Learning theory maintains that anxiety is the conditionable part of fear" (Klein & Rabkin, 1981, p. 242). In other words,

fear is directly related to some object or situation, and anxiety is the conditioned response to that fear and is independent of those fear evoking objects or situations.

Many experts oppose this distinction between fear and anxiety and state that the effects of the two are very similar, or that the distinction between the two emotions is trivial.

> Anxiety like fear and anger arises in response to danger
> or threat (Branch, 1968, p. 10).

> For all practical and experimental purposes, anxiety and
> fear are indistinguishable (Levitt, 1980, p. 16).

In this study, no distinction will be made between fear and anxiety. The behavior of a computer anxious person has already been described behaviorally in the introductory chapter of this work. This description will be used for the operational definition of computer anxiety that will be used throughout this study.

Anxiety theory

A major contributor to the modern theories of anxiety is Spielberger. He states that an adequate theory of anxiety must distinguish between transitory feelings, and relatively unchanging personality characteristics. Spielberger also sees a need for a comprehensive theory of anxiety to distinguish between the behavioral symptoms of anxiety and the stimulus that causes the anxious reaction (Spielberger, 1972a).

Spielberger developed a theory according to these guidelines, and it has proven to be a prominent and useful one for studies in the area of anxiety. This theory seems to help define more clearly what

is meant by anxiety and is useful in explaining some of the research discrepancies that are encountered in the study of anxiety. Spielberger's theory is referred to as the state-trait theory. It is quite widely accepted in the psychological community. According to the state-trait theory, anxiety takes two forms. The first form is state anxiety which occurs when an "individual is anxious at the moment." The second form is trait anxiety which is "a constant condition without time limitation" (Levitt, 1980, pp. 11-12).

The assumptions that are drawn from this theory are probably as important as the theory itself. Spielberger summarizes the assumptions as follows:

1. In situations that are viewed by an individual as threatening, an A-state (anxiety state) reaction will be evoked. Through sensory and cognitive feedback mechanisms, high levels of A-state will be experienced as unpleasant.

2. The intensity of an A-state reaction will be proportional to the amount of threat that the situation poses for the individual.

3. The duration of an A-state reaction will depend upon the persistence of the individual's interpretation of the situation as threatening.

4. High A-trait (anxiety trait) individuals will perceive situations or circumstances that involve failure or threats to self-esteem more threatening than will persons who are low in A-trait.

5. Elevations in A-state have stimulus and drive properties that may be expressed directly in behavior, or that may serve to initiate psychological defenses that have been effective in reducing A-state in the past.

6. Stressful situations that are encountered frequently may cause an individual to develop specific coping responses or psychological defense mechanisms which are designed to reduce or minimize A-state (Spielberger, 1972a, p. 44).

Although Spielberger's theory deals with anxiety in general, his theory also applies directly to the study proposed here. This theory of anxiety and its associated assumptions will be used in designing the experimental procedure in this study and in interpreting the results.

<u>Research with a direct bearing on computer anxiety</u>

Anxiety can often be beneficial to the individual experiencing it. Anxiety can be a very strong motivating force in decision making situations, and it can often spark creativity in the individual experiencing it. Berthold (1963) states that "Anxiety is the mother of the drive to know." Very intense anxiety can, on the other hand, be very incapacitating. In an experiment on habit formation in mice, Yerkes and Dodson found that mid-range stimuli (anxiety causing) improves cognitive processes, while the extremes (either high or low) will hinder such processes (Yerkes and Dodson, 1908). These findings were later dubbed the Yerkes-Dodson Law.

The effect of strong anxiety on various cognitive processes is an area that has been quite comprehensively investigated. Levitt sums up

the negative effects of anxiety that this research has demonstrated:

> Experimental investigations indicate that anxiety
> detrimentally affects various cognitive processes
> such as problem-solving, incidental learning, and
> verbal communications skills. Under extreme stress,
> human problem-solving falls from its lofty cerebral
> level and resembles the performance of infrahuman
> mammals (Levitt, 1980, p. 122).

Several examples of the research in the area of anxiety which substantiate Levitt's opinion follow.

In a study on anxiety and problem solving, Sarason et al. (1960) found that an individual who scored high on the anxiety scales manifested greater interference in problem solving than a peer who scored low, despite the fact that both scored the same on an intelligence test. Since the computer is used extensively in a problem solving environment, this finding illustrates the probable need for identification of strongly computer anxious individuals. The use of the computer as a problem solving tool by strongly anxious persons could be very significantly hindered.

Two other studies, one by Malmo and Amsel (1948) and another by Welch and Diethelm (1950), illustrated the negative effects of high anxiety in learning situations. Malmo and Amsel found greater "forget-fulness" in highly anxious subjects, and Welch and Diethelm found higher levels of failure in higher anxiety groups in the learning environment.

Montague (1953) found that highly anxious subjects performed better on simple learning tasks than did less anxious subjects. However, when faced with more difficult tasks, the situation was reversed.

On the difficult tasks, the lower anxiety group showed better performance than the high anxiety group.

In a very bizarre study on problem solving, Patrick (1934) found some very clear evidence of the effects of anxiety on human problem solving. Patrick's problem was for an individual to attempt to get out of a room by determining the pattern of locked doors. To raise the anxiety level, subjects were subjected to three different anxiety causing situations. One group of subjects was given continual electric shock, a second group was continuously sprayed with a high pressure water hose, and a third group was blasted with a loud horn until they got out of the room. From this study, Patrick found that human problem solving degenerates to an animal level when anxiety is markedly increased. Without anxiety causing stimuli, humans were quite proficient in solving the problem, but when exposed to very extreme anxiety causing stimuli, the human subjects became very poor at solving the problem. Their behavior greatly resembled the behavior of laboratory rats that were given the identical problem solving environment but were not exposed to the anxiety causing stimuli.

Very little of the information necessary to make meaningful use of the computer can be gathered intuitively. To begin using computer technology there must first be a considerable amount of learning about computers. Since the computer industry is changing so rapidly, and will likely continue to do so, users of computer technology must be life-long learners in order to keep current with the industry. A computerized environment is necessarily also a learning environment.

Any interference with learning could also interfere with an individual's initiating computer utilization, or could force an individual to be "left behind." Since the computer is most often used in a problem solving environment, any interference with the ability of individuals to solve problems, which might occur when computer anxiety is high, could greatly hamper the successful use of computers.

Measurement Techniques and Instruments

Introduction

This section of the chapter will deal with three topics. The first will be validation. Validation will be defined, and a generally accepted theory on the different types of validation will be described. The second topic will be a discussion of problems found with validation of anxiety measures. Included will be the opinions of several researchers on the validation of anxiety measures. Several recent studies dealing with validation of anxiety measures will be examined, and typical problems will be noted. The third section will discuss a standardized anxiety measure that will be used as a validation tool in this study. Two reviews from the Eighth Mental Measurements Yearbook will be discussed, and two studies that use this standardized measure will be included as examples of how it is used.

Validation

One of the main purposes of this study is to validate a new instrument of computer anxiety. To do this properly, the concept of validity must first be studied. A valid instrument is one that measures what it

purports to measure. In this study, in order to validate this newly
designed instrument, evidence must be gathered to support the claim
that this instrument is actually measuring computer anxiety.

A discussion of validity can be sub-divided into its different
types: criterion-oriented validity, content validity, and construct
validity. Cronbach (1970) makes the following statements about
criterion-related validity:

> Decisions are based on a person's expected future
> performance as predicted from the test score. If
> these expectations are confirmed, the test was
> useful; if what happens later is not consistent with
> the predictions, the test was worthless or harmful.
> In selection or classification, the psychologist wants
> to improve decisions. He wants to pick workers who
> turn out more work, students who learn more, parolees
> who do not commit crimes. To examine whether predic-
> tions are sound, one must make a follow-up study. The
> psychologist gives the test, makes his predictions,
> and waits to see what happens. He obtains a record
> of the outcome (foreman's rating, school grade, or
> probation officer's report, for example). This
> record, which we speak of as the criterion, he
> compares with the prediction. This is a straight-
> forward empirical check on the value of the test -
> a criterion-oriented or predictive validation
> (Cronbach, 1970, p. 122).

Cronback goes on to say:

> When one intends to emphasize that no time has elapsed
> between measures, the study is spoken of as a con-
> current validation. The designer of a new test will
> suggest its validity by comparing it concurrently with
> an established test (Cronbach, 1970, p. 122).

Thus, criterion-oriented validity can be spoken of as two different sub-
types of validity, predictive validity and concurrent validity, depend-
ing on the timing of the administration of the validation instrument.

Criterion-oriented validity is generally measured by correlating the performance on the new measure with performance criterion such as an existing standardized measure.

When a test is being used to measure an amount of change due to a treatment, a different type of validation is involved. If there is a defined universe of content or behaviors that are to be tested for, then content validity may be required. The test must sample from this entire universe, and not from outside of it, if the measure is to be content valid. Unlike criterion-oriented validity, content is not an empirical measure, but must instead be determined through a judgment by the test designer or those using the test (Cronbach, 1970).

The third type of validity is important when a new idea or concept is proposed. Construct validity is the continuing process of adding credence to a new idea or concept. "Construct validity must be investigated whenever no criterion or universe of content is accepted as entirely adequate to define the quality to be measured" (Cronbach and Meehl, 1955, p. 282).

All three of these types of validity will be addressed in this study. For example, the results of the computer anxiety measure will be correlated with other measures to obtain an evaluation of criterion related validity. The content of each item in the measure will be closely examined, and a judgment of the content validity of each item will be made by the experimenter and other experts in the field. The validation study is one small step in the on-going process of construct validation. The construct being validated is computer anxiety. This is

not a widely accepted concept, but positive correlations between the paper and pencil measure to be designed and direct observation will help to demonstrate that a group of computer related feelings and reactions to those feelings exist. These feelings and reactions will be demonstrated as being a construct that can be called computer anxiety.

Problems with anxiety measure validation studies

Many validation studies have been conducted using various anxiety measures. In surveying several of these studies, two problems were noted that can be avoided by following the proper design procedures. The first problem is the reliance on self-report type instruments (Lastovicka, 1982). Many validity studies use only paper and pencil tests that are completed by the subject. This leads to the possibility of unnecessary bias in the experiment. The subject has too much control (in terms of determining the outcome of the study) in such situations. The second problem noted was specifically in the area of predictive validity. An anxiety measure is often used as a predictor of performance. This is a misuse of an anxiety instrument, since anxiety and performance are not equivalent.

These two problems can be partially overcome by using a direct observation technique as part of the validation of an anxiety measure. The direct observation technique will remove some of the self-report bias, and it will also allow the researcher to observe anxiety symptoms as they appear.

A third problem that was noted by Lastovicka (1982) was a failure by some experimenters to determine if all three areas of validity apply to their work (i.e., content validity, criterion-oriented validity, and construct validity). The most noticeable omission related to content validity. Often validity was expressed only as a correlation coefficient. Content validity can only be established through judgment. It cannot be reported as a correlation coefficient (Cronbach, 1970). Construct validity is often not determined for measures because it is not easily demonstrated. The experimenter must make special effort to completely validate any new measure.

State-trait anxiety inventory

One instrument that was used in this study as a concurrent measure of anxiety was the State-Trait Anxiety Inventory (STAI) developed by Spielberger et al. (1970). This standardized, self-report, paper and pencil measure gave an indication of both state and trait anxiety levels. In a review in the Eighth Mental Measurements Yearbook, Dreger states that:

> The STAI is one of the best standardized of anxiety measures if not the best.... For instruments of its type it appears to be deservedly popular, in that the reliabilities are nearly as high as one would expect for intelligence scales; it demonstrates expected differences among groups of persons; and its state form generates nonrandom factor structures when used over time. The only major reservation this reviewer has to recommending the STAI for both research and applied uses is its openness to faking (Burros, 1978, p. 1095).

The only other problem that is pointed out by Dreger concerns the validity of the measure, which he believes may be in question.

The other reviewer of the same instrument in Mental Measurements Year-book does not have this reservation, however. Katkin states:

> It appears that the STAI is an excellent choice for the clinical psychologist or personality researcher looking for an easy-to-administer, easy-to-score, reliable, and valid index of either individual differences in proneness to anxiety or individual differences in transitory experience of anxiety (Burros, 1978, p. 1096).

This measure will be used as a concurrent measure of validity with the computer anxiety index.

The reliability of the STAI has been tested in several studies. In a study by Joesting (1977), 105 educational psychology students were tested with the STAI and retested after a 45-minute class. The correlation reported for the A-state measure was .66, while the correlation for the A-trait was .81. This substantiated the claims made by Spielberger that the tests were highly reliable, and that the trait measure was more stable over time than the state measure.

Another test-retest study of the STAI was reported by Nixon and Steffeck (1977). The subjects were 49 male freshman medical students. The purpose of the study was to check the long-term test-retest reliability of the STAI. The following reliability figures for each of the two parts of the STAI (state and trait) in a test-retest situation were reported:

	August to April	August to July	April to July
Trait	.539	.292	.478
State	.256	.146	.155

These findings clearly show a higher reliability for the trait of anxiety than state anxiety, which should be the case, since the stable

trait of anxiety should be more stable than the transitory state of anxiety. They also show a significantly lower test-retest reliability than was reported (for much shorter periods of time) by the developers of the instrument.

The lower reliability figures found in the Nixon and Steffeck study tend to indicate that the STAI is not as reliable over longer periods of time (4 to 11 months) as it is over shorter periods of time (45 minutes).

In a third study, Metzger (1976) tested the STAI with 71 college students enrolled in an introductory psychology course. Metzger found a very high reliability coefficient in split-half correlations for both the A-state (r from .45 to .85) and the A-trait (r from .78 to .85). Metzger also applied an anxiety causing treatment to the subjects (a classroom test) and found that there was a significant elevation of the A-state following the treatment, while there was no significant eleva-tion in the A-trait. This study lends greater weight to the claim that the STAI is a valid and reliable instrument for measuring anxiety.

Computer Anxiety

Introduction

The literature on the subject of computer anxiety consists mainly of articles dealing generally with broad unsubstantiated statements and conjectures. This type of information is of little or no value in a scientific study, so they will not be included in this literature review. There are three other sources of information on the subject of computer anxiety that will be discussed in the

following sections. Rohner (1981) reported on a study in which he developed a measure of computer anxiety. This is the only direct research on the subject that could be located. The second source of information is a less direct one. In a study by Hedl, O'Neil, and Hansen (1973), a computer was used as part of the experimental procedure, and an unexpected result occurred due to this computer utilization. This study will be discussed and the implications of the findings of this study will be detailed. The third source of information on computer anxiety is another indirect one. There are several articles and research projects that have looked into the problems of implementation of computers. The failure of many organizations to use computers, if viewed as a possible symptom of computer anxiety, has a bearing on the subject of computer anxiety. These studies will be discussed below.

The Rohner study

There is little research specifically dealing with computer anxiety. One study that does relate directly to computer anxiety was conducted at Iowa State University (Rohner, 1981). In Rohner's study, a computer anxiety (CA) index was developed and administered to a group of college teacher education students.

The measure consisted of 10 statements dealing with opinions about computers and computer utilization in the classroom. The respondents were asked to indicate their level of agreement or disagreement with these statements. The responses were recorded on a 5-point Likert scale.

Rohner determined that the new instrument was reliable with an internal consistency reliability coefficient of 0.86. The measure was also correlated with the results of several other measures, including the "Your Style of Learning and Thinking" (SOLAT), and the "Group Embedded Figures Test" (GEFT). The SOLAT is a measure of the subjects' brain hemispheric dominance. Rohner found that there was a slight relationship between the subjects' "computer anxiety" score and their score on the SOLAT, with a correlation constant of -.122 with a subject population of 166. This finding was significant at the .059 level, so the relationship between hemisphericity is in doubt, but possibly worthy of further study.

Another instrument that was related to Rohner's measure of computer anxiety was the GEFT, which is a measure of the field dependence/field independence of a subject. Rohner found that there was no significant relationship between his measure of computer anxiety and the results of the GEFT. The correlation coefficient between the two was -.100 with a subject population of 47.

Rohner also analyzed the results of the CAIN by Gender, and found no significant difference between men and women. The mean score for 47 males on the CAIN was 31.7, and the mean score for 121 females was 31.8. Males had a slightly higher standard deviation of 7.1 as compared to the 6.2 standard deviation of the females.

The relationship between college major and computer anxiety was also analyzed in Rohner's study by grouping subjects by the subject area they were preparing to teach and comparing the mean scores.

The following five groups were used and the means were found:

	College Major	Mean CAIN Score
1.	Elementary Education	31.4
2.	Home Economics	32.5
3.	Science and Humanities	32.2
4.	Education (excluding Elementary Education and Child Development)	34.2
5.	Agriculture	29.2

Note: The higher the score, the more anxious the student. Possible range = 10-50.

With the small number of subjects used in this study, Rohner found that none of these groups was found to be significantly different.

Rohner drew the following conclusions after the completion of the research:

1. The CA index is a reliable instrument.

2. The CA index has no significant relationship to gender.

3. The CA index has no significant relationship to college major.

4. The CA index has no significant relationship to field dependence.

5. The CA index might have a slight relationship to hemisphericity.

6. The CA index might be used in its current form as a measure of intent to use computers in the classroom.

7. The intent to use computers is probably a combination of computer anxiety and personal preference.

8. In the future, CA will become an even more critical problem.

9. The effort to isolate and reduce CA should continue.

Rohner's reliability results (r=0.86) were very encouraging. They indicated that this type of a measure might indeed be used to produce consistent results about the construct of computer anxiety. However, as Rohner states, "The remaining concern is question of validity. Is the CA index actually measuring computer anxiety?" (Rohner, 1981, p. 74). Rohner goes on to say that "It appears the instrument might be measuring a construct that could be called 'intent to use'" (Rohner, 1981, pp. 74-75). This "intent to use" could or could not be related to computer anxiety, as is suggested by Conclusion 7 listed previously. The validity of Rohner's instrument as a measure of the construct of computer anxiety remains an open question.

The Hedl, O'Neil, and Hansen study

In a study on intelligence testing, Hedl, O'Neil, and Hansen (1973) delivered intelligence tests and anxiety measures under several different situations. The anxiety measure that was delivered was the State-Trait Anxiety Inventory (STAI) that was previously discussed. The study was dealing with anxiety related to intelligence testing, but as part of the experimental design, the subjects took part of their intelligence tests with the aid of a computer. There were some rather unexpected findings as a result of the involvement of the computer in the experiment.

> Analysis indicated that the STAI A-state scores were higher
> in the computer testing situation in comparison to either
> of the two examiner testing conditions.... This effect
> was present regardless of the sequence in which the
> computer test was administered (Hedl, O'Neil, and Hansen,
> 1973, p. 219).

In other words, the subject's anxiety level was higher when tested using a computer as opposed to being tested by another individual.

The authors go on to make conjectures about these findings. They suggest inadequate instructions and complications with ending the computer testing situation, especially in the face of repeated failure on the test by the subject. These conjectures may or may not be valid. The important relationship of the Hedl, O'Neil, and Hansen (1973) findings to this study of computer anxiety is that for some reason the introduction of the computer into the testing situation raised the subject's anxiety level. The observation of this elevated anxiety level may be a further indication of the existence of computer anxiety.

Implementation studies

There are several studies in the literature that deal with the failure to implement computers in areas where it would seem that computers could be put to excellent use. One such study was done by EDUCOM (a non-profit consortium of over 350 colleges and universities founded in 1964 to promote the use of computing, communications, and information technology in higher education) for the National Science Foundation. This study looked into the poor implementation of computers in the field of education. Six major obstacles were found, most of which were strictly tangible factors that had little bearing on computer anxiety (e.g., production and distribution of instructional materials and cost). One area that was identified, however, did imply that computer anxiety might be involved. "Several problems underlying the need to change established patterns of

instruction and to restructure the role of the teacher were recognized"
(Anastasio, 1972).

Nickerson (1981), through informal interviews and conversations,
compiled a list of reasons why interactive computing was not being used
in a number of areas. The list included such things as functionality
(computer systems that do not meet the needs of those who were to use
them), accessibility-availability, start-stop problems, response time,
work-session interrupts, training and user aids, and documentation.
All of the reasons stated were contributing factors to computer anxiety,
but possibly even stronger factors were mentioned only as an aside by
Nickerson. These not quite so logical reasons were listed by Nickerson
as follows:

1. General resistance to change.

2. The feeling that direct interaction with a computer system
   is beneath one's position or status.

3. Fear that introduction of a computer will have a dehumanizing
   effect on a job situation.

4. Unfounded assumptions about what knowledge is required to be
   an effective user.

5. The prospects of replacement of procedures that are familiar
   and comfortable with those that are new and strange, and
   the threat of obsolescence or devaluation of hard-won skills.

This list very likely contains many reasons that individuals are
computer anxious. There are a number of explanations why computers are
being so slowly integrated into our culture, and computer anxiety would

seem to be an important one. However, this problem has been only hinted at in the literature dealing with computer implementation. Many of the reasons behind the failure of many of society's institutions to implement computer technology are difficult to understand because they are intangible. If the assumption is made that anxiety can influence computer technology implementation, then the development of a tool to predict computer anxiety in individuals is one step in the solution to the problem of computer anxiety and its effect on computer implementation.

METHODOLOGY

Introduction

This study has three parts: the modification of the already existing computer anxiety index, the validation of the computer anxiety index, and the compilation of normative data on the computer anxiety index. The procedure followed to complete each of these three steps will be discussed in further detail in the following sections.

Modification of the Computer Anxiety Index

Computer anxiety, as defined in this study, refers to the set of attitudes that would tend to indicate behaviors that could inhibit one's effective use of the computer. The assumption is made that this set of attitudes is internally consistent. That is, that all the attitudes that one might have that would inhibit effective use of computers are for the most part uniform, whether they are negative, positive, or somewhere in between. It is further assumed for the purpose of this study that this set of attitudes can be measured using a paper and pencil test. With these assumptions in mind, the following steps were taken to modify Rohner's computer anxiety index (CAIN) into an instrument that would reliably and validly measure these attitudes (Rohner, 1981).

There were two problems identified with Rohner's instrument. It contained items dealing almost entirely with a subject's intent to use computers. The concern was that the instrument was not truly measuring computer anxiety, but it was instead measuring the subject's "intent to use" computers. The second problem was that the instrument was intended

to be given only to people in the teaching profession, or those entering the teaching profession. These two limitations of the Rohner instrument were eliminated by rewording items and by adding new items.

The rewording of the items of the Rohner measure was a fairly straightforward task. Each item that was directed specifically toward teachers was simply rewritten to include all professions. In most cases, the content of the item was changed very little. For a few items, a more complete revision was necessary.

The adding of new items was a much more difficult undertaking. The Henderson, Morris, and Fitz-Gibbon model for developing an attitude measure was used to guide the process of adding items (Henderson, Morris, and Fitz-Gibbon, 1978). One of the intended audiences for this instrument (a group of undergraduate educational media students) was asked to generate statements that exemplified their feelings on computers. These statements were then shaped into suitable items for the computer anxiety measure. The type of item that was being sought by this activity was one that was directed at the feelings of subjects when computer usage was required of them. Since Rohner's instrument already adequately covered the intent to use computers, no additional items were needed in this area, and most of the items that were added to the new draft version of CAIN dealt with the situations where computer usage was required, or assumed. This forced subjects to respond with their feelings about actually using computers.

After all the new items were constructed, each item was carefully screened to insure that it dealt with some aspect of computer anxiety

as defined in the introduction to this thesis. The entire set of items was also examined to insure that the intent of these items was to test the complete range of symptoms of computer anxiety.

Upon completion of this examination of the items, they were pilot tested twice. The first pilot test was used to try out the newly generated items. Since the measure was to be pilot tested a second time, any item that did not appear to be suitable was modified and tested again. The measure was administered in the first pilot test to a group of Iowa State University teacher education students who were enrolled in an educational media methods of teaching course during the 1982 summer session. The results of this test were scored, and ranked according to those scores. The highest one-third of the scores was then compared with the lowest one-third. Those items that were found to be clear negative discriminators (poor items) were then eliminated from the test. The tests were then rescored and reranked without the poor items. This insured that any item that was extremely poor did not affect the selection of other items that might be marginal. After the poorest items were eliminated from the sample, the highest one-third was again compared to the lowest one-third. Any item that was found to be marginal, and that did not discriminate between subjects, was inspected carefully. If there was any possibility of only slightly modifying the item while maintaining its original intent, this was done, and the modified item was retained to be reevaluated in the second pilot test. If the item could not be so modified, it was eliminated from the test entirely. The second pilot test was administered to educational media college students during fall semester, 1982. After

the second pilot test, the best discriminators were retained for the final computer anxiety instrument. The selection of which items to retain or eliminate was done according to the same procedures as in the first pilot test. This methodology is according to the suggestions of Henderson et al. (1978), and it produced the test that was used in the next two sections of the study, the validation study and the establishment of norm references.

<div align="center">The Validation Study</div>

Introduction to the validation study

There were four steps followed in the validation portion of this study. The first step was to administer the computer anxiety index. Since the computer anxiety index was intended to be a measure of the trait of computer anxiety, it was hypothesized that these feelings would be relatively stable over time. The measure was also intended to be predictive of the development of the state of computer anxiety. Therefore, the measure must be administered prior to the subject's use of a computer.

The second step of the validation process was to administer the State-Trait Anxiety Inventory, which was used as a concurrent measure of computer anxiety. The timing of the administration of this measure was crucial, since it was a measure of general anxiety and not specifically computer anxiety. Therefore, this instrument was administered when computer usage was imminent, and supposedly when the subjects were actually experiencing computer anxiety.

The third step of this portion of the study was to actually observe subjects while they were using a computer. During this observation

session, a judgment was made about each individual as to their observed level of computer anxiety. The criterion on which each individual was judged was the set of behaviors defined earlier in this study as being peculiar to an individual who is computer anxious. The results of this observation were used in the predictive validation of the computer anxiety index.

The final step was to evaluate the results of the three measures statistically. From this examination, the reliability of the CAIN had to be first established before any claim could be made about validity. Once reliability of the CAIN was demonstrated, the other measures could be compared to the CAIN as indications of validity.

Administration of the computer anxiety index

The fully pilot tested computer anxiety index was administered to a class of teacher education undergraduates in an educational media methods of teaching course during the fall semester of 1982. The reason for choosing this group was that this particular course contained a unit on micro-computers. During the student's usual sequence of study, they were expected to use a computer. Since this was a group of prospective educators, and they were not specifically in the computer field, this was an ideal opportunity to observe subjects that represented individuals with a cross-section of computer experience and possibly a cross-section of attitudes toward computers, while they are actually using computers.

The computer anxiety index was administered 2 weeks before the students were to begin their unit on computers. The timing of this

administration was important, because the computer anxiety index was being developed as a measure of the trait of computer anxiety and also as a predictor of the development of the state of computer anxiety. For these reasons, the instrument was administered before the unit on computers was introduced.

The CAIN was scored by first reversing the items that were negatively worded, then the average of the responses was calculated. Any test with two or fewer missing item responses was considered an acceptable test. If more than two items were omitted, the test was eliminated from the study. A low score reflected low anxiety, and a high score reflected high computer anxiety.

Administration of the State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1970) was chosen as the instrument for the concurrent validation portion for this study from a group of several likely instruments, because it appeared to be the most widely accepted and the most commonly used measure of general anxiety. Since there was no accepted measure of computer anxiety available, the STAI was the closest instrument that could be used as a concurrent measure.

Since this instrument yielded only values for general anxiety, the timing of its administration was crucial. This instrument had to be administered when computer utilization was imminent. Students were seated in front of the micro-computer, and then they were given the STAI. Subjects who showed relatively high levels of state anxiety on this measure were considered to be showing relatively high levels

of computer anxiety. Subjects with relatively low levels of state

anxiety on the STAI were considered to be low computer anxious subjects.

Observation of computer anxiety

Following the administration of the STAI, students proceeded with

their regular lesson in which they were required to use computers. It

was during this regular classroom session that the students were

observed for overt signs of computer anxiety. Two independent observers

watched the students and judged them on the following signs of computer

anxiety:

1. Avoidance of the computer and the general area where the
   computer was located.

2. Excessive caution with the computer.

3. Negative remarks about the computer.

4. Attempts to cut the computer sessions short.

One of the observers was the experimenter, and the second was the student's

regular teacher. The rating of the experimenter was the score that was

eventually used for validation purposes. The teacher was asked to also

score the students as a check on the experimenter. These two independent

observers gave each student a score of observed computer anxiety. This

score was based on a three-point scale. Subjects were scored as either

low computer anxious, neutral, or high computer anxious. The observers

were instructed to rate students as low or high only for the most extreme

subjects. Those subjects with no rating were assumed to be in the

middle, or neutral, range of observed computer anxiety. The two scores

of the two observers were then compared for any discrepancies. These discrepancies were noted and discussed.

Although the subjects had already completed two questionnaires that gave an indication of their computer anxiety, the observers had no knowledge of any individual responses made by any student. This condition was important in order to eliminate a possible source of bias.

Data analysis procedures

The first factor that was examined in the data analysis procedure was the determination of the reliability of the CAIN. There were two sources of reliability data available. The first was a test of internal consistency. For this measure of reliability, coefficient alpha was calculated for two subsets of the students (Cronbach, 1970, p. 160).

A second source of reliability data was gathered from the group of students that were involved in the second pilot study. Four weeks after these students had been involved in the second pilot test of the CAIN, they were given the final CAIN, which contained items that these students had responded to 4 weeks previously. Since modifications of CAIN after the second pilot test were minimal, these two tests were then correlated as a test/retest measure of reliability.

After reliability was established, the validity of the CAIN was examined. The scores from the STAI were considered to be one possible measure of computer anxiety. The observation rating was considered a second measure of computer anxiety. These two measures were correlated with the CAIN in order to determine if the CAIN was actually measuring computer anxiety. The correlations were considered a measure of the

criterion referenced validity of the CAIN. The final comparison of the STAI with the observation data was made to help demonstrate the validity of the entire procedure.

One qualification must be made about the nature of these three measures of computer anxiety. Although it was hypothesized that each of these measures was a measure of computer anxiety, each of the three measures was somewhat different. The CAIN was intended to measure the trait of computer anxiety, and also to predict the state of computer anxiety. The state anxiety portion of the STAI was intended to measure the general state of anxiety and was not directly related to computers. The relationship of computers to the STAI was induced by having the students fill out the STAI while they were seated in front of a computer. The students expected to be using that computer momentarily.

When the students were being observed, the observers were looking for signs of the state of computer anxiety. Each of the three instruments was measuring computer anxiety from a slightly different perspective.

<div align="center">Normative Information</div>

Since the CAIN produces a single score for each individual taking it, it is necessary to have some normative values for comparative purposes. This would allow an individual to take the CAIN and then compare their score with several groups of individuals who had previously taken the test.

The normative groups were selected from within the state of Iowa. No attempt was made to sample random groups of subjects. Rather, the index was given to a large number of subjects who could be easily

located. The normative group subjects were categorized as follows:

1. Computer professionals.

2. Those who use computers on a daily basis, but are not computer professionals.

3. Educators.

4. Seventh grade students.

5. College students.

6. Adults that fit none of the above categories.

These six categories were selected because they represented groups that would offer interesting and possibly meaningful comparisons for any individual who might take this test in the future.

Administration of the computer anxiety index

The computer anxiety index was administered to the first three groups by mass mailings. Government agencies, businesses, and schools that employ these types of people were contacted and asked to participate in the study. The mail package included the computer anxiety index preceded by several questions dealing with demographic data. This information was used to determine which norm group the individual belonged in. A cover letter was also included with the survey to explain what the study was about and to inform the potential subject of his/her rights as a research subject. (See the Appendix for all instruments and enclosures.) This letter was purposely rather general. Subjects were not informed of the exact nature of the survey in order to reduce the likelihood that someone would give biased answers. Specifically, the word anxiety was never mentioned in the survey.

A second cover letter was included with each packet. It was addressed to the individual who was coordinating the survey at that location. This letter specified in greater detail the intent, purpose, and future use of the instrument. The letter also asked the coordinator to send back the entire packet of questionnaires if he/she did not feel comfortable asking others to fill it out. This second letter offered to inform any participating group of the final results of the research project.

Analysis of the norm data

When the completed surveys were received, the demographic portion of the questionnaire was used to categorize the subjects into the appropriate group. The remainder of the data was analyzed in order to show the distribution of CAIN scores for the different groups graphically. From these data, percentile tables were also generated. This would allow an individual to determine how their CAIN score compared to the distribution of the norm groups. The results of this analysis were reported for each of the six norm groups.

RESULTS

All procedures of the study were completed successfully as described
in the previous chapter. These steps included the modification of the
computer anxiety index (CAIN), the validity study of the CAIN, and the
collection of normative data to accompany the CAIN. The results of
each of these steps will be included and presented in this chapter.

Modification of the Computer Anxiety Index

Forty-two potential items were generated for the first pilot test.
These 42 items were administered to several classes of Iowa State
University undergraduates who were enrolled in an instructional media
course for pre-service teachers during the summer session, 1982. After
the pilot test was completed, the items and their scores were examined.
Procedures for development of an attitude test described by Henderson
et al. (1978) were followed. The pilot CAIN was scored for each student,
and those scores were ranked. Those scoring in the top one-third on
the questionnaire were compared with those scoring in the bottom one-
third. Effective discriminators were distinguished from the ineffective
discriminators on the basis of that comparison. Those items that were
answered high by the individuals who scored high on the entire test,
and low by those who scored low on the entire test, were considered to
be effective discriminators. Those items that were not scored high by
individuals who scored high on the entire test, and likewise, those
items that were not scored low by those who scored low on the entire
test, were considered to be poor discriminators. Items that were found

to be ineffective discriminators were considered for elimination or modification. As a result of this initial examination, eight items were eliminated from the test completely, and six of the items were modified and tested again in the second pilot test.

The remaining 34 items were tested using a similar group of under-graduates. This was done during the following semester. As a result of the second pilot test, eight additional items were eliminated from the CAIN. None of the remaining items was modified in any way. These 26 items constituted the final version of the computer anxiety index (CAIN) that was used in the remainder of the study. The first two pilot versions of the CAIN can be examined in the Appendix.

In the process of modifying and eliminating items, it was important to note that one particular type of item was found to be a non-discriminator. In other words, the subject's score on this type of item was random in relation to the remaining items on the test. These items were ones that attempted to measure excessive caution towards the use of computers as a significant symptom of computer anxiety. After each CAIN item was examined separately, and items were eliminated that did not appear to be positively discriminating, it was noted that all these "caution" items were eliminated. It is possible that this type of item is not appropriate for a self-report questionnaire. People are probably not aware of their own behavior of excessive caution in relation to computers or are reluctant to express this feeling of caution.

The Validation Study

The reliability of the CAIN had to first be established before any validity estimate could be made. Two forms of reliability data were collected, test/retest data and internal consistency data (Cronbach, 1970). The test/retest data were collected using the group that was involved with the second pilot test of the CAIN. The students who participated in the second pilot test of the CAIN also responded to the final version. Their scores from the items in the pilot test that were not eliminated were compared to their scores on the final version of the CAIN for a test/retest estimate of reliability. The coefficient of reliability was .90 (r=.90).

The internal consistency was calculated twice for two different groups. It was first calculated for the subjects involved in the test/ retest portion of the study. The reliability (coefficient alpha) for this group on the second administration of the CAIN was .94, using the Cronbach formula (Cronbach, 1970). A second measure of internal consistency was calculated for a randomly selected group of 25 subjects who were not involved in the pilot test. The coefficient alpha for this group was .96 (r=.96).

The data for the remainder of the validation study were collected from Iowa State University undergraduates in several sections of a class in instructional media for pre-service teachers. These data were collected as described in the previous chapter of this report.

Scores were determined for a group of 111 students for the three independent measures: the CAIN, the State-Trait Anxiety Index (STAI),

and the observational evaluation of students. Mean, standard devia-
tion, and range for the measures are given in Table 1.

Table 1. Means, standard deviation, and ranges of three computer
          anxiety measures[a]

	CAIN	STAI	Observation
N	111	111	111
Mean score	2.70	37.7	2.03
Standard deviation	.709	9.61	.475
Possible range	1-6	20-80	1-3
Actual range	1.00-5.04	21-71	1-3

[a]Higher scores for all measures indicate greater anxiety.

The correlations between the three measures of computer anxiety
appear in Table 2. With each correlation constant, a significance level
is listed. All of the possible correlations were statistically
significant (p < .05).

Table 2. Correlation constants

	CAIN	STAI	Observation
CAIN	1.00	.32	.36
Significance level		<.01	<.01
STAI		1.00	.19
Significance level			.05
Observation			1.00
Significance level			

One significant event worth noting occurred during the process of
observing the student for computer anxious behavior. Following the

observation of two subjects, the two observers (this researcher and the classroom teacher) made the exact opposite judgment of a student's computer anxiety. In both cases, when the discrepancy was discussed, each observer viewed very definite behaviors that were used in making the judgment, but the two observers attended to different sets of behaviors. The two students involved both showed very "mixed emotions" behaviorally. One example of this behavior was a student who made numerous negative verbal remarks about the computer, while at the same time using the computer quickly and without hesitation in a fashion that could be interpreted as eagerness. One of the observers noted the negative verbal behavior, and the other noted the eager use of the computer.

This situation pointed out the problem of using a single rating for those few subjects who might exhibit varied behaviors toward computer utilization. It was hypothesized that individuals using computers would show uniform behavior toward the utilization of computers, but in a small number of instances, this was not found to be the case. These individuals may need to be dealt with separately, or the rating system may need to be improved to take their mixed behaviors into account.

The Collection of Normative Data

Normative information was collected for the CAIN as described in the third chapter. Five groups (computer users, computer professionals, junior high school students, public school teachers, and individuals not belonging to any of the previous five groups) were surveyed, and

the data collected were analyzed. Also analyzed were the data from the subjects involved with the validation study (college students). Thus, norm data are reported below for six groups. The number of individuals responding to the survey in each of the six groups is reported in Table 3, along with the means, standard deviations, and ranges of the final CAIN scores.

The means and ranges of the scores illustrate that the scores are not distributed normally. This skewed distribution is more obvious when depicted graphically. The data were first grouped into .2 intervals; next each score was mathematically rounded to the nearest .2. These grouped data were used to generate Figures 1 through 7.

These grouped data were also used to generate a percentile table. This table can be used to compare scores on subsequent testings using the CAIN. This information is shown in Table 4.

It should be repeated that the normative data were not intended to be representative of a scientifically selected or statistically valid representation of each group. The intent in gathering these data was to compile a large number of CAIN scores from individuals in each group so that comparisons could be made.

Summary

The CAIN was found to have reliability estimates of .90 for the test/retest measure of reliability and .94 and .96 for the internal consistency measures of reliability. The measures of criterion referenced validity, the correlations between the CAIN, the STAI, and the direct observation of students were shown to be significant

Table 3. Means, standard deviations, and ranges of <u>CAIN</u> scores by norm groups

	College student	Junior high	Teacher	Professional	User	Other	All subjects
N	111	247	42	67	122	25	614
Mean score	2.70[a]	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

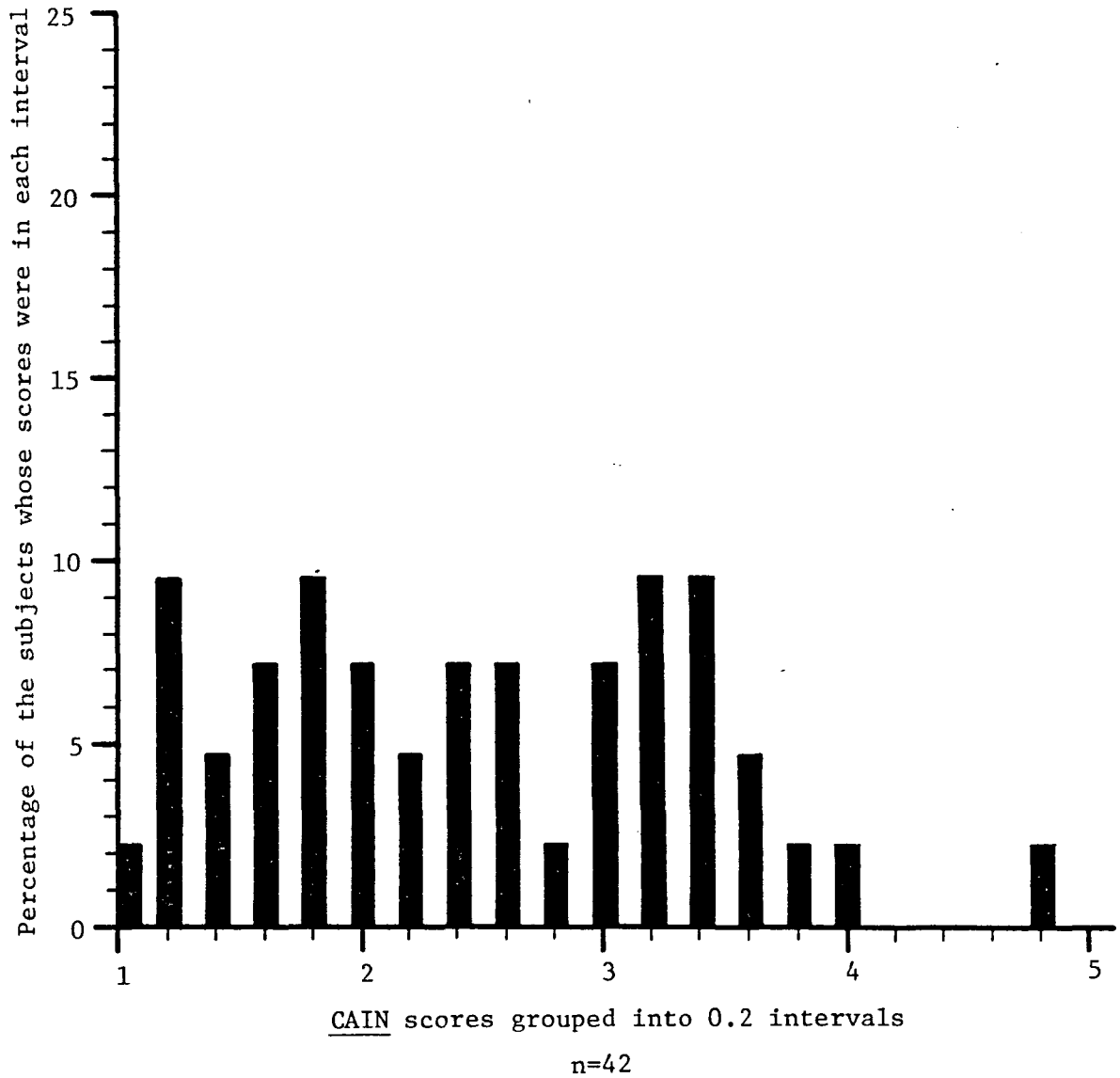[a]The higher the score, the more computer anxious the individual.
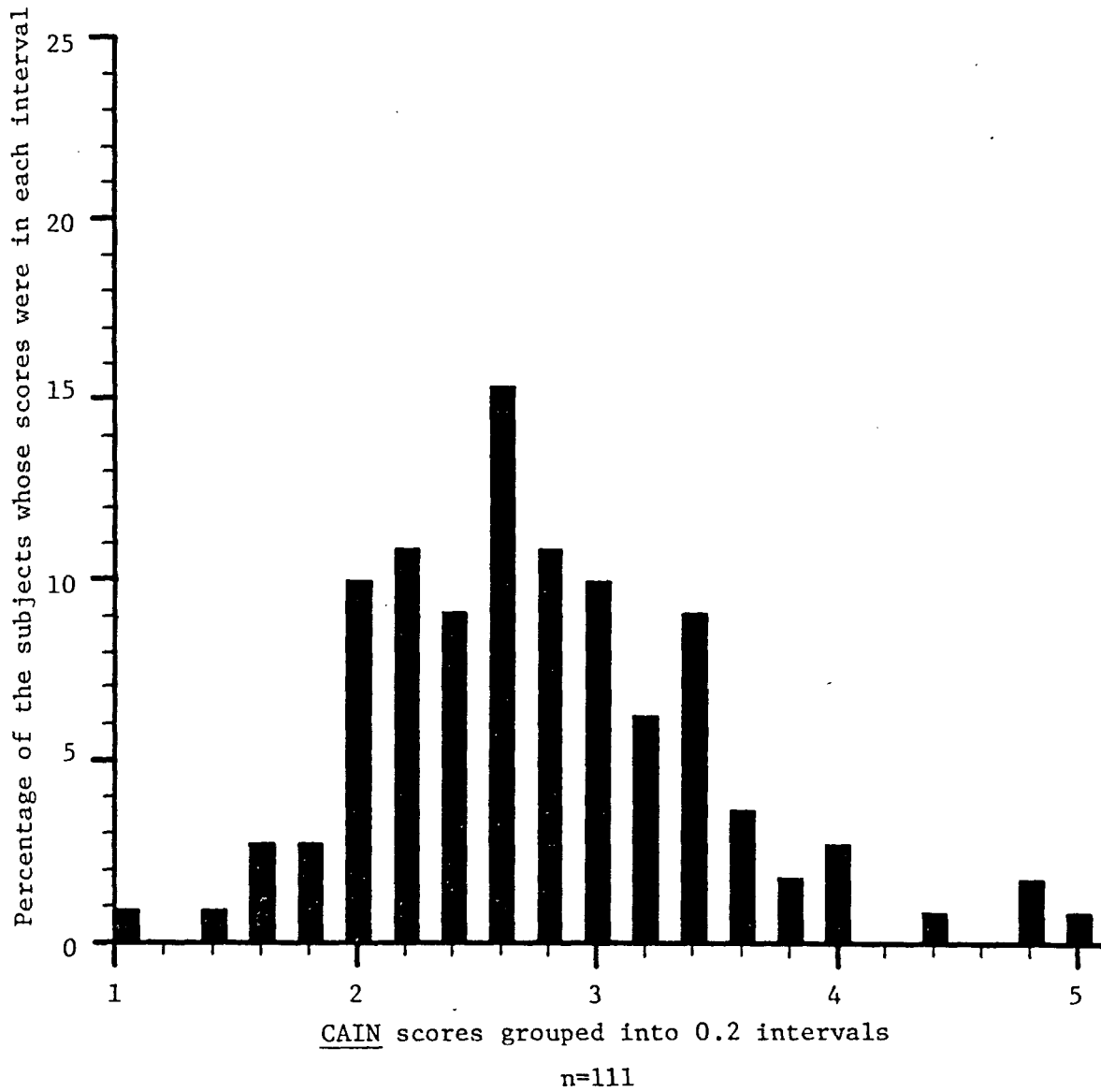
The grouped CAIN scores are reported as a percentage of the total group to show distribution of scores and to allow comparison between groups.

Figure 1. CAIN scores of college students
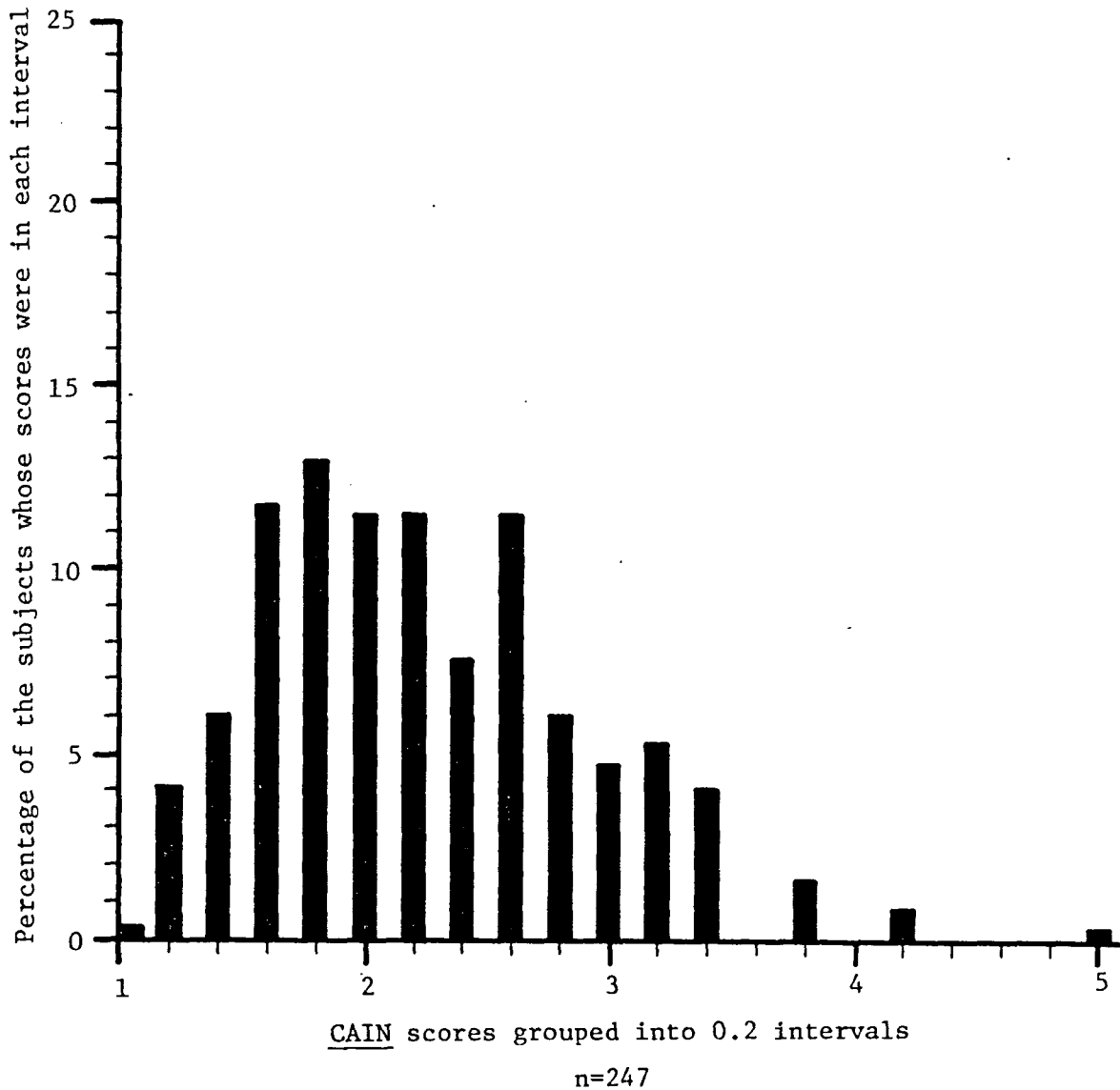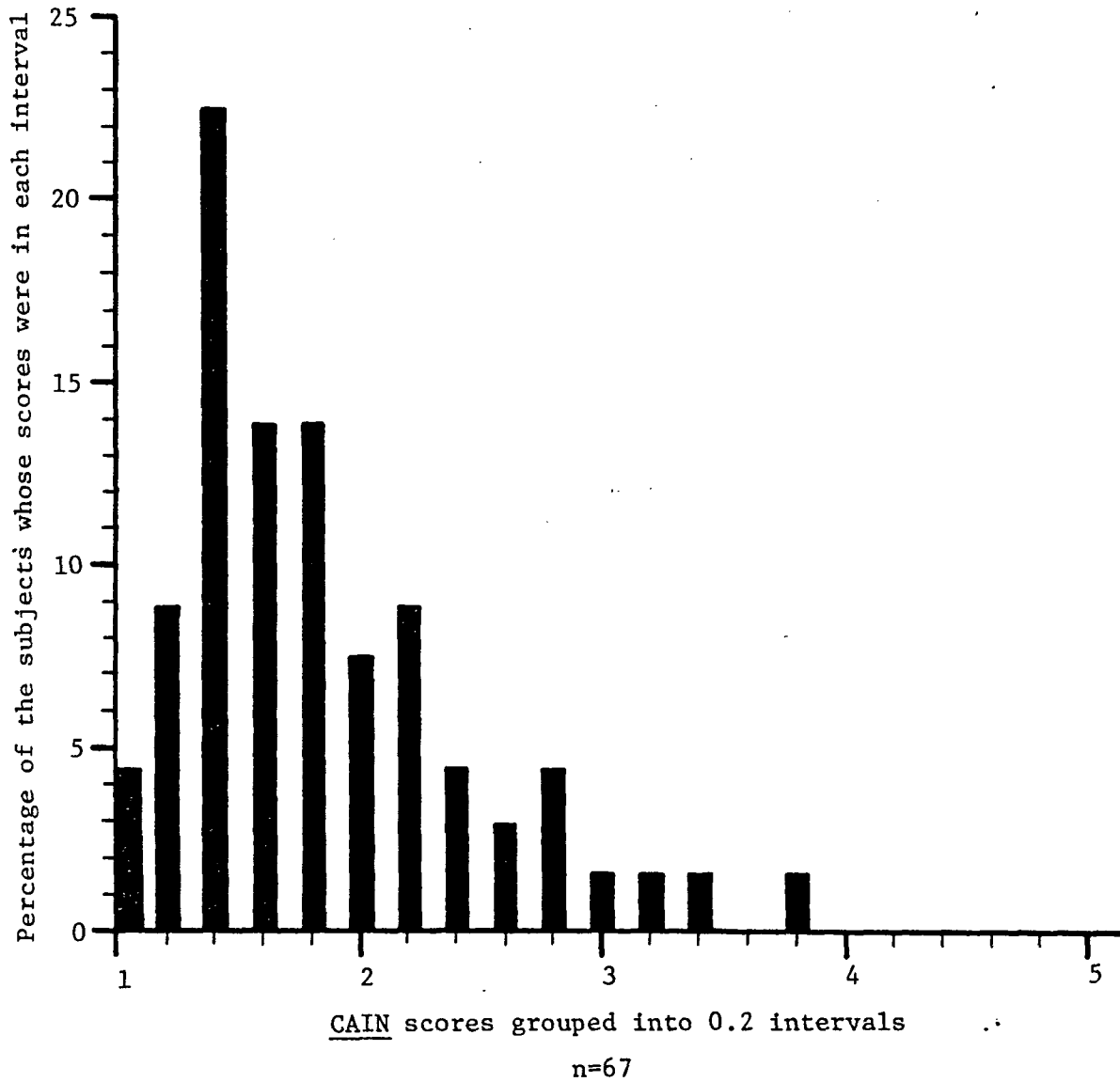
The grouped CAIN scores are reported as a percentage of the total group to show distribution of scores and to allow comparison between groups.

Figure 2. CAIN scores of junior high school students

The grouped CAIN scores are reported as a percentage of the total group to show distribution of scores and to allow comparison between groups.

Figure 3. CAIN scores of teachers

CAIN scores grouped into 0.2 intervals
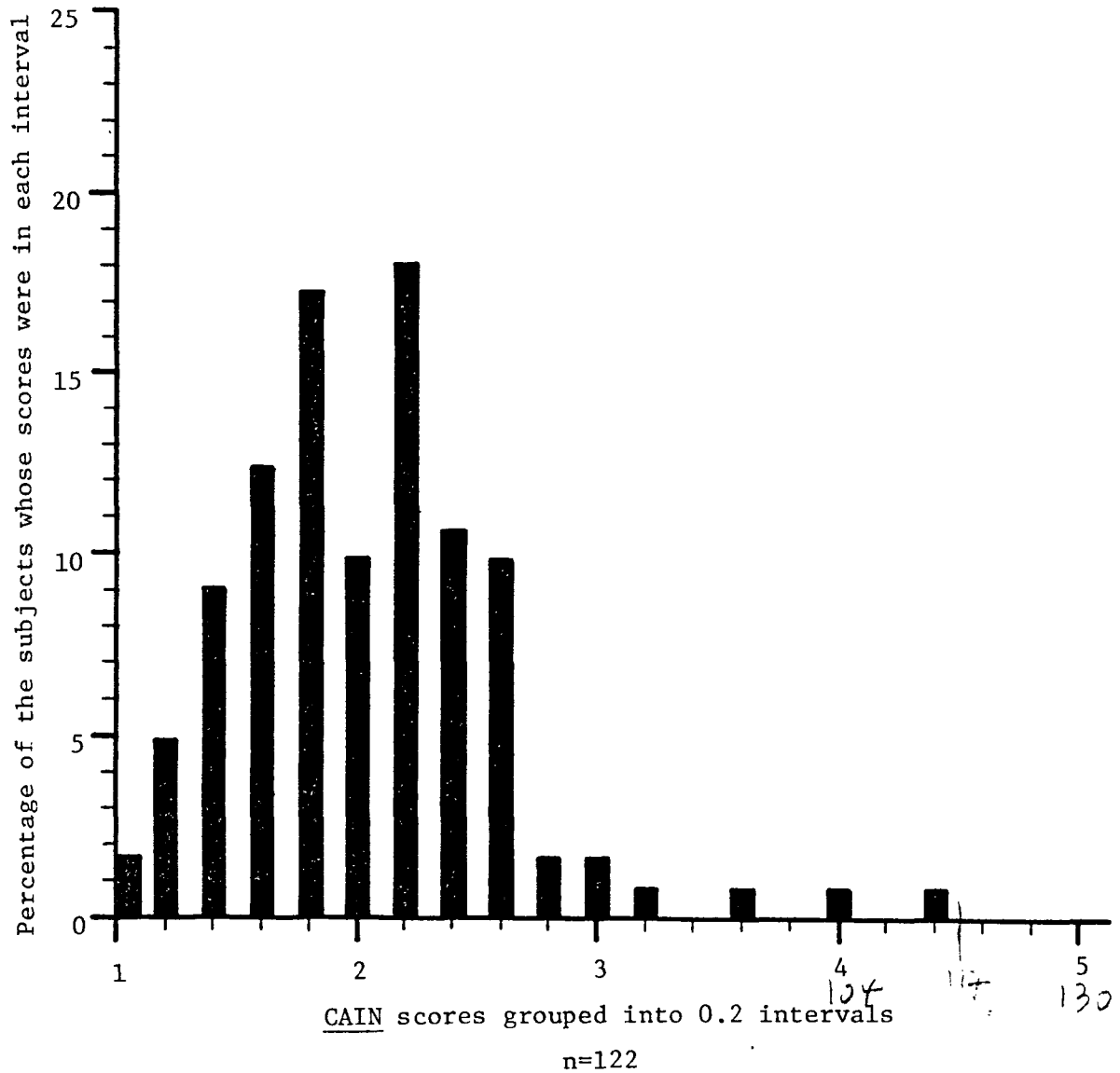
n=67

The grouped CAIN scores are reported as a percentage of the total group to show distribution of scores and to allow comparison between groups.

Figure 4. CAIN scores of data processing professionals

The grouped CAIN scores are reported as a percentage of the total group to show distribution of scores and to allow comparison between groups.

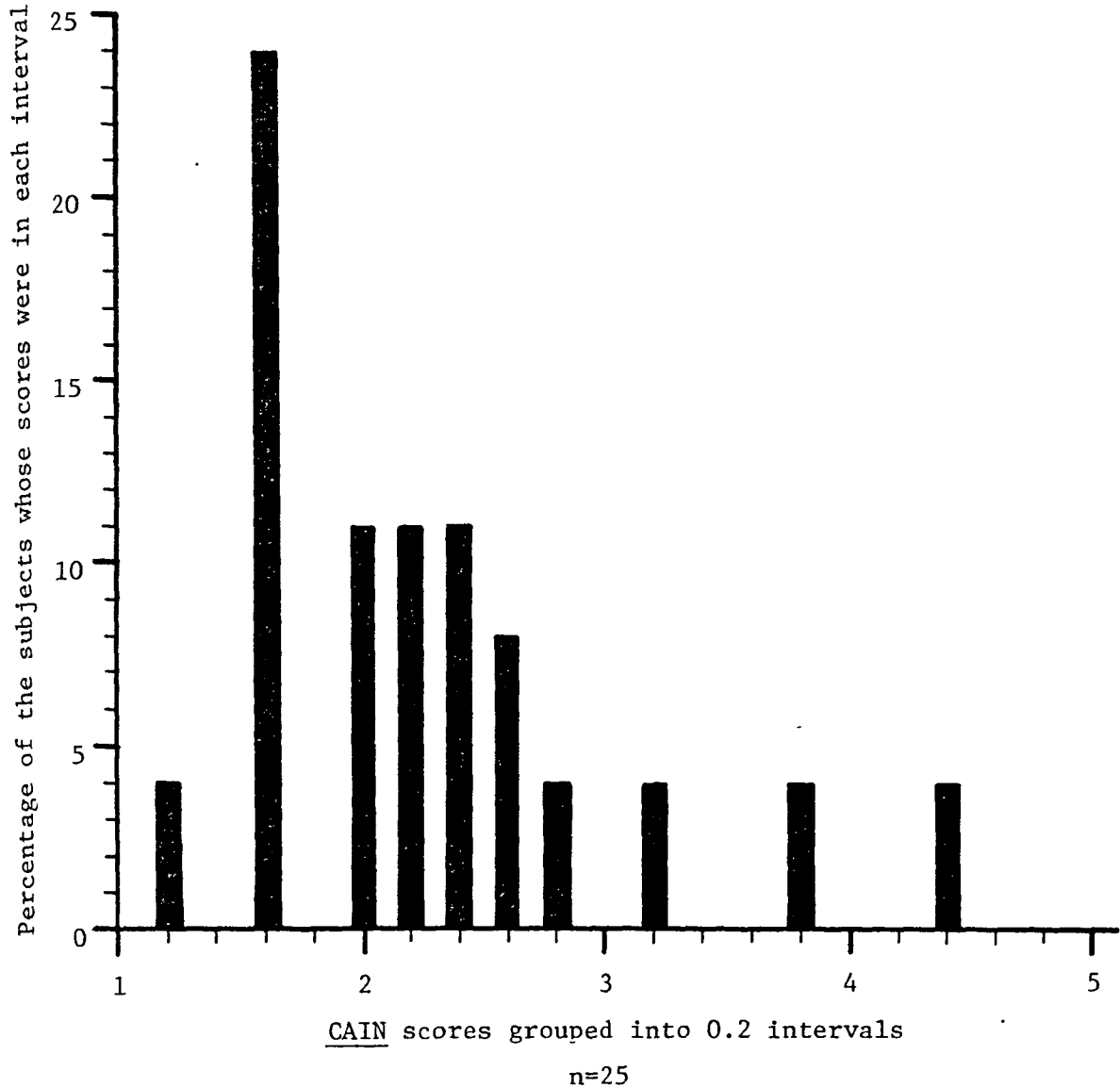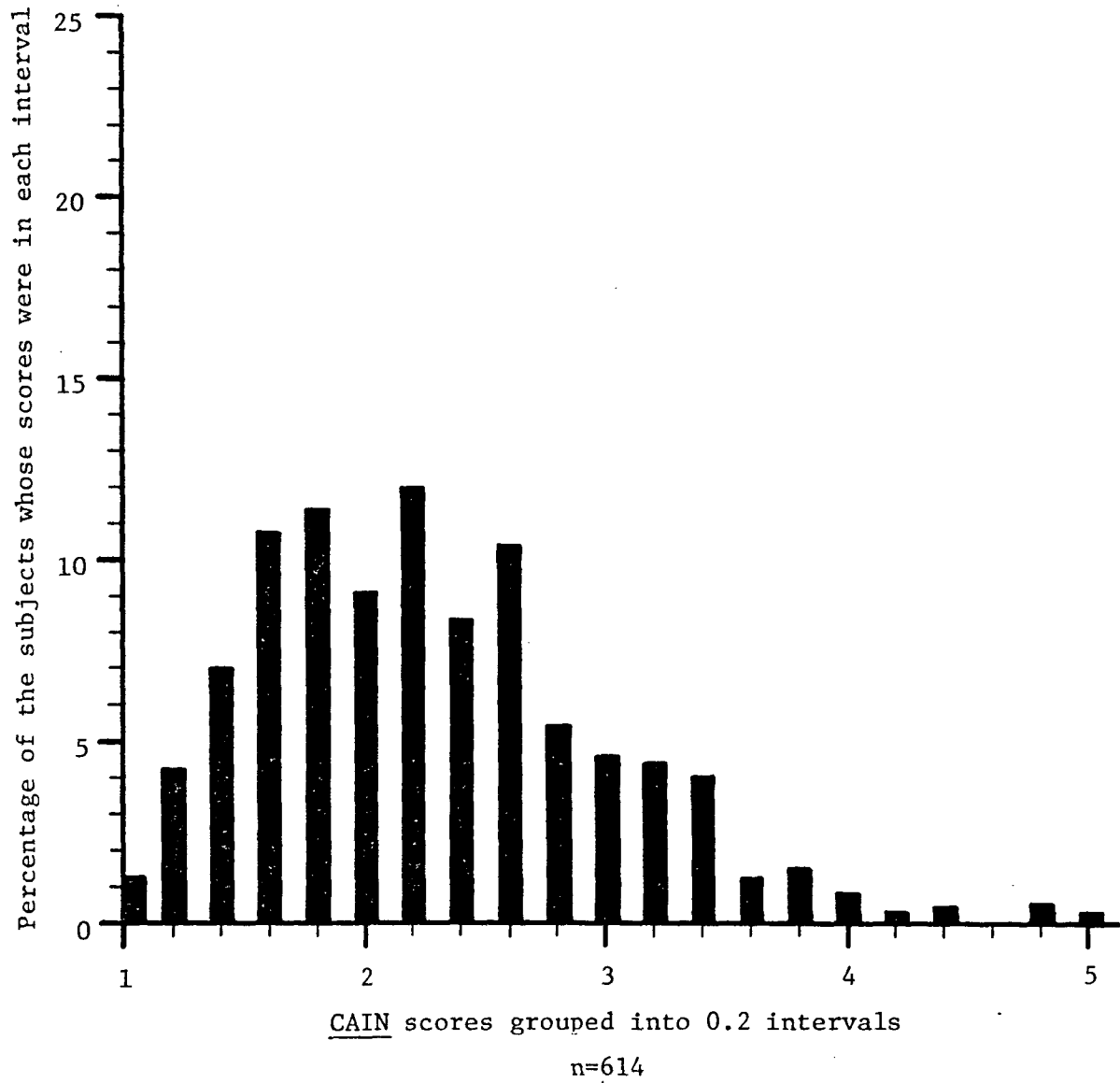Figure 5. CAIN scores of users of data processing services

The grouped CAIN scores are reported as a percentage of the total group
to show distribution of scores and to allow comparison between groups.

Figure 6. CAIN scores of individuals not belonging to any previous group

CAIN scores grouped into 0.2 intervals

n=614

The grouped CAIN scores are reported as a percentage of the total group to show distribution of scores and to allow comparison between groups.

Figure 7. CAIN scores of all groups

Table 4. Percentile table for <u>CAIN</u> raw scores by norm group

	College student	Junior high	Teacher	Professional	User	Other	All subjects
1.0	0	1	2	4	2	–	1
1.2	–	4	8	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

beyond the .01 level. The normative data were compiled and represented both graphically and in table form.

DISCUSSION OF RESULTS

This study was a continuation of computer anxiety work done by Daniel Rohner (1981), and it consisted of the following three parts:

1) Modification of the computer anxiety instrument developed by Rohner.

2. Validation of that instrument.

3. Collection of norm reference data for the instrument.

In the first part of the study, an attempt was made to solve the problems that Rohner identified with his instrument. First, items that made up the computer anxiety index were modified to apply to a broader variety of individuals. Next, the instrument was validated by comparing the results of two other measures of anxiety with the results of the computer anxiety index (CAIN). Finally, the CAIN was administered to a large number of individuals to develop norm data tables.

Development of the CAIN

The steps involved in developing and modifying the CAIN were very successful. The revision process produced a measure that had a test/retest reliability coefficient of 0.90 (r=0.90). There was a 4-week period between testings. The internal consistency reliability estimate was even higher (r=.94).

The Validation Study

As mentioned above, the CAIN was demonstrated to be very reliable. Additionally, it was validated very comprehensively. The CAIN was correlated with two other measures of computer related anxiety.

The first was a general anxiety measure (STAI) administered as students sat before a computer. The second was an observer's rating of computer anxiety while students used a micro-computer. The results of the correlations with the CAIN were 0.32 (r=0.32) for the general anxiety measure and 0.36 (r=0.36) for the observed measure of computer anxiety.

Although these correlations are highly significant (significant beyond the .01 level), their values were not high enough to indicate that each of the measures were identical and measuring identically. There was variation between these measures. This can be partially explained by the fact that they were not designed to measure identical characteristics. The STAI is a general anxiety measure, while the CAIN is specifically a measure of computer anxiety. The observation measure was a measure of the state of anxiety (anxiety while it is actually being experienced) and the CAIN is a measure of trait anxiety (the personality characteristic that would cause an individual to become anxious when dealing with computers). While these variables are related, they are not identical.

The correlations could be further explained by the fact that the CAIN is a self-report instrument. An individual must have an awareness of a personality characteristic to be able to report it on this type of test. Many of the subjects may have a consistent bias or lack of personal awareness that is reflected in their CAIN score, but which would be discovered in the observation of that individual's use of the computer.

The magnitude of the correlations indicates that the process of measuring computer anxiety could benefit from further examination. The correlations were highly significant, indicating a strong relationship between the three tests, but they were not high enough to indicate that the three instruments were measuring the same phenomenon. It is the conjecture of this researcher that through further research, a short battery of tests could be developed to yield a more detailed computer anxiety profile. This battery would not simply rely on self-report data, but would also contain an actual observation of the subject.

The measurement of computer anxiety could possibly also be made more useful if the different symptoms of computer anxiety were observed and scored separately, rather than observing the subject's general behaviors, and giving them a single score.

Collection of Normative Data

The main purpose of the collection of the norm data was to produce tables with which subsequent CAIN scores could be compared. These data were not collected randomly, so conclusions must be tentative. However, some interesting conjectures can be made from these data.

One important observation was that each group tested had a small percentage of scores on the highly anxious end of the scoring range that were separated from the rest of the scores. These scores could be said to be indicative of individuals who were "critically" computer anxious.

A second observation that can be made about the data was that there did not appear to be the expected difference between the scores of the junior high school students and the other groups. Much conjecture has

been made in the popular press about the ability of the young to better
integrate themselves into our computerized society. One might expect
the junior high school group to be the least computer anxious group
tested; yet, they in fact scored very close to the mean of all the
subjects, and the group with the highest average level of computer
anxiety was the group of college students. This could indicate that
there is not the strong relationship between computer anxiety and age
that had been accepted in the past.

A third noticeable feature of the normative data is the skew to
the high end of the scale. This skew is typical of attitude measures
(Spielberger et al., 1970). Individuals seem to have an aversion to
reporting strong feelings that are considered to be socially "negative."

Possible Uses of the Computer Anxiety Index

The computer anxiety index has two primary potential uses. The
first would be for diagnostic purposes. The second would be for
screening or selection purposes.

As suggested by the normative data, there seems to be a small
but significant number of individuals in our society who have a great
deal of computer anxiety. These individuals will most probably be
hampered in their daily life by this anxiety, as computers become more
and more integrated into daily activities. The CAIN can be used as a
tool to help identify these individuals so that they can be helped.
Programs could be developed for those who show high levels of computer
anxiety, and the CAIN could be used to choose those in need of this
remediation.

The second use of the computer anxiety index would be as a tool to help identify those who might be suited for a profession involving computers, and conversely, to identify those who would probably not be suited for such a job. Schools could use the <u>CAIN</u> in their career counseling programs, and employers could use it in helping individuals with career planning. Certainly, the <u>CAIN</u> should not be used alone as a basis for these decisions, but it could be used in conjunction with other tests in order to give an individual a better idea of their computer related potential.

Summary of Conclusions

1. The <u>CAIN</u> is a highly reliable measure.

2. The <u>CAIN</u> is a valid measure of computer anxiety.

3. Further research is needed to better understand computer anxiety.

4. Measurement of computer anxiety could be made more exact through further research.

5. As it now exists, the <u>CAIN</u> can be a useful psychological testing tool.

BIBLIOGRAPHY

Alexander, W. J. Microcomputers: Impact on Society and Education.
    Business Education Forum, May 1981, 35, 19-21.

Alpert, R., & Ralph, N. H. Anxiety in Academic Achievement Situations.
    Journal of Abnormal Social Psychology, 1960, 61(2), 207-215.

Alty, J. L., & Coombs, M. J. Face-to-Face Guidance of University
    Computer Users - I. A Study of Advisory Services. Internation
    Journal of Man-Machine Studies, May 1980, 12(4), 389-405. (a)

Alty, J. L., & Coombs, M. J. Face-to-Face Guidance of University
    Computer Users - II. Characterizing Advisory Interactions.
    Internation Journal of Man-Machine Studies, May 1980, 12(4),
    407-429. (b)

Anastasio, E. J. The Study of Factors Inhibiting the Use of Computers
    in Instruction. EDUCOM, 1972, 17(1), 2-10.

Berthold, F. Anxious Longing. Constructive Aspects of Anxiety.
    New York: Abingdon Press, 1963.

Branch, H. C. H. Aspects of Anxiety. Philadelphia: J. B. Lippincott
    Company, 1968.

Burros, O. K. (Ed). Tests in Print. Highland Park, N.J.: Gryphon
    Press, 1974.

Burros, O. K. (Ed). The Mental Measurements Yearbook. Highland Park,
    N.J.: Gryphon Press, 1978.

Burrows, G. D., & Davies, B. Handbook of Studies on Anxiety. Amsterdam:
    Elsevier/North-Holland Biomedical Press, 1980.

Cattell, R. B. Personality and Mood. San Francisco: Jossey-Bass
    Publishers, 1973.

Chu, Hung M. Attitudes toward Technology Change among Vietnamese
    Employees. Psychological Reports, June 1979, 44, 739-742.

Connell, J. J. The Automated Office, the Challenge. Datamation,
    1978, 24, 162-164.

Cronbach, L. J. Essentials of Psychological Testing. Third Edition.
    New York: Harper and Row, 1970.

Cronbach, L. J., & Meehl, P. E. Construct Validity in Psychological
    Tests. Psychological Bulletin, July 1955, 52(4), 281-301.

Davies, P. The American Heritage Dictionary of the English Language. New York: Dell Publishing Company, 1970.

Dorn, P. H. The Automated Office, the Road to Disaster. Datamation, 1978, 24, 154-162.

Firnberg, D. Trends in Computer Systems and Peripherals. Frontiers of Technology. London: Engineer's Digest Ltd., 1979.

Hanfmann, E. Psychological Approaches to the Study of Anxiety. Anxiety. New York: Grune & Stratton, 1950.

Hardin Branch, C. H. Aspects of Anxiety. Philadelphia: J. B. Lippincott Company, 1968.

Hedl, J. J., O'Neil, H. F., & Hansen, D. N. Affective Reactions toward Computer-Based Intelligence Testing. Journal of Consulting and Clinical Psychology, 1973, 40(2), 217-222.

Henderson, M. E., Morris, L., & Fitz-Gibbon, C. How to Measure Attitudes. Beverly Hills, CA: Sage Publications, 1978.

Hiltner, S., & Menninger, K. Constructive Aspects of Anxiety. New York: Abingdon Press, 1963.

Hoch, P. H., & Zubin, J. Anxiety. New York: Grune & Stratton, 1950.

Joesting, J. Test-Retest Correlations for the State-Trait Anxiety Inventory. Psychological Reports, 1977, 40, 671-672.

Johnson, M. F. Computer Literacy: What is It? Business Education Forum, December 1980, 35(3), 18-22.

Jones, E. The Life and Work of Sigmund Freud. New York: Basic Books, Inc., 1961.

Kitch, D. Computer Literacy: The Fourth Basic Skill. Business Education Forum, November 1980, 35(2), 22-23.

Klein, D. F., & Rabkin, J. G. Anxiety: New Research and Changing Concepts. New York: Raven Press, 1981.

Kolstoe, R. H. Introduction to Statistics for the Behavioral Sciences. Homewood, Ill.: The Dorsey Press, 1969.

Krause, M. S. The Measurement of Transitory Anxiety. Psychological Review, 1961, 68(3), 178-189.

Lastovicka, J. L. On the Validation of Lifestyle Traits: A Review
    and Illustration. <u>Journal of Marketing Research</u>, February 1982,
    19, 126-138.

Laver, M. <u>Computers and Social Change</u>. Cambridge: Cambridge Uni-
    versity Press, 1980.

Leherissey, B. L., O'Neil, H. F., Heinrich, D. L., & Hansen, D. N.
    Effect of Anxiety, Response Mode, Subject Matter Familiarity,
    and Program Length on Achievement in Computer-Assisted Learning.
    <u>Journal of Educational Psychology</u>, 1973, 64(3), 310-324.

Lemon, N. <u>Attitudes and Their Measurement</u>. New York: Halsted Press,
    1973.

Levitt, E. E. <u>The Psychology of Anxiety</u>. Second Edition. Lawrence
    Relbaum Associates: Hillsdale, New Jersey, 1967.

Levitt, E. E. <u>The Psychology of Anxiety</u>. New York: The Bobbs-
    Merrill Company, Inc., 1980.

Mallow, J. V. <u>Science Anxiety</u>. New York: Van Nostrand Reinhold
    Company, 1981.

Malmo, R. B., & Amsel, A. The Effects of Anxiety on Memory. <u>Journal
    of Experimental Psychology</u>, 1948, 38, 440-444.

Mandler, G., & Sarason, S. B. A Study of Anxiety and Learning.
    <u>Journal of Abnormal Social Psychology</u>, 1952, 47, 166-173.

Martin, B. The Assessment of Anxiety by Physiological Behavioral
    Measures. <u>Psychological Bulletin</u>, 1961, 58(3), 234-255.

Matthews, W. M. <u>Monster or Messiah, the Computer's Impact on Society</u>.
    Jackson: University Press of Mississippi, 1980.

May, R. <u>The Meaning of Anxiety</u>. New York: W. W. Norton and Company,
    Inc., 1977.

Mellstrom, M., Cicala, G. A., & Zuckerman, M. General Versus Specific
    Trait Anxiety Measures in the Prediction of Fear of Snakes,
    Heights, and Darkness. <u>Journal of Consulting and Clinical
    Psychology</u>, 1976, 44(1), 83-91.

Metzger, R. L. A Reliability and Validity Study of the State-Trait
    Anxiety Inventory. <u>Journal of Clinical Psychology</u>, 1976, 32(2).

Montague, E. K. The Role of Anxiety in Serial Rote Learning. <u>Journal
    of Experimental Psychology</u>, 1953, 45, 91-98.

Nickerson, R. S.   Why Interactive Computing Systems are not Used by
     People who Might Benefit from Them.   Internation Journal of Man-
     Machine Studies, November 1981, 15(4), 469–483.

Nixon, G. F., & Steffneck, J. C.   Reliability of the State-Trait Anxiety
     Inventory.   Psychological Reports, 1977, 40, 357–358.

O'Neil, H. F.   Effects of Stress on State Anxiety and Performance in
     Computer-Assisted Learning.   Journal of Educational Psychology,
     1972, 63(1), 473–481.

Patrick, J. R.   Studies in Rational Behavior and Emotional Excitement.
     II.   The Effect of Emotional Excitement on Rational Behavior in
     Human Subjects.   Journal of Comparative Psychology, 1934, 18,
     153–195.

Pazer, H. L., & Swanson, L. A.   Modern Methods for Statistical Analysis.
     Toronto: Intext Educational Publishers, 1972.

Plake, B. S., Smith, E. P., & Damsteegt, D. C.   A Validity Investigation
     of the Achievement Anxiety Test.   Educational and Psychological
     Measurement, 1981, 41, 1215–1222.

Rivizzigno, V. L.   Overcoming the Fear of Using the Computer and Basic
     Statistical Methods.   Journal of Geography, December 1980, 79(7),
     263–268.

Rohner, D. J.   Development and Validation of an Index of Computer
     Anxiety among Prospective Teachers.   Unpublished Master's Thesis.
     Iowa State University, 1981.

Sainesbury, P.   Gestural Movement During Psychiatric Interview.
     Psychosomatic Medicine, 1955, 17, 458–469.

Sanders, D. H.   Computers in Society.   New York: McGraw-Hill Book
     Company, 1981.

Sarason, S. B., Davidson, K. S., Lighthall, F. F., Waite, R. R., &
     Ruebush, B. K.   Anxiety in Elementary School Children.   New
     York: Wiley, 1960.

Schriesheim, C. A., & Hill, K. D.   Controlling Acquiescence Response
     Bias by Item Reversals: The Effect on Questionnaire Validity.
     Educational and Psychological Measurement, 1981, 41, 1101–1114.

Sippl, C. J., & Robert, B.   Computers at Large.   New York: The Bobbs-
     Merrill Company, Inc., 1976.

Spielberger, C. D.   Anxiety Current Trends in Theory and Research.
     Volume I.   New York: Academic Press, 1972.   (a)

Spielberger, C. D. Anxiety Current Trends in Theory and Research. Volume II. New York: Academic Press, 1972. (b)

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. STAI Manual. Palo Alto: Consulting Psychologists Press, Inc., 1970.

Stein, M. R., Vidich, A. J., & White, D. M. Identity and Anxiety. Glencoe, Ill.: The Free Press, 1960.

Strachey, J., Freud, A., Strachey, A., & Tyson, A. The Standard Edition of the Complete Psychological Works of Sigmund Freud. London: The Hogarth Press, 1971.

Strauss, H., Hadar, M., Shavit, H., & Itskowitz, R. Relationship between Creativity, Repression, and Anxiety in First Graders. Perceptual and Motor Skills, August 1981, 53(1), 275-282.

Summers, G. F. Attitude Measurement. Chicago: Rand McNally and Company, 1970.

Taylor, A. L., III. Dealing with Terminal Phobia. Time Magazine, July 1982, 120(3), 82.

Thurstone, L. L. Attitudes can be Measured. American Journal of Sociology, January 1929, 33, 529-554.

Thurstone, L. L., & Chave, E. J. The Measurement of Attitude. Chicago: University of Chicago Press, 1929.

Tobias, T., & Abramson, T. Interaction among Anxiety, Stress Response Mode, and Familiarity of Subject Matter on Achievement from Programmed Instruction. Journal of Educational Psychology, 1971, 62(4), 357-364.

Tonkins, S. S., & Izard, C. E. Affect, Cognition and Personality. New York: Springer Publishing Company, 1965.

Welch, L., & Diethelm, O. Anxiety in the Learning Environment. Archives of Neurology and Psychiatry, 1950, 63, 87-95.

Williams, E. H., & Hoag, E. B. Our Fear Complexes. Indianapolis: The Bobbs-Merrill Company, 1923.

Xiaotong, F. Glimpses of America. Datamation, 1978, 24, 234-237.

Yerkes, R. M., & Dodson, J. D. The Relation of Strength of Stimulus to Rapid Habit-Formation. Journal of Comparative Neurology and Psychology, 18, 1908, 459-482.

ACKNOWLEDGMENTS

Many people gave me a lot of help and support in completing this project. First on the list is Dr. Michael Simonson. Thank you, Mike, for your guidance, support, but most of all, your hard work.

I also want to thank my family members, who each offered me their unique brand of emotional support. Thank you Pete, Marc, Max, Mary, Mitch, Fred, and June.

Most of all, I wish to thank my wife Carol Bowman. Your support was invaluable to me even though it went mostly unnoticed and un-acknowledged. One of the true tragedies in life and love is when the important things get overlooked in pursuit of the minor details. I have learned much from this project.

APPENDIX A.

FIRST PILOT TEST INSTRUMENT
(COMPUTER ANXIETY INDEX)

EXPLANATION OF THE COMPUTER ATTITUDE SURVEY

The use of computers in our society has been growing rapidly in the past few years, and as a result, many more people are now involved with computers than were in the past. Because of this change, the attitude of people toward computers is much more important now than it has been. This is a study authored by a graduate student at Iowa State University to determine computer attitudes. You are being asked to participate, but you are in no way required to participate. This type of work is important to the future development of teaching/training programs involving computers. As a participant, you will be aiding in producing more effective educational programs.

Please fill out the following questionnaire. The results of this survey will be statistically analyzed. No individual in the study will be identified, and your responses will be reported only in statistical terms (i.e., averages, ranges, and standard deviations). Please remove this page and only return the survey itself. Thank you for your help with this project.

COMPUTER ATTITUDE SURVEY

Instructions: Please indicate how you feel about the following state-
                ments.   Use the following scale to indicate your feelings.

<div align="center">

1 = Strongly agree
2 = Agree
3 = Slightly agree
4 = Slightly disagree
5 = Disagree
6 = Strongly disagree

</div>

1. Having a computer available to me would
   improve my productivity.   1 2 3 4 5 6

2. If I had to use a computer for some reason,
   it would probably save me some time and work.   1 2 3 4 5 6

3. Having a computer available to me would
   improve my general satisfaction.   1 2 3 4 5 6

4. If I were required to use a computer, I
   would feel very anxious.   1 2 3 4 5 6

5. The things I do would not be suitable for
   using a computer.   1 2 3 4 5 6

6. Given the choice between doing my work with
   the aid of a computer or without it, I would   1 2 3 4 5 6
   probably choose to do my work without a
   computer.

7. Having a computer available to me could make
   things easier for me.   1 2 3 4 5 6

8. Having a computer available to me could make
   things more fun for me.   1 2 3 4 5 6

9. I feel very negative about computers in
   general.   1 2 3 4 5 6

10. If I had a computer at my disposal, I would
    try to get rid of it.   1 2 3 4 5 6

11. I look forward to a time when computers are
    more widely used.   1 2 3 4 5 6

12. I doubt if I would ever use computers very much.   1 2 3 4 5 6

13. If I had to use a computer, I would be extremely careful, and would take plenty of time to make sure that I did not make a mistake.   1 2 3 4 5 6

14. I avoid using computers whenever I can.   1 2 3 4 5 6

15. I am very uncomfortable when I have to use computers.   1 2 3 4 5 6

16. I enjoy using computers.   1 2 3 4 5 6

17. I get very nervous just thinking about computers.   1 2 3 4 5 6

18. If I were forced to use a computer, I would probably mess something up.   1 2 3 4 5 6

19. I feel that there are too many computers around now.   1 2 3 4 5 6

20. I go out of my way to learn more about computers.   1 2 3 4 5 6

21. Having to use a computer would make my life less enjoyable.   1 2 3 4 5 6

22. I could never learn to use a computer.   1 2 3 4 5 6

23. If I had to use a computer, I would probably feel confused.   1 2 3 4 5 6

24. Computers can be used for our benefit.   1 2 3 4 5 6

25. Computers are probably going to be an important part of my life.   1 2 3 4 5 6

26. If I were forced to use a computer, I would find it very scary.   1 2 3 4 5 6

27. Computers are too complicated to be of any use to me.   1 2 3 4 5 6

28. Computers are modern and advanced.   1 2 3 4 5 6

29. If I used a computer, I could get a better picture of the facts and figures.   1 2 3 4 5 6

30. A computer could make learning fun.   1 2 3 4 5 6

31. If I were to use a computer, I could get   1 2 3 4 5 6
     a lot of satisfaction from it.

32. If I used computers a lot, I would feel   1 2 3 4 5 6
     more comfortable in using them.

33. Computers make me feel intimidated.   1 2 3 4 5 6

34. Computers are smarter than I am.   1 2 3 4 5 6

35. If I had to use a computer, I would not   1 2 3 4 5 6
     know what to do with it.

36. Computers will take over our society.   1 2 3 4 5 6

37. Computers are very important in our society.   1 2 3 4 5 6

38. If I had to use a computer all the time,   1 2 3 4 5 6
     I would be very unhappy.

39. I can think of many ways that I could use   1 2 3 4 5 6
     a computer.

40. If I had to use a computer, it would probably   1 2 3 4 5 6
     be more trouble than it was worth.

41. I do not feel in total control of a situation   1 2 3 4 5 6
     in which a computer is involved.

42. I am usually at ease using computers.   1 2 3 4 5 6

APPENDIX B.

SECOND PILOT TEST INSTRUMENT
(COMPUTER ANXIETY INDEX)

EXPLANATION OF THE COMPUTER ATTITUDE SURVEY

The use of computers in our society has been growing rapidly in the past few years, and as a result, many more people are now involved with computers than were in the past. Because of this change, the attitude of people toward computers is much more important now than it has been. This is a study authored by a graduate student at Iowa State University to determine computer attitudes. You are being asked to participate, but you are in no way required to participate. This type of work is important to the future development of teaching/training programs involving computers. As a participant, you will be aiding in producing more effective educational programs.

Please fill out the following questionnaire. The results of this survey will be statistically analyzed. No individual in the study will be identified, and your responses will be reported only in statistical terms (i.e., averages, ranges, and standard deviations). Please remove this page and only return the survey itself. Thank you for your help with this project.

COMPUTER ATTITUDE SURVEY

Instructions: Please indicate how you feel about the following statements. Use the following scale to indicate your feelings.

1 = Strongly agree
2 = Agree
3 = Slightly agree
4 = Slightly disagree
5 = Disagree
6 = Strongly disagree

1. Having a computer available to me would improve my productivity.   1 2 3 4 5 6

2. If I had to use a computer for some reason, it would probably save me time and work.   1 2 3 4 5 6

3. Having a computer available to me would improve my general satisfaction.   1 2 3 4 5 6

4. If I were required to use a computer, I would feel very anxious.   1 2 3 4 5 6

5. The things I do would not be suitable for using a computer.   1 2 3 4 5 6

6. Given the choice between doing my work with the aid of a computer or without it, I would probably choose to do my work without a computer.   1 2 3 4 5 6

7. Having a computer available to me could make things easier for me.   1 2 3 4 5 6

8. I feel very negative about computers in general.   1 2 3 4 5 6

9. Having a computer available to me could make things more fun for me.   1 2 3 4 5 6

10. If I had a computer at my disposal, I would try to get rid of it.   1 2 3 4 5 6

11. I look forward to a time when computers are more widely used.   1 2 3 4 5 6

12. I doubt if I would ever use computers very much. 1 2 3 4 5 6

13. I avoid using computers whenever I can.   1 2 3 4 5 6

14. I enjoy using computers.   1 2 3 4 5 6

15. If I were forced to use a computer, I would probably mess something up.   1 2 3 4 5 6

16. I feel that there are too many computers around now.   1 2 3 4 5 6

17. Computers are probably going to be an important part of my life.   1 2 3 4 5 6

18. If I used a computer, I could get a better picture of the facts and figures.   1 2 3 4 5 6

19. A computer could make learning fun.   1 2 3 4 5 6

20. If I were to use a computer, I could get a lot of satisfaction from it.   1 2 3 4 5 6

21. If I had to use a computer, it would probably be more trouble than it was worth.   1 2 3 4 5 6

22. I do not feel in total control of a situation in which a computer is involved.   1 2 3 4 5 6

23. I am usually at ease using computers.   1 2 3 4 5 6

24. I am usually uncomfortable when I have to use computers.   1 2 3 4 5 6

25. I sometimes get nervous just thinking about computers.   1 2 3 4 5 6

26. Having to use a computer could make my life less enjoyable.   1 2 3 4 5 6

27. I will probably never learn to use a computer.   1 2 3 4 5 6

28. If I were required to use a computer, I would find it somewhat scary.   1 2 3 4 5 6

29. Computers are too complicated to be of much use to me.   1 2 3 4 5 6

30. If I had to use a computer all of the time, I would probably be very unhappy.   1 2 3 4 5 6

31. I sometimes feel intimidated when I have to use a computer.   1 2 3 4 5 6

32. I sometimes feel that computers are smarter   1 2 3 4 5 6
     than I am.

33. If I had to use a computer, I would   1 2 3 4 5 6
     probably not know what to do with it.

34. I can think of many ways that I could use   1 2 3 4 5 6
     a computer.

APPENDIX C.

COMPUTER ANXIETY INDEX (FINAL VERSION)

EXPLANATION OF THE COMPUTER ATTITUDE SURVEY

The use of computers in our society has been growing rapidly in the past few years, and as a result, many more people are now involved with computers than were involved with them in the past. Because of this change, the way that people feel about computers is becoming much more important. The attached survey is part of a Master's degree thesis authored by a student at Iowa State University to study computer attitudes. You are being asked to participate in this study by filling out the attached survey. You are not, however, required in any way to fill it out. If you object to taking such a survey, please leave it blank.

This type of work is important to the future development of teaching and training programs involving computers. As a participant in this study, you will be aiding in producing more effective educational programs.

To participate, please fill out the questionnaire according to the directions. No one's individual score will be reported from this study. The scores will be reported in statistical terms only (i.e., averages, ranges, etc.). When you have completed the survey, please return it to your teacher. You need not return this letter, because it is for your information only, so please tear it off before returning the survey.

Thank you very much. Your help with this project is greatly appreciated.

COMPUTER ATTITUDE SURVEY

STUDENT

Instructions: Please indicate how you feel about the following state-
ments. Use the following scale to indicate your feelings.

1 = Strongly agree	4 = Slightly disagree
2 = Agree	5 = Disagree
3 = Slightly agree	6 = Strongly disagree

1. Having a computer available to me would improve my productivity.   1 2 3 4 5 6

2. If I had to use a computer for some reason, it would probably save me some time and work.   1 2 3 4 5 6

3. If I use a computer, I could get a better picture of the facts and figures.   1 2 3 4 5 6

4. Having a computer available to me would improve my general satisfaction.   1 2 3 4 5 6

5. Having to use a computer could make my life less enjoyable.   1 2 3 4 5 6

6. Having a computer available to me could make things easier for me.   1 2 3 4 5 6

7. I feel very negative about computers in general.   1 2 3 4 5 6

8. Having a computer available to me could make things more fun for me.   1 2 3 4 5 6

9. If I had a computer at my disposal, I would try to get rid of it.   1 2 3 4 5 6

10. I look forward to a time when computers are more widely used.   1 2 3 4 5 6

11. I doubt if I would ever use computers very much.   1 2 3 4 5 6

12. I avoid using computers whenever I can.   1 2 3 4 5 6

1 = Strongly agree	4 = Slightly disagree
2 = Agree	5 = Disagree
3 = Slightly agree	6 = Strongly disagree

13. I enjoy using computers. 1 2 3 4 5 6

14. I feel that there are too many computers around now. 1 2 3 4 5 6

15. Computers are probably going to be an important part of my life. 1 2 3 4 5 6

16. A computer could make learning fun. 1 2 3 4 5 6

17. If I were to use a computer, I could get a lot of satisfaction from it. 1 2 3 4 5 6

18. If I had to use a computer, it would probably be more trouble than it was worth. 1 2 3 4 5 6

19. I am usually uncomfortable when I have to use computers. 1 2 3 4 5 6

20. I sometimes get nervous just thinking about computers. 1 2 3 4 5 6

21. I will probably never learn to use a computer. 1 2 3 4 5 6

22. Computers are too complicated to be of much use to me. 1 2 3 4 5 6

23. If I had to use a computer all the time, I would probably be very unhappy. 1 2 3 4 5 6

24. I sometimes feel intimidated when I have to use a computer. 1 2 3 4 5 6

25. I sometimes feel that computers are smarter than I am. 1 2 3 4 5 6

26. I can think of many ways that I could use a computer. 1 2 3 4 5 6

APPENDIX D.

RATE OF RETURN INFORMATION

RATE OF RETURN INFORMATION

In gathering the normative information, packets of from 10 to 75 surveys were sent to the following groups:

    2 private businesses

    8 government agencies

    6 schools (surveying teachers)

Each group that was surveyed returned from as few as three surveys to as many as 75 surveys. Some response was received from all of those who were sent surveys with the exception of one government agency.

Two schools were also sent surveys to be administered to their 7th graders. Both of these schools returned approximately the number of surveys that were sent.

APPENDIX E.

USE OF HUMAN SUBJECTS RELEASE FORM

INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY
(Please follow the accompanying instructions for completing this form.)

83

(1.) Title of project (please type): _Development and Validation of a Measure of_

Computer Anxiety

(2.) I agree to provide the proper surveillance of this project to insure that the rights' and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

Signature redacted for privacy

Matthew M. Maurer   _9/8/82_   _____
Typed Named of Principal Investigator   Date   Signature of Principal Investigator

709 1/2 Clark Ave   _232-2537_
     Campus Address   Campus Telephone

(3.) Signatures of others (if any)   Date   Relationship to Principal Investigator
Signature redacted for privacy

     _9/20_   _Major Professor_

(4.) ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

- ☐ Medical clearance necessary before subjects can participate
- ☐ Samples (blood, tissue, etc.) from subjects
- ☐ Administration of substances (foods, drugs, etc.) to subjects
- ☐ Physical exercise or conditioning for subjects
- ☒ Deception of subjects
- ☐ Subjects under 14 years of age and(or)   ☐ Subjects 14-17 years of age
- ☐ Subjects in Institutions
- ☐ Research must be approved by another institution or agency

(5.) ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

- ☐ Signed informed consent will be obtained.
- ☒ Modified informed consent will be obtained.

(6.) Anticipated date on which subjects will be first contacted:

	Month	Day	Year
	10	01	82

Anticipated date for last contact with subjects: 12   20   82

(7.) If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments:

_01_   _20_   _82_
Month   Day   Year

(8.) Signature of Head or Chairperson   Date   Department or Administrative Unit
Signature redacted for privacy   _9/21/82_   Signature redacted for privacy

(9.) Decision of the University Committee on the Use of Human Subjects in Research:

☒ Project Approved   ☐ Project not approved   ☐ No action required

George G. Karas   _9/23/82_   Signature redacted for privacy
Name of Committee Chairperson   Date   Signature of Committee Chairperson