A MULTIVARIATE ANALYSIS OF GENDER, AGE, AND ETHNICITY AS ELEMENTS SHAPING TECHNOLOGICAL ATTITUDES, ANXIETY AND SELF-EFFICACY IN WORKPLACE SETTINGS

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CHAPTER I

INTRODUCTION

Nature of the Problem

Computers are dramatically altering the way the American public lives and works. These mechanical assistants are seemingly everywhere in modern life, from the grocery store to the bank. Many individuals now have personal computers in their homes that can instantly communicate with people virtually anywhere using text, pictures, and sound. Public computer networks provide links to an almost overwhelming amount of electronic information, accessible at will.

American industry has also made increasing use of computing technology for information access and quick data manipulation. Calculations that took hours or days just a few years ago can now be completed in a matter of minutes. Evolving technologies have greater capacities and speed, and costs are going down steadily. Decision makers in business and industry can move administrative tasks to electronic mediums, freeing employees for more important tasks. With this movement, corporate costs are lowered and organizational flexibility increases. However, the proliferation of technology in the workplace has complicated work, increasing both the skill and cognitive requirements of employees (Wirth, 1993; Zuboff, 1984).

Technological Apprehension

The integration of personal computers in the workplace has brought about more change than just required skill improvements. This electronic influx has many psychological, sociological, and cultural implications for employees in corporate America. The technological rate of change has caused many individuals to experience increased levels of anxiety, frustration, and helplessness (Simes & Sirsky, 1988). One of these identified problems is technological apprehension. Technological apprehension, also called computerphobia, technophobia, cyberphobia, and analogophobia, is ". . . a fear or resistance to computer technology" (Hudiburg, 1990, p. 311). Recognition of human technological apprehension in industry is important because it is a well-documented barrier to effective utilization of computers (e.g., Craig, 1993; Harrington, 1988; McDonald, 1985; McKenna, 1993; Simes & Sirsky, 1988).

Technological fear and resistance to automation represent barriers to personal and professional skill improvements in the workforce of today and tomorrow. Apprehension may also cause certain groups to avoid educational settings and occupations centered around, or involving the use of computers. People may fear technology because they lack previous access (George & Jeffers, 1993; Neuman, 1991), because they feel forced into acceptance (McDonald, 1985), or they lack understanding of how computer technology is changing the way we live and work (George et al., 1993). Cultural factors and forms of societal approval may also encourage or discourage technological fear. Boden (1992) suggested that people may fear technology and its resultant dehumanization because it may ultimately reduce self-image, morale, and increase our sense of helplessness.

Whether these theories are true is debatable. It is more certain that new types of information and high performance workplaces of the future will require innovative, knowledge-based workers to be a primary competitive resource (Hawkins, 1985; Senge, 1993; Webber, 1993). Impediments to participation and preparation in computer-based activities due to computer anxiety could seriously hinder development of that human resource. It has even been suggested that how we come to terms with this electronic "love-fear" relationship that currently exists in America may dictate the future of industry (Sullivan, 1988).

Technological Attitudes

Attitudes toward computers are closely related to computer anxieties, but they are not identical constructs (Rosen et al., 1987). Computer anxiety is a function of fear and may involve resistance, avoidance, and possibly hostility toward computers (Heinssen et al., 1987). Computer attitudes are the feelings and perspectives people have about the impact of computers on society and on the quality of life (Heinssen et al., 1987). These attitudes may include the belief that computers are beneficial for man's purposes in science and industry, or that computers will eventually replace the role of man in society (Lee, 1970).

The importance of researching computer attitudes is twofold. First, positive predispositions foster user acceptance of computers, which can ultimately translate into greater productivity (Davis & Bostrom, 1992). Secondly, motivation to use computer systems is modified by worker's attitudes toward computers, an important effect for those individuals with particularly high computer anxiety (Davis & Bostrom, 1992).

Conversely, a corporate environment that promotes motivation to use computers may also have a positive effect on computer attitudes.

Individuals possessing positive attitudes toward computers may see them as a means to make work easier, while those with negative attitudes may view computers as human oppressors (Fariña et al., 1991). Those viewing computers as having negative potential for society are likely to be susceptible to higher levels of computer anxiety (Fariña et al., 1991). In a workplace setting, technological attitudes may affect the willingness to participate in computer-related training and the success of that training.

Technological Self-Efficacy

Self-efficacy is another factor often associated with technological anxiety and attitudes. The relationship between these elements is complimentary; research has strongly linked self-confidence to performance outcomes (e.g., Bandura, 1991; Gist, 1987; Gist & Mitchell, 1992; Wood et al., 1990; et al.).

Self-efficacy is a central and pervasive mechanism of self-regulation, consisting of a personal belief in one's capability to perform a specific task and achieve different levels of performance (Gist, 1987; Gist & Mitchell, 1992; Wood et al., 1990). Bandura (1991) stated that efficacious beliefs develop from three main categories of self-regulation. First, motivations and actions are influenced through observation of personal performance. This process provides the information necessary for setting realistic goals and evaluating how one is progressing toward accomplishing those goals. Secondly, individuals form personal behavior standards based on the reactions of others. Reactions from others provide measures of how adequate a person's performance is, and what future activities will be valued by the individual. Finally, efficacy is partially derived from self-reactive influences. When self-satisfaction or other benefits are conditional upon certain accomplishments, individuals motivate themselves to achieve the necessary performance levels. In turn, these efficacious beliefs affect task effort, task persistence, expressions of interest, and levels of goal difficulty selected for performance (Bandura, 1991; Bandura & Bailey, 1990; Bandura & Cervone, 1986; Bandura & Wood, 1989; Gist, 1987; Gist & Mitchell, 1992; Lee & Bobko, 1994).

Studies have shown that efficacious beliefs are predictors of motivation and task performance in organizations (e.g., Bandura & Wood, 1989; Gist, 1987). Gist (1987) wrote that if an individual is in an aroused state, (such as may be associated with computer anxiety), those feelings may be interpreted as debilitating fear and make one feel more vulnerable to failure. Even in studies where self-efficacy has been altered by various treatments, the resulting efficacy perceptions still predict subsequent performance (Gist, 1987).

One may then infer that if self-efficacy plays a major role in acquiring computer-related skills, specific interventions enhancing those self-perceptions of ability might affect personal success or failure during technology-based activities. Computer anxiety or negative technological attitudes may retard the purposeful development of efficacious behavior. Beginners may face difficulties during the initial stages of technology exposure, or while mastering new software packages. Strong self-efficacy could provide the psychological resilience and intrinsic motivation to remain with the learning task instead of abandoning it in the face of adversity.

Demographic Changes

Technological anxiety, negative technological attitudes, and low self-efficacy all represent potential limitations to the optimal use of computers by workers. The size of those limitations can be influenced by the characteristics of individuals who are employed in corporations and their skills. Labor force projections indicate that future employees will include more women, minorities, and older workers than today (Coates et al., 1991; Fullerton, 1993; Kutscher, 1992).

When coupled with technology usage, these demographic trends impact how organizations are structured, technology is used, and work is accomplished. A diverse labor pool will be created, consisting of different employee skill levels, education, and expectancies. Technological attitudes, anxiety, and efficacy in future employees may be shaped by vastly different sociocultural and economic forces. In turn, these forces could then promote or undermine effective computer usage by these individuals.

Several authors maintain individual differences, such as demographic characteristics, may be correlated with the performance and preferences of each subgroup, and should be incorporated into human-computer interface designs (Aykin, 1989; Lee & Paz, 1991; Rosen & Weil, 1995b). Others suggest that fair and effective methods to deal with individual differences could conceivably open computer-based jobs to more people and increase productivity (Egan et al., 1988). To do these things, however, requires a model and a knowledge base of performance parameters and preferences (Aykin, 1989; Lee & Paz, 1991). Investigating the existence or nonexistence of these individual differences through this research can contribute to, and expand this knowledge base.

Concepts of Attitudes, Fear, Phobias and Anxieties

It would be useful to make distinctions between computer attitudes, fears, anxieties, and phobias. Computer attitudes were previously defined as the feelings and perspectives people have about the impact of computers on society and on the quality of life (Heinssen et al., 1987). Attitudes toward computer systems are important because positive predispositions foster user acceptance that can translate into greater productivity (Davis & Bostrom, 1992). The motivation derived from attitudes is an important consideration in those individuals with high computer anxiety (Davis & Bostrom, 1992).

Fear is generally defined as an unpleasant emotional experience associated with specific objects or situations (Carey, 1990). A phobia may be defined as a persistent and intense irrational fear that will generally lead to situational or object avoidance (Carey, 1990), and may have psychological and physiological consequences (Agras, 1985). Phobias may be distinguished from common fears by the degree to which they interfere with everyday life (Agras, 1985). Adults generally show less progress than children in phobic improvement, so it must be concluded that in adults phobias can be long lasting (Agras, 1985).

While anxiety has no agreed upon construct or definition (Torkzadeh & Angulo, 1992), it may be described as a concept in two-parts; namely, trait anxiety and state anxiety (Phillips et al., 1972). Trait anxiety is a general predisposition to anxiety and is related to personality while state anxiety is related to a specific situation, at a specific point in time (Phillips et al., 1972). Anxiety associated with computers seems to fit better into the category of state anxiety rather than trait anxiety, and as such is subject to change over time (Cambre & Cook, 1985). Specifically, computer anxiety can be defined as an affective response to actual or anticipated interaction with computers or automated processing systems (Weinberg, cited in Harrison & Rainer, 1992a). This fear may go beyond individuals that have never used a computer to include experienced users that are using new hardware and applications for the first time.

Responses to these apprehensive conditions may be expressed by the avoidance or resistance to computer technology (Heinssen et al., 1987; Rosen & Weil, 1995a). Anxiety inhibits motivation and impedes effective performance in situations requiring initiative, adaptation, and higher cognitive processes (Elder et al., 1987; Simes & Sirsky, 1988). Technological fear and avoidance can also hinder user acceptance of automation, and ultimately affect individual productivity in the workplace. Over time, stress caused by computer apprehension can manifest itself through sabotage, motivational declines, loss of work quality, morale, increases in absenteeism, and interpersonal conflicts (Elder et al., 1987).

The terms fear, anxiety, apprehension, and phobia are distinct concepts, although definitionally they occasionally overlap. For example, Gardner et al. (1989) distinguished computerphobics and the computer-anxious largely based on physiological responses. Phobics in this research exhibited symptoms such as computer avoidance, panicky feelings, sweating palms, and pounding heartbeats. Computer-anxious individuals demonstrated computer avoidance and discomfort, but lacked the physiological mannerisms of phobics. For the purposes of this research, the terms will all be used interchangeably. It is not uncommon for anxiety and fear to be used interchangeably by professionals and nonprofessionals alike (Hodiamont, 1991; Torkzadeh & Angulo, 1992). Furthermore, it may be argued that since fear motivates avoidance (such as computer avoidance), there is no fundamental difference between it and anxiety, at least as far as the response state is concerned (Epstein, 1972). Only attitudes and anxiety will be held conceptually distinct, given that they clearly correlate but are not identical constructs (Kernan & Howard, 1990; Rosen et al., 1987).

Statement of the Problem

Computer use will increase in response to issues of cost-effectiveness and profitability, competitiveness in a global economy, the ability to adapt to various training needs, and shorter training intervals (Geber, 1990; Johnson, 1991). Studies have suggested that there may be significant levels of technological anxiety, negative computer attitudes, and low technological self-efficacy in females (e.g., Dambrot et al., 1985; Massoud, 1991; Nickell & Pinto, 1986; Ogletree & Williams, 1990; Popovich et al., 1987), older persons (e.g., Elder et al., 1987; Igbaria & Parasuraman, 1989; Morris, 1988; Pinto et al., 1985), and some ethnic minority groups (e.g., Badagliacco, 1990; Rosen & Weil, 1995b; Rosen et al., 1987; Winkel et al., 1985). These respective groups are projected to increase their presence in the labor force by the year 2005. Given this projected change, it becomes important that barriers to workplace participation in computer-based activities are empirically identified, substantiated, and remediated.

The problem addressed by this study is that the fear of technology, negative technological attitudes, and low technological self-efficacy may prevent the effective and productive use of computers by certain groups in the workplace. Unless studies are conducted to identify specific components of technological anxiety, attitudes, and self-efficacy, vague and ineffective methods of dealing with these problems will remain. A general lack of understanding of how computer anxiety impacts organizations and people may explain the inadequate attempts at finding solutions (Torkzadeh & Angulo, 1992). The first step in trying to increase the effective use of technology by these groups is to determine empirically that these problems do in fact exist, so that interventions can be developed to remedy these problems.

Statement of Purpose

The purposes of this study were: (1) to determine if there were any significant differences in workforce computer anxiety, attitudes, and self-efficacy based on gender, race, and age and (2) to learn if there was a relationship among the constructs of computer anxiety, computer attitudes, and computer self-efficacy. This should give an indication of whether greater computer self-efficacy relates to improved attitudes and reduced technological anxiety.

Limitations

Generalizability of this study was limited to the participants involved in this study. There were reasons for taking this conservative approach. First, the companies who participated in the study constituted a self-selected sample; second, the initial employee request letter mailed to selected company officials did not contain overly prescriptive details for selecting which employees should be involved. The letter asked for 50 employees, with the criterion of being from ". . . different management, administrative, and technical areas," and largely relied on administrative discretion. It was believed that overly rigorous employee selection criteria would reduce participation by the companies involved. Therefore, it is unknown exactly what selection methods were used, or if the employee names received are truly representative of those companies. Employees also had the opportunity to self-select themselves by participating in the research or refusing to do so.

A second limitation of this study related to a reported male tendency to lie on fear or anxiety surveys. Social desirability effects on self-report instruments are not limited to males, but there is some evidence that females consistently report higher scores than men on instruments measuring fear (Arrindell & Buikhuisen, 1992; Pierce & Kirkpatrick, 1992), although it is uncertain why that occurs. Some theorists suggest that men have lower fear levels, or have different fear stimuli (Arrindell & Buikhuisen, 1992). It has also been suggested that admission of fear may be aversive to a traditional male role (e.g., O'Neil et al., 1986; O'Neil et al., 1984), but evidence on this point is debatable (e.g., Thompson et al., 1985).

Pierce & Kirkpatrick (1992) wrote "It is apparent that men do lie when responding to fear surveys as they are typically administered" (p. 417). Pickersgill & Arrindell (1994) rebutted those findings with "It is the contention of the present authors that whether or not men lie, it is certainly not apparent" (p. 21). While the instruments in this study are not considered particularly invasive, fear and anxiety are terms commonly used interchangeably by professionals and nonprofessionals alike (Hodiamont, 1991; Torkzadeh & Angulo, 1992). Given the lack of topical consensus in the literature, the inability to statistically control for it, and the possibility that some males may perceive these questions as admissions of fear, this phenomenon was noted and viewed as a minor confounding variable.

Another limitation of this study involved not sampling a more concentrated ethnic population instead of a general workforce population. Ostensibly, this resulted in a reduced nonwhite response, requiring some modifications to the planned statistical analyses (see Hypothesis 1 in Chapter III). However, after reviewing the literature it was felt that some inconsistencies in computer anxiety, attitudes, and self-efficacy findings were due in part to population-specific characteristics (e.g., college students, younger ages, nonworkforce groups, etc.). Targeting a largely ethnic population to achieve greater nonwhite response may have resulted in a sample with computer usage characteristics different from the general workforce, further reducing generalizability.

A final limitation of this study involved omitting examination of the effects of organizational culture and management levels upon computer anxiety, attitudes, and self-efficacy scores. There is some evidence that organizational culture may influence an employee's perception and acceptance of technological change. It has been suggested that optimal technological integration and acceptance occur only in highly-developed cultures inspired by visionary managers (Bates, 1995). However, no empirical literature was found to support or dispel the specific effects of company culture upon technological anxiety, attitudes, or self-efficacy, so this analysis would have been exploratory in nature.

Evidence for examining differences between managers and nonmanagers was stronger, based on the findings of Howard (1986). His research indicated that computer attitudes and anxieties were significantly different between these two groups. This information was gathered for future research and used for examining differences between groups, but was not treated as an independent variable.

Definition of Terms

The following terms were used during the conduct and description of this study:

Computer is, for the purposes of this study, defined as a digital, general-purpose, stored-program machine commonly associated with microcomputers, minicomputers, or mainframes. This definition is in contrast to the analog, special-purpose, fixed-program computer found in automated teller machines or digital wristwatches.

Computer anxiety is an affective response to actual or anticipated interaction with computers or automated processing systems (Weinberg, cited in Harrison & Rainer, 1992a). This response may be manifested in humans by the avoidance or resistance to computer technology (Heinssen et al., 1987). The Computer Anxiety Rating Scale (CARS) is an instrument for measuring this interaction (Heinssen et al., 1987).

Computer apprehension is, for the purposes of this study, definitionally equivalent to computer anxiety.

Computer attitudes generally are the feelings and perspectives people have about the impact of computers on society and on the quality of life (Heinssen et al., 1987). The Computer Attitude Scale (CAS) is an instrument for measuring this interaction (Nickell & Pinto, 1986).

Computer functionality is the general ability to accomplish a task using a computer.

Computer self-efficacy, for the purposes of this study, is defined as the confidence an individual expresses in his or her ability to use a computer (Murphy et al., 1989). The Computer Self-Efficacy Scale (CSES) is an instrument for measuring this interaction (Murphy et al., 1989).

Computer usability is a refined, specific subset of functionality, and involves the ease and intuitiveness of accomplishing a task on a computer.

Ethnicity is the term used to describe a group that is set apart based on characteristics of culture or nationality (Feagin, 1989). For the purposes of this study, race and ethnicity will be used interchangeably. (Also see Race).

Human factors are the implied accommodations for human characteristics in the design of equipment and systems intended to be used by people (Nickerson & Pew, 1990).

Human-mediated computer-based learning is the presence of humans during computer-based training activities to assist participants while accomplishing learning objectives.

Locus of control concerns the belief or perceptions that individuals have concerning control over 'self' within specific environments (Simes & Sirsky, 1988).

Race is the distinct categorization of human beings by descent and physical characteristics (Feagin, 1989). Race generally deals with physiological features, while ethnicity generally deals with classifications by culture or nationality. For the purposes of this study, race and ethnicity will be used interchangeably. (Also see Ethnicity).

Stereotypes are overgeneralizations applied to groups of people (e.g., races or ethnicities) that are beyond the bounds of supporting evidence (Feagin, 1989).

Technological anxiety is, for the purposes of this study, definitionally inclusive of computer anxiety. However, also included are affective responses (avoidance, minimization of use, etc.) to anticipated interactions with other electronic equipment such as fax machines, VCRs, advanced telephone systems, and compact-disc players.

Technological attitudes are, for the purposes of this study, definitionally inclusive of computer attitudes. However, how other electronic equipment such as fax machines, VCRs, advanced telephone systems, and compact-disc players is felt to impact society (value to society, how life will change due to use, etc.) may also be included in this definition.

Technology consists of systems, objects, or artifacts created using knowledge from the physical and social worlds (Friedman, cited in Kozak, 1992). The term technology includes computers, but also fax machines, VCRs, advanced telephone systems, compact-disc players, as well as other electronic equipment.

CHAPTER II

REVIEW OF THE LITERATURE

Purpose of the Chapter

The purpose of this literature review is to investigate the phenomena of computer attitudes, computer anxiety, and computer self-efficacy by gender, ethnicity, and age. Research in these areas will be summarized, and implications for the workplace will be explored.

Greater application of technology by industry for reasons of competitiveness and cost-effectiveness may force workers to use computers and other technologies for the first time. Brock & Sulsky (1994) termed these *compulsory users*. These initial interactions, if predicated by anxiety, attitudinal negativity, or uncertainty may cause employees to exhibit hesitancy toward using computers. In order for technological integration to be successful, workers will need to accept and adopt these technologies as productive tools that expedite their job tasks. Technological apprehension, negative attitudes, and low self-efficacy may obstruct that acceptance, by hindering effective employee utilization and lowering corporate returns on technological investments.

Technological Infusion

Technology has expanded to the point that almost all aspects of our personal and professional lives are affected by it to some extent. Personal computers, fax machines, voice mail, and video teleconferencing are all examples of electronic intercessors serving to expand the boundaries of human productivity. The home has not escaped this expansion; approximately 22.6 million households (22.8%) had computers in 1993, up from 13.6 million (15%) in 1989 and 6.9 million (8.2%) in 1984 (United States Bureau of the Census, 1993a). Moreover, technologies are finding greater acceptance and more novel use in the corporate world, thus altering the way work is done and thought about (Brock & Sulsky, 1994; Cordtz, 1992; Craig, 1993; Kerka, 1994b; Toffler, 1990).

Growing numbers of computers and fax machines in U.S. offices bear out evidence of these changes. Specifically, the number of computers in American offices has increased by over 25 million units since 1983, while fax machines in U.S. offices and homes have increased by over 10 million units since 1987 (Tetzeli, 1994). Overall computer use has increased in most occupations and within all races in the period of 1984-1993 (United States Bureau of the Census, 1993a). Roughly 46 percent of all American employees (51 million persons) used computers at work in 1993, up from 37 percent (40 million) in 1989 and 25 percent (24 million) in 1984 (United States Bureau of the Census, 1993a).

As computer usage becomes more prevalent one may infer that computer skills will become increasingly important within many occupations. Increased computer usage at home and in the workplace also implies that problems associated with computer anxiety, negative technological attitudes and low computer self-efficacy have been overcome by many individuals.

The growth of computer usage and information systems has possibly impacted organizations more than any other single factor in the last 30 years (Ivancevich et al., 1983). A paradox has been created--organizations are using technology for the flexibility it provides in a global marketplace, while simultaneously, skills and behaviors critical to personal productivity, managerial techniques, and the structure of workplace communities are being irrevocably altered (Cordtz, 1992; Dyson et al., 1994; Harrington, 1988; Kerka, 1994a; Simes & Sirsky, 1988; Torkzadeh & Angulo, 1992; Zuboff, 1982). Work has not been simplified; instead, technology has eliminated many low-skill jobs, increased task complexities, and demanded greater cognitive abilities from employees.

Demographic Variables

How technological apprehension affects the acquisition of necessary computer skills becomes increasingly important when considered with the individuals needing those skills. Different types of workers may come to the workplace with different skill sets, shaped by various external and internal factors. As technology rapidly changes the skills necessary in the workplace, continual skill training will become essential for employees to retain currency. Who these employees are and how they will respond to computer usage may predict job satisfaction and success.

There are indications that in the coming years the labor force will change within three demographic classifications. Women, minorities, and older workers are all estimated to make up a greater portion of the labor force in the future (Coates et al., 1991;

Fullerton, 1993; Kutscher, 1992). Together with technology, these demographic trends are likely to have an impact on the way organizations are structured, the way technology is used, and the way work is accomplished. Technological attitudes, anxiety, and efficacy in each of these groups may be shaped by their vastly different sociocultural and economic pressures. Understanding how these external forces affect computer attitudes, anxiety, and technological self-confidence is important since computing is not merely a cognitive ability, but a form of social behavior as well (Chen, 1987).

The Overall Labor Force

The ways in which women, minorities, and older persons will change the composition of the labor force can be seen in demographic forecasts. The Bureau of Labor Statistics has made several projections about labor force demographics and participation rates for the years 1992-2005. Although different trends have been forecast, this research will focus on a conservative growth projection versus the more tenuous moderate and high-growth patterns.

Under this conservative premise, by the year 2005 those working or looking for work are expected to be about 151 million persons, up 24 million from 1992, an increase of 19 percent (Fullerton, 1993). Growth for men in the labor force is expected to be similar to the past, but women will have a slightly greater labor presence in 2005 than in 1992 (Fullerton, 1993). This is due to more men leaving but equal numbers of men and women entering (Kutscher, 1992). Older workers, aged 45 to 64, are expected to show the most rapid growth as a group (Fullerton, 1993). Different ethnic groups will have varying rates of growth, based on different immigration, birth, and death rates (Fullerton, 1993).

Gender Shifts

Male workers, aged 16 and older, are expected to increase in number by 9.5 million between 1992 and 2005, a shift of 13.8 percent (Fullerton, 1993). During this same period, women aged 16 years and older are expected to increase their labor force presence by 14 million, a shift of 24.2 percent (Fullerton, 1993). The labor force participation rate of men and women, or the percentage of males and females in the labor force, is expected to decrease by .1 percent for men and increase by .7 percent for women in the years 1992-2005 (Fullerton, 1993).

This projected gender shift of the labor force has several corporate and educational implications. Currently, women are well represented in several of the fastest growing occupational groups (e.g., health assessment, health treatment, and personal services), but overrepresented in slow-growing or declining occupations (e.g., financial records processors, secretaries, and stenographers) (Kutscher, 1992). With the declining numbers of male workers, females might begin to occupy more positions in the faster growing occupational groups. Since these fast-growing occupations are requiring greater educational preparation (Kutscher, 1992), the types of courses and occupations that females are encouraged to pursue in high school and college may also change. These courses and occupations may involve more training in computers and other advanced office technologies. For those women already employed, this may necessitate more corporate training in the use of technology and interpersonal skills.

Gender Training

Corporate training patterns have positioned females to take advantage of these demographic and occupational shifts. During the years 1983 to 1991, females received more skill-improvement training than males (Carnevale & Carnevale, 1994). Females have been found to approach training more aggressively than males, perhaps because they view this training as a lever for employment and increased earnings (Carnevale & Carnevale, 1994). In addition, workers employed as administrative support staff (frequently women) commonly received training that is computer-related (Carnevale & Carnevale, 1994).

Indeed, technology may provide one lever to facilitate the movement of females from lower skilled occupations to higher skilled occupations. Women may find themselves positioned to occupy jobs that have been traditionally held by men. However, these jobs may require more education or skills training.

Yet some females may harbor apprehension about using technology causing avoidance of computer-related courses in high school and college. Computer anxiety in these females could also block their management and administrative opportunities. Training may be neglected, or promotions refused because they require working with computers.

Age Shifts

The general population, and specifically the workforce, is growing older. Those 45 years and older are expected to comprise almost 40% of the American population in the year 2005 (Fullerton, 1993). The domestic civilian labor force aged 25-54 is projected to total some 105 million, up some 14 million, or 15.3 percent from 1992 (Fullerton, 1993). Those aged 55 and older will number approximately 21 million in the labor force, an increase of some six million persons, or 38.3 percent from 1992 (Fullerton, 1993).

Older Worker Training

The aging of the workforce will have implications for future corporate training. Older workers may have a lifetime of work experience, but in a rapidly changing workplace, their skills may be obsolete. If retirees reenter the workforce in a different job than they previously had, they may not have the right type of skills to be effective in a computer-based workplace. These and other reasons could explain why from 1983-1991, training began to be concentrated on older workers (Carnevale & Carnevale, 1994). Specifically, employees aged 35-44 received 31 percent of all skill-improvement training programs during this period (Carnevale & Carnevale, 1994).

Unfortunately, older persons involved in technology-related training may not have had the everyday exposure to computers in the home and in school that younger workers might have had. As business computer use grows, the content of corporate training may become more technology-oriented. Therefore, it would be important to recognize the special learning needs of seniors and adapt the uses of technology to meet those needs (e.g., larger screens, configurable software, and other ergonomic considerations). While promotions or occupational mobility may be of less concern to the retired or semi-retired worker, the ability to reenter the workforce may require the worker to learn new computer skills. Helping senior employees alleviate technology apprehension is one way to ease this transition and achieve greater productivity in computer-based workplaces.

Ethnic Group Shifts

White non-Hispanics 16 years and older are predicted to have approximately 110 million persons in the labor force by the year 2005, an increase of almost 11 million people or 11.1 percent (Fullerton, 1993). By the year 2005, blacks 16 years and older will have approximately 17.4 million persons in the labor force, an increase of almost 3.5 million people, or 25.2 percent (Fullerton, 1993). Hispanics 16 years and older will have approximately 16.5 million persons in the labor force by the year 2005, an increase of almost 6.4 million people or 63.7 percent (Fullerton, 1993). Asians and other ethnic groups, (Pacific Islanders, American Indians and Alaskan Natives), 16 years and older, will have approximately 8.2 million persons in the labor force during this period, an increase of almost 3.7 million people or 81.2 percent (Fullerton, 1993). Asian labor participation rates are projected to grow at .1 percent a year through the year 2005, slower than the .3 percent growth in the white non-Hispanic and black participation rate (Fullerton, 1993).

Unfortunately, the representation of blacks in the labor force belies corresponding gains in prosperity. Coates et al. (1991) estimated that while 70% of blacks have found the American dream and are increasing their economic power, the remaining 30% are on a course destined for failure and poverty. Because of past racial prejudices, nonwhites may have been discouraged from educational opportunities leading to higher-paying white-collar work. The effects of this are seen in how blacks and Hispanics are both overrepresented in slow growing or declining industries and underrepresented in the projected rapid growth occupations (Kutscher, 1992). If blacks and Hispanics are deficient in basic computer skills, transitioning into rapid growth industries may be difficult. A cycle of menial employment and low socioeconomic status could repeat itself in another generation.

Ethnic Training

Corporate training patterns may be improving the outlook for some ethnic groups. As Hispanics change the face of America (Coates et al., 1991) they, along with blacks, have received large increases in training. The rate of skill-improvement training among Hispanics increased 120 percent in the period between 1983-1991 (Carnevale & Carnevale, 1994). Skill-improvement training during this period saw increases of 59 percent for blacks and 36 percent for whites (Carnevale & Carnevale, 1994). Asians and other races increased skill-improvement training 68 percent in the period between 1983-1991 (Carnevale & Carnevale, 1994).

Although whites are projected to see the smallest growth gains, all of the described ethnicities are expected to increase their presence in the labor force by the year 2005. Skill-improvement training rates have similarly increased for each group. Since rapid-growth industries tend to have employees with greater educational attainment (Kutscher, 1992), blacks and Hispanics may need even more preparatory education and training to facilitate their movement from low-growth industries. If these population trends prove true and historical training trends persist, the likelihood of increased computer interaction in the workplace by these groups should also increase. However, despite ethnic gains in skill training, effectiveness may be reduced if this training is accompanied by technological apprehension, negative attitudes, skepticism, and avoidance by the workers.

Demographic Summary

Why are these human population trends important in relation to research of computer attitudes, anxiety, and self-efficacy? Maurer (1994) wrote that demographic characteristics may well interact directly with computer anxiety by affecting the amount of computer experience. Almost all of the projected growth in the labor force is expected in the service-producing industries (Kutscher, 1992). Service-providers (e.g., service bureaus, consulting firms) often make heavy use of technology and may have to accommodate more minorities, many of whom are currently underrepresented in growth industries.

One-third of the new entrants into the future workforce will come from racial and ethnic minority groups who have limited access to computers (George et al., 1993). The gap between those who have technology and those who do not is also increasing (George et al., 1993; Hancock, 1992). Widening gaps in the education and skill levels of entry level employees may also accompany inequities of access. While training pattern increases have positioned women and ethnic minorities to move to growth industries, computer avoidance in the workplace due to apprehension or uncertainty may block that movement. This apprehension may also cause avoidance of courses in high school or postsecondary schools that involve computers.

Individual Differences

The diverse backgrounds of females, older workers, and ethnic minorities can combine to form a complex mix of employee differences. These individual differences may determine whether humans can use computers to perform a job effectively. Understanding these differences is important because user differences account for more performance variances than do differences in system designs or in training procedures (Egan et al., 1988). In turn, the decisions that each individual makes regarding technology use are weighed by an assessment of risks and rewards which are shaped by personal and cultural values (Selby, 1993). Danziger & Kraemer (1986) described the importance of individual differences in computer usage this way:

> Our focus on the individual person as the unit of analysis has resulted in a compelling empirical case that computing has quite differential impacts across individuals, across roles, and across domains of work. The nature and the level of computing impacts on people vary, and many of the differences are systematically associated with aspects of the individual's context of computing use (p. 220).

Evolutions in computer speed, capacity, and software configurability create easier and more effective ways to deal with these computing differences. A better understanding of characteristics within certain groups may determine success and failure in acquiring computer skills. Because individual performance differences are systematic, we can predict them and then begin to understand their underlying causes (Egan et al., 1988). To ignore them could have the effect of reinforcing fears and apprehensions that certain groups may have.

Computer avoidance by females, older persons, and certain ethnic groups might exclude them from opportunities in the information-rich, high-performance workplaces of the future. This exclusion may keep these groups in jobs that are lower paying and less satisfying, primarily concentrated in slow-growth industries. Consequently, negative attitudes could be reinforced, along with greater feelings of technological alienation and personal uncertainty. On the other hand, positive attitudes toward technology may contribute to an acceptance and motivation to use computers. Examining the attitudes in each of these groups is one starting place to begin building a base of understanding.

Technological Attitudes

History of Computer Attitudinal Research

Before reviewing the many variables which impact technological attitudes, it might be useful to develop a historical context. Attitudes toward the usage of computers have a measured attitudinal history dating from the 1960s. This evolution provides an interesting insight about how public perceptions regarding the use of technology at work and in homes have changed. These insights may also provide a background and inferential evidence for modern attitudes toward technology.

One of the earliest surveys gauging public attitudes about computers was made by Lee (1970) from interviews of over 3,000 persons, aged 18 and older in May 1963. Two predominant beliefs emerged from this research. First, the majority (from 56-76%, rising in parallel with educational level) believed that the computer was an instrument beneficial to man's purposes in science and industry. Secondly, a minority of the survey participants (24-44%, falling in parallel with educational level) seemed to view the computer as an "awesome thinking machine," ready to assume the role of humans in the universe. Most of the individuals holding the belief of the "awesome thinking machine" were in a lower income and less educated category.

Gardner et al. (1989) surveyed 462 managers and professional workers in the Washington area to investigate how the public's attitudes toward technology had changed since the 1960s. The two major factors that emerged in this research, enjoyment and quality of life, accounted for 47% of individual variance. Some findings in this research seemed to correlate with Lee's (1970), but differed in importance. Lee's (1970) research had shown some public concern with awesome and fearful aspects of the computer, while Gardner et al. (1989) found a greater appreciation of the beneficial aspects. Gardner et al. (1989) concluded that the public was becoming more acclimated to computers, and was more aware of the benefits technology holds for society. Their study showed that only 14% of those sampled were computer anxious or phobic.

This shift of public perception is promising, since more informed conceptions about technology might lead to more realistic expectations of computer functionality. Better information should begin to allay technological fear and negativity while simultaneously increasing acceptance. Yet both fear and negative attitudes toward computerization remain throughout different segments of society (e.g., Badagliacco, 1990; Chen, 1987; Collis, 1985; et al.). Lee's (1970) research bore this out, and Gardner et al. (1989) support it almost 30 years later, although diminished. People still harbor negative attitudes toward technology despite the greater widespread recognition of computing benefits to the individual and the workplace.

Gender Differences in Computer Attitudes

Negative technological attitudes may persist in contemporary society because children and young adults are being influenced in different ways. Specifically, while technological attitudes may have changed considerably over the years in the general populace, those being encouraged to use computers may not be sufficiently motivated to do so (Charness et al., 1992).

The ways in which boys and girls socialize may illustrate this lack of motivation and explain some contemporary adult attitudes. During adolescence, the development of computer behaviors and expectations may be influenced by peer groups and socialization processes. Boys tend to behave in ways in that stress interactive dominance and competition, while girls rely more on strategies of consensus building (Chen, 1987). These differences may be significant later, for instance, if boys and girls have to compete for limited access to computers (see Arch & Cummins, 1989). Also, if boys view computers as controllable, versus being controlled by them, they might become more attracted to using them than would girls (see Hattie, 1990; Hill et al., 1987; Kay, 1989; Nelson et al., 1991). This controllability may also influence personal choices regarding computer usage. Howard (1986) noted that the computer limits the freedom with which one can exercise choice, thereby leading to greater anxiety and resistance.

Differences in computer attitudes are strongly ingrained at an early age. Collis' (1985) research suggested that computer attitudes are well entrenched in both genders by the eighth grade. Collis (1985) also found little difference in computer attitudes between eighth and twelfth grade girls. She also found that males were consistently more positive about using computers and expressed more interest in them.

Technological attitudes developed in children may be carried into young adulthood. These early adolescent habits and socialization processes may also have some impact on adult computer learning and achievement. Chen (1987) hypothesized that role models and peers who encourage and legitimize computer use may play a role in the stronger male interest in computers. A major difference Chen's (1987) research found between genders was in peer interactions. High school boys reported a higher percentage of friends who knew about computers and encouraged their use. Boys reported more interest, more self-confidence, and lower anxiety about computers than did girls. High school girls had stronger feelings than boys about equality in computers, but neither their aspirations nor interest matched their sentiments. In other words, girls felt like they should have the same access and opportunities with computers as boys do, but they did not want to pursue those opportunities.

Sex-Typing and Gender Roles

Could this legitimization of computer use by adolescent peers contribute to adult computer attitudes? It might if certain tasks, abilities, and occupational roles are associated with a specific gender. Ogletree & Williams (1990) suggested that children categorize their environment based on gender, and subsequently adopt roles that are consistent with that gender. They also found that gender roles are reinforced through a complex system of rewards and punishments for actions appropriate to that gender. Male peer interaction and legitimization of computer activities by friends may be instances of these types of psychological "rewards" in childhood.

For example, computers are often thought of as male-oriented, while occupations such as nursing are often associated with females. The first example, computers, is a case of sex-typing an inanimate object, while the second example, nursing, is a perceived gender role. If the belief in these concepts is strong enough, different behaviors can occur in different situations. Both males and females may avoid or disavow interest in subjects associated with the opposite sex, in the fear that their actions may be deemed inappropriate by their peers and society. With computers, females may avoid computer-related activities that are strongly associated with males, both in the classroom and the workplace.

The effects of perceived gender roles and sex-typing on computer attitudes have been empirically investigated. In one study, Vredenburg et al. (1984) found several significant sex-typing effects in college undergraduates. They found that men were more positive about having computers in the home and liked computers more than females liked computers. Women reported being more afraid of computers than their male counterparts. There were no significant gender differences in having computers in school, parental attitudes toward computers, enjoyment of computers, perceived need for computers, or capabilities of computers. Seventy-five percent of the participants ascribed a male gender to computers, and women viewed computers as masculine objects to be used and enjoyed by men. Therefore, Vredenburg et al. (1984) stated, computer avoidance by females in this group would be perfectly natural. They appear to be simply avoiding male behavior that may have real or perceived negative consequences.

This study points out why sex-typing computers and computer-based occupations as masculine and therefore inappropriate for females, can be harmful. Women may avoid courses in high school and college that involve computers because they feel that they are engaging in behavior inappropriate to their gender. A belief may exist that some type of reprisal would result from parents, friends, or society for engaging in this behavior. This stereotypical belief has the effect of limiting computer exposure and education for females through avoidance, at a risk to their future occupational preparedness. In the workplace, females may avoid activities involving computers or computer-related training, possibly limiting their productivity and effectiveness. The cumulative effects of this lifelong computer avoidance may reinforce negative attitudes and inhibit professional growth for females.

Gender Computer Attitudinal Research

Even though research into attitude and gender may be the most heavily researched topics in this genre, overwhelming conclusive evidence is not present for any previously described gender differences in computer attitudes. Kay (1992) noted that in a comprehensive review of 98 gender-related studies, males had more positive attitudes about computers 48 times, females had more positive attitudes in 14 studies, and male and females expressed similar attitudes 36 times. While this finding tends to support the notion that there is an attitudinal difference between genders, directional support is weaker. Errors in sample selection, sample size, scale development, scale quality, and construct definition could account for some of these inconsistencies (Kay, 1992). Another possible explanation for these research discrepancies is that females may be expressing a general attitude on what they feel should be, versus what they know or feel personally. Chen's (1987) research hinted at this possibility, with the finding that females supported equal opportunities for access and use of computers. Yet they did not seem to have the interest or motivation to commit personal resources to learn or use computers (Chen, 1987).

Computer Attitudes of Older Workers

Older workers may also be subject to technological gender stereotypes, compounded by stereotypes commonly associated with age. This is unfortunate, since many conditions in industry are becoming conducive for the retention or reemployment of older workers. Flexible schedules, less physically demanding work, and increased usage of part time workers make continued employment feasible for the retired or semi-retired (Barth & McNaught, 1991).

As computer usage becomes more prevalent at work, the eventuality of older workers using this technology becomes more likely. However, younger managers and co-workers may hold stereotypical beliefs about the physical and mental abilities of older employees. Seniors themselves may believe that they do not have the cognitive or physical abilities to effectively work with new technologies. Internalized perceptions like these may lower their self-esteem while reinforcing negative attitudes toward work and technology (e.g., Myers, 1991).

Older people may also have other attitudes about technology that younger people do not. Seniors may reenter or stay in the labor force for a variety of positive reasons (see Olivero, 1992). However, there may also be negative reasons as well. For example, some older people may have to reenter the workforce against their will, due to insufficient retirement income and a higher cost of living. Because some older workers may feel cheated of leisure time, they may have negative attitudes against work in general. Older workers who are required to learn new computer skills could have those feelings of negativity reinforced.

There is evidence suggesting that older adults may be less likely to use newer technologies, such as computers (see Charness et al., 1992). A hesitancy to use technology (automated teller machines, credit card machines, etc.) may be due to simple unfamiliarity or lack of perceived relevance. In the workplace, hesitancy may be due to a lack of opportunity to acquire new skills due to changing work requirements. Many older persons did not grow up in a society where technology was prevalent, so development of any computer skills they might have has been delayed until later in life. Older workers may have a lack of computer skills, compounded by the fact they are often less educated than younger members of the workforce (Staufer, 1992). Older workers may contrast their skills with those of younger workers who have been using computers since high school or even earlier. These factors could further contribute to the development and reinforcement of negative attitudes of seniors toward computers.

Research on Computer Attitudes and Age

Charness et al. (1992) noted that there is relatively little literature on the relationship between age and computer attitudes, and in the research done, the results have been mixed. Some studies have found the relationship between age and computer attitudes alternately significant (e.g., Dyck & Smither, 1994; Igbaria & Parasuraman, 1989; Meier & Lambert, 1991; Morris, 1988; Nickell & Pinto, 1986). Other studies have found it to be nonsignificant (e.g., Loyd & Gressard, 1984; Massoud, 1991; Rosen et al., 1987). In those studies showing age as a significant factor, further inconsistencies arose about whether older persons had more positive or more negative attitudes toward computers than did younger persons. Studies have suggested that older persons had more positive attitudes (e.g., Dyck & Smither, 1994; Meier & Lambert, 1991), and more negative attitudes (e.g., Igbaria & Parasuraman, 1989; Nickell & Pinto, 1986) toward computers than did younger people.

This limited amount of research does conclude that age influences computer attitudes. Although inconsistencies remain in these findings, several things can be safely stated. Conditions in industry are beginning to favor the continued employment or reemployment of senior workers beyond retirement age. Any advantage of the older workers may diminish if these older workers resist the use of technology. There is evidence to support the idea that the acquisition of computer skills and the subsequent willingness to use computers could possibly be hampered by the presence of negative attitudes.

Differences in Ethnic Computer Attitudes

Conventional stereotypes similar to those imposed upon females and older workers may also apply to ethnic groups. The view of technology as "white" and "male" may discourage these groups from taking advantage of educational opportunities and thereby widen the gap between those who have access to technology and those who do not. Hernandez (1994) reported that in a Washington Post survey of African-American, Hispanic, Asian, and Native-American journalism professionals, 57% expressed concern about the widening gap between technology haves and have-nots. Sixty percent (60%) of those journalists expressed concern that minority technology access may a problem, and 55% said that technology training might not be made available to minorities (Hernandez, 1994). Almost half the journalists (46%) were afraid technological advances would cause their respective ethnic group to be left behind (Hernandez, 1994).

The effect of this lack of access could have effects on ethnic minority attitudes toward technology and its use. Computer unavailability in the home or school may unintentionally reduce its importance to the child. Parents and peers alike may substantiate these attitudes of the non-necessity of computers due to their own lack of computer experience, or through the lack of encouragement toward computer use. Even in those black and Hispanic homes that have a computer, children (aged 17 and under) use them eight to 13 percent less than white children (United States Bureau of the Census, 1993a).

As the child grows into adulthood, an attitude of unimportance toward computers may continue until computer use is required. At that time, previous avoidance of computer related education and related skills training based on his or her beliefs may have the effect of reinforcing negative attitudes. If the cycle of computer avoidance continues, high-level job opportunities and societal progression in a computer-based workplace of the future may decrease.

Research on Ethnic Differences in Computer Attitudes

As with older workers, there has been little research on the attitudes of ethnic groups toward computers (Badagliacco, 1990). But there is some empirical evidence that some attitudinal differences toward computers exist between the races. Winkel et al. (1985) found that non-Hispanics who used computers regularly displayed significantly more positive attitudes toward computers than Hispanics, whether they used computers or not. Winkel et al. (1985) noted that Hispanics may have felt more threatened, dehumanized, and controlled by computers than their white non-Hispanic counterparts. The researchers wrote that attitudes toward computers are composed of more than previous experience and familiarity, at least in Hispanics.

Another study seems to support Winkel et al.'s (1985) findings about Hispanic computer attitudes. Badagliacco (1990) undertook a study with two undergraduate groups--a computer group, (1,420 students who had previously enrolled in a computer course), and a noncomputer group, (1,420 students who had never enrolled in a computer course). The noncomputer group showed no significant differences in computer attitudes among ethnic groups, suggesting that people who choose not to use computers have little variance in overall attitudes about them. In the computer group, non-Hispanic blacks had significantly more favorable overall attitudes toward computers than did whites and Hispanics, who had the least favorable attitudes. Badagliacco (1990) concluded that blacks may view technology as the key to upward social mobility, whereas Hispanics may not.

As with females and older workers, negative technological beliefs may inhibit professional growth in a computer-based workplace. These negative feelings may intensify through various social and cultural experiences. However, the impact may be even more serious for some ethnic minorities since they are already overrepresented in low growth industries and underrepresented in the projected high growth industries of the future (Kutscher, 1992).

Summary of Computer Attitudinal Research

Technological attitudes may have a large part to play in the decision to accept and use new technologies. Computer attitudes have evolved from the "awesome thinking machine" mentality of the 1960s, to more realistic perceptions of computer functionality today. Although contemporary attitudes reflect a greater appreciation of computers and their benefits to society (e.g., Gardner et al., 1989), measurable attitudinal negativity remains in some groups (e.g., Badagliacco, 1990; Chen, 1987; Collis, 1985; et al.).

Attitudinal differences that exist between males and females about technology may develop in a variety of ways. Young boys and girls socialize in different ways during play, and these methods of interaction appear to carry through to adulthood. The knowledge and support of peers may also have a part to play in this development. Boys may have friends who are more knowledgeable about computers and legitimize their use. Girls may feel that they should have the same opportunities as boys concerning computer access and use, but they may not aggressively pursue these opportunities. Chen (1987) suggested that this finding may reflect that while gender equality has been socially accepted, female commitment of personal resources lags behind.

Adolescent perceptions of technology may shape the ways that individuals perceive technology as adults. Messages that society sends to young boys and girls as to the appropriateness of computer use may unconsciously establish "male" and "female" roles. The societal classification of computers as appropriate for males may discourage females from educational opportunities involving computers, thus hindering preparation for a computer-based workplace. Certain jobs and activities may also be stereotyped as "male" or "female." Stereotyping occupations as "male," such as computer programming, may cause females to avoid them. Together this educational and occupational avoidance may limit future employment opportunities, if computer skills are necessary.

Older workers and nonwhite computer attitudes may similarly be shaped by societal stereotypes. Older workers may adhere to gender role stereotypes besides facing stereotypes of age. Fellow employees may feel senior employees incapable of many tasks involving psychomotor skills, especially those that involve computers. The older individual may also believe this. These perceptions, if internalized, may have the effect of reducing self-esteem and value in the older employee.

Some ethnic minorities may view technology as a way to progress socially and within the corporation. Technology may be assigned an ethnicity (white), similar to the way females assign technology a gender (male). The effects of this racial perception may also be similar to sex-typing. "White" technology usage may be deemed inappropriate by some within their ethnic culture, causing avoidance in school and at work.

Older workers and ethnic minorities may not have had lengthy computer exposure and experience. These groups may feel inadequate regarding computer use, thereby reinforcing a perceived bias. Differing levels of education and equity of access may also serve to limit computer interaction and intensify the formation of negative computer attitudes in these groups. Negative attitudes could then lead to anxiety and avoidance of computers, at the expense of higher paying jobs and future occupational opportunities.

Computer Anxiety

Computer anxiety, or technophobia, was previously defined as an affective response to actual or anticipated interaction with computers or automated processing systems (Weinberg cited in Harrison & Rainer, 1992a). Rosen et al. (1987) noted that computer anxiety and attitudes are clearly correlated, but not identical constructs. Technological attitudes deal with how people feel computers impact society, their quality of life and their understanding of computers (Heinssen et al., 1987). Technological anxieties are functions of fear and apprehension, and involve resistance, avoidance, intimidation and possibly hostility (Heinssen et al., 1987).

Estimates vary, but there may be as much as 55% of the American population that has some fear or hesitation about using various technologies (Dell Computer Corporation, 1993). Even if this figure is exaggerated, a much smaller 5-10% anxiety rate in an organization with 50 thousand employees could result in the loss of millions of productive manhours per year. In a Southern California study, Rosen & Weil (1995a) found that over half of the elementary teachers and between one-third and one-half of the secondary teachers were technophobic to some extent.

Technophobia Studies

Howard (1986) suggested that a certain percentage of the population will always be susceptible to computer anxiety, so as a phenomenon, it is here to stay. If true, how widespread is computer anxiety and in what groups does it exist? To answer questions like these, one may look at studies conducted to develop general perspectives on technophobia. Dell Computer Corporation (1993) surveyed 1,000 adults and 500 teenagers to better understand the public's everyday usage of technology. Dell found that 55% of all Americans are technophobic to some degree, and 67% of those are adults. Women were found significantly more likely to suffer from technophobia (55%) than men (45%). The survey found 27% of all adults polled had never used a computer, 55% of adults had never bought a computer, and 32% of the adults were intimidated by computers and worried about damaging them. There was a stark contrast in technological literacy between adults and teens in using various technologies (e.g., VCRs, compact-disc players, telephone answering machines, computers, etc.). As for computers, 74% of adults were comfortable using them, and 92% of teens.

In another corporate study, Logitech Incorporated (1992) surveyed 300 business computer users in small, medium, and Fortune 1000 companies. The purpose of the study was to examine the fears associated with computers, and to uncover adoption patterns by personal computer users. Approximately 7% of those polled expressed some fear in using personal computers. Over 98% agreed that computers were valuable tools in getting work done. The American business women surveyed used personal computers approximately twice as much as men, but both equally shared in clerical and administrative functions. However, only 50% of those surveyed classified personal computers as user friendly, while the other 50% thought that manufacturers had a long way to go to improve user friendliness.

While these studies may not have had the scientific controls of more academic research, they do highlight two things. First, there were dramatic differences in the numbers of adults expressing fear about computers. In Dell's survey, 67% of adults expressed fear of computers, while in Logitech's survey, only 7% of adults expressed fear. This difference could be partially attributable to the different populations surveyed. Dell used adults and teenagers from the general public, while Logitech limited their study to business populations. Business populations probably had more exposure to computers as part of their jobs and daily routines. This suggests that researchers should be aware of the differences between groups when conducting computer anxiety research.

Secondly, Dell's survey clearly contrasted differences in technological fear between men and women, as well as adults and teenagers. Some of these findings seem to support the gender and age beliefs held by many Americans. However, other questions are raised: Are there measurable differences between other groups that relate to computer anxiety? What are other factors that encourage or discourage computer anxiety?

Origins of Computer Anxiety

Because technophobia appears to be a broad construct, it may have several underlying factors contributing to its makeup. Howard & Smith (1986) suggested that the root causes of computer anxiety are of three types: psychological, educational, and operational. Psychological roots are tied to specific personality traits, and have long-term connotations. Educational roots relate to an individual's lack of general knowledge of computer capability which is based on a lack of education. Operational roots stem from the inability to turn on the computer, insert diskettes, etc.

From these explanations, it is unclear whether these definitions are independent contributors to computer anxiety. For example, the inability to power up a computer might be an educational deficiency as well as an operational deficiency, in the absence of physical impairment. Keyboarding skills may be a more understandable operational deficiency, but that too, could be viewed as an educational deficiency instead of mere inability.

But Howard & Smith (1986) do make a valid point. Anxiety toward computers may be partially the presence or absence of skills, abilities, and perceptions that together encourage or discourage computer use. Many of these combinations, suspected of having relationships with computer anxiety, are suggested in the literature (e.g., Chu & Spires, 1991; Koohang, 1989; Morris, 1988; Simes & Sirsky, 1988; et al.). Even so, a comprehensive set of characteristics that could serve as predictors of computer anxiety have not surfaced. Weil et al. (1990) conducted a meta-analysis of 79 empirical anxiety studies and drew the conclusion that research has not established a consistent personality profile of computerphobics.

Perhaps part of the reason for the lack of a computerphobic profile is that so many different correlates of anxiety have been hypothesized and investigated. For example, some anxiety correlates investigated have included: education (Morris, 1988), experience (Chu & Spires, 1991; Heinssen et al., 1987; Kernan & Howard, 1990; Rosen & Weil, 1995a; Todman & Monaghan, 1994; et al.), keyboarding skills (Koohang, 1989), locus of control (Crable et al., 1994; Harrington, 1988; Simes & Sirsky, 1988), math anxiety (Dambrot et al., 1985; Harrington, 1988), skill (Arch & Cummins, 1989; Harrison & Rainer, 1992b), and others. While this list is not exhaustive, it does provide an illustration of how complex the construct of computerphobia may be.

Anxiety Correlates in this Research

The main independent variables of this research, gender, age, and ethnicity have also been investigated for their relationships to computer anxiety. If relationships to anxiety are shown to exist among genders, age groups, and ethnic classifications, how do they relate, and what is the strength of those relationships? Do any unique features of these groups contribute to computer anxiety? Answers to those questions may identify factors that discourage participation in computer-related education and corporate training by these individuals. Investigating the literature on these specific categories in further detail will help to further refine and substantiate the questions posed in this study.

Computer Anxiety and Gender

Is there a widely-held conception that technology is for one sex or the other? Computers may seem gender-neutral, but may be viewed and valued very differently by men and women (Bulkeley, 1994; George et al., 1993). Researchers debate genetic differences that are related to these perceptions, but suspicions of a physiological link remain (e.g., Bulkeley, 1994; Hawkins, 1985). Biological differences, even if they exist, do not account for all the achievement-related differences between boys and girls in the general population (Hawkins, 1985).

As with computer attitudes, messages from society may support the notion that some vocational and career choices are inappropriate for females. Gender roles and sex-typing may also be seen in advertising and media that focus on male audiences. Tittle (1986) stated that the media can be male-oriented, but also stated "Heredity appears to set potentials, and environmental events influence those potentials" (p. 1161). Environmental factors shaping computer anxiety development may also be similar to those described with computer attitude development. That is, gender biases may be introduced at an early age and reinforced throughout adolescence and into adulthood. Early anxiety development in children appears to have personal usage patterns intermixed with peer interaction (see Chen, 1987; Pereira, 1994).

Development of Computer Anxiety

Early strong male computer usage patterns may develop in childhood with video games that focus on dominance, competition, and violence (Pereira, 1994; Reisman, 1990). The element of competitiveness often follows male socialization processes. The added aspect of subordination through violence may run counter to female socialization tendencies. Furthermore, video games may use the types of physical skills boys are often better at than girls, such as depth perception and spatial reasoning, thereby reinforcing the gender bias (Pereira, 1994). Yet in one study of 1,138 high school students, Chen (1987) found no significant differences between genders with respect to the percentages of homes that had video game players. Chen (1987) did find that in those homes with personal computers, boys used them significantly more than girls did, 6.1 hours to 3.6 hours respectively. More recent 1993 findings show that males (aged three to 17) tended to use home computers only slightly more than females, 71% to 70%, respectively (United States Bureau of the Census, 1993b). Males in this group used the computer more for educational programs, games, graphics, and programming while females used them more for learning, school assignments and word processing (United States Bureau of the Census, 1993b).

Several authors (e.g., Arch & Cummins, 1989; Canada & Brusca, 1991) reported that computer-inexperienced females were more likely to report feelings of alienation, and considered themselves less equipped than males to deal with computers. Some of these feelings may originate through the early educational process. Girls start ahead of boys, yet they fall behind in an educational system designed for competitively-oriented males (Fear-Fenn, 1986). Differences then appear in post-secondary settings, in the decreased relevance females ascribe to the role of computers in future work, interest in how a computer works, and plans to take a computer course (Miura, 1987).

Hawkins (1985) suggested that female hesitancy toward technology is due in part to its strong historical linkages with math and science, based on assumptions that may not be entirely true. These areas have long been dominated by males, and those perceptions extend into the classroom, creating learning inequities. Male dominance in these areas has created a dearth of female role models, causing confusion in roles and in resolving conflicts that arise between work and traditional family responsibilities. Girls may not be motivated to enroll in math and science courses since they may be viewed as irrelevant to their later lives (Brush cited in Hawkins, 1985).

Socially, the male role seems to be a learned one from observing role models, societal interactions, and interactions with peers (Franklin & Fear-Fenn, 1993). It may be noted that gender socialization processes were also considered factors in computer attitudinal development. In an anxiety context, learned social roles appear similar to the sex-typing and gender roles associated with computer attitudes.

Research in Gender Computer Anxiety

If computers are viewed as a male domain, it is reasonable to conclude that females may have higher levels of anxiety and more negative technological attitudes. However, research examining the relationship between anxiety and gender is decidedly mixed (Dyck & Smither, 1994; Igbaria, 1993; Maurer, 1994). For example, gender differences in computer anxiety have been found alternately significant (e.g., Gilroy & Desai, 1986; Igbaria, 1993; Massoud, 1991; Meier & Lambert, 1991; Vrendenburg et al., 1984; et al.) and nonsignificant (e.g., Chu & Spires, 1991; Howard & Smith, 1986; Igbaria & Parasuraman, 1989; Loyd & Gressard, 1984; Pope-Davis & Twing, 1991; Rosen et al., 1987 [Study one]; et al.). Maurer (1994) suggested that greater prior computer experience and access by males is not always considered when developing conclusions in this research area.

Kramer & Lehman (1990) noted that much of the research on computer gender differences does not account for the number of different contexts in which computing can be applied. They argued that computer learning may be more contextual than is reflected in research, augmented by the requirements of particular situations. Therefore, by labeling computer use as an opportunity, perceptions of strict gender roles and anxiety may erode to an extent (e.g., Martocchio, 1992). Reclassifying computer use in another context may be one way to have females cast off perceptions of technology as a male domain.

This reclassification may be important since gender differences in technological apprehension can lead to behavioral changes. As with computer attitudes, females engaging in computer-related activities may be discouraged by society or peers for several reasons. Increased computer anxiety may cause computer-related education to be avoided, and for females to drop out once they do enroll. Hands-on experience may not always mitigate that anxiety. For example, Nelson et al. (1991) found that females who dropped out of an introductory computer class reported more computer anxiety than those females that remained. However, while males reported less anxiety and less confusion about using computers after taking a computer course, females still reported more anxiety and confusion than when they began the course. In addition, females felt more controlled by computers after the class than did males.

The mere presence of differing technological views between males and females does not, by itself, mandate the presence of computerphobia. Kramer & Lehman (1990) argued that discrimination and stereotypes may be confused with female preferences in thinking and knowing. However the preferences in thinking that do not match instruction and perceptions of technology as a masculine domain may still result in computer avoidance by females, self-exclusion from learning opportunities, and self-limited computer access. Computer anxiety may alter female vocational interest, their choice of occupation, and preparation for employment. As a consequence of these choices, women may have fewer computer skills upon entering the workforce, and may exhibit reluctance toward computer use once they are employed.

Women are poised to enter the workforce in greater numbers, changing the entire structure of corporate culture (Smith & Smits, 1994). Discriminatory barriers based on gender, apart from technology, already exist that may retard or halt their corporate success. Technological skills may provide leverage to overcome some of these discriminatory barriers, including increased earnings and corporate advancement. Yet anxiety resulting in reduced skill attainment or computer avoidance could minimize the potential of technology to assist women in these efforts.

Computer Anxiety and Age

Is technology use only for the young? The picture of technological anxiety is complicated in the aged because of the previously mentioned stereotypes of gender compounded by the stereotypes of age. Societal roles considered appropriate for males and females in earlier years were more rigorously adhered to when industrialization was still embryonic (Miller, 1985). Males worked outside the house or on the farm and females stayed home and reared children. With the passage of time, some gender roles have been changed for younger persons, but perhaps not for the elderly.

Computers were not available when senior workers were young. Older workers may have been able to avoid extensive computer use throughout much of their careers if they were at higher organizational levels and could subordinate computer tasks. Because of these and other reasons, they may have developed minimal computer skills, or none at all. However, if the retired or semi-retired person continues to work, they may be employed at lower levels in the company, requiring hands-on computer skills to be productive. These types of conditions provide fertile ground for the development of computer anxiety.

Fortunately, while older adults may demonstrate lower levels of computer skill, there is no evidence that they cannot learn these skills (Harrison & Rainer, 1992b). The cognitive, creative, and intellectual changes in aging employees are minimal, and are generally comparable with younger employees (Goddard, 1987; Johnson, 1988). Even so, problems arise if training dollars are redirected from older workers to younger, more "worthy" employees. This may be done because older workers may not be viewed as long-term employees, or because employers believe they cannot recoup training costs (Goddard, 1987). In this case, older worker computer skills may be neglected and productivity may be lowered. Computer anxiety could also be enhanced, since lower-skilled computer users have more anxiety than higher-skilled users (Harrison & Rainer, 1992b).

Research in Computer Anxiety and Age

A review of age and anxiety research does little to resolve these issues. Computer anxiety research has commonly focused on younger adults or narrow age ranges (Dyck & Smither, 1994; Maurer, 1994). Studies with wider age ranges tended to report an age effect, with younger participants being less anxious, although these findings are not consistent (Maurer, 1994).

These age restrictions may explain some mixed empirical results. For example, the amount of computer anxiety associated with age has been found significantly (e.g., Elder et al., 1987; Igbaria, 1993; Rosen et al., 1987 [Study one]; Todman & Monaghan, 1994; et al.) and nonsignificant (e.g., Gilroy & Desai, 1986; Howard & Smith, 1986; Igbaria & Chakrabarti, 1990; Loyd & Gressard, 1984; Massoud, 1991; Temple & Gavillet, 1990; et al.). Thus, the relationship between age and computer anxiety remains unclear.

As the population and the labor force continue to age, attention may be placed on the productive capabilities of older workers in a technological workplace. Conditions in the corporate environment are becoming more conducive to employing older persons.

However, older employees may not have had the computer exposure or education that younger workers may have had. Older workers may feel as if they are less equipped to handle tasks involving computers, thereby reducing their productivity and increasing their anxiety. Physiological deterioration may also hamper the effective utilization of technology by older workers. These problems, as well as others, will need to be addressed in order for older employee contributions to be valued by the organization.

Computer Anxiety and Ethnicity

Is technology viewed as merely an instrument to be used by certain ethnic groups? Just as women and older workers may view technology through perspectives partially shaped by society, so may ethnic minorities. The origins of these ethnic views, however, were shaped by very different events in history. Some of these ethnic perspectives of technology have been shaped by racial prejudice (Freeman & Williams, 1992). Computers may represent just another form of "white male" control (Badagliacco, 1990), used to exclude certain groups from full participation in society. Some races may feel that to embrace culturally disindigenous technologies is to somehow deny or reject their culture. Kotkin (1993) wrote that global cultures do not sacrifice their perceived ethnic identities to adapt to science and technology, but instead cope within their learned mores.

These ethnic paradigms are not entirely without foundation. Americans may not be aware of the biases, values, or assumptions made by those who create technologies, and these assumptions may have unintended repercussions (Madaus, 1994). It was previously noted that females may strongly perceive computing as a male domain. If ethnic minorities add a "white" ethnicity to their view of computers, the problems of perception are compounded. To many groups, computing and computers may represent power that is still predominantly held by men, and that perception may further alienate women and the disadvantaged (Gerver, 1987).

While the origins and strength of perceptions about technology in ethnic minorities may be different from those of females and the elderly, the effects are very similar. Negative attitudes about technology may translate into computer anxiety that leads to avoidance. This avoidance may be reinforced early in life through a lack of computer access or limited computer usage in education. For example, from 1984 to 1993, blacks and Hispanics aged three to 17 consistently had less computer access in the home than whites (United States Bureau of the Census, 1993a). School computer usage was also higher for whites (aged three to 17) than for blacks or Hispanics during this period (United States Bureau of the Census, 1993a).

Although technology can empower people through increased choices and new freedoms, it may also negatively impact certain populations (Maudaus, 1994). These choices and freedoms may be predicated upon career and educational decisions based on computer anxiety and discrimination. Examples of prejudice can be found both in education and within the individual. Particular cultures may have discouraged computer involvement at any level because it was not considered a priority, or because it represented a form of control by another culture or gender. Enrollment in computer classes or foundational math classes may have been discouraged by teachers (e.g., Mallow, 1981; Sleeter & Grant, 1988). People involved in career and educational guidance may encourage students to take certain courses or training. These types of encouragements may have the effect of assimilating individuals into occupations familiar to their own race, gender, or social class (Sleeter & Grant, 1988).

Racial discrimination appears to have similar effects as gender roles or sex-typing upon computer anxiety, with an ethnic slant. Occupational preparation and choice may be lessened with the avoidance of education involving computers. Once in the workplace, ethnic minorities may continue to avoid activities and training involving computers, possibly limiting their earnings and corporate mobility.

Research in Ethnic Computer Anxiety

As with ethnic attitudes, studies investigating relationships of computer anxiety to race are sparse. The research done on ethnicity and computer anxiety has had mixed results. Rosen et al. (1987) found that whites had higher anxiety on several computer anxiety subscales than other races. Rosen & Weil (1995b) conducted cross-cultural research on 2,456 freshmen in ten countries, but found the Japanese had significantly higher computer anxiety than any other country. As a further example of inconsistent results, Gilroy & Desai (1986) found that race was not predictive of computer anxiety.

Nonwhites may have a more complex mix of reasons for computer anxiety than either females or the elderly. They share the societal stereotypes these have, in addition to other cultural persuasions. Racial minorities may view technology anxiously because of socioeconomic pressures or lack of computer access. Prejudices in educational and career guidance may have limited the range of opportunities made available to certain groups. Technology may be viewed by some races as instruments of control by other cultures

(Badagliacco, 1990). Software packages may have inherent biases that hinder nonwhite acceptance of computers and also their willingness to use them (e.g., Marcus, 1993).

If strong enough, these elements contributing to anxiety may influence ethnic occupational interest, decisions, and preparation. Moreover, decisions regarding computer usage and the further acquisition of computer skills in the workplace may also be affected. To ignore these factors as possible contributors to anxiety relegate ethnic minorities to the current positions they hold in slow- or non-growth industries.

Computer Anxiety Summary

Reviewing the literature on computer anxiety reveals evidence that it is a real and possibly pervasive phenomenon. Estimates vary as to the extent and impact of anxiety on the American public and the American worker. Furthermore, there is evidence that different segments of the workforce may have differing levels of anxiety, based on familiarity and patterns of usage.

Part of the variation within anxiety research may lie in the numerous correlates examined. Almost all of those correlates, including the ones in this research, have had inconsistent findings within different populations. This has possibly contributed to the non-emergence of a consistent personal profile of computerphobics. More research is necessary into these and other anxiety characteristics.

Researchers (e.g., Bulkeley, 1994; George et al., 1993; Hawkins, 1985; et al.) have suggested that males and females may view technology very differently. These gender differences may be due to biological differences, environmental differences, or some combination of the two. Many differences are shared between computer anxiety and computer attitudes. Sex-typing and gender roles may shape how young boys and girls view technology, and how they will use it. Socialization processes and peer legitimization for computer use may also have an effect on use.

Educational systems that encourage competitiveness possibly favor the more competitive nature of boys and discourage females from computer-based education. This disfavor is further exacerbated if limited computer time and access is based on competition. Science and math classes may further discourage females from using computers, since these have also been promoted as male domains. The cumulative effects from these female dissuasions may result in negative technological attitudes that lead to computer anxiety.

Computer anxiety in older adults may encompass gender inequalities plus stereotypes associated with growing older. In fact, gender stereotypes may be more intense in the elderly since their respective male and female social roles were more restrictive in their youth. These gender roles have softened somewhat in the middle and later years of the 20th century, but older persons may not have adopted the changes.

Younger individuals in our society also had the advantage of growing up around various technologies. The elderly did not have this luxury, and may have been able to avoid using computers during their working lives. Moreover, the permeation of technology into industry will require higher levels of computer skills, even from those who are acclimated to them (Torkzadeh & Angulo, 1992). Therefore, seniors may not have the productive computer skills necessary to reenter or remain in a computer-using workforce. These skills may not be developed with corporate training if dollars are redirected toward younger workers. Anxiety in the older worker may be enhanced in these situations.

Research on anxiety and aging is inconclusive at best. It might be argued that a clear relationship between age and anxiety has not been proven yet. However, there seems to be enough evidence to suggest different ages do make a difference in the degree of computer anxiety, although directionality is more uncertain.

Ethnic anxiety toward computers, while sharing some attributes of gender and age, has developed under a more diverse set of circumstances. Prejudice has been a real and present reality to many races, in many aspects of their everyday lives. Technology is possibly one of those aspects tinged by this prejudice, allowing the attachment of a "white" ethnicity to computers.

Discrimination has also had an effect in educational settings. Ethnic minorities may have been discouraged from math and science courses, much like females have, and for different reasons. Counselors and teachers may encourage preparation for vocations occupied by members of their own race, gender, or social class.

The relationship of ethnicity to computer anxiety has not received a great deal of attention in the literature. Prejudice may be to blame, or it may be that ethnicity has been somewhat discounted as a possible contributor to anxiety. There is sufficient evidence, however, to conclude that the cultural experiences unique to ethnic minorities may affect their anxiety levels. The reasons underlying this anxiety may be more complex than those relating to either females or the elderly.

Heightened anxiety in females, the aged, and nonwhite minorities may have detrimental effects upon their abilities to adopt and use computers. Perceived societal approval and various educational obstacles may change their vocational preparation, and increase anxiety toward computer use. This in turn could limit the occupations made available to these groups, and their mobility within those occupations.

Self-Efficacy

Concepts of Self-Efficacy

Self-efficacy is occasionally related in research to technological anxiety and attitudes. The relationship between these elements is complimentary; research has strongly linked self-confidence to performance outcomes (e.g., Bandura, 1991; Gist, 1987; Gist & Mitchell, 1992; Wood et al., 1990; et al.). In addition, employees with higher levels of commitment, self-efficacy, and motivation can be expected to make greater organizational contributions (Tannenbaum et al., 1991).

The concepts of self-regulation and its subset, self-efficacy, are deeply rooted in the writings and research of the social cognitivist Albert Bandura. Specifically, Bandura (1991) developed his Social Cognitive Theory to explain the relationships between self-influence, confidence, motivation, and the regulation of behavior. Performance plays a key role in an individual's regulatory process, providing feedback to influence personal motivations, subsequent behaviors, and intrinsic goal-setting (Bandura, 1991). As Mitchell et al. (1994) suggested, goal-setting may be extremely important in the later stages of new computer skill acquisition, as the influence of self-efficacy diminishes.

Performance

A key link of self-efficacy to this research is how it relates to the outcomes of performance. Strong self-confidence resulting in more effective performance is well supported in the literature (e.g., Gist et al., 1989; Sanna & Pusecker, 1994; et al.). Performance and self-efficacy seem to have a cyclical effect, in that they reinforce each other. Conversely, computer anxiety may attenuate self-efficacy. For example, it has been found that subjects with high computer anxiety expect to have significantly poorer performance even before they began working on a computer task, than did low-anxious subjects (Glass & Knight, 1988).

Computer Self-Efficacy and Computer Adoption

Self-efficacy appears important in determining acceptance or rejection of innovative computer technology (Hill et al., 1986). Only three years prior to Hill et al. (1986) when the home computer was fairly new, Dickerson & Gentry (1983) researched the characteristics of home computer adopters. While many characteristics were expected, (e.g., more education, higher income, seeks information, etc.), the expected relationship to computer adoption and self-confidence was not present. One possible explanation for this lack of an expected relationship is that personal computers were so new, those who used them realized very few people had a real depth of experience. This may have made these early users feel less incompetent by making beginner mistakes, or asking simplistic questions.

As personal computers became more commonplace, the connection of self-efficacy to computer adoption seems to have changed. Hill et al. (1987) conducted two studies of computer self-efficacy and how it alters decisions to adopt or use technology. Results suggested that perceived computer efficacy was related to the decision to use computers. Prior computer experience alone did not significantly predict subsequent behavior to learn about computers. However, computer experience combined with a stronger sense of perceived computer self-efficacy did lead to a higher likelihood of computer adoption and use (Hill et al., 1987).

Given this foundation, we may pose similar questions about computer self-efficacy that we did with attitudes and anxiety. That is, does computer self-efficacy differ with gender? Does computer self-efficacy vary among different age groups or ethnic classifications? If these groups do vary regarding self-efficacy, are there relationships to computer anxiety and attitudes?

Computer Self-Efficacy and Gender

Several similarities exist between the development of gender attitudes, anxieties, and self-efficacy. That is, the ways in which females conceptualize computers as "male" may play a role in the development of adult efficacious behavior. For example, sex-typing and gender roles may also play a role in developing self-efficacy, as it did in computer attitudes. Ogletree & Williams (1990) found computer usage was also associated with more positive attitudes and higher self-efficacy for males; for females, it was associated with attitude and aptitude. Miura's (1987) findings support this. In her study, men gave themselves significantly higher computer self-efficacy ratings than did women.

Impostor Phenomenon

How gender roles and sex-typing relate to self-efficacy can be illustrated by briefly examining a closely related topic, the imposter phenomenon. The imposter phenomenon is the intensely personal, secret belief that one is less competent than their peers, although generally viewed as successful and intelligent (Harvey et al., 1981). Symptomatic of this condition is the fear that one will be discovered as "phony" by others, an attribution of success to luck and personality and an otherwise low confidence in one's own ability (Harvey et al., 1981). Harvey et al. (1981) found that this condition is prevalent in persons with occupations that violate traditional gender roles (e.g., men in nursing, women in construction, etc.). In short, the impostor phenomenon appears in the same genre as self-perceived gender roles discussed in the sections on attitudes and anxiety.

The impact of this condition upon computer self-efficacy is twofold. First, the perception of computers and computer-related vocations as male-oriented presents an initial barrier to females. If that barrier is overcome, women in these fields may still be subject to self-doubt and lowered self-estimation of ability. A second danger is the fear that one's self-perceived ineptness with computers will be discovered. Therefore, a highly successful person may avoid situations where he or she has to demonstrate computer abilities, for fear of having his or her ineptness "found out."

No literature that specifically discusses this phenomenon specifically in relation to computer self-efficacy was found. This impostor phenomenon may not even be a distinctly different factor from efficaciousness. It is possible, however, that the imposter phenomenon may be masked in self-efficacy studies under unaccounted-for variance.

Women in male-dominated fields may attribute their skills to something other than competency, thereby avoiding the stigma of being labeled less feminine. For example, women in these nontraditional professions may feel defensive for achievement in these fields, due to their violation of a perceived gender role. Conversely, women who have overcome occupational entry barriers, such as in computer-related occupations, may feel confident they can overcome other discriminatory barriers. By having conquered societal stereotypes and discrimination, self-efficacy may be enhanced.

Both suppositions are empirically supported. Long (1989) found that low-masculine women in all occupations reported significantly greater strain, anxiety, and lower self-efficacy than more masculine women. In contrast, however, low-feminine women in nontraditional occupations reported higher self-efficacy and problem-coping skills than low-feminine women in traditional occupations. While there might be a conflict in these findings for conclusive support of the impostor phenomenon, the concept of gender roles influencing self-efficacy does appear to have support.

Research in Computer Self-Efficacy and Gender

Gender self-efficacy appears to have been researched more thoroughly than either age or ethnic self-efficacy. Hattie (1990) conducted a meta-analysis on 19 empirical studies of male and female computer attitudes, and found that overall there were substantial differences. Many reasons found for gender differences related to control or self-efficacy issues (Hattie, 1990). Inefficacious individuals were unlikely to initiate changes in their environment, even when there were many opportunities in that environment (Bandura & Wood cited in Hattie, 1990). Those individuals with high levels of perceived self-efficacy and control over computers were more likely to set high goals and be committed to attainment of those goals (Bandura & Wood cited in Hattie, 1990). Therefore, Hattie (1990) suggested that girls may not feel in control of a computer or understand how to reduce negative outcomes.

Hattie's (1990) suggestion relates back to previous discussions on the socialization processes of boys and girls. The ability to control computers or their outcomes runs counter to the consensual nature of girls. This lack of control may have the effect of altering vocational interest as well as lowering self-efficacy. Combined with the previous linkage of self-efficacy to gender roles, we can see that formidable barriers are raised against attracting women to computers and computer-related fields.

Church et al. (1992) found that women had a significantly higher tendency to reject occupations that were dominated by males. Not unexpectedly, Hackett et al. (1992) found that vocational interest was a strong predictor of academic self-efficacy. If all these factors are put together, it appears to set up a lifelong cycle of reinforcement regarding female self-efficacy. Socialization processes by girls may not lend themselves to creating beliefs of control over computers. Societally influenced gender roles may steer females away from occupations involving computers if they are perceived as male domains. Because of this, women may have a greater tendency to reject these male-oriented vocations. Instead, females may concentrate their academic pursuits in fields they believe appropriate to their gender. Successes in traditional academic choices may then reinforce their self-efficacy, possibly discouraging consideration of other "male-perceived" professions, such as computer engineering.

This cycle, left to itself, appears impervious to change without some type of intervention, either personal or external. This belief is illustrated and supported by the research findings of Scheye & Gilroy (1994). Women in this study, who rated themselves higher in nontraditional self-efficacy, regarded male teachers as highly influential. Scheye & Gilroy's (1994) findings suggest that if males could encourage low efficacious females into nontraditional pursuits (e.g., math, science, computers, etc.) then greater female participation in computer-related activities might follow.

Computer Self-Efficacy and Age

Self-efficacy in the elderly also shows relationships with elements pointed out in age-related computer attitudes and anxiety. Several reasons are similar for the development of all three. Senior employees may have internalized stereotypes exhibited by younger managers or coworkers. Older workers may compare their computer skills with younger workers who have been using computers for longer periods (Ridgway, 1992), and conclude that they are unable to attain the same level of performance. They may also have doubts in their own abilities to work with computers, if they expect that their cognitive functions may decrease with age (e.g., Ryan & See, 1993).

Gender roles may not have the impact on self-efficacy in the elderly that they have on attitudinal development. Older individuals are not as likely to make the educational and vocational decisions that younger people would make who have their careers ahead of them. Retired or semi-retired older workers are probably reentering the workforce to supplement their retirement income, because they are bored, or for another reason. The particular occupation would not likely be as important as it would be to a younger entry level employee, as long as the physical demands are reasonable. Therefore, self-efficacy in the older employee seems to have more influence at the task level, versus a broader career level.

Given this, personal expectation of cognitive declines may be one factor in analyzing computer self-efficacy in the older individual. Ryan & See (1993) found that adults between the ages of 18-75 years of age expected memory declines both in capacity and the amount of change. These expectations, in turn, could enhance lowered self-efficacy (Ryan & See, 1993). If older workers believe that they are subject to cognitive impairment, it is reasonable to assume that they may not feel confident learning new skills. They may also be more susceptible to negative influences from others. Inefficacious feelings may be more intensive for those tasks that they might consider highly cognitive in nature, such as computer work.

Some of these impacts on self-efficacy in the elderly may not be readily apparent. As mentioned in the discussion of attitudinal development, older workers may have to deal with different life experiences than do younger people (see Myers, 1991). Elderly persons also generally deal with losses more frequently than do younger persons. Spouses, friends, and relatives die, possibly creating voids in their personal lives. Besides personal bereavement, these losses may challenge the widow or widower to continue with a fulfilling life (LaGrand, 1992). They may not believe they can live a rewarding life after the loss of a loved one. This lowered self-efficacy may transfer itself to other facets of their lives, including the diminished belief that they cannot or will not learn new skills.

Research in Computer Self-Efficacy and Age

There appears to be very little empirical literature linking age to computer self-efficacy. However, in two studies, confusing findings emerged. Dyck & Smither (1994) found that older adults, (55 years of age and older), had less anxiety, more positive attitudes, more liking, but less confidence for computers than did younger subjects (less than 23 years of age). In contrast to this, Pope-Davis & Twing (1991) also conducted research into computer self-efficacy and found an older group (23 years old and up) reported more computer confidence than the younger group.

Findings about computer self-efficacy clearly contrast, but do suggest that differences may exist between age groups. The age groupings are obviously different, but that is not the only difference. For example, one would expect the older group in Dyck & Smither's (1994) research to exhibit consistently negative attitudes, high anxiety, and low self-efficacy. However, this is not the case. Older participants in this research expressed more positive attitudes and lower anxiety but also lower self-efficacy toward computers. Dyck & Smither (1994) suggested that different types of experience by older workers may account for this difference. Another possible explanation is that some older individuals may express positive attitudes about computers because they feel unaffected by any potential for usage. In other words, seniors in this research may not have felt that personal computer use was imminent, or that they would have to learn new skills. With foreseeable computer use, older individuals may have expressed more negative attitudes and more anxiety, especially if they had low skill levels. This would be one possible explanation for the low computer self-efficacy finding in this research. As Dyck & Smither (1994) recommended, more research is warranted in this area.

Computer Self-Efficacy and Ethnicity

Ethnic minorities share similarities in self-efficacy with females and older workers. Various cultural and prejudicial experiences may have resulted in discouragement of certain ethnic groups from computer-related activities and education. Several factors discussed concerning ethnic computing attitudes and anxieties may also play a role in ethnic self-efficacy.

Lack of computer access in childhood could lower computer self-efficacy in nonwhites. The mere lack of exposure reduces the potential usage and experience levels of the child. Having experience more clearly delineates between what the child believes he or she thinks they can do and what their abilities actually are. The ability to grasp ideas and develop basic skills should develop from experience, even if proficiency does not. Here one might expect to see improved computer attitudes but possibly lower self-efficacy, depending on the context of use (e.g., computer programming versus copying a file).

Some parents may minimize the importance of computer use due to their own inexperience with computers or their lack of computing self-efficacy. Parents who were reared in a time when occupational opportunities were more limited to nonwhites may feel that high technology jobs are unobtainable by their children. Such a view may be based upon their own experiences of job discrimination (Freeman & Williams, 1992). However, the parental influence in this respect may not be that strong. Chen (1987) found the parental role was nonsignificant in a child's computer learning. Furthermore, Chen (1987) did not report ethnicity as an intervening variable in computer interest or learning. Chen (1987) wrote that most of the children felt both of their parents were equally knowledgeable about computers and encouraged learning about them. This may not be typically representative of some ethnic minority families, due to the previously mentioned inequities in computer access, education, and socioeconomic status (see United States Bureau of the Census, 1993a; United States Bureau of the Census, 1993b).

Other factors that could have an impact upon ethnic self-efficacy are teachers and peers, if their actions discourage taking computer-related classes. As previously stated, some ethnic minorities may have been discouraged from taking math and science courses due to discriminatory counseling (Mallow, 1981). The counselor may have felt that the child was incapable of grasping these complex topics, and an effort might have been made to guide a child into a vocation where their race predominates (Sleeter & Grant, 1988). The effect of this discouragement may have been to convince the child or young adult that they had insufficient cognitive abilities for computers. In this situation, low self-efficacy about technology is not unexpected. Hackett et al. (1992) found that high levels of faculty encouragement were consistently related to academic performance, although ethnicity was not reported as an intervening variable.

Research in Computer Self-Efficacy and Ethnicity

No empirical research could be found that investigated the specific relationship of adult computer self-efficacy to ethnicity. This lack of research is similar to what is found in ethnic computer attitudes and anxiety, although more extreme. It could be that prior research has lumped ethnic attitudinal findings together to form an assumed confidence finding. Yet the two should not be confused. Blacks in Badagliacco's (1990) research felt like technology may be a vehicle for social progression. If this is so, attitudes may be positive toward computer use, but self-efficacy may be low because of inadequate skills. These skills may have been discouraged by their culture or by counselors with conscious or unconscious prejudices.

In lieu of specific research of ethnic computing self-efficacy, we may explore how ethnic self-efficacy alters the range of occupations considered. Church et al. (1992) found that although ethnic minorities did tend to restrict their considerations of vocations to those they generally felt confident in, ethnicity did not significantly contribute to the consideration. Although this research did not consider computer-related occupations, those occupations could conceivably be included. This finding is supported by an earlier finding of Rotberg et al. (1987) who also failed to find ethnicity to be a contributor to the range of vocational consideration or self-efficacy expectations.

However, these findings are not unanimous. Lauver & Jones (1991) found ethnicity to be a significant contributor to the range of occupations considered, and the level of efficacy for those occupations. Although Badagliacco (1990) focused on ethnic computer attitudes, the findings of Lauver & Jones (1991) would not be contradictory to those findings (e.g., negative attitudes and low self-efficacy). Lauver & Jones (1991) suggested that Hispanics may have greater occupational aspirations than they do motivation or expectancies of achieving them. A similar gender-related effect was found by Chen (1987) while researching computer attitudes of high school girls. They felt they should have equal computer access and opportunities as boys, but they did not have the aspirations or interest to pursue them. What the gender and ethnic similarities may reflect is that attitudinal self-efficacy is different from self-efficacy for specific skills (Luzzo, 1993).

A similar efficacious effect has been found in blacks. Hughes & Demo (1989) found that black self-esteem was relatively unaffected by discrimination. However, black self-efficacy was affected by discrimination, explaining why blacks often have high self-esteem but low self-efficacy (Hughes & Demo, 1989). This phenomenon is akin to what was previously described for women and Hispanics. While self-esteem and personal efficacy are highly correlated, the factors affecting them are sometimes different (Hughes & Demo, 1989). Self-esteem was predicted by family, friendships, and religious involvement, without a significant relationship to discrimination. Self-efficacy was found significantly related to discrimination and inequality.

These findings imply that it may be difficult to derive accurate measurement of occupational self-efficacy. Females and some ethnic minorities may respond positively to lofty vocational suggestions, but have very little expectation (or motivation) to achieve them. Instead, what may be measured is aspiration versus expectation or efficacy to achieve. The potential for harm can be seen here. For example, if a nonwhite student is counseled on coursework to take based on an unrealistic self-estimate of vocational ambition, they may be placed in courses beyond their abilities. Failure or mediocrity in this type of class may exacerbate inefficacious feelings. If these courses involve computers, feelings of fear or low self-confidence may be ascribed to them.

Summary of Self-Efficacy

Self-efficacy has been associated with computer anxiety and attitudes due to its relationship to performance outcomes. Performance may serve to reinforce positive or negative efficacious feelings about technology. In addition, self-efficacy may play a major role an individual's decision to accept technology, and then in subsequent performance.

As with attitudes and anxiety, self-efficacy may be influenced by sex-typing computers and computer-related occupations, thus excluding females and ethnic minorities from educational and occupational opportunities. Females may have strong beliefs in computer equality and opportunity, but may not pursue those opportunities. Females may also have a greater tendency to avoid male-dominated occupations (e.g., computer-related fields), altering both educational and vocational choices.

Self-efficacy in the aged may also bear resemblance to several factors associated with computer attitudes and anxiety. Older workers may internalize certain stereotypes and this may have an effect upon their perceived ability or willingness to learn new computer skills. Due to their stage in life, older persons may also have other life experiences that will modify their level of self-efficacy. Death and loss may adversely affect the elderly, causing diminished desire or attenuated self-confidence.

Ethnic groups face similar stereotypes as females and the aged do, with some additional cultural influences. Nonwhites may have limited access to computers in the home and school, reducing the early development of basic skills. Parents, educators and counselors may steer ethnic minorities away from certain educational preparation toward vocations occupied by their race and social class. In turn, these factors may influence nonwhite self-efficacy and their range of considered vocations.

While many of the factors developing self-efficacy are different in these respective groups, their outcomes may be similar. Professions that are computer-based may not be considered by females and nonwhites due to stereotypical social influences. Aging workers may have low self-efficacy about developing new computer skills due to stereotypical beliefs about cognitive abilities. Diminished self-efficacy may lower the willingness to use computers in the workplace, and also the success of training involving advanced technologies. Consequently, this may result in lowered productivity and performance in a computer-based workplace of the future.

Literature Review Summary

The American public is making greater use of computers in both the home and at work. In the corporate realm, the computer represents a way to cut costs and maintain flexibility through quick adaptation to changing markets. This greater use of technology in the workplace has simultaneously eliminated jobs and increased the need for higher levels of employee skill.

The kinds of skills and the types of people that will be necessary in the future workforce are important. Women, older workers, and minorities are projected to make up a greater part of this labor market. Women are increasing their labor force presence, and are positioning themselves with skills-training to increase earnings and achieving promotions. Conditions are becoming conducive for older workers to remain in the work force longer. Ethnic minorities are also projected to make up a larger percentage of future entry level workers. All these groups are also benefitting from increased training, but ethnic minorities may have greater hurdles to prosperity, due to underrepresentation in fast growing occupations and overrepresentation in slow growing occupations (Kutscher, 1992). Nevertheless, greater corporate use of technology presents unique challenges and opportunities to these groups, and to the organizations that hire them. Corporations should consider the characteristics of these groups that help or hinder the optimal use of technology in the workplace.

Each of these groups will bring technological attitudes to the workplace. While these attitudes have progressively evolved from the 1960s, many remnants of the threatening "awesome thinking machine" mentality persists. These attitudes may develop in childhood through societal influence, and through different modes of interaction with peers. Early computer experiences may also play a role in attitudinal development.

Educational choices based on attitudes may be related to gender roles, sex-typing, stereotypes, and prejudice. Future experience and exposure to computers may be subsequently limited or enhanced based on these choices. Adoption or nonadoption of technology could be decided by personal strategies and goals conceived during adolescence and early adulthood. The cultural and societal pressures possibly mold the technological attitudes developed by females, older workers, and nonwhites.

Technological anxiety may also be a result of restricted computer usage by females, the aged, and certain ethnic groups. While computer apprehension has noticeably decreased since the early 1960s, a measurable percentage of people expressing computer anxiety remain. Computer anxiety has been linked to several correlating factors including locus of control, education, math anxiety, keyboarding skills, experience, gender, age, and ethnicity. These fears can lower technological acceptance and result in avoidance of education involving computers, and avoidance of computer-related vocations.

Self-efficacy was presented as being subject to many of the same developmental pressures as computer attitudes and anxieties. It was suggested that self-efficacy may not only partially dictate the adoption of technology, but also the accomplishment of computer-related goals. These beliefs about self-efficacy possibly have a strong influence on computer interest and task persistence.

Several of the same stereotypes that contribute to negative computer attitudes and anxiety may also contribute to low self-efficacy. Females may exhibit low self-efficacy toward computer-based occupations that are male dominated. The elderly worker may have expectations of cognitive decline that could lower computer self-efficacy. Ethnic minorities may be discouraged from education that prepares one for a computer-related career. Although ethnic expressions of high vocational aspirations are high, expectancies for actual vocational achievement are lower.

Several facets of attitudes, anxiety, and self-efficacy have been explored within different segments of society. Females, older persons, and nonwhites share some developmental commonalities and some dissimilarities. Unfortunately, the effects of these problems on these groups may be similar. Barriers to professional preparation in a computer-based workplace may result in low skill sets, being relegated to lower paying jobs, and minimal opportunities. A greater understanding of group differences and the forces shaping their perceptions of technology may assist productivity in the future workforce.

Implications for the Study

Three demographic trends are projected to converge with increased corporate technology usage. Women, older workers, and ethnic minorities are all projected to increase their labor presence by the year 2005. Yet many socioeconomic, cultural, and physiological differences could hamper their full participation in the new information society. These differences could manifest themselves through increased computer anxiety, negative attitudes, or defeating nonefficacious behavior. Finding out if these differences truly exist in the workplace is a first step for remediation.

Assertions made in the literature need further substantiation, using samples from the workforce. At a macro level, it appears that a combination of computer anxiety, negative attitudes, and low self-efficacy may influence vocational interest and the range of occupational consideration. At a micro level, this combination may have influences on specific computer-related choices, both in education and in the workplace. Enrollment in computer-related courses may be avoided, thereby reducing computer exposure and lessening occupational preparation. Once in the workforce, reduced willingness to use and train using computer-based technologies could thwart earnings and promotions.

Little research on computer attitudes, anxiety, and self-efficacy has been conducted with workplace populations. Many of those studies focus on specific populations, such as management. Computer attitudinal research with respect to gender (e.g., Kay, 1992), age (e.g., Charness et al., 1992), and ethnicity (e.g., Badagliacco, 1990) has suggested the need for further research.

With respect to computer anxiety, studies by Dell (Dell Computer Corporation, 1993) and Logitech (Logitech, Inc., 1992) suggested that different populations may harbor different levels of these dependent variables. The relationship of gender, age, and ethnicity to computer anxiety and attitudes is unclear, and the body of empirical evidence is sparse. This literature review also found a similar condition in existence for self-efficacy research in the aged and nonwhites.

A consistent profile of computerphobics still eludes researchers. Part of the problem lies in using inappropriate populations, sample sizes, and unreliable instruments (Kay, 1992; Rainer & Harrison, 1993). These flaws may make it difficult to effectively use the research results in occupational settings. Some empirical results are not generalizable to corporate environments and the unique problems faced there.

Individual differences, such as demographic characteristics, may be correlated to the performance and preferences of the group, and should be incorporated into human-computer interface designs (Aykin, 1989; Lee & Paz, 1991; Rosen & Weil, 1995b). Furthermore, fair and effective methods to deal with individual differences could conceivably open more computer-based jobs to more people and increase productivity (Egan et al., 1988). To do these things, however, requires a model and a knowledge base of performance parameters and preferences (Aykin, 1989; Lee & Paz, 1991). Investigating the existence, or nonexistence, of these individual differences through this research can contribute to, and expand this knowledge base.

Hypotheses

Based on research conducted or reported by Badagliacco (1990), Dyck & Smither (1994), Gist et al. (1989), Harrison & Rainer (1992a), Heinssen et al. (1987), Igbaria (1993), Nickell & Pinto (1986), and Nickell et al. (1987), the following hypotheses were formulated:

Hypothesis 1: There will be a significant interaction effect among gender, age, and ethnicity in computer self-efficacy, computer attitudes, and computer anxiety.

Hypothesis 2: Females will express significantly greater computer anxiety than males.

Hypothesis 3: Nonwhites will express significantly greater computer anxiety than whites.

Hypothesis 4: Older persons will express significantly greater computer anxiety than younger persons.

Hypothesis 5: Males will express significantly greater computer self-efficacy than females.

Hypothesis 6: Whites will express significantly greater computer self-efficacy than nonwhites.

Hypothesis 7: Younger persons will express significantly greater computer self-efficacy than older persons.

Hypothesis 8: Males will express significantly more positive computer attitudes than females.

Hypothesis 9: Whites will express significantly more positive computer attitudes than nonwhites.

Hypothesis 10: Younger persons will express significantly more positive computer attitudes than older persons.

Hypothesis 11: There will be a significant negative correlation between computer self-efficacy scores (CSES), and computer anxiety scores (CARS) within each base group of independent variables (gender, age, and ethnicity).

Hypothesis 12: There will be a significant positive correlation between computer self-efficacy scores (CSES), and computer attitudinal scores (CAS) within each base group of independent variables (gender, age, and ethnicity).

Hypothesis 13: There will be a significant negative correlation between computer anxiety scores (CARS) and computer attitudinal scores (CAS) within each base group of independent variables (gender, age, and ethnicity).

CHAPTER III

METHODOLOGY

Statement of the Problem

Computer use will increase in response to issues of cost-effectiveness and profitability, competitiveness in a global economy, the ability to adapt to various training needs, and shorter training intervals (Geber, 1990; Johnson, 1991). Studies have suggested that there may be significant levels of technological anxiety, negative computer attitudes, and low self-efficacy in females (e.g., Dambrot et al., 1985; Massoud, 1991; Nickell & Pinto, 1986; Ogletree & Williams, 1990; Popovich et al., 1987), older persons (e.g., Elder et al., 1987; Igbaria & Parasuraman, 1989; Morris, 1988; Pinto et al., 1985), and some ethnic minority groups (e.g., Badagliacco, 1990; Rosen & Weil, 1995b; Rosen et al., 1987; Winkel et al., 1985). These respective groups are projected to increase their presence in the labor force by the year 2005. Given this projected change, it becomes important that barriers to workplace participation in computer-based activities are empirically identified, substantiated, and remediated.

The problem addressed by this study is that the fear of technology, negative technological attitudes, and low technological self-efficacy may prevent the effective and productive use of computers by certain groups in the workplace. Unless studies are conducted to identify specific components of technological anxiety, attitudes, and self-efficacy, vague and ineffective methods of dealing with these problems will remain. A general lack of understanding of how computer anxiety impacts organizations and people may explain the inadequate attempts at finding solutions (Torkzadeh & Angulo, 1992). The first step in trying to increase the effective use of technology by these groups is to determine empirically that these problems do in fact exist, so that interventions can be developed to remedy these problems.

Design

The design of this study was a 2 x 2 x 3 (12 cells) between-subjects design with multiple dependent variables. Specifically, the independent variables included two genders (male and female), two classifications of ethnicity (white and nonwhite), and three age groups.

Subjects

Study interest was in the levels of workforce computer anxiety, attitudes, and self-efficacy. One readily available source of needed company information is published annually in Fortune magazine. One hundred fifty-five companies in the 1993 domestic Fortune 500 (Fortune, April 18, 1994) were randomly selected and contacted by mail. Of this group, three agreed to participate in this research by supplying the names of employees. Another public source for company information is published by the Oklahoma Department of Commerce. This list details Oklahoma-based businesses and public institutions of 500 or more employees. All businesses (n=60) on this list were also contacted by mail. Selection from this list excluded all public educational institutions. Of those sixty businesses contacted, four agreed to participate in this research.

The first Fortune 500 company is a manufacturer and provided the names and addresses of 743 employees. These names included every administrative and office-based employee in 25 different subsidiaries in eight states. The second Fortune 500 company is an energy developer. They provided the names and addresses of 60 employees. The third Fortune 500 company is a scientific, photo, and control equipment manufacturer. They provided the names of 71 employees. The other four companies were all Oklahoma-based, one company providing 55 names and the rest supplying the names of 50 employees, for a total of 205 subjects. The industries of these four companies represented retailing, manufacturing, photographic imaging, and city government. The overall subject total consisted of 1079 employees from management, administrative, and technical areas in 31 companies (see Table 1) in 12 states (see Table 2). Followup procedures for companies that declined to participate are presented in Chapter IV

Subject Selection

Because of the varying numbers of names submitted by several companies (see Table 1), a selection process was devised to reduce the chances for overrepresentation by any one organization. Therefore, companies submitting fewer than 30 employee names (n=10) were eliminated from the subject list (n=136). Employee lists numbering between 30 and 50 inclusive (n=16) were left intact (n=648). Companies submitting more than 50 names (n=5) were randomly sorted and 50 names were randomly selected from each

Table 1

Frequency Distribution of Initial Subject Pool by Company Prior to Final Selection

Company Descriptor	Frequency	Percent
Fortune 500 Co. (1.01)*	55	5.1
Fortune 500 Co. (1.02)	54	5.0
Fortune 500 Co. (1.03)	34	3.2
Fortune 500 Co. (1.04)	35	3.2
Fortune 500 Co. (1.05)	35	3.2
Fortune 500 Co. (1.06)	45	4.2
Fortune 500 Co. (1.07)	44	4.1
Fortune 500 Co. (1.08)	42	3.9
Fortune 500 Co. (1.09)	31	2.9
Fortune 500 Co. (1.10)	37	3.4
Fortune 500 Co. (1.11)	33	3.1
Fortune 500 Co. (1.12)	47	4.4
Fortune 500 Co. (1.13)	36	3.3
Fortune 500 Co. (1.14)	46	4.3
Fortune 500 Co. (1.15)	33	3.1
Fortune 500 Co. 1.xx	14	1.3
Fortune 500 Co. 1.xx	25	2.3
Fortune 500 Co. 1.xx	8	0.7
Fortune 500 Co. 1.xx	17	1.6
Fortune 500 Co. 1.xx	12	1.1
Fortune 500 Co. 1.xx	9	0.8
Fortune 500 Co. 1.xx	1	0.1
Fortune 500 Co. 1.xx	23	2.1
Fortune 500 Co. 1.xx	1	0.1
Fortune 500 Co. 1.xx	26	2.4
Fortune 500 Co. (16)	60	5.6
Fortune 500 Co. (17)	71	6.6
Oklahoma Co. #1 (18)	50	4.6
Oklahoma Co. #2 (19)	50	4.6
Oklahoma Co. #3 (20)	50	4.6
Oklahoma Co. #4 (21)	55	5.1

Note. *Company-1 is the first Fortune 500 company, with subsidiaries indicated by a decimal point and sequence number (or xx for eliminated companies). Numbers in parentheses are the selected company designators after final selection was done.

Table 2

Frequency Distribution of Initial Subject Pool by State Prior to Final Selection

Company State	Frequency	Percent
Alabama	32	3.0
Arkansas	1	0.1
Arizona	71	6.6
Connecticutt	17	1.6
Florida	55	5.1
Georgia	26	2.4
Kentucky	288	26.7
North Carolina	233	21.6
Oklahoma	265	24.6
Oregon	35	3.2
South Carolina	33	3.1
Wisconsin	23	2.1

(n=250), further eliminating 45 names. This selection process resulted in a total participant count of 898 employees in 21 companies (see Table 3) from eight different states (see Table 4). Response rates and followup procedures for this subject pool are reported in Chapter IV.

Instrumentation

Three instruments were used in this study, all with the written permission of the authors or coauthors. There were 118 items for the entire questionnaire, on six pages (see Appendix A). A postage-paid business reply envelope was also included for returning the completed questionnaire.

Cover Letter

The first page of the instrument packet was a cover letter informing participants of the nature of the study and the extent of their desired participation (see Appendix B). A brief overview of the content of the questionnaire was given, as were reasons for the research and estimated completion time (20 minutes). Subjects were told that their risk in this research was small and confidentiality was assured. In exchange for returning the questionnaire by the deadline, participants were told they would be eligible for one of three $100 awards, to be awarded in a random drawing.

An explanation was given for the name and address label attached to each questionnaire. Labels were attached to the back of the instrument set to provide a mechanism for tracking individual responses, and to have a printed date of when each

Table 3

Frequency Distribution of Selected Subject Pool by Company

Company Designator	Initial Number of Subjects	Percent	Responding Number of Subjects	Percent
COMPANY-1.01*	50**	5.6	10	2.5
COMPANY-1.02	50**	5.6	12	3.0
COMPANY-1.03	34	3.8	14	3.5
COMPANY-1.04	35	3.9	9	2.3
COMPANY-1.05	35	3.9	17	4.3
COMPANY-1.06	45	5.0	17	4.3
COMPANY-1.07	44	4.9	22	5.5
COMPANY-1.08	42	4.7	18	4.5
COMPANY-1.09	31	3.5	9	2.3
COMPANY-1.10	37	4.1	19	4.8
COMPANY-1.11	33	3.7	21	5.3
COMPANY-1.12	47	5.2	9	2.3
COMPANY-1.13	36	4.0	5	1.3
COMPANY-1.14	46	5.1	14	3.5
COMPANY-1.15	33	3.7	9	2.3
COMPANY-16	50**	5.6	41	10.3
COMPANY-17	50**	5.6	24	6.0
COMPANY-18	50	5.6	31	7.8
COMPANY-19	50	5.6	32	8.0
COMPANY-20	50	5.6	30	7.5
COMPANY-21	50**	5.6	35	8.8
TOTALS	898	100.0	398	100.0

Note. *Company-1 is the first Fortune 500 company, with subsidiaries indicated by a decimal point and sequence number.
** indicates these subjects were randomly selected from an employee list numbering > 50. Number of responding subjects does not include incomplete responses or subjects declining to participate.

Table 4

Frequency Distribution of Selected Subject Pool by State

Company State	Initial Number of Subjects	Percent	Responding Number of Subjects	Percent
Alabama	31	3.5	9	2.3
Arizona	50	5.6	24	6.0
Florida	50	5.6	10	2.5
Kentucky	220	24.5	81	20.4
North Carolina	229	25.5	75	18.8
Oklahoma	250	27.8	169	42.5
Oregon	35	3.9	9	2.3
South Carolina	33	3.7	21	5.3
TOTALS	898	100.0	398	100.0

Note. Responding frequency counts do not include incomplete responses or subjects declining to participate.

questionnaire was sent out. It was felt that removing anonymity from the subject would not inordinately hurt response rates, since the questions were not invasive.

Demographic Sheet

The second sheet of the questionnaire packet was designed to gather demographic information. Questions one through three asked for the gender, age, and classification of ethnicity, the three independent variables of this study. Classifications of ethnicity were obtained from the United States Office of Management and Budget's Directive 15, Standards for the Classification of Federal Data on Race and Ethnicity (United States Office of Management and Budget, 1977). Questions four through eleven were questions designed to more thoroughly describe the sample characteristics, supply data for further research, and to substantiate computer attitude and apprehension correlates suggested in the literature. The reasoning for those questions is now discussed in more detail to establish their connection with this research.

Question four asked the subject to select the highest educational level completed. Higher levels of education have been found significant in reducing anxiety and improving technological attitudes (Igbaria, 1993; Igbaria & Parasuraman, 1989; Rosenfeld et al., 1988). Question five concerned the ownership of a personal computer. This was based first on the suggestions of negative relationship between age and computer ownership, and secondly, of a positive correlation with computer ownership and positive computer attitudes by Nickell & Seado (1986). Question six dealt with subject participation in any type of computer course (introductory or advanced). Prior participation in introductory computer courses has been correlated with reduced anxiety and more positive technological attitudes (Chu & Spires, 1991; Kolehmainen, 1992). Question seven asked if the subject had ever taken a computer programming language course. Enrollment in computer programming courses has been shown to be significant (Gilroy & Desai, 1986) in reducing computer anxiety and negative attitudes. In addition, Ogletree & Williams (1990) suggested that males may have more confidence in their ability to program computers, and are more likely to have taken a programming course. Question eight asked the subject to indicate whether he or she managed or supervised people at work. Howard (1986) found significant differences in the technological attitudes and anxieties of managers versus non-managers. Questions nine and ten both deal with approximate estimates of experience expressed in years and months, on mainframe computers and all other computer types (micro, mini, supercomputers, etc.), respectively. Maurer (1994) wrote that demographic characteristics may interact directly with computer anxiety by affecting the amount of computer experience. Other studies have also shown strong positive and inverse relationships between experience, computer anxiety, and negative attitudes (e.g., Igbaria, 1993; Kernan & Howard, 1990; Kolehmainen, 1992; et al.). Question eleven asked the subject to estimate the number of hours a week spent using a computer at work. Relationships between negative attitudes and the number of hours a week spent using a computer has previously been suggested by Popovich et al. (1987). Question twelve was used to extract information about the different types of applications being used in the workplace. This question was primarily for sample descriptiveness, but Koohang (1989) did find that word processing, spreadsheet, and database knowledge had mixed effects on decreasing technological anxiety, increasing computer confidence, liking, and the perception of usefulness in college students.

Computer Self-Efficacy Scale

The first dissertation instrument was the Computer Self-Efficacy Scale (CSES) developed by Murphy et al. (1989). This instrument is a 32-item, self-reporting questionnaire, with 5-point Likert scale (1=Very Little, 5=Quite a Lot) that measures various perceptions of computer knowledge and confidence levels. The scores range from 32 (32*1, extremely low computer self-efficacy), to 160 (32*5, extremely high computer self-efficacy). The CSES was used to establish a self-reported computer confidence level total score for each subject. Using a total self-efficacy score (as opposed to subscale scores) is similar to the usage reported by Harrison & Rainer (1992b).

Factor analysis with oblique rotation of the CSES by Murphy et al. (1989) found three dimensions of reported skill level that explained 92% of systematic covariance. Factor one, (16 items), accounted for 76% of the covariance and represents beginning computer skills. The alpha reliability for this factor was .97 and had loadings ranging from .52 to .91. Factor two, (13 items), accounted for only 10% of the covariance and represents more conceptual, or advanced computer skill. The alpha reliability of factor two was .96 and had loadings ranging from .35 to .99. Factor three, (three items), accounted for 6% of covariance and represents levels of mainframe computer skill. The alpha reliability of factor three was .92 and had loadings ranging from .83 to .88. The original sample in this study consisted of 414 graduate students, adult vocational students, and some professionals.

Harrison & Rainer (1992a) factor analyzed the CSES scale with orthogonal rotation, producing three underlying dimensions identical to those found by Murphy et al.

(1989), explaining 68.7% of systematic covariance. The first factor, beginning or low skill, consisted of 16 items, explained 52.3% of the covariance, and had loadings ranged from .69 to .89. The second factor, moderate skill level, consisted of 12 items, explained 11.1% of the covariance, and had loadings ranging from .61 to .89. The third factor, advanced or high skill level, consisted of three items, explained 5.3% of the covariance, and had loadings ranging from .93 to .99. The responding sample in this study was 776 faculty and staff members from a large university.

According to Murphy et al. (1989), and Harrison & Rainer (1992a), the derived factor solutions and reliability coefficients suggest good construct validity and reliability for the CSES.

Computer Attitude Scale

The second instrument used was the Computer Attitude Scale (CAS) developed by Nickell & Pinto (1986). This instrument is a 20-item, self-reporting questionnaire, with a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree) designed to gauge responses about computer attitudes. The CAS was used to establish a self-reported computer attitude score for each subject. Total computer attitude scores (as opposed to subscale scores) have also been used by Nickell & Pinto (1986), Nickell et al. (1987), and Nickell & Seado (1986).

There are eight positive and 12 negative attitude statements contained in the CAS. The scores range from 20 (20*1, extremely negative attitude toward computers), to 100 (20*5, extremely positive attitude toward computers). A score of 60 (midpoint of the range) would suggest attitudinal indifference. That is, a respondent would be neither particularly positive nor particularly negative in his or her attitude toward computers.

Five samples of different sizes were originally used to analyze the psychometric properties of the CAS (Nickell & Pinto, 1986). The authors did not originally factor analyze this instrument, but did report scale internal-consistency reliability as .81. Hudiburg (1989) reported a coefficient alpha = .81 and Zakrajsek et al. (1990) reported an internal consistency alpha coefficient of .82 for the CAS.

Using five samples, Nickell & Pinto (1986) found test-retest reliability in sample five (undergraduate students) produced a statistically significant, positive correlation ($r(45) = .86, p < .001$). Tests of short-term predictive validity were extrapolated from sample two (introductory computer course students) scores, and yielded a statistically significant, positive correlation with final course grades ($r(80) = .32, p < .01$) (Nickell & Pinto, 1986). Concurrent validity was extrapolated from sample three (computer operators) scores, and yielded statistically significant, positively correlated results with recent work performance and recent supervisor evaluations ($r(45) = .63, p < .001$) (Nickell & Pinto, 1986). Construct validity was assessed by correlating sample four (undergraduate students) CAS scores with a previously validated scale of computer anxiety, Oetting's Computer Anxiety Scale (COMPAS) (Oetting, 1983). This analysis resulted in a statistically significant, negative correlation for the total COMPAS scale, ($r(47) = -.71, p < .001$), as well as for all of the subscales (Nickell & Pinto, 1986).

Harrison & Rainer (1992a) factor analyzed the CAS with orthogonal rotation, producing three underlying dimensions that explained 41.2% of systematic covariance. The first factor (eight items), negative feelings about computers, accounted for 26.9% of the covariance, and had loadings from .42 to .67. The second factor (seven items) positive feelings about computers, accounted for 8.9% of the covariance, and had loadings from .45 to .68. The third factor (four items), computer intimidation due to lack of understanding, accounted for 5.5% of the covariance, and had loadings from .65 to .74. Factor one, negative feelings, significantly correlated with factor two, positive feelings (r=-.37, $p < .001$), and with factor three, lack of understanding (r=.51, $p < .001$). Factor two significantly correlated with factor three (r=-.31, $p < .001$).

Harrison & Rainer (1992a) also examined intercorrelations between the CAS and the CSES. Factor one of the CAS, negative attitudes, correlated negatively with factor one of the CSES, beginning skill (r=-.33, $p < .001$), correlated negatively with CSES factor two, moderate skill (r=-.30, $p < .001$), and correlated negatively with CSES factor three, high skill (r=-.17, $p < .001$). Factor two of the CAS, positive attitudes, correlated positively with factor one of the CSES, beginning skill (r=.34, $p < .001$), correlated positively with CSES factor two, moderate skill (r=.21, $p < .001$), and correlated positively with CSES factor three, high skill (r=.17, $p < .001$). Factor three of the CAS, intimidation due to lack of understanding, correlated negatively with factor one of the CSES, beginning skill (r=-.56, $p < .001$), correlated negatively with CSES factor two, moderate skill (r=-.59, $p < .001$), and correlated negatively with CSES factor three, high skill (r=-.36, $p < .001$).

The CAS has been used in several other studies with varying demographic populations and purposes (e.g., Ballance & Rogers, 1991; Brock & Sulsky, 1994; Hudiburg, 1989; Nickell et al., 1987; Pinto et al., 1985; Rosenfeld et al., 1988; Winkel et al., 1985; et al.). According to Nickell & Pinto (1986), Harrison & Rainer (1992a), Zakrajsek et al. (1990) the derived factor solutions and reliability coefficients suggest good construct validity and reliability for the CAS.

Computer Anxiety Rating Scale

The third dissertation instrument used was the Computer Anxiety Rating Scale (CARS) developed by Heinssen et al. (1987). This instrument is a 20-item, self-reporting questionnaire, with a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree) and is designed to gauge dimensions of computer anxiety. The scores range from 20 (20*1, extremely low computer anxiety), to 100 (20*5, extremely high computer anxiety). A score of 60 (midpoint of the range) would suggest neither high nor low computer anxiety. That is, a respondent would be neither particularly anxious nor particularly non-anxious about using computers. The CARS was used to establish a singular self-reported computer anxiety score for each subject. Total computer anxiety scores (as opposed to subscale scores) were also reported by Chu & Spires (1991), Heinssen et al. (1987), and Meier & Lambert (1991).

There are 11 "anxiety-laden" computer statements and nine non-anxious statements contained in the CARS (Heinssen et al., 1987). This instrument was not originally factor analyzed, but the authors reported a high internal consistency (Cronbach alpha = .87), reliability (r=.70, $p < .0001$), and stability (t=-1.06, $p < .30$) over a test-retest period of four weeks using 270 introductory psychology students. Zakrajsek et al. (1990) reported an internal consistency alpha coefficient of .90 for the CARS.

Meier & Lambert (1991) investigated test-retest reliabilities of the CARS over three separate times covering 15 weeks (week one, week eight, and week 15). The sample in this study was 1,234 students enrolled in an introductory psychology course. The test-retest reliabilities were .47 (week one to week 15) to .51 (week one to week eight) (Meier & Lambert, 1991). However, Meier & Lambert (1991) noted that these reliability coefficients were underestimated since the students participating had received computer exposure during the testing period.

Harrison and Rainer (1992a) factor analyzed the CARS using orthogonal rotation that revealed two underlying, independent dimensions, explaining 40% of systematic covariance. The first factor (10 items), high anxiety toward computers, explained 33% of the covariance and had loadings from .39 to .71. The second factor (nine items), confidence or enthusiasm about computer use, explained 7% of covariance and had loadings from .37 to .72. The responding sample in this study was 776 faculty and staff members from a large university.

Harrison & Rainer (1992a) also examined intercorrelations between the CARS, CAS, and the CSES. Factor one of the CARS, high anxiety, correlated positively with factor one of the CAS, negative attitudes (r=.52, $p < .001$), correlated negatively with CAS factor two, positive attitudes (r=-.34, $p < .001$), and positively with CAS factor three, lack of understanding (r=.76, $p < .001$).

Harrison & Rainer (1992a) reported that CARS high anxiety (factor one) correlated negatively to the three skill dimensions of the CSES--low (r=-.60, $p < .001$), moderate (r=-.61, $p < .001$), and high (r=-.36, $p < .001$). The CARS dimension of confidence (factor two) correlated positively to the three skill dimensions of the CSES--low (r=.55, $p < .001$), moderate (r=.43, $p < .001$), and high (r=.29, $p < .001$).

Chu & Spires (1991) factor analyzed the CARS using orthogonal rotation that revealed five underlying, independent dimensions, explaining 62.5% of variance in scores. Eighteen items had loadings of .50 or greater and were retained. The first factor (six items), technical capability, had loadings from .50 to .76. The second factor (four items), appeal of learning about and using computers, had loadings from .56 to .81. The third factor (three items), being controlled by computers, had loadings from .53 to .84. The fourth factor (three items), learning computer skills, had loadings from .52 to .80. The fifth and final factor (two items), traits to overcome anxiety, had loadings from .64 to .79. The responding sample in this study was 132 MBA students from a large Midwestern university.

Meier & Lambert (1991) factor analyzed the CARS using a principal components analysis with varimax rotation that revealed three underlying dimensions explaining 50% of variance in scores. The first factor (eight items loading at .30 or above), negative feelings about computers, had loadings ranging from .30 to .74. The second factor (six items loading at .30 or above), positive feelings about using computers, had loadings from .51 to .72. The third factor (six items loading at .30 or above), ability to learn computer skills, had loadings from .44 to .80. The responding sample in this study was 1,234 university undergraduates as a part of a research project.

According to Chu & Spires (1991), Heinssen et al. (1987), Harrison & Rainer (1992a), LaLomia & Sidowski (1993), Meier & Lambert (1991), and Zakrajsek et al. (1990), the derived factor solutions and reliability coefficients suggest good construct validity and reliability for the CARS.

Supplemental Questions

Five questions used with the original CARS Development Project concluded the questionnaire. These questions explored general feelings of anxiety due to computer use and were used for the purposes of sample descriptiveness and to supply data for further research. It should be noted that these questions were not included in the previous discussions about CARS reliability and validity. Correspondence from a CARS coauthor indicated these questions were used in an exploratory fashion while developing questions for the CARS scale and were deleted from the final version of the instrument.

Instrument Alteration

Minor modifications were made to the Computer Attitudes Scale (CAS) and the Computer Anxiety Rating Scale (CARS) for the purposes of scale uniformity and to minimize questionnaire completion time. Both instruments in their original form were based on 5-point Likert scales (1=Very Little, 5=Quite a Lot) but required the subject to write in the number of their responses versus circling the number. Both the CAS and CARS were changed to correspond to the response format of the first instrument, the Computer Self-Efficacy Scale (CSES). That is, subjects circled their Likert response on all three instruments, rather than just the first one.

Procedures

In May of 1995, packets of the previously described instruments were mailed to 898 employees in 21 companies (see Table 3) located in eight states (see Table 4). Distributed were a cover letter, a demographic information form, the Computer Self-Efficacy Scale (CSES), the Computer Attitude Scale (CAS), the Computer Anxiety Rating Scale (CARS), the five supplemental CARS questions and a prepaid business reply envelope (see Appendix A and Appendix B). This initial mailing netted 245 responses.

After the questionnaire return deadline was past, a reminder card (see Appendix D) was sent to 653 nonrespondents, thereby extending the return deadline. This resulted in receiving an additional 183 responses. Two weeks after the reminder card deadline expired, a final copy of the original questionnaire was sent to all remaining 470 nonrespondents. This final mailing resulted in the receipt of an additional 44 responses, for a total response count of n=472 (52.56%). Of those subjects, 73 declined to participate, 398 returned completed questionnaires, and one questionnaire was incomplete, for a total of 398 (44.32%) usable responses (see Tables 3 and 4). A more thorough description of these subjects is given in Chapter IV.

Data Analysis

Several statistical analyses were conducted on the data gathered from administration of the questionnaires. All procedures used the Statistical Analysis System (SAS™) at Oklahoma State University Computer Services. Brief overviews of those procedures and the reasons for their use are presented here, with the results presented in Chapter IV.

First, simple frequency procedures and means analyses were executed against the data (questions one through 12, page one) to provide simple descriptive summary statistics about the sample group. These procedures gave an idea of how representative sample characteristics (e.g., education, personal computer ownership, computer coursework, etc.) compared to those existing in the labor force. In addition, these frequency tables were examined to ascertain if cell sizes for each categorization were large enough for use by analysis of variance. This procedure was also used to initially establish the three categories of age, a principle independent variable. Tests for differential significance in this phase, appropriate to the data type, were restricted to the three basic categories (male and female, white and nonwhite, and among the three age groups). This was done due to the small cell size of nonwhite ethnicities, and because of the large number of tests that would be required.

The second step consisted of multiple phases. This was necessary since on the CAS and the CARS, several Likert-items are reversed scored, that is, 5=1, 4=2, 2=4, and 1=5. For the CAS, the following item numbers were reverse scored: 2, 3, 5, 6, 8, 9, 12, 13, 15, 16, 18 and 20. For the CARS, the following item numbers were reverse scored: 2, 4, 5, 6, 7, 10, 11, 18 and 20. Following this study design, ethnicity was internally recoded from seven categories to two categories--white and nonwhite. After these revisions were done, each reported scale score was summed (CSES, CAS, and CARS).

The next phase of the second step involved obtaining measures of central tendency and dispersion. Each summed scale score (CSES, CAS, CARS) was calculated for each category of independent variable: gender (male and female), age (three levels), and ethnicity (white and nonwhite). With each of these described independent variable pairs, the following statistics were calculated for each summed scale score: The minimum, maximum, range, mean, variance, and the standard deviation.

These calculations were also performed for each category of age, gender, and ethnicity on the last five questions (questions one through five, page six) that were not associated with the specific scales (see Appendix A). Also, correlation procedures were run against all scale scores (CSES, CAS, and CARS) to derive a Cronbach reliability alpha (α) estimate.

Step three involved specific analyses to answer each of the previously stated hypotheses. To reduce the possibility of inflated Type I errors (due to multiple ANOVAs), all of the following analyses were done at $p < .01$ levels. For clarity, those hypotheses are reproduced here, along with the corresponding analyses executed to answer them.

Hypothesis 1: There will be a significant interaction effect among gender, age, and ethnicity in computer self-efficacy, computer attitudes, and computer anxiety.

Hypothesis 1: There will be a significant interaction effect between gender, age groups, and ethnicity in computer self-efficacy, computer attitudes, and computer anxiety.

a. A three-way ANOVA was planned to establish if there was an interaction among the three independent variables on computer self-efficacy.

b. A three-way ANOVA was planned to establish if there was an interaction among the three independent variables on computer attitudes.

c. A three-way ANOVA was planned to establish if there was an interaction among the three independent variables on computer anxiety.

Because of the low response rate from nonwhite groups (n=29), resulting cell sizes were too small for three-way ANOVAs in each preceding case and were abandoned (see Limitations in Chapter I). Instead, two-way ANOVAS were used. This action is discussed in more detail in Chapter IV.

If appropriate (ordinal interaction or no interaction), the main effects from each of these respective analyses were then analyzed to address hypotheses two through ten:

Hypothesis 2: Females will express significantly greater computer anxiety than males.

Hypothesis 3: Nonwhites will express significantly greater computer anxiety than whites.

Hypothesis 4: Older persons will express significantly greater computer anxiety than younger persons.

Hypothesis 5: Males will express significantly greater computer self-efficacy than females.

Hypothesis 6: Whites will express significantly greater computer self-efficacy than nonwhites.

Hypothesis 7: Younger persons will express significantly greater computer self-efficacy than older persons.

Hypothesis 8: Males will express significantly more positive computer attitudes than females.

Hypothesis 9: Whites will express significantly more positive computer attitudes than nonwhites.

Hypothesis 10: Younger persons will express significantly more positive computer attitudes than older persons.

Specific analyses were then performed to answer hypotheses 11-13.

Hypothesis 11: There will be a significant negative correlation between computer self-efficacy scores (CSES), and computer anxiety scores (CARS) within each base group of independent variables (gender, age, and ethnicity).

Hypothesis 12: There will be a significant positive correlation between computer self-efficacy scores (CSES), and computer attitudinal scores (CAS) within each base group of independent variables (gender, age, and ethnicity).

Hypothesis 13: There will be a significant negative correlation between computer anxiety scores (CARS) and computer attitudinal scores (CAS) within each base group of independent variables (gender, age, and ethnicity).

A Pearson product-moment correlation procedure was executed with each scale score (CSES, CAS, and CARS) to determine if any significant relationships existed among these constructs.

The correlation analyses performed for hypotheses 11 through 13 answered the question of whether computer self-efficacy, anxiety and attitude are significantly related, and whether that relationship existed in an expected direction. That is, as computer confidence increases do anxieties decrease and do attitudes improve? Does decreased anxiety improve computer attitudes?

The outputs from these analyses are all reported in Chapter IV.

CHAPTER IV

PRESENTATION OF FINDINGS

The purposes of this study were: (1) to determine if there were any significant differences in workforce computer anxiety, attitudes, and self-efficacy based on gender, race, and age and (2) to learn if there was a relationship among the constructs of computer anxiety, computer attitudes, and computer self-efficacy. This should give an indication of whether greater computer self-efficacy relates to improved attitudes and reduced technological anxiety.

This chapter presents the results of that research. The first section briefly reviews sample response rates and the followup procedures done for companies and individuals declining to participate. This section also describes the gender, ethnicity, and age of the participating subjects. Section two details demographic characteristics of the participating group garnered from responses to questions four through 12 on page one of Appendix A. Section three reviews the three instruments and then addresses each previously described hypothesis in turn. The fourth section presents the results of the last five supplemental questions concluding the questionnaire.

Respondents

Response Rate

Out of an original subject pool of 898 employees in 21 companies (see Table 3) located in eight states (see Table 4), 472 responses were received, for an overall participation rate of 52.56%. Of those subjects, 73 declined to participate, 398 returned completed questionnaires, and one questionnaire was incomplete, for a total of 398 (44.32%) usable responses. Frequency distributions of all participation types are provided, broken down by company (see Table 5), and by state (see Table 6).

Company Followup

The small participation rate by Fortune 500 companies (n=3, 2%) and by Oklahoma companies (n=4, 7%) created an interest in discovering the reasons for their refusal. It is possible that the contacted companies did not consider computer anxiety a problem, or did not feel it was an important issue. Correspondence from the companies refusing to participate aided in investigating this issue.

Seventy-eight (51.3%) responses were received from the 152 Fortune 500 companies refusing to participate. Seventy-four companies provided no response. Six responding companies (7.6%) wrote that it was against their policy to release employee information for any reason. Nine companies (11.5%) responded that company resources were not available to assist in the study. Six companies (7.6%) wrote that there was no organizational interest in participating in computer anxiety research. Fifty-two companies (66.66%) indicated that it was corporate policy not to participate in any research studies,

Table 5

Frequency Distribution of All Subject Response Types by Company

Company Designator	Participation Type	Frequency	Percent
COMPANY-1.01*	NR	35	3.9
COMPANY-1.01	N	5	0.6
COMPANY-1.01	Y	10	1.1
COMPANY-1.02	NR	34	3.8
COMPANY-1.02	N	4	0.4
COMPANY-1.02	Y	12	1.3
COMPANY-1.03	NR	18	2.0
COMPANY-1.03	N	2	0.2
COMPANY-1.03	Y	14	1.6
COMPANY-1.04	N	4	0.4
COMPANY-1.04	X	22	2.4
COMPANY-1.04	Y	9	1.0
COMPANY-1.05	NR	14	1.6
COMPANY-1.05	N	4	0.4
COMPANY-1.05	Y	17	1.9
COMPANY-1.06	NR	22	2.4
COMPANY-1.06	N	6	0.7
COMPANY-1.06	Y	17	1.9
COMPANY-1.07	NR	20	2.2
COMPANY-1.07	N	2	0.2
COMPANY-1.07	Y	22	2.4
COMPANY-1.08	NR	18	2.0
COMPANY-1.08	N	6	0.7
COMPANY-1.08	Y	18	2.0
COMPANY-1.09	NR	19	2.1
COMPANY-1.09	N	3	0.3
COMPANY-1.09	Y	9	1.0
COMPANY-1.10	NR	13	1.4
COMPANY-1.10	N	5	0.6
COMPANY-1.10	Y	19	2.1
COMPANY-1.11	NR	12	1.3
COMPANY-1.11	Y	21	2.3
COMPANY-1.12	NR	36	4.0
COMPANY-1.12	N	2	0.2
COMPANY-1.12	Y	9	1.0
COMPANY-1.13	NR	26	2.9
COMPANY-1.13	I	1	0.1
COMPANY-1.13	N	4	0.4
COMPANY-1.13	Y	5	0.6
COMPANY-1.14	NR	29	3.2
COMPANY-1.14	N	3	0.3
COMPANY-1.14	Y	14	1.6
COMPANY-1.15	NR	19	2.1
COMPANY-1.15	N	5	0.6
COMPANY-1.15	Y	9	1.0
COMPANY-16	NR	3	0.3
COMPANY-16	N	5	0.6
COMPANY-16	X	1	0.1
COMPANY-16	Y	41	4.6
COMPANY-17	NR	21	2.3
COMPANY-17	N	5	0.6
COMPANY-17	Y	24	2.7
COMPANY-18	NR	18	2.0
COMPANY-18	N	1	0.1
COMPANY-18	Y	31	3.5
COMPANY-19	NR	13	1.4
COMPANY-19	N	5	0.6
COMPANY-19	Y	32	3.6
COMPANY-20	NR	19	2.1
COMPANY-20	N	1	0.1
COMPANY-20	Y	30	3.3
COMPANY-21	NR	14	1.6
COMPANY-21	N	1	0.1
COMPANY-21	Y	35	3.9

Note. *Company-1 is the first Fortune 500 company, with subsidiaries indicated by a decimal point and sequence number. Participation Types: NR = No Response; N = No, will not participate; Y = Yes, will participate; X = Remailed by request but never responded; I = Incomplete.

Table 6

Frequency Distribution of All Subject Response Types by State

Company State	Participant Type	Frequency	Percent
Alabama	NR	19	2.1
Alabama	N	3	0.3
Alabama	Y	9	1.0
Arizona	NR	21	2.3
Arizona	N	5	0.6
Arizona	Y	24	2.7
Florida	NR	35	3.9
Florida	N	5	0.6
Florida	Y	10	1.1
Kentucky	NR	112	12.5
Kentucky	I	1	0.1
Kentucky	N	26	2.9
Kentucky	Y	81	9.0
North Carolina	NR	137	15.3
North Carolina	N	17	1.9
North Carolina	Y	75	8.4
Oklahoma	NR	67	7.5
Oklahoma	N	13	1.4
Oklahoma	X	1	0.1
Oklahoma	Y	169	18.8
Oregon	N	4	0.4
Oregon	X	22	2.4
Oregon	Y	9	1.0
South Carolina	NR	12	1.3
South Carolina	Y	21	2.3

Note. Participation Types: NR = No Response; N = No, will not participate; Y = Yes, will participate; X = Remailed by request butnever responded; I = Incomplete.

due to the large number of requests received. Five companies (6.4%) refused participation by giving two or more of previously mentioned reasons.

Correspondence was also received from 19 of the 56 Oklahoma companies refusing to participate (33.9%). Thirty-seven companies provided no response. Twelve companies (63%) indicated that no employee information was ever released for any reason. Three companies (15.7%) responded that no corporate resources were available to aid in the research. Four companies (21%) responded that there was no interest in the subject of computer anxiety.

Company Followup Discussion

It is difficult to ascertain why the companies did not participate in this research. Of those responding the reasons for refusal were similar. While the reasons given are plausible, it is likely that these companies did not consider computer anxiety a problem, or that there was no recognition of this problem in their organization. It is also possible that if these companies had taken internal measures to overcome computer anxiety problems that had surfaced in the past. Therefore, the corporate reasons given for refusing to participate in this research were taken at face value. However, it was understood that other reasons may have factored into the decision to refuse.

Nonrespondent Followup

In order to ascertain if nonrespondents were significantly different from respondents in certain categories, a final followup procedure was derived. A followup questionnaire of 13 questions was extracted from the original, consisting of one openended question, questions 4, 6, 7, 8, 9, 10, and 11 from page one, and questions 1-5 from page six (see Appendix C). The remaining nonrespondent subject pool (n=426) was then randomly sorted and 30 names were randomly selected. Subjects were telephoned by the researcher until 25 usable followup questionnaires were completed.

Nonrespondent Analysis

When asked, "Why didn't you answer the questionnaire?" 15 (60%) replied that they were too busy or did not have time at work to complete it. Six (24%) nonrespondents replied they did not recall seeing the questionnaire, two (8%) said that they received too many to answer all of them, and two (8%) replied they did not use a computer at work and were not interested in participating.

A median test was performed on the ordinal level data of the second question, highest educational level completed. No significant difference was found (median=3, $\chi^2(1)=.0194$, $p > .01$), between nonrespondents (n=24) and participating respondents (n=375).

Chi-square tests were then performed on the nominal level data of questions three, four, and five. No significant differences were found in having taken a computer course ($\chi^2(1)=.227$, $p > .01$) , having taken a programming course ($\chi^2(1)=.100$, $p > .01$), or in supervising ($\chi^2(1)=.576$, $p > .01$) between respondents (n=25) and nonrespondents (n=398).

Differences in computer experience, (questions six and seven), and hours a week spent using a computer (question eight) were examined. T-tests uncovered significant differences in total mainframe experience ($t(36)=-3.1264$, $p < .01$), with respondents having more mainframe experience ($\bar{x}$=5.54 years) than nonrespondents ($\bar{x}$=3.18 years). No significant differences were found in other computer experience ($t(28)=-.0008$, $p > .01$). Nor were significant differences found when years of mainframe experience were combined with years of other computer experience ($t(32)=-1.2948$, $p > .01$). No significant difference was found in average total hours spent using a computer at work ($t(27)=.3264$), $p > .01$) between the nonrespondent group (n=25) and the responding group (n=398).

T-tests were then performed on the last five questions (questions nine through 13) of the followup questionnaire. No significant differences were found in questions nine ($t(26)=-.7937$, $p > .01$), ten ($t(26)=-.9763$, $p > .01$), eleven ($t(26)=-1.6833$, $p > .01$), or twelve ($t(26)=1.6474$, $p > .01$). However, significance was reached for question 13 ($t(27)=2.9343$, $p < .01$), "How uneasy or anxious would you feel if you were in the midst of a work session at that computer and you just couldn't get your job to run?" Nonrespondent answers reflected significantly more anxiety ($\bar{x}$=62.4, s=26.18), than respondents ($\bar{x}$=46.54, s=26.59).

Nonrespondent Discussion

Thirteen (13) tests were run searching for significant differences between nonrespondents and participating respondents in several categories: education, computer coursework, supervision, computer experience levels, average hours of usage per week and computer anxiety. Of those 13 tests, only two resulted in significant findings (questions six and 13).

Significantly less mainframe experience alone (question six) by the nonrespondent group diminishes in importance when one considers the contemporary proliferation of mini- and micro-computers in the workplace. This perspective is partially supported by the nonsignificant findings regarding other types of computer experience and overall computer experience.

The greater anxiety expressed by nonrespondents in answering question 13 is of interest since admission of anxiety or fear could present a psychological barrier to response (see Limitations in Chapter I). However, the type of computer anxiety posed in this question is more reactive than predispositional. That is, the anxiety encountered is after the user has begun using the computer, rather than the type of anxiety that would preclude them from ever using the computer. The case for linking the difference in this question to a cause for nonresponse is not as strong as it would be with questions nine through 12.

Time limitations at work were expressed by a majority of nonrespondents (n=15, 60%) as a reason for not returning the questionnaire (question one). If the two significant differences are considered together with question one responses, it becomes difficult to support an overall view of difference between respondents and nonrespondents in the categories examined. Therefore, it was concluded that nonresponse was largely caused by the lack of time at work to complete the questionnaire and not because nonrespondents were somehow characteristically different.

Gender and Ethnic Representation

Frequency distributions for participating respondents of two independent variables, gender, and ethnicity, are shown in Table 7. A comparison of gender percentages reveals that this sample (males=58.5%, females=41.5%) is similar to percentages in the labor force (N=118,400,000) for males (54.29%) and females (45.71%) (see United States Bureau of the Census, 1993c). Ethnic percentages are less representative than gender, with whites in this sample (92.7%) greater than that found in the workforce (85.95%). Correspondingly, the nonwhite percentage in this sample (7.3%) is underrepresented relative to that of the labor force percentage of 14.01% (see United States Bureau of the Census, 1993c).

Age

The third independent variable in this study design was age. Specific age ranges were not defined prior to the beginning of the research, but rather after all questionnaires were received. Three groups were proposed, in order to minimize restriction of range concerns, and to more closely pinpoint the effects (if any) of computer anxiety, attitudes, and self-efficacy within age categories.

Examination of an age frequency distribution (see Table 8) revealed that respondents age (n=396, missing=2, minimum=23, maximum=64, range=41, $\bar{x}$=40.47, s=9.65) closely approximate the spectrum of the normal working life (e.g., ages 21 through 64). Tentative age ranges were then established from dividing this frequency distribution into approximate thirds, while keeping whole age groups intact. This division

Table 7

Frequency Distribution of Participating Respondents by Gender and Ethnicity

Level	Frequency	Percent
Female	165	41.5
Male	233	58.5
White	369	92.7
Nonwhite	29	7.3

Table 8

Frequency Distribution of Participating Respondents by Age

Age	Frequency	Percent	Cumulative Frequency	Cumulative Percent
23	2	0.5	2	0.5
24	3	0.8	5	1.3
25	10	2.5	15	3.8
26	8	2.0	23	5.8
27	6	1.5	29	7.3
28	11	2.8	40	10.1
29	14	3.5	54	13.6
30	13	3.3	67	16.9
31	13	3.3	80	20.2
32	15	3.8	95	24.0
33	16	4.0	111	28.0
34+	13	3.3	124	31.3
35*	16	4.0	140	35.4
36	13	3.3	153	38.6
37	22	5.6	175	44.2
38	13	3.3	188	47.5
39	10	2.5	198	50.0
40	15	3.8	213	53.8
41	11	2.8	224	56.6
42	14	3.5	238	60.1
43	10	2.5	248	62.6
44*+	14	3.5	262	66.2
45*+	11	2.8	273	68.9
46	18	4.5	291	73.5
47	8	2.0	299	75.5
48	13	3.3	312	78.8
49	6	1.5	318	80.3
50	7	1.8	325	82.1
51	8	2.0	333	84.1
52	6	1.5	339	85.6
53	10	2.5	349	88.1
54	7	1.8	356	89.9
55	5	1.3	361	91.2
56	7	1.8	368	92.9
57	8	2.0	376	94.9
58	3	0.8	379	95.7
59	8	2.0	387	97.7
60	2	0.5	389	98.2
61	3	0.8	392	99.0
62	1	0.3	393	99.2
63	1	0.3	394	99.5
64	2	0.5	396	100.0

Note. Frequency Missing = 2.
* = Denotes initial cutoff points for age categories.
+ = Denotes final cutoff points for age categories.

resulted in age group 1 (A_1, ages 23-35, n=140, 35.4%), age group 2 (A_2, ages 36-44, n=122, 30.8%), and age group 3 (A_3, 45-64, n=134, 33.8%).

However, the mere mathematical division of respondent ages into thirds alone was insufficient (due to possible clustering), without other substantiation. Two factors for regrouping were considered. First, it was important to be able to accurately compare each age grouping with similar groupings in the literature. Secondly, it was desirable for each group to represent percentages in the labor force as closely as possible, while simultaneously maintaining equitable balances within the sample. Because of the wide range of respondent ages, both conditions were satisfied with only one minor modification to the original table. Reports from the United States Bureau of Labor Statistics on employment (e.g., United States Bureau of Labor Statistics, 1994a; United States Bureau of Labor Statistics, 1994b; United States Bureau of Labor Statistics, 1994c; et al.) and from the United States Bureau of the Census on computer use and population (e.g., United States Bureau of the Census, 1993b; United States Bureau of the Census, 1993c; United States Bureau of the Census, 1993d; et al.) generally use more than three age categories. However, several cutoff points used to categorize age in these reports (e.g., 18 to 21, 22 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 and up) closely resemble the initial categories derived from the first age frequency distribution in Table 8. Thus, these groupings can be combined to provide reasonably close age comparisons for this research. By decreasing the sample cutoff age of A_1 from 35 to 34 years comparative age ranges are developed, representative percentages relative to the labor force are maintained, and balance is preserved within the sample.

These new age divisions resulted in age group 1 (A_1, ages 23-34, n=124, 31.3%), age group 2 (A_2, ages 35-44, n=138, 34.9%), and age group 3 (A_3, ages 45-64, n=134, 33.8%). These age ranges also provide good representativeness percentage-wise compared with the overall employed labor force (N=118,400,000). A census report (United States Bureau of the Census, 1993c) reflects ages 22 to 34 are 34.01% (n=40,317,000) of those employed, ages 35 to 44 are 27.71% (n=32,810,000), and ages 45 to 64 are 29.02% (n=34,357,000). Crosstabulated frequency matrices of age and race groupings controlling for gender are shown in Table 9 (female), Table 10 (male), and Table 11 (combined).

Demographic Characteristics

Education

Question four of the demographic questionnaire asked for the highest educational level completed (see Appendix A). An overall frequency distribution (see Table 12) shows that most subjects (n=205, 51.5%) have a junior college degree or less. This is a lower percentage than found in the labor force (N=118,400,000) percentage of 63.5% (n=75,184,000) (United States Bureau of the Census, 1993c). Remaining subjects (n=193, 48.5%) have four year or advanced degrees, greater than that of the labor force percentage of 25.57% (n=30,280,000). The only statistically significant sample difference in education was found between males and females, (median=3, $\chi^2(1)=18.075$, $p < .01$). A greater percentage of males tended to have more education (above the median of junior college level) than females.

Table 9

Frequency Distribution Matrix of Female Respondents by Race and Age

Frequency Percent Row Pct Col Pct	------ Age Groups -------			
	23 - 34	35 - 44	45 - 64	Total
White	58 35.37 38.93 92.06	51 31.10 34.23 87.93	40 24.39 26.85 93.02	149 90.85
Nonwhite	5 3.05 33.33 7.94	7 4.27 46.67 12.07	3 1.83 20.00 6.98	15 9.15
Total	63 38.41	58 35.37	43 26.22	164 100.00

Note. Frequency Missing = 1.

Table 10

Frequency Distribution Matrix of Male Respondents by Race and Age

Frequency Percent Row Pct Col Pct	------ Age Groups -------			
	23 - 34	35 - 44	45 - 64	Total
White	56 24.14 25.69 91.80	77 33.19 35.32 96.25	85 36.64 38.99 93.41	218 93.97
Nonwhite	5 2.16 35.71 8.20	3 1.29 21.43 3.75	6 2.59 42.86 6.59	14 6.03
Total	61 26.29	80 34.48	91 39.22	232 100.00

Note. Frequency Missing = 1.

Table 11

Frequency Distribution of All Respondents by Gender, Race and Age Group

Gender	Race	Age Group	Frequency	Percent
Female	White	1	58	14.6
Female	White	2	51	12.9
Female	White	3	40	10.1
Female	Nonwhite	1	5	1.3
Female	Nonwhite	2	7	1.8
Female	Nonwhite	3	3	0.8
Male	White	1	56	14.1
Male	White	2	77	19.4
Male	White	3	85	21.5
Male	Nonwhite	1	5	1.3
Male	Nonwhite	2	3	0.8
Male	Nonwhite	3	6	1.5

Note. Frequency Missing = 2.
Age Groups: 1=23-34; 2=35-44; 3=45-64.

Table 12

Frequency Distribution of Educational Level for All Respondents

Classification	High School Freq./%		Some College Freq./%		Junior College Freq./%		College Freq./%		Masters Freq./%		Doctorate Freq./%	
Overall	65	16.3%	117	29.4%	23	5.8%	159	39.9%	29	7.3%	5	1.3%
Fmales	33	20.0%	64	38.8%	7	4.2%	53	32.1%	8	4.8%	0	0.0%
Males	32	13.7%	53	22.7%	16	6.9%	106	45.5%	21	9.0%	5	2.1%
White	60	16.3%	106	28.7%	21	5.7%	148	40.1%	29	7.9%	5	1.4%
Nonwhite	5	17.2%	11	37.9%	2	6.9%	11	37.9%	0	0.0%	0	0.0%
Ages 23 to 34	12	9.7%	28	22.6%	5	4.0%	72	58.1%	7	5.6%	0	0.0%
Ages 35 to 44	22	15.9%	44	31.9%	10	7.2%	50	36.2%	10	7.2%	2	1.4%
Ages 45 to 64	29	21.6%	45	33.6%	8	6.0%	37	27.6%	12	9.0%	3	2.2%

Personal Computer Ownership

Question five of the demographic questionnaire asked, "Do you have a personal computer at home?" (see Appendix A). Total response to this question indicated that most subjects (n_{yes}=242, 60.8%) did own a personal computer (see Table 13). This percentage is greater than the national population percentage that own a PC of 40.53% (n=47,988,000), for persons aged 18 and older (United States Bureau of the Census, 1993c). Examination of gender also reflects a larger percentage of PC ownership than the national averages both for females (n_{yes}=99)--60% versus 24.3%, and males (n_{yes}=143)--61.4% versus 27.1% (United States Bureau of the Census, 1993c).

Whites in this sample (n_{yes}=229) also exceeded the national percentage in PC ownership, 62.1% versus 26.9% (United States Bureau of the Census, 1993c). The nonwhite (n_{yes}=13, 44.8%) percentage of PC ownership was almost exactly equal to the national figure of 45.1% (United States Bureau of the Census, 1993c).

Two of the age groups, A_1 (n_{yes}=68) and A_3 (n_{yes}=80), closely resembled national percentages for home computer ownership: A_1=54.8% versus 50.7% and A_3=59.7% versus 54.3% respectively (United States Bureau of the Census, 1993c). The second age group, A_2, (n_{yes}=93) contrasted markedly from the national figures of PC ownership, A_2=67.4% versus 34.2% (United States Bureau of the Census, 1993c). In addition, subjects in A_2 (ages 35 to 44) were significantly more likely than A_1 (ages 23 to 34) to own a personal computer ($\chi^2(1)=4.344$, $p < .01$).

Table 13

Frequency Distribution of Home Computer Ownership by All Respondents

Classification	No Frequency	No Percent	Yes Frequency	Yes Percent
Overall	156	39.2	242	60.8
Females	66	40.0	99	60.0
Males	90	38.6	143	61.4
Whites	140	37.9	229	62.1
Nonwhites	16	55.2	13	44.8
Ages 23 to 34	56	45.2	68	54.8
Ages 35 to 44	45	32.6	93	67.4
Ages 45 to 64	54	40.3	80	59.7

Previous Computer Coursework

Questions six and seven of the demographic questionnaire (see Appendix A) dealt with having previously taken computer courses. Question six asked about introductory computer courses, while question seven specifically addressed taking computer programming courses. No national percentages were found that could be appropriately compared to either question.

Most respondents (n_{yes}=354, 88.9%) replied that they had taken some kind of computer course, introductory or otherwise (see Table 14). No significant differences with respect to introductory computer courses were found between any of these groups.

In response to question seven, less than half of all respondents (n_{yes}=194, 48.7%) replied that they had taken a programming course (see Table 15). Males were significantly more likely than females to have taken a programming course, ($\chi^2(1)=12.584$, $p < .01$). Subjects in the first two age groups, A_1 and A_2, were significantly more likely to have taken a programming course than those subjects in A_3, (A_1 vs. A_3 ($\chi^2(1)=22.099$, $p < .01$), and (A_2 vs. A_3 ($\chi^2(1)=13.713$, $p < .01$)).

Supervising

Question eight of the demographic questionnaire asked if the subject managed or supervised other people as a part of their job (see Appendix A). By taking the total labor force figure (N=118,400,000), and the figure from the managerial occupation category (n=16,381,000) (see United States Bureau of the Census, 1993e), a roughly approximate national comparative percentage of 13.84% was extrapolated.

Table 14

Frequency Distribution of Prior Enrollment in Any Computer Course by All Respondents

Classification	No Frequency	No Percent	Yes Frequency	Yes Percent
Overall	44	11.1	354	88.9
Females	14	8.5	151	91.5
Males	30	12.9	203	87.1
Whites	42	11.4	327	88.6
Nonwhites	2	6.9	27	93.1
Ages 23 to 34	11	8.9	113	91.1
Ages 35 to 44	12	8.7	126	91.3
Ages 45 to 64	21	15.7	113	84.3

Table 15

Frequency Distribution of Prior Enrollment in a Computer Programming Course by All Respondents

Classification	No Frequency	No Percent	Yes Frequency	Yes Percent
Overall	204	51.3	194	48.7
Females	102	61.8	63	38.2
Males	102	43.8	131	56.2
Whites	192	52.0	177	48.0
Nonwhites	12	41.4	17	58.6
Ages 23 to 34	48	38.7	76	61.3
Ages 35 to 44	63	45.7	75	54.3
Ages 45 to 64	91	67.9	43	32.1

More than half of the responding sample (n_{yes}=222, 55.8%) stated that they were in positions of management or supervision (see Table 16). It can be seen that this sample was far above the national percentage (13.84%) in this category. Females (n_{yes}=62, 37.6%) had a significantly fewer number of managerial positions ($\chi^2(1)$=37.862, $p < .01$) than did males (n_{yes}=160, 68.7%). No significant differences were found between whites and nonwhites with regard to supervising. However, subjects in the first age group, A_1 (n_{yes}=53, 42.7%), were significantly less likely to be in positions of management than either A_2 (n_{yes}=84, 60.9%) or A_3 (n_{yes}=84, 62.7%) (A_1 vs. A_2 ($\chi^2(1)$=8.603, $p < .01$), and (A_1 vs. A_3 ($\chi^2(1)$=10.287, $p < .01$)).

Computer Experience

Questions nine and ten on the demographic questionnaire (see Appendix A) asked participants about experience with two different types of computers, mainframes and others (minis, micros, supercomputers, etc.). A total experience level in years was derived by combining the years of mainframe experience and the years of other computer experience. As with questions six and seven, no readily available national figures were available for comparative purposes. A comprehensive means table for all three experience types is provided in Table 17. This table provides an initial view of the experience levels for each base level of independent variable. No significant differences in mainframe experience were found between males and females or between whites and nonwhites. However, the youngest age group, A_1 had significantly less mainframe experience than either A_2 ($t(223)$=-4.3521, $p < .01$), or A_3 ($t(187)$=-3.4240, $p < .01$). Males had

Table 16

Frequency Distribution of All Respondents That Manage or Supervise Others as a Part of Their Job

Classification	No Frequency	No Percent	Yes Frequency	Yes Percent
Overall	176	44.2	222	55.8
Females	103	62.4	62	37.6
Males	73	31.3	160	68.7
Whites	160	43.4	209	56.6
Nonwhites	16	55.2	13	44.8
Ages 23 to 34	71	57.3	53	42.7
Ages 35 to 44	54	39.1	84	60.9
Ages 45 to 64	50	37.3	84	62.7

Table 17

Means Analysis on Mainframe, Other and Total Years of Computer Experience by All Respondents

Classification	n	Experience	Minimum	Maximum	Range	Mean	Variance	Std Dev
Overall	398	Mainframe	0.00	34.00	34.00	5.54	43.33	6.58
		Other	0.00	35.00	35.00	7.40	29.61	5.44
		Total	0.00	66.00	66.00	12.94	81.09	9.00
Females	165	Mainframe	0.00	30.00	30.00	6.09	35.83	5.99
		Other	0.00	20.00	20.00	6.68	18.95	4.35
		Total	0.00	45.00	45.00	12.78	53.63	7.32
Males	233	Mainframe	0.00	34.00	34.00	5.15	48.45	6.96
		Other	0.00	35.00	35.00	7.91	36.65	6.05
		Total	0.00	66.00	66.00	13.06	100.81	10.04
Whites	369	Mainframe	0.00	34.00	34.00	5.50	43.18	6.57
		Other	0.00	35.00	35.00	7.46	29.52	5.43
		Total	0.00	66.00	66.00	12.95	79.97	8.94
Nonwhites	29	Mainframe	0.00	25.00	25.00	6.10	46.55	6.82
		Other	0.00	25.00	25.00	6.69	31.34	5.60
		Total	1.00	50.00	49.00	12.79	98.67	9.93
Ages 23 to 34	124	Mainframe	0.00	14.00	14.00	3.65	13.73	3.71
		Other	0.00	20.00	20.00	6.49	16.37	4.05
		Total	1.00	24.00	23.00	10.15	27.42	5.24
Ages 35 to 44	138	Mainframe	0.00	25.00	25.00	6.44	41.28	6.43
		Other	0.00	21.00	21.00	7.94	26.51	5.15
		Total	1.00	32.00	31.00	14.38	70.01	8.37
Ages 45 to 64	134	Mainframe	0.00	34.00	34.00	6.36	68.83	8.30
		Other	0.00	35.00	35.00	7.70	44.74	6.69
		Total	0.00	66.00	66.00	14.06	133.64	11.56

significantly more experience than females with other computers ($t(396)$=-2.3575, $p < .01$). Age group one had significantly less experience with other computers than A_2 ($t(256)$= -2.5328, $p < .01$). Age group one also had significantly less total experience than either A_2 ($t(233)$=-4.9541, $p < .01$), or A_3 ($t(189)$=-3.5439, $p < .01$).

Usage Hours Per Week

Question 11 of the demographic questionnaire asked respondents to specify the approximate number of hours per week they spent using a computer at work. No national figures in this category were available for comparative use. A combined means analysis is provided in Table 18 for the complete sample, in addition to the seven base levels of independent variables.

T-tests revealed significant differences between three sample groupings. Females used a computer at work significantly more than males ($t(377)$=5.2193, $p < .01$). Age group one reflected significantly greater computer usage per week when compared to A_3 ($t(251)$=45439, $p < .01$). Age group two also used the computer at work significantly more than A_3 ($t(270)$=4.0181, $p < .01$).

Computer Applications and Functions

Question 12 of the demographic questionnaire asked subjects to select from 12 possible computer applications they may use at work. Distinctions between specific types of computers (mainframe or other) were not given for these applications, so their usage may be interpreted as including both types. A frequency distribution is provided in Table 19 for the complete sample, in addition to the seven base levels of independent variables.

Table 18

Means Analyses of Hours Per Week of Computer Usage by Respondent Categories

Category	n	Minimum	Maximum	Range	Mean	Variance	Std Dev
Overall	398	0.00	55.00	55.00	21.68	164.41	12.82
Females	165	0.00	55.00	55.00	25.47	132.92	11.53
Males	233	0.00	55.00	55.00	19.00	169.97	13.04
Whites	369	0.00	55.00	55.00	21.62	161.07	12.69
Nonwhites	29	0.00	50.00	50.00	22.52	213.47	14.61
Aged 23-34	124	0.00	55.00	55.00	24.45	160.67	12.68
Aged 35-44	138	0.00	55.00	55.00	23.49	162.32	12.74
Aged 45-64	134	0.00	50.00	50.00	17.47	142.70	11.95

Note. There were two missing values with respect to age.

Table 19

Frequency Distribution of Applications Used at Work by All Respondents

Classification	No Use (Freq.) (Pct.)	CAD/CAM (Freq.) (Pct.)	E-Mail (Freq.) (Pct.)	Spread-Sheets (Freq.) (Pct.)	Stat. Analysis (Freq.) (Pct.)	Computer Program (Freq.) (Pct.)	Database /Files (Freq.) (Pct.)	Desktop Publish (Freq.) (Pct.)	Internet Resources (Freq.) (Pct.)	Word Process (Freq.) (Pct.)	Instruct (Freq.) (Pct.)	Other (Freq.) (Pct.)
Overall	10	46	251	291	152	42	261	84	39	313	47	63
	2.5	11.6	63.1	73.1	38.2	10.6	65.6	21.1	9.8	78.6	11.8	15.8
Females	4	4	114	130	59	16	112	37	16	131	17	29
	2.4	2.4	69.1	78.8	35.8	9.7	67.9	22.4	9.7	79.4	10.3	17.5
Males	6	42	137	161	93	26	149	47	23	182	30	34
	2.6	18.0	58.8	69.1	39.9	11.2	63.9	20.2	9.9	78.1	12.9	14.5
Whites	9	44	234	272	140	39	246	78	35	295	41	58
	2.4	11.9	63.4	73.7	37.9	10.6	66.7	21.1	9.5	79.9	11.1	15.7
Nonwhites	1	2	17	19	12	3	15	6	4	18	6	5
	3.4	6.9	58.6	65.5	41.4	10.3	51.7	20.7	13.8	62.1	20.7	17.2
Ages 23 to 34	3	14	71	93	44	17	88	31	10	101	18	22
	2.4	11.3	57.3	75.0	35.5	13.7	71.0	25.0	8.1	81.5	14.5	17.7
Ages 35 to 44	3	21	99	109	60	18	98	29	18	111	14	19
	2.2	15.2	71.7	79.0	43.5	13.0	71.0	21.0	13.0	80.4	10.1	13.7
Ages 45 to 64	4	11	80	89	47	7	73	24	11	99	15	21
	3.0	8.2	59.7	66.4	35.1	5.2	54.5	17.9	8.2	73.9	11.2	15.6

Computer Use

Item a of question 12 asked if the respondent used a computer at work. Sample response indicated that 97.5% did use a computer at work. This is far above the national percentage (employed workers (N=118,400,000) spanning all occupations), of 43.16% (see United States Bureau of the Census, 1993f). Females in this sample that used a computer at work were also above the national percentage (97.6% versus 49.32%), as were males (97.4% versus 37.98%) (see United States Bureau of the Census, 1993f). Sampled whites exceeded national percentages in computer use (97.6% versus 47.1%), as did sampled nonwhites (96.6% versus 34.75%) (see United States Bureau of the Census, 1993c). All three age groups likewise surpassed national percentages in computer use: A_1, 97.6% versus 45.31%, A_2 97.8% versus 47.81%, and A_3 97.0% versus 42.80% (see United States Bureau of the Census, 1993c). No statistically significant differences were found between any of these groups regarding computer usage at work.

CAD/CAM

Item B of question 12 asked if the respondent used CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) applications. This type of computer application is largely used in manufacturing and engineering. This sample exceeded national percentages for CAD/CAM use, 11.6% versus 3.3% (see United States Bureau of the Census, 1993f). Males in this sample (n_{yes}=42) were significantly more likely to use a CAD/CAM application at work than females (n_{yes}=4) ($\chi^2(1)$=23.001, $p < .01$).

Electronic Mail

Item C of question 12 asked if the respondent used electronic mail (e-mail) at work. Response to this question reflected a greater use of e-mail by the sample (63.1%) than the national percentage of 9.18% (see United States Bureau of the Census, 1993f). Significant differences in electronic mail usage were found between sampled males and females ($\chi^2(1)=4.393$, $p < .01$), age groups A_1 and A_2 ($\chi^2(1)=6.011$, $p < .01$), and A_2 and A_3 ($\chi^2(1)=4.378$, $p < .01$). Sampled males were significantly more likely to use e-mail than females. Subjects in the middle age range of 35 to 44 were significantly more likely to use e-mail than those in age groups A_1 or A_3.

Spreadsheets

Item D of question 12 asked if the respondent used spreadsheet applications. Spreadsheet usage in this sample, 73.1%, exceeded the national percentage of 10.17% (see United States Bureau of the Census, 1993f). Significant differences in spreadsheet usage were found between males and females ($\chi^2(1)=4.613$, $p < .01$), and A_2 and A_3 ($\chi^2(1)=5.422$, $p < .01$). Sampled males were significantly more likely to use spreadsheet applications at work than females. The middle age range (ages 35 to 44) was significantly more likely to use spreadsheets than the oldest age range of 45 to 64.

Statistical Analysis

Item E of question 12 asked if the respondent used the computer for statistical analysis. While the subject percentage of use (38.2%) was lower than several previous applications, it still exceeded the national percentage in this category of 10.99% (see United States Bureau of the Census, 1993f). No statistically significant differences were found between the base levels of independent variables with respect to statistical analysis computer usage.

Computer Programming

Item F of question 12 asked the subject if their computer at work was used for computer programming. Sample percentages (10.6%) were approximately twice that of the national figure, 5.63% (see United States Bureau of the Census, 1993f). Age group one was significantly more likely to use the computer at work for programming purposes than A_3 ($\chi^2(1)=5.497$, $p < .01$), as was A_2 ($\chi^2(1)=4.981$, $p < .01$).

Database/File Management

Item G of question 12 asked subjects if they used their computer at work for database or file management. The sample percentage of 65.6% showed greater usage for this application than the national percentage of 14.83% (see United States Bureau of the Census, 1993f). Significant differences in database management computer usage were found between age groups A_1 and A_3 ($\chi^2(1)=7.464$, $p < .01$), and A_2 and A_3 ($\chi^2(1)=7.964$, $p < .01$). Both A_1 and A_2 were significantly more likely to use computers at work for database and file management than the age group, A_3.

Desktop Publishing

Item H of question 12 asked subjects if they used their computers at work for desktop publishing purposes. Sample percentages (21.1%) for desktop publishing exceeded the national percentage of 5% (see United States Bureau of the Census, 1993f). No statistically significant differences were found for this application between the base levels of the independent variables.

Internet Resources

Item I of question 12 asked subjects if they used their computers at work to access Internet resources. The Internet is a group of interconnected computer systems that all communicate in a configuration known as a network. A collection of these networks was developed in the early 1970's by the United States Department of Defense (Dern, 1994). These networks consist of many different kinds of computers, owned by governmental agencies, private companies, individuals, and educational institutions. Many of these institutions make articles, graphics, and statistical data freely available for use by other users. Accessing these types of resources is what is implied by this question.

While the Internet has existed for approximately 25 years, exploitation of its vast data resources is relatively new. This is reflected in the low percentage of Internet use (9.8%) by the responding sample. Unfortunately, while statistics exist for the category of communications (see United States Bureau of the Census, 1993f), it cannot be appropriately compared to this item, since all computer communications are not related to

Internet access. No statistically significant differences were found between groups for Internet resource access.

Word Processing

Item J of question 12 concerned the use of word processing applications at work. Affirmative sample response (78.6%) surpassed the national percentage (19.10%) for this category. Whites were significantly more likely to use computers at work for word processing than nonwhites ($\chi^2(1)=5.116$, $p < .01$).

Instructional Purposes

Item K of question 12 asked subjects if they used computers at work for instructional purposes. While not specifically expressed, this category could reasonably include computer-based training, software tutorials, and other types of instruction. In order to develop a roughly comparative national figure, two application categories (educational programs and learning to use) were combined to derive an approximate percentage of 8.0% (see United States Bureau of the Census, 1993f).

Sample response (11.8%) closely approximated this extrapolated national percentage of 8.0%. No statistically significant differences were found regarding instructional use between any of the base independent variable levels.

Company Differences

It was desirable to discover if the two company types (Fortune 500 companies versus Oklahoma companies) were from similar populations. The existence of differences may have necessitated treating these two groups separately. Therefore, each scale score (CSES, CAS, and CARS) and several demographic characteristics (from page one of Appendix A) of the two company types were tested for significant differences.

No significant differences were found between Fortune 500 company participants (n=270) and Oklahoma company participants (n=128) in computer self-efficacy scores ($F(1, 396)=0.60$, $p > .01$), computer attitude scores ($F(1,396)=0.15$, $p > .01$), or in computer anxiety scores ($F(1,396)=0.0$, $p > .01$). Likewise, no significant differences were found for: having a personal computer at home ($\chi^2(1)=.155$, $p > .01$), having taken a computer course ($\chi^2(1)=.155$, $p > .01$), supervising ($\chi^2(1)=3.156$, $p > .01$), mainframe experience ($t(318)=2.108$, $p > .01$), other computer experience ($t(244)=1.3856$, $p > .01$), or total computer experience ($t(265)=2.30$, $p > .01$). Neither were significant differences found for the average number of hours per week using a computer ($t(245)=-0.621$, $p > .01$) nor for any of the five supplemental questions.

The only significant difference found between Fortune 500 company participants and Oklahoma company participants was in having taken a computer course ($\chi^2(1)=7.078$, $p < .01$). Fortune 500 company subjects were significantly more likely to have taken a programming course than Oklahoma company subjects.

Out of the 16 tests done, only one resulted in a significant finding. It was therefore concluded that these two groups were from the same population and could be treated similarly.

Instrument Scales and Hypotheses

The respective scales, (CSES, CAS, and CARS) followed the demographic questionnaire (see Appendix A). The first instrument was the Computer Self-Efficacy Scale (32 items), used to assess computer confidence levels. The second instrument was the Computer Attitude Scale (20 items), used to assess computer attitudes. The third instrument was the Computer Anxiety Rating Scale (20 items) used to assess various anxieties people may have when interacting with computers. There were 72 total items for these three instruments. The derived Cronbach reliability alphas for each scale were: CSES=.97, CAS=.84, and CARS=.85.

Preliminary means analyses were performed on each scale sum to gauge the base existence of computer self-efficacy, attitudes, and anxiety in each group. The results of those means analyses are provided in Table 20 for the complete sample, in addition to the seven base levels of independent variables. Analyses of these scale scores form the foundation for answering the previously stated research hypotheses. For purposes of clarity, those hypotheses are replicated here, along with the methods initially proposed to answer them.

Hypotheses

Hypothesis 1: There will be a significant interaction effect among gender, age, and ethnicity in computer self-efficacy, computer attitudes, and computer anxiety.

Due to the low response rate from nonwhite groups (n=29), resulting cell sizes were too small for three-way ANOVAs and were not done. Instead, two-way general

Table 20

Means Analysis on CSES, CAS and CARS Scale Score Summations for All Respondents

Classification	n	Scale Sum	Minimum	Maximum	Range	Mean	Variance	Std Dev
Overall	398	CSES	32.00	160.00	128.00	122.32	769.80	27.75
		CAS	51.00	100.00	49.00	79.36	93.95	9.69
		CARS	22.00	63.00	41.00	38.83	76.99	8.77
Females	165	CSES	32.00	160.00	128.00	122.81	628.71	25.07
		CAS	51.00	100.00	49.00	78.29	111.59	10.56
		CARS	23.00	63.00	40.00	39.18	73.39	8.57
Males	233	CSES	32.00	160.00	128.00	121.98	872.56	29.54
		CAS	51.00	100.00	49.00	80.11	80.50	8.97
		CARS	22.00	63.00	41.00	38.58	79.72	8.93
Whites	369	CSES	32.00	160.00	128.00	122.68	763.56	27.63
		CAS	51.00	100.00	49.00	79.48	94.41	9.72
		CARS	22.00	63.00	41.00	39.01	77.01	8.78
Nonwhite	29	CSES	51.00	156.00	105.00	117.79	856.31	29.26
		CAS	62.00	100.00	38.00	77.83	88.65	9.42
		CARS	24.00	54.00	30.00	36.59	73.89	8.60
Ages 23 to 34	124	CSES	43.00	160.00	117.00	129.21	472.82	21.74
		CAS	51.00	100.00	49.00	79.72	93.94	9.69
		CARS	24.00	58.00	34.00	37.35	58.70	7.66
Ages 35 to 44	138	CSES	32.00	160.00	128.00	126.12	627.85	25.06
		CAS	57.00	100.00	43.00	79.29	79.10	8.89
		CARS	22.00	63.00	41.00	38.80	80.89	8.99
Ages 45 to 64	134	CSES	32.00	160.00	128.00	111.91	1036.29	32.19
		CAS	55.00	100.00	45.00	78.99	109.68	10.47
		CARS	24.00	63.00	39.00	40.28	86.67	9.31

linear model (GLM) ANOVAs were used, appropriate for an unbalanced design (SAS/STAT Users Guide, 1990).

Hypothesis 1a

In order to test this hypothesis, a GLM ANOVA was conducted for self-efficacy (CSES) scores using the three independent variables (gender, race, and age) as two-way interaction class variables. All main effects were specified in the model, and two-way interactions were at $\alpha = .01$ to control for inflated Type I error. The resultant ANOVA summary table from this procedure is shown in Table 21. Examination of this table shows a significant interaction was found for gender x age ($F(2,386)=4.66$, $p < .01$). No other significant interactions or significant main effects are indicated.

Further investigation as to the sources of variation in this interaction was done by using a Scheffé post hoc. This particular post hoc was selected for two persons. First, it is flexible for analysis of an unbalanced experiment, and secondly, its analysis tends to control the Type I experimentwise error rate for all pairwise comparisons (α_{pc}) (Keppel, 1991). The severity of the Scheffé correction accomplishes this through its reduced region of rejection and a consistent pairwise comparison rate (Keppel, 1991). The output from the Scheffé procedure for the gender x age interaction is shown in Table 22.

Post hoc results reveal significant differences in computer self-efficacy scores between two age groups: A_1 vs. A_3, and A_2 vs. A_3. Since interest lay in the gender x age interaction, the second table of means, corresponding to the gender and age grouping, was

Table 21

General Linear Model (GLM) ANOVA Summary Table for Computer Self-Efficacy Scores (CSES)

Dependent Variable: Self Efficacy Scores

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	31380.68563682	3486.74284854	4.93	0.0001
Error	386	273019.20072682	707.30362883		
Corrected Total	395[a]	304399.88636364			
	R-Square	C.V.	Root MSE		CSES Mean
	0.103090	21.74936	26.59518056		122.28030303

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Gender	1	5.37339616	5.37339616	0.01	0.9306
Race	1	596.43838560	596.43838560	0.84	0.3590
Age	2	1625.29583733	812.64791866	1.15	0.3181
Gender x Race	1	0.16960212	0.16960212	0.00	0.9877
Gender x Age	2	6592.42576174	3296.21288087	4.66	0.0100*
Race x Age	2	1274.86999665	637.43499832	0.90	0.4069

*p < .01.
[a]n = 396.

Table 22

Results From Scheffé Post Hoc Procedure for Computer Self-Efficacy (CSES) Scores

Scheffe's test for variable: CSES Scores

Alpha= 0.01 Confidence= 0.99 df= 386 MSE= 707.3036
Critical Value of F= 4.66055

Comparisons significant at the 0.01 level are indicated by '***'.

Age Group Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
$A_1 - A_2$	-6.961	3.086	13.133	
$A_1 - A_3$	7.181	17.299	27.417	***
$A_2 - A_1$	-13.133	-3.086	6.961	
$A_2 - A_3$	4.365	14.213	24.060	***
$A_3 - A_1$	-27.417	-17.299	-7.181	***
$A_3 - A_2$	-24.060	-14.213	-4.365	***

Level of Gender	Level of Ethnicity	N	CSES Mean	CSES SD
Female	White	149	123.503356	24.8567855
Female	Nonwhite	15	116.933333	27.8477151
Male	White	218	122.041284	29.4465562
Male	Nonwhite	14	118.714286	31.7403615

Level of Gender	Level of Age(group)	N	CSES Mean	CSES SD
Female	1	63	124.793651	24.1848785
Female	2	58	123.344828	25.0589142
Female	3	43	119.534884	26.7736089
Male	1	61	133.770492	17.9790558
Male	2	80	128.137500	25.0188505
Male	3	91	108.307692	33.9998994

Level of Ethnicity	Level of Age(group)	N	CSES Mean	CSES SD
White	1	114	129.842105	20.6918303
White	2	128	127.046875	24.8240610
White	3	125	111.544000	32.2991321
Nonwhite	1	10	122.000000	31.9895816
Nonwhite	2	10	114.300000	26.3440906
Nonwhite	3	9	117.000000	32.0468407

taken and plotted. Two mean score plots were done: age at gender (see Figure 1) and gender at age (see Figure 2).

Examination of these plots helped in determining the next interaction analysis procedure. Figure two most clearly shows the gender x age interaction effect in A_3. The age at gender plot in figure one shows age groups A_1 and A_2 linearly moving away from A_3. The similar directionality for lines for A_1 and A_2 in figure one suggested that an interaction comparison would be appropriate for further followup.

Harmonic Mean

The unbalanced nature of the design posed a problem at this point. It has been stated that differing response rates resulted in unequal cell sizes. While the statistical procedures used for ANOVA and post hocs handle this condition internally, interaction comparisons generally do not, without complex modifications. To reduce complexity and ease interpretation, it was desirable to approach the interaction comparison with a balanced design (equal *n* per cell). One way that this can be accomplished is by calculating the average sample size, n_h, also known as the *harmonic mean* ($\bar{x}$*) of the sample sizes (Keppel, 1991). The harmonic mean is calculated by the following formula:

$$n_h = \frac{(a)(b)}{1/n_{1,1} + 1/n_{1,2} + \ldots} = \frac{(a)(b)}{\Sigma(1/n_{ij})}$$

where *(a)(b)* are the total number of treatment cells divided by the sum of the reciprocals of the cell sample sizes, n_{ij} (Keppel, 1991, p. 289). The calculated n_h using the two-factorial means table (gender x age) generated in the Scheffé post hoc (see Table 22)

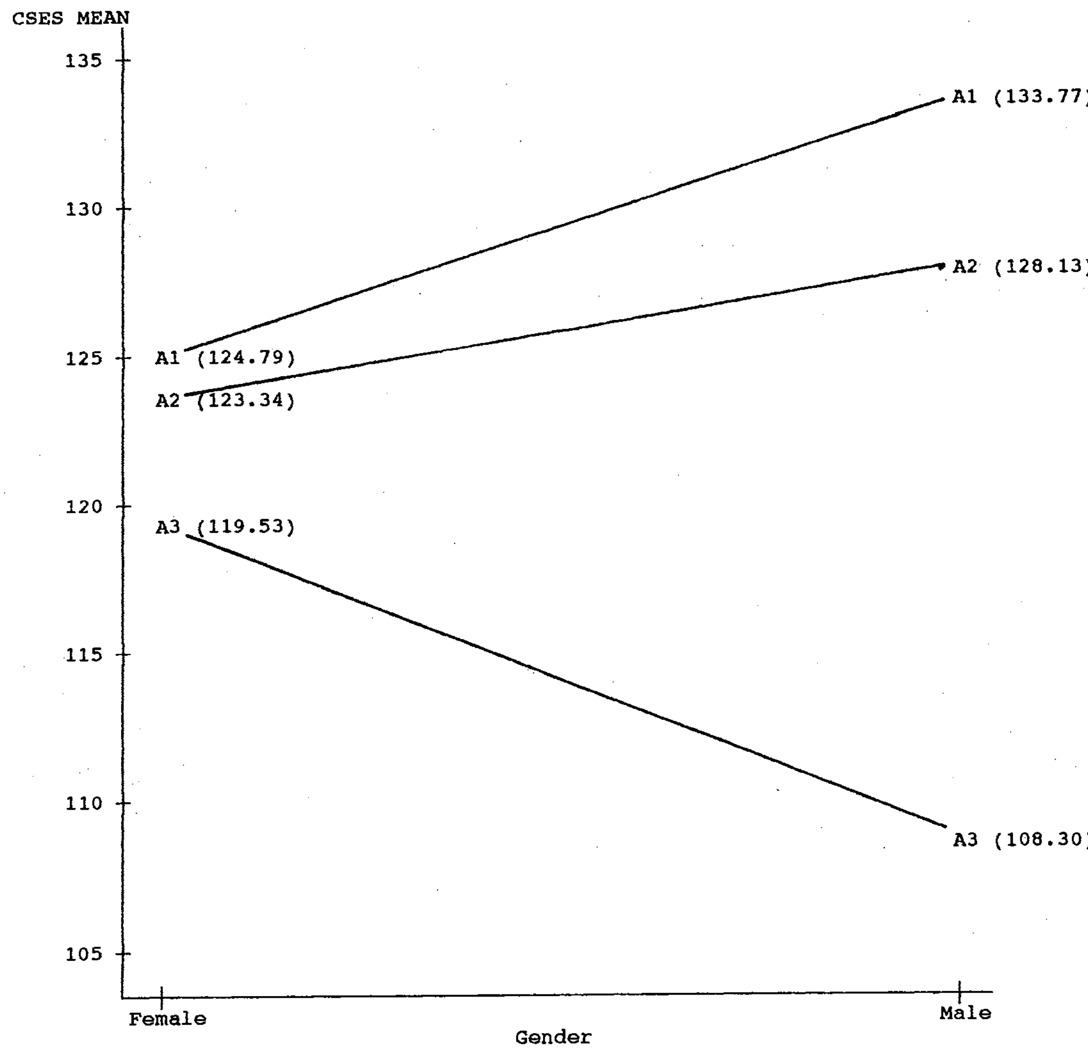

Figure 1. Age at Gender Interaction Plot of Mean ($\bar{x}$) Computer Self-Efficacy (CSES) Scores.

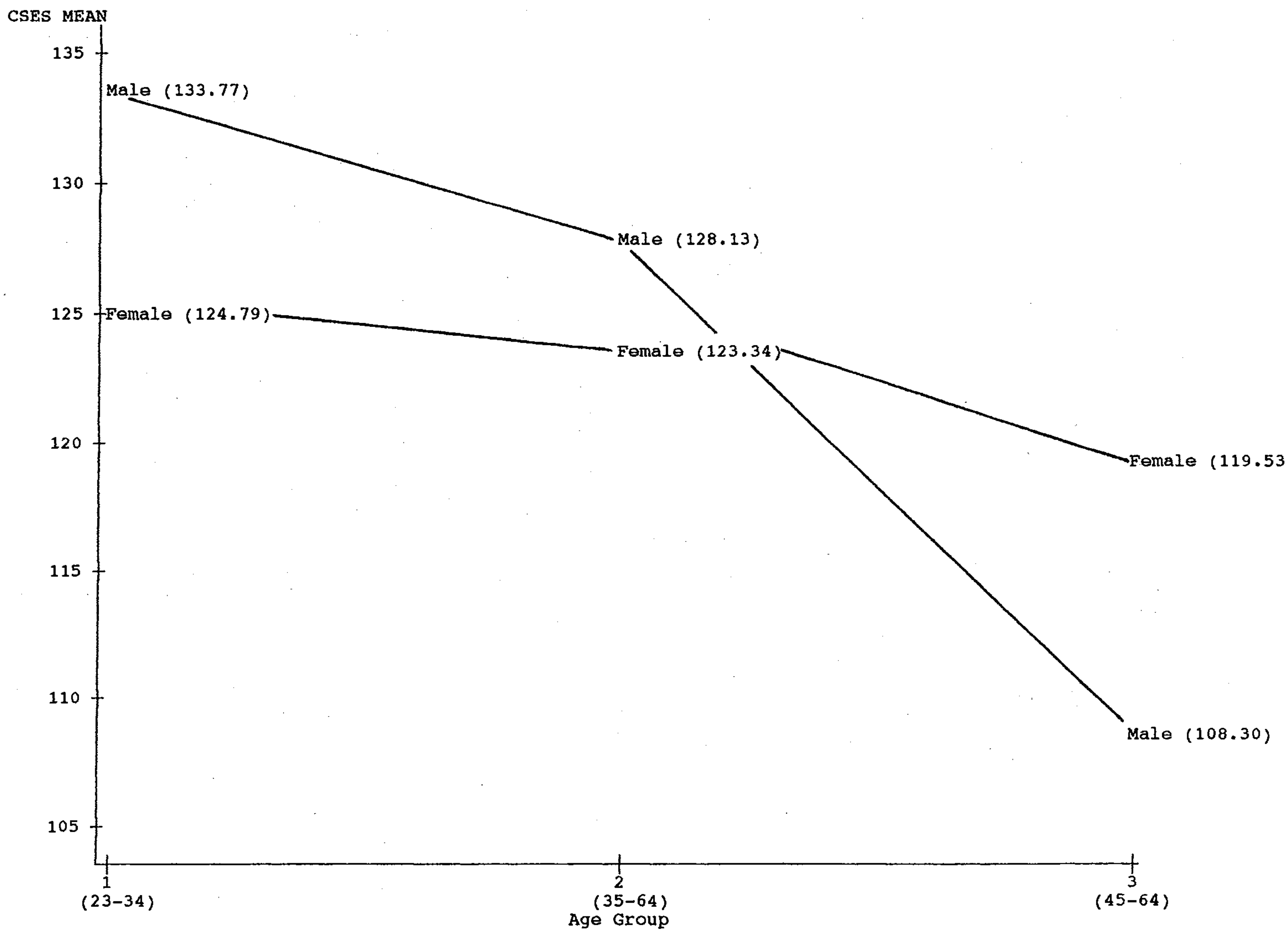

Figure 2. Gender at Age Interaction Plot of Mean ($\bar{x}$) Computer Self-Efficacy (CSES) Scores.

equalled 60. Each of the original cell means was then multiplied by n_h, creating the new cell means ($\bar{x}$*) shown in Table 23. In addition, a new mean square error ($MS_{S/GA}$) was calculated (366210.52) using the uncorrected sum of squares.

These new cell means ($\bar{x}$*) were then plotted exactly like the originals: age at gender (see Figure 3) and gender at age (see Figure 4). Comparisons of like plots, e.g., figure one vs. figure three and figure two vs. figure four, reveal that multiplying the original cell means (gender x age) by n_h did not alter the plot shapes. What was accomplished was the derivation of an equal $n_{g/a}$ and a new mean square error for use in the interaction comparison procedure.

Interaction Comparison

The plots in figures one and two created suspicion that age (as opposed to gender) was the greater influencing factor in self-efficacy scores. Therefore, the interaction comparison procedure was carried out using the three age groupings as the two line comparisons. Categorization in this manner also created 1 *df* for each comparison, thus allowing direct interpretation. The results of this interaction comparison are shown in Table 24.

It can be seen that the interaction comparison resulted in a significant *F* value for A_1 x A_3, as well as A_2 x A_3 ($p < .01$). With one degree of freedom, it may be interpreted that the effects of computer self-efficacy are not consistent across age groups. Age group three self-efficacy scores significantly decreased, across gender, as compared to A_1 and A_2. Figure one shows that age appears to be a larger influence on male computer self-efficacy than for females. Figure two shows that as males age their computer self-efficacy

Table 23

Gender by Age CSES Scores Means Table, Original ($\bar{x}$) and Harmonic ($\bar{x}^*$)

Gender	Age Groups 23 - 34	Age Groups 35 - 44	Age Groups 45 - 64	Total
n $\bar{x}$ sum $\bar{x}^*$				Σn_a $\bar{x}_{\bar{x}an}$ Σsum $\bar{x}_{\bar{x}^*an}$
Female	63 124.79 7862 7487.4	58 123.34 7154 7400.4	43 119.53 5140 7171.8	164 122.55 20156 7353.2
Male	61 133.77 8160 8026.2	80 128.14 10251 7688.4	91 108.31 9856 6498.6	232 123.41 28267 7404.4
Σn_g $\bar{x}_{\bar{x}g}$ Σsum $\bar{x}_{\bar{x}^*g}$	124 129.28 16022 7756.8	138 125.74 17405 7544.4	134 113.92 14996 6835.2	396 122.98 48423 7378.8

$n_h = 60$.

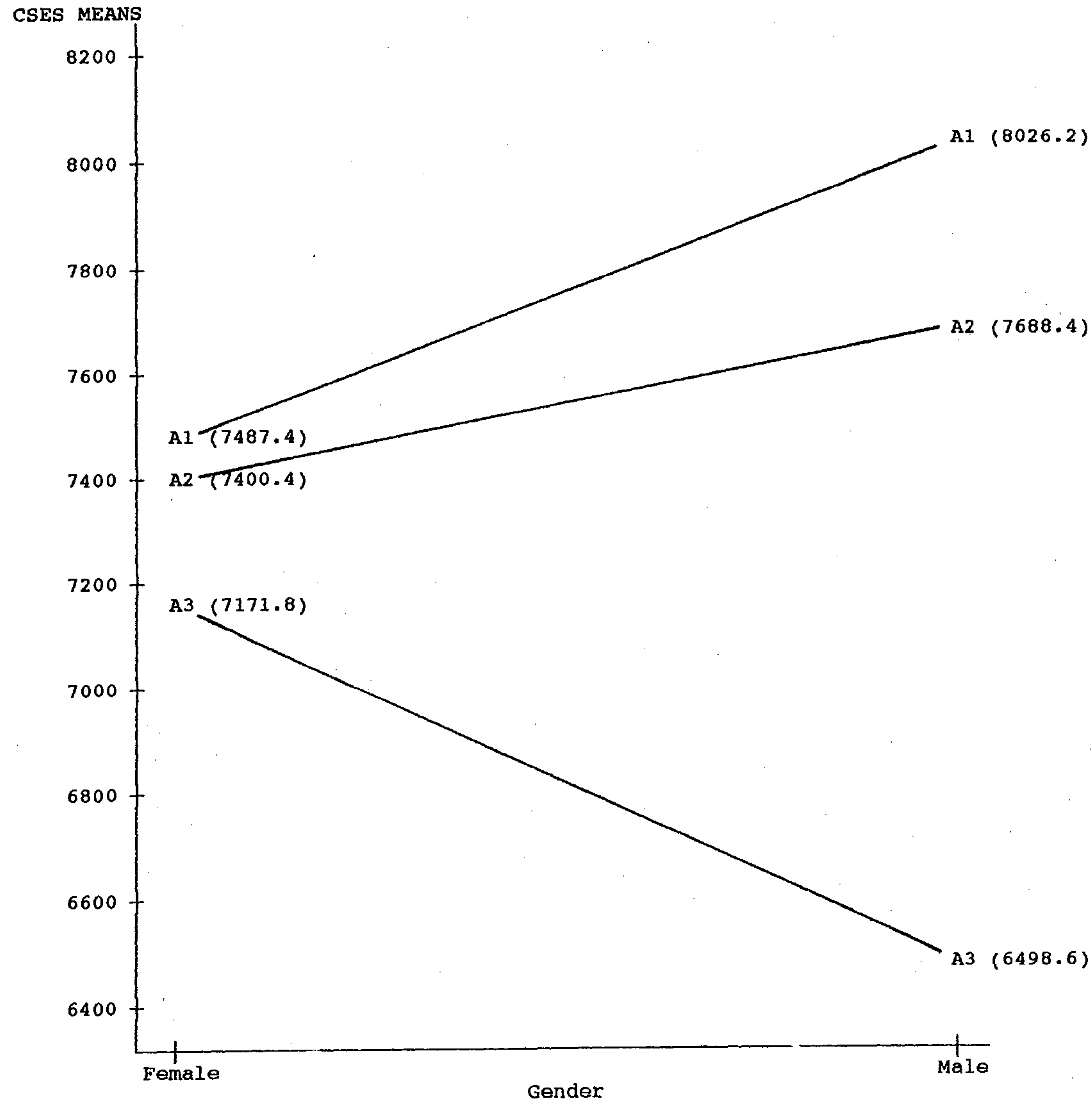

Figure 3. Age at Gender Interaction Plot of Harmonic Mean ($\bar{x}$*) Computer Self-Efficacy (CSES) Scores.

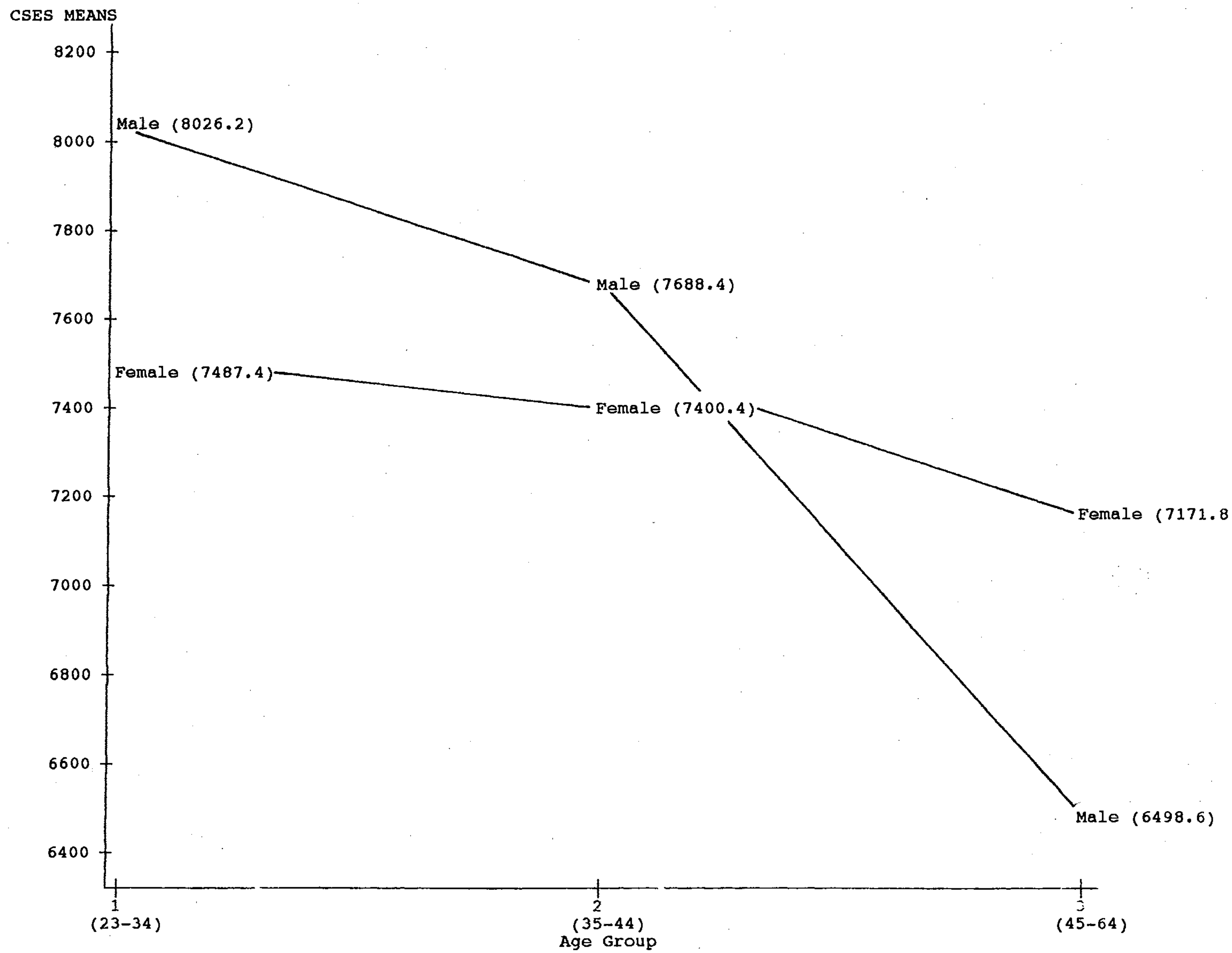

Figure 4. Gender at Age Interaction Plot of Harmonic Mean ($\bar{x}$*). Computer Self-Efficacy (CSES) Scores.

Table 24

Results of Interaction Comparison Procedure for Age x Gender Using Harmonic Mean ($\bar{x}^*$)

Age Group Comparison	df	Mean Square	F-Value	P-Value
$A_1 - A_2$	1	943518.25	2.576	0.1052
$A_1 - A_3$	1	22034216	60.168	0.0000*
$A_2 - A_3$	1	13858594	37.843	0.0000*

*$p < .01$.
$n_h = 60$.

decreases, particularly for the oldest group. Younger males have higher computer self-efficacy than young females, but older females have more computer self-efficacy than older males. The strength of this effect was measured using $\hat{\omega}^2_{GA}$ (omega squared), calculated as .02. According to Cohen (cited in Keppel, 1991), this $\hat{\omega}^2_{GA}$ value approximates a "small" effect (p. 66).

Hypothesis 1b

In order to test this hypothesis, a GLM ANOVA was conducted for computer attitude (CAS) scores using the three independent variables (gender, race, and age) as two-way interaction class variables. All main effects were specified in the model, and two-way interactions were at $\alpha = .01$ to control for inflated Type I error. The resultant ANOVA summary table from this procedure is shown in Table 25. Examination of this table shows no significant interactions nor main effects at $p < .01$. Therefore, no further analysis or interpretation was undertaken.

Hypothesis 1c

In order to test this hypothesis, a GLM ANOVA was conducted for computer anxiety (CARS) scores using the three independent variables (gender, race, and age) as two-way interaction class variables. All main effects were specified in the model, and two-way interactions were at $\alpha = .01$ to control for inflated Type I error. The resultant ANOVA summary table from this procedure is shown in Table 26. Examination of this table shows no significant interactions nor main effects at $p < .01$. Therefore, no further analysis or interpretation was undertaken.

Table 25

General Linear Model (GLM) ANOVA Summary Table for Computer Attitude Scores (CAS)

Dependent Variable: Computer Attitude Scores

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	830.37403585	92.26378176	0.98	0.4524
Error	386	36183.89616617	93.74066364		
Corrected Total	395[a]	37014.27020202			
	R-Square	C.V.	Root MSE		CAS Mean
	0.022434	12.20611	9.68197623		79.32070707

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Gender	1	154.37333832	154.37333832	1.65	0.2002
Race	1	54.77513338	54.77513338	0.58	0.4451
Age	2	31.91367714	15.95683857	0.17	0.8435
Gender x Race	1	14.38529536	14.38529536	0.15	0.6955
Gender x Age	2	211.30784660	105.65392330	1.13	0.3250
Race x Age	2	160.44662660	80.22331330	0.86	0.4257

*$p < .01$.
[a]$n = 396$.

Table 26

General Linear Model (GLM) ANOVA Summary Table for Computer Anxiety Scores (CARS)

Dependent Variable: Computer Anxiety Scores

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	959.94875382	106.66097265	1.40	0.1863
Error	386	29422.26084214	76.22347368		
Corrected Total	395[a]	30382.20959596			

R-Square	C.V.	Root MSE	CARS Mean
0.031596	22.47202	8.73060557	38.85101010

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Gender	1	34.76962974	34.76962974	0.46	0.4998
Race	1	166.53375182	166.53375182	2.18	0.1402
Age	2	92.51401395	46.25700698	0.61	0.5456
Gender x Race	1	2.25426119	2.25426119	0.03	0.8635
Gender x Age	2	16.52000074	8.26000037	0.11	0.8973
Race x Age	2	135.24991631	67.62495815	0.89	0.4126

*$p < .01$.
[a]$n = 396$.

Hypothesis 1 Outcome

The significant interaction finding (gender x age) in computer self-efficacy scores coupled with the nonsignificant findings of attitudes and anxiety scores render hypothesis one only partially supported. Significance or nonsignificance of each of these interactions and main effects will be dealt with in the subsequent hypotheses.

Main Effect Hypotheses

If appropriate, the main effects from each two-way ANOVA done in hypothesis one were analyzed to address hypotheses two through 10.

Hypothesis 2: Females will express significantly greater computer anxiety than males.

This hypothesis was answered by reviewing the CARS ANOVA summary table in Table 26. The lack of a significant main effect for gender ($F(1,386)=0.46$, $p > .01$), caused this hypothesis to be rejected. No significant differences in computer anxiety between males and females were found.

Hypothesis 3: Nonwhites will express significantly greater computer anxiety than whites.

This hypothesis was answered by reviewing the CARS ANOVA summary table in Table 26. The lack of a significant main effect for race ($F(1,386)=2.18$, $p > .01$), caused this hypothesis to be rejected. No significant differences in computer anxiety between whites and nonwhites were found.

Hypothesis 4: Older persons will express significantly greater computer anxiety than younger persons.

This hypothesis was answered by reviewing the CARS ANOVA summary table in Table 26. The lack of a significant main effect for age ($F(1,386)=0.61$, $p > .01$), caused this hypothesis to be rejected. No significant differences in computer anxiety between any age groupings were found.

Hypothesis 5: Males will express significantly greater computer self-efficacy than females.

This hypothesis was answered by reviewing the CSES ANOVA summary table in Table 21. The lack of a significant main effect for gender ($F(1,386)=0.01$, $p > .01$), caused rejection of this hypothesis. No *independent* significant differences in computer self-efficacy between males and females were found.

Hypothesis 6: Whites will express significantly greater computer self-efficacy than nonwhites.

This hypothesis was answered by reviewing the CSES ANOVA summary table in Table 21. The lack of a significant main effect for race ($F(1,386)=0.84$, $p > .01$), caused this hypothesis to be rejected. No significant differences in computer self-efficacy between whites and nonwhites were found.

Hypothesis 7: Younger persons will express significantly greater computer self-efficacy than older persons.

This hypothesis was answered by reviewing the CSES ANOVA summary table in Table 21. The lack of a significant main effect for age ($F(1,386)=1.15$, $p > .01$), caused this hypothesis to be rejected. No *independent* significant differences in computer self-efficacy between any of the three age groups were found.

Hypothesis 8: Males will express significantly more positive computer attitudes than females.

This hypothesis was answered by reviewing the CAS ANOVA summary table in Table 25. The lack of a significant main effect for gender ($F(1,386)=1.65$, $p > .01$), caused rejection of this hypothesis. No significant differences in computer attitudes between males and females were found.

Hypothesis 9: Whites will express significantly more positive computer attitudes than nonwhites.

This hypothesis was answered by reviewing the CAS ANOVA summary table in Table 25. The lack of a significant main effect for race ($F(1,386)=0.58$, $p > .01$), caused this hypothesis to be rejected. No significant differences in computer attitudes between whites and nonwhites were found.

Hypothesis 10: Younger persons will express significantly more positive computer attitudes than older persons.

This hypothesis was answered by reviewing the CAS ANOVA summary table in Table 25. The lack of a significant main effect for age ($F(1,386)=0.17$, $p > .01$), caused this hypothesis to be rejected. No significant differences in computer attitudes between any age grouping were found.

Correlational Hypotheses

Hypothesis 11: There will be a significant negative correlation between computer self-efficacy scores (CSES), and computer anxiety scores (CARS) within each base group of independent variables (gender, age, and ethnicity).

In order to answer this hypothesis, a Pearson product-moment correlation was performed for the computer self-efficacy (CSES) scores with computer anxiety scores (CARS). Additional correlation procedures were also performed, using the same dependent score combinations, for each base level of the independent variables in this research (gender, race, and age).

Overall, computer self-efficacy scores ($\bar{x}$=122.32, s=27.75) showed a significant inverse correlation with anxiety scores ($\bar{x}$=38.83, s=8.77), r=-0.59, ($p < .01$). Male self-efficacy scores ($\bar{x}$=121.98, s=29.54) also showed a significant inverse correlation to anxiety scores r=-0.60, ($p < .01$), as did females ($\bar{x}$=122.81, s=25.07), r=-0.58, ($p < .01$). White self-efficacy scores ($\bar{x}$=122.68, s=27.63) also showed a significant negative correlation to anxiety r=-0.62, ($p < .01$). However, nonwhite self-efficacy scores ($\bar{x}$=117.79, s=29.26) did not significantly correlate with anxiety scores r=-0.32, ($p > .01$), although negative directionality was similar to the other groups. Self-efficacy scores in all of the age groups showed significant inverse correlations with anxiety: A_1 ($\bar{x}$=129.21, s=21.74; r=-0.57, ($p < .01$)), A_2 ($\bar{x}$=126.12, s=25.06; r=-0.62, ($p < .01$)), and A_3 ($\bar{x}$=111.91, s=32.19; r=-0.56, ($p < .01$)).

This hypothesis seems largely supported by the evidence, even with the noted exception of race. In other words, computer anxiety does appear to significantly decrease, in most cases, as computer self-efficacy increases.

Hypothesis 12: There will be a significant positive correlation between computer self-efficacy scores (CSES), and computer attitudinal scores (CAS) within each base group of independent variables (gender, age, and ethnicity).

In order to answer this hypothesis, a Pearson product-moment correlation was performed for computer self-efficacy (CSES) scores with computer attitude scores (CAS). Additional correlation procedures were also performed, using the same dependent score combinations, for each base level of the independent variables in this research (gender, race, and age).

Overall, computer self-efficacy scores ($\bar{x}$=122.32, s=27.75) showed a significant positive correlation with attitude scores ($\bar{x}$=79.36, s=9.69), r=0.42, ($p < .01$). Male self-efficacy scores ($\bar{x}$=121.98, s=29.54) also showed a significant positive correlation to attitude scores r=0.35, ($p < .01$), as did females ($\bar{x}$=122.81, s=25.07), r=0.54, ($p < .01$). White self-efficacy scores ($\bar{x}$=122.68, s=27.63) also indicated a significant positive correlation to attitudes r=0.42, ($p < .01$). However, nonwhite self-efficacy scores ($\bar{x}$=117.79, s=29.26) did not significantly correlate with attitude scores r=0.36, ($p > .01$), although positive directionality was similar to the other groups. Self-efficacy scores in all of the age groups showed significant positive correlations with attitudes: A_1 ($\bar{x}$=129.21, s=21.74; r=0.49, ($p < .01$)), A_2 ($\bar{x}$=126.12, s=25.06; r=0.48, ($p < .01$)), and A_3 ($\bar{x}$=111.91, s=32.19; r=0.36, ($p < .01$)).

This hypothesis seems largely supported by the evidence, even with the noted exception of race. In other words, computer attitudes do appear to significantly increase or improve in most cases, as self-efficacy increases.

Hypothesis 13: There will be a significant negative correlation between computer anxiety scores (CARS) and computer attitudinal scores (CAS) within each base group of independent variables (gender, age, and ethnicity).

In order to answer this hypothesis, a Pearson product-moment correlation was performed for computer anxiety (CARS) scores with computer attitude scores (CAS). Additional correlation procedures were also performed, using the same dependent scores, for each base level of the independent variables in this research (gender, race, and age).

Overall computer anxiety scores ($\bar{x}$=38.83, s=8.77) showed a significant inverse correlation with attitudinal scores ($\bar{x}$=79.36, s=9.69), r=-0.68, ($p < .01$). Male anxiety scores ($\bar{x}$=38.58, s=8.92) also showed a significant inverse correlation to attitudinal scores r=-0.66, ($p < .01$), as did females ($\bar{x}$=39.18, s=8.57), r=-0.71, ($p < .01$). White anxiety scores ($\bar{x}$=39.01, s=8.78) also indicated a significant negative correlation to attitudes r=-0.69, ($p < .01$), as did nonwhite anxiety scores ($\bar{x}$=36.59, s=8.60; r=-0.65, ($p < .01$)). All of the age groups showed significant inverse correlations with attitudes: A_1 ($\bar{x}$=37.35, s=7.66; r=-0.62, ($p < .01$)), A_2 ($\bar{x}$=38.80, s=8.99; r=-0.66, ($p < .01$)), and A_3 ($\bar{x}$=40.28, s=9.31; r=-0.75, ($p < .01$)).

This hypothesis is supported with no evident exceptions. In other words, computer anxiety does appear to significantly decrease as computer attitudes improve. No causality can be inferred.

Concluding Questions

Five questions used with the original CARS development project concluded the questionnaire (see Appendix A). These questions explored general feelings of anxiety due to computer use and were used for the purposes of sample descriptiveness and to supply data for further research. As noted with question 12 (page one of Appendix A), no explicit distinction was made between mainframes and other computers, so responses can be considered inclusive of both types. Descriptive statistics are provided in Table 27 for the complete sample, in addition to the seven base levels of independent variables.

Supplemental Question One

Supplemental question one asked, "Have you ever thought that you would like to learn how to operate a computer but were too intimidated to try?" A response scale of one to five was provided (1=I have thought this very often, 5=I have never thought this). Sample response indicated a low computer intimidation factor ($\bar{x}$=4.26, s=0.99). Significant differences were found for this question only between two age groups, A_1 ($\bar{x}$=4.39, s=0.94) and A_3 ($\bar{x}$=4.11, s=1.01). Age group 1 responses indicated significantly less computer intimidation than A_3 ($t(256)=2.225$, $p < .01$).

Table 27

Means Table for Overall Responses to Supplemental Questions One Through Five

Classification	n	Supplemental Question	Minimum	Maximum	Range	Mean	Variance	Std Dev
Overall	398	1. Have you ever thought...	1.00	5.00	4.00	4.26	0.97	0.99
Females	165		1.00	5.00	4.00	4.22	1.04	1.02
Males	233		1.00	5.00	4.00	4.29	0.93	0.96
Whites	369		1.00	5.00	4.00	4.26	0.93	0.96
Nonwhites	29		1.00	5.00	4.00	4.28	1.64	1.28
Ages 23 to 34	124		1.00	5.00	4.00	4.39	0.89	0.94
Ages 35 to 44	138		1.00	5.00	4.00	4.30	0.91	0.95
Ages 45 to 64	134		1.00	5.00	4.00	4.11	1.09	1.05
Overall	398	2. Would you describe...	1.00	5.00	4.00	4.50	0.63	0.80
Females	165		2.00	5.00	3.00	4.43	0.70	0.84
Males	233		1.00	5.00	4.00	4.55	0.58	0.76
Whites	369		1.00	5.00	4.00	4.49	0.64	0.80
Nonwhites	29		3.00	5.00	2.00	4.62	0.53	0.73
Ages 23 to 34	124		3.00	5.00	2.00	4.59	0.50	0.71
Ages 35 to 44	138		1.00	5.00	4.00	4.52	0.60	0.78
Ages 45 to 64	134		2.00	5.00	3.00	4.39	0.78	0.88
Overall	398	3. Does the thought of...	1.00	5.00	4.00	4.47	0.64	0.80
Females	165		2.00	5.00	3.00	4.41	0.72	0.85
Males	233		1.00	5.00	4.00	4.51	0.59	0.77
Whites	369		1.00	5.00	4.00	4.48	0.64	0.80
Nonwhites	29		3.00	5.00	2.00	4.38	0.74	0.86
Ages 23 to 34	124		2.00	5.00	3.00	4.59	0.49	0.70
Ages 35 to 44	138		2.00	5.00	3.00	4.45	0.63	0.79
Ages 45 to 64	134		1.00	5.00	4.00	4.37	0.79	0.89
Overall	398	4. How uneasy or anxious...	0.00	100.00	100.00	15.70	416.22	20.40
Females	165		0.00	70.00	70.00	14.94	358.53	18.93
Males	233		0.00	100.00	100.00	16.24	458.09	21.40
Whites	369		0.00	100.00	100.00	15.86	423.80	20.59
Nonwhites	29		0.00	50.00	50.00	13.62	326.60	18.07
Ages 23 to 34	124		0.00	80.00	80.00	10.69	229.40	15.15
Ages 35 to 44	138		0.00	100.00	100.00	16.76	429.79	20.73
Ages 45 to 64	134		0.00	100.00	100.00	19.18	544.43	23.33

Table 27 (Continued)

Classification	n	Supplemental Question	Minimum	Maximum	Range	Mean	Variance	Std Dev
Overall	398	5. How uneasy or anxious...	0.00	100.00	100.00	46.54	707.20	26.59
Females	165		0.00	100.00	100.00	49.12	674.00	25.96
Males	233		0.00	100.00	100.00	44.72	725.68	26.94
Whites	369		0.00	100.00	100.00	46.54	694.85	26.36
Nonwhites	29		0.00	100.00	100.00	46.55	894.83	29.91
Ages 23 to 34	124		0.00	100.00	100.00	43.87	574.73	23.97
Ages 35 to 44	138		0.00	100.00	100.00	47.86	744.48	27.29
Ages 45 to 64	134		0.00	100.00	100.00	47.53	792.66	28.15

Supplemental Question Two

Supplemental question two asked, "Would you describe yourself as a person who is afraid of computers?" Respondents circled their answer on a scale ranging from one to five (1=Yes, 5=Not at all). Responses indicated a very low fear of computers ($\bar{x}$=4.50, s=0.80). As with question one, significant differences were only found between the first and last age groups, A_1 ($\bar{x}$=4.59, s=0.71) and A_3 ($\bar{x}$=4.39, s=0.88). Age group 1 responses showed significantly less computer fear than A_3 ($t(251)=2.0174$, $p < .01$).

Supplemental Question Three

Supplemental question three asked, "Does the thought of interacting with a computer make you nervous or uneasy?" The provided response scale ranged from one to five (1=Yes, definitely, 5=Not at all). Sample response ($\bar{x}$=4.47, s=0.80) reflected very little nervousness about working with a computer. As with the previous two questions, the only statistically significant difference found was between the first and last age groups, A_1 ($\bar{x}$=4.59, s=0.70) and A_3 ($\bar{x}$=4.37, s=0.89). Age group 1 responses suggested significantly less uneasiness about working with a computer than did A_3 ($t(250)=2.1725$, $p < .01$).

Supplemental Question Four

Supplemental question four asked, "How uneasy or anxious would you feel if you sat down to begin working with a computer?" The response scale for this question ranged from 0 to 100 (0=Not at all, 100=Very much so). The sample mean ($\bar{x}$=15.70, s=20.40) indicated very low anxiety about working with a computer. Differences between genders and races were nonsignificant. However, age group one ($\bar{x}$=10.69, s=15.15) showed significantly less anxiety about computer work than either A_2 ($\bar{x}$=16.76, s=20.73; t(250, -2.7267), $p < .01$), or A_3 ($\bar{x}$=19.18, s=23.33; $t(230)=-3.4929$, $p < .01$).

Supplemental Question Five

The fifth and final supplemental question asked, "How uneasy or anxious would you feel if you were in the midst of a work session at that computer and you just couldn't get your job to run?" The response scale for this question ranged from 0 to 100 (0=Not at all, 100=Very much so). While this question reflected the most computer anxiety of any of the five final questions ($\bar{x}$=46.54, s=26.59), no statistically significant differences were found between any of the base independent variable levels.

CHAPTER V

PURPOSE, SUMMARY, CONCLUSIONS AND DISCUSSION

Purpose of the Chapter

The purpose of this chapter is to briefly reiterate the purpose of the study, present conclusions gleaned from the research findings, and to discuss its relevance to the body of knowledge and future research. Section one revisits the study purposes and the influence of the literature upon the study design. Section two discusses the conclusions reached from examination and reflection upon the results of this research. Section three discusses the study parameters and recommendations for further research in the areas addressed.

Study Purpose

The purposes of this study were: (1) to determine if there were any significant differences in workforce computer anxiety, attitudes, and self-efficacy based on gender, race, and age and (2) to learn if there was a relationship among the constructs of computer anxiety, computer attitudes, and computer self-efficacy. This should give an indication of whether greater computer self-efficacy relates to improved attitudes and reduced technological anxiety.

The writer undertook a literature review to better understand the issues of computer self-efficacy, attitudes, and anxiety in the workplace. Several issues emerged from this review that guided the design development for this study.

Technology has evolved since the 1960s until it has become an ever present fixture in everyday life. Greater usage of, and reliance upon, this technology is reflected in the growing numbers of computers and fax machines in the home and office. Various technologies have not only changed the nature of work, but the skill sets required by the workers using them. These changes have also been reflected in the attitudes and beliefs toward computers. A more realistic appreciation of computers has emerged over time, but fears, anxiety, and self-doubt remain in certain segments of the population.

Three of these population segments were suggested by the literature that coincided with demographic trends for the future labor force. Females, nonwhite ethnicities, and older persons are all forecast to have a greater labor presence by the year 2005. Moreover, these three groups have been researched regarding computer self-efficacy, attitudes, and anxiety. The literature specifies that socialization processes, culture, and the range of occupational opportunities may influence technological apprehension in these groups. However, consistent empirical findings concerning females, minorities, and the elderly are missing. This lack of empirical consistency becomes important when one considers that existence of technological apprehension may preclude one from opportunities at work and in society.

Conclusions

Subject Representativeness

Subject representativeness is presented here for two reasons. First, it was previously noted that many empirical studies regarding computer self-efficacy, attitudes, and anxiety used college students and other populations that may not be typical of the current labor force. Some evidence presented by the literature suggested that technological apprehension may vary by group, so population selection in the labor force was one foundation for this study. Secondly, characteristic representativeness of the subjects may introduce some variables that could influence the outcomes of this study.

This purposive sample differed characteristically from the current employed population in several key areas and the self-selection to participate in the study influenced the results and limits generalizability. Percentage-wise, whites were overrepresented and nonwhites underrepresented compared with the labor force. Educational levels among the respondents were mixed, but generally these subjects were better educated than the general labor force. Substantial percentage differences between subjects and the labor force were also found in personal computer ownership, supervision, and the various applications posed in question 12 of the demographic questionnaire (see Appendix A). While no comparative national figures were given for previous computer coursework, computer experience levels and usage hours per week, large percentages of the responding sample had high levels in all three categories.

Instrument Differences

The abundance of subject computer exposure and use, when combined with an examination of within group differences, may serve to shape the conclusions of the instrument (CSES, CAS, and CARS) results. Each of the independent variables, beginning with race, will be taken in turn with discussion focusing on their relationships to the research outcomes.

Race

The low nonwhite response in this research (n=29) has previously been discussed in relation to how it modified the data analyses. Three-way ANOVAs (gender x race x age) were abandoned due to the insufficient cell sizes necessary for appropriate comparisons. Added to this is the nonrepresentativeness of the nonwhites sampled compared with similar populations in the workforce. Nonwhite ethnicities were underrepresented percentage-wise and their characteristics may not be typical of similar employed groups. The lack of significant differences between sampled whites and nonwhites in education, computer coursework, supervision, computer experience, and usage hours per week, etc., may not be typical of existing labor force conditions. These two conditions, low response and nonrepresentativeness, make the number and depth of conclusions about this group more tenuous. Yet, one effect was noted that is worth mention.

Only nonwhite comparisons showed the lack of a significant correlation between self-efficacy and anxiety and self-efficacy and attitudes. Directionality was similar to the other groups, but significance was not reached. No significant differences were found in the three types of computer experience, (mainframe, other, and total), nor in computer usage in hours per week. This finding suggests that experience may increase self-efficacy but may not modify anxiety and attitudes in sampled nonwhites to the same extent as it does in the other sampled groups.

Nonwhites showed general equivalence to whites in most of the mentioned demographic characteristics. Given this, change in another factor may be necessary in nonwhites to achieve the equal correlational strength between computer self-efficacy, anxiety, and attitudes seen in whites. This unknown factor, when considered with the previous discussed sample limitations, is difficult to ascertain. Indeed it may be symptomatic of this sample only. However, Winkel et al. (1985) noted that Hispanics may feel more threatened, dehumanized, and controlled by computers than their white non-Hispanic counterparts. The researchers wrote that computer attitudes are composed of more than previous experience and familiarity, at least in Hispanics. Discovering whether this effect extends to computer anxiety and other nonwhite ethnicities will be left to further research.

Gender and Age

Sample limitations and characteristic dissimilarities between these two groups and the labor force were found, but patterns emerging in this research made conclusions more defensible than those with ethnicity. Since the only significant difference in scale scores was found as an interaction between gender and age, they will be discussed together. The difference in computer self-efficacy will be dealt with first, leading into a discussion of anxiety and attitudes.

Computer Self-Efficacy

A significant interaction was found for self-efficacy between gender and age. Since no significant main effects were found, evidently gender and age operate together in this sample to affect computer self-efficacy, but not independently. Further investigation of this interaction led the researcher to construct a two-factor gender x age permutation structure, shown in Table 28. This table will help illustrate and clarify the conclusions presented.

Table Pairwise Comparisons

Item a of Table 28 shows that overall comparison of sampled male and female self-efficacy scores shows no significant difference. This lends credence to the previous statement in Chapter IV that self-efficacy effects are not consistent across age groups in this sample. Items b, c, and d show a within group comparison of females in each age group. Items e, f, and g are similar within group age comparisons, except designated for males. Item h begins the male and female between group comparisons for all age groups.

Items b, c, and d show a general age effect for females (younger females are more efficacious) but that effect lacks significance. Items e, f, and g also show a similar age effect for males, but $male_{A1}$ and $male_{A2}$ are significantly more self-efficacious than those in $male_{A3}$. These effects become more salient when placed in the context of several demographic characteristics.

Table 28

<u>All Permutations of Gender and Age Within Self-Efficacy With T-Test Results</u>

Item	Comparison	Significant or Nonsignificant	T-Test Results
a.	All *Females x All Males	Nonsignificant	$t(383, 0.3033)$, $p > .01$
b.	*Female$_{A1}$ x Female$_{A2}$	Nonsignificant	$t(117, 0.3231)$, $p > .01$
c.	*Female$_{A1}$ x Female$_{A3}$	Nonsignificant	$t(84, 1.0322)$, $p > .01$
d.	*Female$_{A2}$ x Female$_{A3}$	Nonsignificant	$t(87, 0.7266)$, $p > .01$
e.	*Male$_{A1}$ x Male$_{A2}$	Nonsignificant	$t(139, 1.5549)$, $p > .01$
f.	*Male$_{A1}$ x Male$_{A3}$	Significant	$t(143, 6.0012)$, $p < .01$
g.	*Male$_{A2}$ x Male$_{A3}$	Significant	$t(164, 4.3767)$, $p < .01$
h.	Female$_{A1}$ x *Male$_{A1}$	Significant	$t(114, -2.3507)$, $p < .01$
i.	Female$_{A1}$ x *Male$_{A2}$	Nonsignificant	$t(135, -0.8084)$, $p > .01$
j.	*Female$_{A1}$ x Male$_{A3}$	Significant	$t(152, 3.5158)$, $p < .01$
k.	Female$_{A2}$ x *Male$_{A1}$	Significant	$t(103, 2.5962)$, $p < .01$
l.	Female$_{A2}$ x *Male$_{A2}$	Nonsignificant	$t(123, -1.1098)$, $p > .01$
m.	*Female$_{A2}$ x Male$_{A3}$	Significant	$t(144, 3.1000)$, $p < .01$
n.	Female$_{A3}$ x *Male$_{A1}$	Significant	$t(68, 3.0371)$, $p < .01$
o.	Female$_{A3}$ x *Male$_{A2}$	Nonsignificant	$t(81, 1.7382)$, $p > .01$
p.	*Female$_{A3}$ x Male$_{A3}$	Significant	$t(103, 2.0715)$, $p < .01$

<u>Note.</u> * by a comparison category indicates the higher mean self-efficacy score.

Males in this sample had significantly more education than females, and this applied in the specific case of age group one (median=4, $\chi^2(1, 9.71)$, $p < .01$). Both $males_{A1}$ and $females_{A1}$ had similar amounts of total computer experience, but males in all three age groups were significantly more likely to be in managerial or supervisory positions. This suggests that these females were more likely than males to be in subordinate jobs throughout their working lives. Supporting evidence for this is seen in how females in this sample consistently use the computer more than males, in hours per week, in all three age groups. This usage characteristic is statistically significant for sampled females in age groups A_2 ($t(132, 3.3096)$, $p < .01$) and A_3 ($t(100, 5.4680)$, $p < .01$).

The scenario set by these characteristics suggests that females in this sample were positioned to have computer work, (and other work), delegated to them. Sampled males and females had similar computer usage patterns and experience levels early in their working lives (e.g., age group one). Male self-efficacy is significantly higher than that of females in these early ages (Table 28 item h), perhaps due to more education and academic computer exposure. In addition to significantly more education, males in this sample were also significantly more likely to have taken a programming course. However, as they age, the men in this study may delegate more "hands on" work to others as they transition into increasingly responsible managerial roles. These roles may decrease the amount of time spent by these males doing computer work themselves. These findings support the work of Gutek & Bikson (1985). They found that men had more technological flexibility and autonomy; women had more subordinate roles and their computer usage reflected those roles (Gutek & Bikson, 1985).

As these usage patterns develop into the ages of 35 to 44 (A_2), the higher self-efficacy seen in sampled males$_{A1}$ apparently begins to diminish in comparison to the continually growing experiential base of sampled females. This is seen in the nonsignificant self-efficacy between group effects of Table 28 items i, l, and o. It also plausibly explains the nonsignificant self-efficacy findings of females in all age groups (items b, c, and d), and why males show significant differences between A_1 and A_3 (item f), and A_2 and A_3 (item g). Older males in this sample may delegate computer work and progressively become less efficacious that they personally can do it. Sampled female computer usage patterns changed somewhat over their work lives, but did not consistently decrease as it did with males. Self-reported total computer experience in this sample also steadily increased with females in each age group but actually decreased for males between A_2 and A_3.

Other questions are raised by these suppositions. If increased computer experience and use alone increased female self-efficacy, why would each succeeding female age group not be significantly more efficacious than the preceding one (items b, c, and d)? Also, why would females, at the height of their experience, still possess significantly less self-efficacy than younger males (item n)? The empirical suggestion is that another factor beyond experience could moderate self-efficacy in this sample, at least for females. It is also plausible that sampled females are reflecting the same career similarities previously attributed to males, except in diminished form. That is, females in this sample are also transitioning into increasingly responsible positions as they age, leading to greater computer delegation and personal disuse. This is partially supported by the fact that sampled younger females consistently had higher mean self-efficacy scores than older females. Sampled younger males also exhibited this trait. However, it appears that women in this study may perform more hands-on computer work themselves, even as managers. Female managers in A_2 had higher mean usage hours per week (n=27, $\bar{x}$=25.15, s=11.86) than males in A_2 (n=57, $\bar{x}$=19.49, s=13.11) that closely approached significance (t(56, 1.9723), p > .01). This usage difference was significant for females in A_3 (n=17, $\bar{x}$=22.94, s=8.90), t(29, 3.8610), p < .01.

<u>Computer Anxiety and Attitudes</u>

Conclusions concerning the other two dependent variables in this study, computer anxiety and attitudes, remain unstated. Although causality is not assumed, significant correlational effects were found between computer self-efficacy and anxiety as well as computer self-efficacy and attitudes. It is therefore reasonable to anticipate some effect surfacing during the analysis of variance. Yet no significant interactions nor main effects were found for either attitudes (see Table 25) or anxiety (see Table 26).

These are not difficult conditions to explain for this sample. It is easy for the general populace to have positive attitudes about computers and to see the beneficial aspects of computing. Lee (1970) found this attitude in the early 1960s, especially among persons with more education. In Chapter Four it was reported that this sample had more education than the national average (also see United States Bureau of the Census, 1993c). Gardner et al. (1989) found that these attitudes had continuously evolved from the early 1960s into an even greater appreciation for technology today. Evidence gathered from this sample seems to support that philosophy.

Computer attitudes can be projected frames of reference. That is, attitudes may be a personal view of the technological impact upon society (e.g., Heinssen et al., 1987), but does not have to involve the person directly. People can express positive (or negative) viewpoints about computers at home and work and not have any personal involvement with them. This suggestion is similar to the finding of Hill et al. (1987) that the beliefs people hold about the instrumental value of computers is independent from the decision to use them. Arch & Cummins (1989) also found a similar effect, but only for females. These possibilities weaken some previously suggested strong linkages in the literature between attitudes, self-efficacy, and anxiety.

For example, in this sample, respondents with an attitude score (CAS) less than the indifferent score of 60 were classified as attitudinally negative. At this level, ($n=9$, $\bar{x}=55.89$, $s=2.97$), an interesting effect appeared. Attitudinal scores displayed a nonsignificant inverse correlation with self-efficacy scores ($r=-0.37$, $p > .01$), and a nonsignificant positive correlation with anxiety scores ($r=0.43$, $p > .01$). The directions of these relationships are different from normal expectations. However, in a more anxious group with CARS scores greater than 50 ($n=40$, $\bar{x}=54.88$, $s=3.31$), a significant inverse correlation with self-efficacy ($r=-0.49$, $p < .01$) and a nonsignificant inverse correlation with attitudes ($r=-0.27$, $p > .01$) was found. Although noncausal, the expected directionality and significant anxiety finding suggest a stronger link between self-efficacy and anxiety than with attitudes, at least in this sample.

Thus, self-efficacy and anxiety may be more personal frames of reference, requiring reflection upon personal experience (or the lack of it). At first, this assertion may make the absence of a significant finding for computer anxiety (see Table 26) more puzzling, especially in the older age groups. As self-efficacy decreased for the aging males in this sample, presumably due to increased disuse (see items e, f, and g of Table 28), it is reasonable to assume that anxiety about use would have increased, thus resulting in a significant effect. Yet in this sample, this was not so. The reasons for this lack of anxiety may have commonalities with self-efficacy.

The key to understanding computer anxiety in this sample may lie in understanding the threat of imminent usage. In other words, although these subjects may indicate low self-efficacy in their ability to perform a specific computer task, expressed anxiety may also be low because they do not feel it will be necessary for them to *personally* accomplish that task any time soon. It may be possible to delegate the task, or do it in another nonautomated way. It would not be surprising to find that much computer-based work delegated by older managers in these companies are attempts to avoid anxiety as well as personal cognizance of ineptness.

Discussion and Recommendations

The previous conclusions and evidence support the view that increased exposure to computers and experience attenuates the levels of computer self-efficacy, attitudes, and anxiety. Apprehension and self-doubt may not be consistent global phenomenons, but increase or decrease within the context of use and application. As reported earlier, females in this study appear to have lower computer self-efficacy compared to males early in their careers, but consistently increase through experience. Sampled males, on the other hand, begin their careers highly efficacious but decrease over their careers. The decrease may be related to apparent computer disuse and the managerial ability to delegate computer work. Sampled females also exhibit this pattern across age groups, but may use computers even in managerial roles. Training professionals may use this knowledge when developing computer-based courses for employees who are at different career stages.

Future researchers should be aware that differences in socialization processes and culture may represent early developmental opportunities for computer apprehension for females, nonwhites, and the elderly. Whites may share many commonalities that shape nonwhites computer self-efficacy, attitudes, and anxiety. However, other factors beyond personal experience may also be present that can enhance or erode nonwhite computer apprehension. Other research may identify or eliminate that possibility.

Computer attitudes within specific segments of this sample (e.g., attitudinally indifferent or attitudinally negative) may not have the strong linkages to computer self-efficacy and anxiety as some literature suggests. Attitudes on scales may be more of a projection of belief as it affects others (e.g., society) rather than oneself. Self-efficacy and anxiety may implicitly require more personal introspection, but require context for proper interpretation. Anxiety variables may include the ability to delegate computer work to subordinates. The threat of immediate computer use, especially under conditions that include approaching deadlines or unfamiliar software, may dramatically change expressed computer anxiety. Compulsory computer use in the workplace may also lessen the influence of attitudes upon performance and outcomes. Future studies should explore how computing attitudes affect anxiety and self-efficacy in compulsory and noncompulsory computing-use environments.

Future studies could provide stronger evidence by including more contrasts between different levels of computer users and nonusers in the design. Increased nonpurposive random sampling of each independent variable in this study, especially nonwhites, would have also fortified this assertion. Close attention to isolating specific populations would also seem warranted in new research, given that levels of these dependent variables change, as reflected by current literature and this study.

Researchers may also explore other mitigating factors to gauge their influences on computer self-efficacy, attitudes, and anxiety in the labor force. Organizational culture, the type of organization, and the organizational propensity for change may all be moderating influences. Their relationships to computer self-efficacy, attitudes, and anxiety have been largely unexplored thus far. Greater isolation of these variables may require more subjective techniques of research (observation, interviews, etc.), rather than the reliance upon fixed scales. Resolution of these questions is left to further research.

Future Changes

While the conclusions presented in this study fit the gathered evidence, other possible explanations exist. Samples in other industries and other occupations may reveal different work patterns across careers. Furthermore, the conditions in this research have the potential to change dramatically in the coming years. Redefinition of societal roles, along with the influx of more women, minorities, and older workers into the workforce may alter currently existing labor archetypes. These changes may be reflected in how computers are used in organizations, as well as who uses them. Longitudinal research of workers beginning their careers now would assist in confirming or denying that hypothesis.

However, the evidence is strong that existing older workers may encounter difficulties reentering the workforce if computer work is involved (Charness et al., 1992; Elder, et al., 1987; Staufer, 1992; and Tmle & Gavillet, 1990). Older males may be especially prone to this condition, due to progressive computer disuse later in their careers. It may be prudent for organizations to consider the evidence presented here, and in other studies, when retraining reemployed seniors. Males may require a longer learning curve with more hands-on computer work to adequately reestablish their skills and self-confidence.

Other Recommendations

Two factors emerged from this study that may be considered for future workforce research in this genre. First, results need to be viewed *holistically*. It was evident in this study that interpretation of the results needed an overall perspective of current groups in the workplace. How certain groups progress through their careers and how that changes their levels of computer interaction was necessary for reasonable, balanced conclusions. Without this complete inclusiveness, interpretations become a mere snapshot of current conditions.

Secondly, computer apprehension research needs *interpretive context*. An understanding of *who* uses computers in the workplace, *why* they use them, and *what* they are used for is necessary for results to be applied in the real world. This lack of context in earlier studies may have contributed to the many inconsistent results previously noted.

It would be advisable for future researchers to avoid implicit causal conclusions regarding computer preparation, later use, and apprehension. The danger for this is more evident in college-age populations on whom many previous computer anxiety studies were conducted. For example, in this study, males were significantly more likely to have had computer programming courses than females. However, there were no significant differences between sampled males and females who used the computer for programming at work. Preparation for computer programming *does not* necessitate using it later while employed. Caution in projecting causality would provide appropriate context for interpretation.

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APPENDIXES

APPENDIX A

DISTRIBUTED QUESTIONNAIRE

Background Information

This sheet is designed to gather some background information about you. It will help to determine if there are any relationships between certain types of computer attitudes, anxieties and other personal characteristics. Once again, this information is **entirely confidential** and will not be shared with anyone else in any form that would identify or associate you with your responses. Please **circle** or **write** your response in the blank next to each statement.

1. Gender: A. Male B. Female

2. What is your age? _____ years

3. Ethnic Group (please circle one or write your response):

   1. Black, Non-Hispanic 2. American Indian or Alaskan
   3. Hispanic 4. Asian or Pacific Islander
   5. White, Non-Hispanic
   6. Other (Please specify): ____________

4. Highest educational level completed (please circle one):

   1. High School (or GED) 2. Some College
   3. Junior College 4. College
   5. Masters 6. Doctorate

5. Do you have a personal computer at home? A. Yes B. No

6. Have you ever taken *any* kind of computer course in school or at work (introductory, programming, etc.)
   A. Yes B. No

7. Have you ever taken a computer programming language course at school or work?
   A. Yes B. No

8. Do you manage or supervise other people as a part of your job?
   A. Yes B. No

9. Approximately how much total experience do you have working with mainframe computers? (If you have no experience, write a zero). Years: _____ Months: _____

10. Approximately how much total experience do you have working with all other types of computers besides mainframe computers? (If you have no experience, write a zero).
    Years: _____ Months: _____

11. Approximately how many hours a week, on the average, do you use a computer at work? (If you do not use a computer at work, write a zero). ______ hours a week

12. If you use a computer at work, for what applications or functions do you use it for? (Check all that apply)

___ a. I do not use a computer at work ___ b. CAD/CAM
___ c. Electronic Mail ___ d. Spreadsheets
___ e. Statistical Analysis ___ f. Computer Programming
___ g. Database/File Management ___ h. Desktop Publishing
___ i. Internet Resources ___ j. Word Processing

___ k. Instructional Purposes (e.g., training, computer-based learning, etc.)

l. Other (please describe): ____

 (Turn the page over please)

INSTRUCTIONS: This instrument is designed to measure computer confidence levels. It is not a test, so there are no right or wrong answers. Using the scale below, circle the number that best describes *HOW CONFIDENT YOU FEEL* about doing each of the activities listed. Consider each of these statements *IN GENERAL*, rather than thinking of them in reference to a specific software application you may know or use

1	2	3	4	5
Very Little				Quite a Lot

EXAMPLE:

Using the computer to write a report	1	2	3	4	5

By circling the number 4 you indicate that you have some confidence in your ability to use the computer to write a report.

I feel confident...

	Very little				Quite a lot
1. Working on a personal (micro-) computer	1	2	3	4	5
2. Getting the software up and running	1	2	3	4	5
3. Logging onto a mainframe computer system	1	2	3	4	5
4. Working on a mainframe computer	1	2	3	4	5
5. Using the user's guide when help is needed	1	2	3	4	5
6. Entering and saving data (numbers or words) into a file	1	2	3	4	5
7. Escaping/exiting from the program (software)	1	2	3	4	5
8. Logging off the mainframe computer system	1	2	3	4	5
9. Calling-up a data file to view on the monitor screen	1	2	3	4	5
10. Understanding terms/words relating to the computer hardware	1	2	3	4	5
11. Understanding terms/words relating to the computer software	1	2	3	4	5
12. Handling a floppy disk correctly	1	2	3	4	5
13. Learning to use a variety of programs (software)	1	2	3	4	5
14. Learning advanced skills within a specific program (software)	1	2	3	4	5

I feel confident...

	Very little				Quite a lot
15. Making selections from an on-screen menu	1	2	3	4	5
16. Using the computer to analyze number data (e.g., spreadsheets, databases, & statistical software)	1	2	3	4	5
17. Using a printer to produce a copy of my work	1	2	3	4	5
18. Copying a disk	1	2	3	4	5
19 . Copying an individual file	1	2	3	4	5
20. Adding or deleting information from a data file	1	2	3	4	5
21. Moving the cursor around the monitor screen	1	2	3	4	5
22. Writing simple programs for the computer	1	2	3	4	5
23. Using the computer to write a letter or essay	1	2	3	4	5
24. Describing the function of the computer hardware (e.g., keyboard, monitor, disk drives, and computer processing unit)	1	2	3	4	5
25. Understanding the three stages of data processing: input, processing,output	1	2	3	4	5
26. Getting help for problems in the computer system	1	2	3	4	5
27. Storing software disks correctly	1	2	3	4	5
28. Explaining why a program (software) will or will not run on a given computer	1	2	3	4	5
29. Using the computer to organize information	1	2	3	4	5
30. Getting rid of files when they are no longer needed	1	2	3	4	5
31. Organizing and managing files (e.g., disk management, directories, sub-directories, & paths)	1	2	3	4	5
32. Troubleshooting computer problems	1	2	3	4	5

 (Turn the page over please)

INSTRUCTIONS: This instrument is designed to measure attitudes toward the use of computers in our society. It is not a test, so there are no right or wrong answers. Using the scale below, circle the number that best describes your level of agreement or disagreement.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

	Strongly Disagree				Strongly Agree
1. Computers will never replace human life.	1	2	3	4	5
2. Computers make me uncomfortable because I don't understand them.	1	2	3	4	5
3. People are becoming slaves to computers.	1	2	3	4	5
4. Computers are responsible for many of the good things we enjoy.	1	2	3	4	5
5. Soon our lives will be controlled by computers.	1	2	3	4	5
6. I feel intimidated by computers.	1	2	3	4	5
7. There are unlimited possibilities of computer applications that haven't even been thought of yet.	1	2	3	4	5
8. The overuse of computers may be harmful and damaging to humans.	1	2	3	4	5
9. Computers are dehumanizing to society.	1	2	3	4	5
10. Computers can eliminate a lot of tedious work for people.	1	2	3	4	5
11. The use of computers is enhancing our standard of living.	1	2	3	4	5
12. Computers turn people into just another number.	1	2	3	4	5
13. Computers are lessening the importance of too many jobs now done by humans.	1	2	3	4	5
14. Computers are a fast and efficient means of gaining information.	1	2	3	4	5
15. Computers intimidate me because they seem so complex.	1	2	3	4	5
16. Computers will replace the need for working human beings.	1	2	3	4	5
17. Computers are bringing us into a bright new era.	1	2	3	4	5
18. Soon our world will be completely run by computers.	1	2	3	4	5
19. Life will be easier and faster with computers.	1	2	3	4	5
20. Computers are difficult to understand and frustrating to work with.	1	2	3	4	5

<u>INSTRUCTIONS:</u> This questionnaire deals with the feelings and attitudes people have about computers. It is not a test, so there are no right or wrong answers. Using the scale below, circle the number that best describes your level of agreement or disagreement.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

	Strongly Disagree				Strongly Agree
1. I feel insecure about my ability to interpret a computer printout.	1	2	3	4	5
2. I look forward to using a computer on my job.	1	2	3	4	5
3. I do not think I would be able to learn a computer programming language.	1	2	3	4	5
4. The challenge of learning about computers is exciting.	1	2	3	4	5
5. I am confident that I can learn computer skills.	1	2	3	4	5
6. Anyone can learn to use a computer if they are patient and motivated.	1	2	3	4	5
7. Learning to operate computers is like learning any new skill -- the more you practice, the better you become.	1	2	3	4	5
8. I feel that if I don't learn how to operate computers I will be left behind on the job and in my career.	1	2	3	4	5
9. I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills.	1	2	3	4	5
10. I am sure that with time and practice I will be as comfortable working with computers as I am in working with a typewriter.	1	2	3	4	5
11. I feel that I will be able to keep up with the advances happening in the computer field.	1	2	3	4	5
12. I dislike working with machines that are smarter than I am.	1	2	3	4	5
13. I feel apprehensive about using computers.	1	2	3	4	5
14. I have difficulty in understanding the technical aspects of computers.	1	2	3	4	5
15. It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key.	1	2	3	4	5
16. I hesitate to use a computer for fear of making mistakes that I cannot correct.	1	2	3	4	5
17. You have to be a genius to understand all the special keys contained on most computer terminals.	1	2	3	4	5
18. If given the opportunity, I would like to learn about and use computers.	1	2	3	4	5
19. I have avoided computers because they are unfamiliar and somewhat intimidating to me.	1	2	3	4	5
20. I feel computers are necessary tools in both educational and work settings.	1	2	3	4	5

 (Turn the page over please)

Answer the following five questions using the rating scales provided below:

1. Have you ever thought that you would like to learn how to operate a computer but were too intimidated to try? (Circle the appropriate rating.)

1	2	3	4	5
I have thought this very often		I have sometimes thought this		I have never thought this

2. Would you describe yourself as a person who is afraid of computers? (Circle the appropriate rating.)

1	2	3	4	5
Yes, definitely		Sometimes yes, Sometimes no		Not at all

3. Does the thought of interacting with a computer make you nervous or uneasy? (Circle the appropriate rating.)

1	2	3	4	5
Yes, definitely		Sometimes yes, Sometimes no		Not at all

4. How uneasy or anxious would you feel if you sat down to begin working with a computer? (Circle the appropriate rating.)

0	10	20	30	40	50	60	70	80	90	100
Not at all					Somewhat					Very much so

5. How uneasy or anxious would you feel if you were in the midst of a work session at that computer and you just couldn't get your job to run? (Circle the appropriate rating.)

0	10	20	30	40	50	60	70	80	90	100
Not at all					Somewhat					Very much so

This concludes the survey.
If a label with your name and address is not attached to the bottom of this page, or if the information on the label is incorrect, please fill in the following information: (This area will be detached from the questionnaire and discarded after scores are recorded)

Your Name: ____________________

Company Name: ____________________

Company Address: ____________________

Company City: ______________ State: ________ Zip: ____________

Your Phone Number: ( ) – Extension: ______

Thank you for your participation in this survey. Please insert the completed questionnaire in the business reply envelope that came with this letter and mail. If the business reply envelope that came with this letter is **missing**, please mail this completed questionnaire to:

Oklahoma State University
School of Occupational and Adult Education
Classroom Building 406
Stillwater, Oklahoma 74078-0406
ATTN: Eddie Ruth

APPENDIX B

DISTRIBUTED COVER LETTER

May 1, 1995

Mr. John Doe
ABC Company
123 Main Street
Anytown, US 12345

Dear John,

This study focuses on computer use. It is being done as a dissertation requirement for the researcher's Ed.D. in Occupational and Adult Education at Oklahoma State University. Your name was given to me by a company representative as someone who might be willing to assist me in my research.

You are under no risk in assisting me. A more complete statement of the nature and purpose of the research will be available when my data collection is completed. All participants returning completed forms by May 12, 1995 will be entered into a drawing for one of three $100 awards. The winners will be randomly selected by a faculty member at Oklahoma State University, and notified by mail.

If you agree to participate in this research project, the required completion time is about 20 minutes. The items that I am asking you to complete include a 12-item background information sheet, a 32-item self-reported computer skill level questionnaire, a 20-item computer attitude scale, a 20-item computer anxiety scale, and five additional questions.

Your participation is valuable, but entirely voluntary. You may terminate your involvement at any time with no penalty whatsoever. **All data are <u>confidential</u>** and will not be shared with anyone, in any form, that would identify or associate you with your responses. A label has been placed on the back of your questionnaire for response tracking and statistical purposes only. All of the data that I gather will be used for research purposes only, and grouped for reporting. The area containing the name and address information will be detached from the questionnaire and discarded after scores are recorded.

Your employer is not endorsing this study, nor will they have access to any completed questionnaires. If you have questions about the research, or need to talk to me after you fill out the survey, you can contact me by calling (405) 744-6276, by e-mailing: ekruth@osuunx.ucc.okstate.edu
or by writing to:

Oklahoma State University
School of Occupational and Adult Education
College of Education
Classroom Building 406
Stillwater, Oklahoma 74078-0406
ATTN: Eddie Ruth

If you ***do not*** wish to participate in this research, mark the box below and return this letter in the enclosed self-addressed, business reply envelope.

☐ I ***do not*** wish to participate in this study.

If you ***do*** wish to participate in this research, please keep this letter for future reference, and return the stapled questionnaire in the enclosed self-addressed business reply envelope after you have finished completing it. Please leave the remaining sheets stapled together.

Your assistance and participation is important and greatly appreciated.

Sincerely,

Eddie Ruth

APPENDIX C

NONRESPONDENT FOLLOWUP

QUESTIONAIRE

<PAGE 1> NAME:______________________________ OBS#:______

1. WHY DIDN'T YOU ANSWER THE QUESTIONNAIRE?:______________________________

2. (p1q4). Highest educational level completed (please circle one):
   1. High School (or GED) 2. Some College
   3. Junior College 4. College
   5. Masters 6. Doctorate

3. (p1q6). Have you ever taken *any* kind of computer course in school or at work (introductory, programming, etc.)
   A. Yes B. No

4. (p1q7). Have you ever taken a computer programming language course at school or work?
   A. Yes B. No

5. (p1q8). Do you manage or supervise other people as a part of your job?
   A. Yes B. No

6. (p1q9). Approximately how much total experience do you have working with mainframe computers?
(If you have no experience, write a zero). Years:_____ Months:_____

7. (p1q10). Approximately how much total experience do you have working with all other types of computers besides mainfram computers? Years:_____ Months:_____

8. (p1q11). Approximately how many hours a week, on the average, do you use a computer at work? (If you do not use a computer at work, write a zero). ______ hours a week

<PAGE 6>
Answer the following five questions using the rating scales provided below:

9. (p6q1). Have you even thought that you would like to learn how to operate a computer but were too intimidated to try?

1	2	3	4	5
I have thought this very often		I have sometimes thought this		I have never thought this

10. (p6q2). Would you describe yourself as a person who is afraid of computers?

1	2	3	4	5
Yes, definitely		Sometimes yes, Sometimes no		Not at all

11. (p6q3). Does the thought of interacting with a computer make you nervous or uneasy? (Circle the appropriate rating.)

1	2	3	4	5
Yes, definitely		Sometimes yes, Sometimes no		Not at all

12. (p6q4). How uneasy or anxious would you feel if you sat down to begin working with a computer?

0	10	20	30	40	50	60	70	80	90	100
Not at all					Somewhat					Very much so

13. (p6q5). How uneasy or anxious would you feel if you were in the midst of a work session at that computer and you just couldn't get your job to run?

0	10	20	30	40	50	60	70	80	90	100
Not at all					Somewhat					Very much so

APPENDIX D

NONRESPONDENT FOLLOWUP

REMINDER CARD

Dear John,

I have received many responses to my computer attitudes questionnaire, but I missed seeing yours! If you have already mailed it, thanks for your participation. If not, I have extended the return deadline to May 31st so that you can still be eligible for one of the three $100 awards. If you need another questionnaire, call (405) 744-6276, leave your name and I will send you another one. You can also e-mail:
ekruth@osuunx.ucc.okstate.edu

If you have any questions or need clarification on participating, please contact me. Your input is important and greatly appreciated.

Thanks again for your help,
Eddie Ruth

APPENDIX E

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 05-22-95 **IRB#:** ED-95-090

Proposal Title: A MULTIVARIATE ANALYSIS OF GENDER, AGE, AND ETHNICITY AS ELEMENTS SHAPING TECHNOLOGICAL ATTITUDES, ANXIETY AND SELF-EFFICACY IN WORKPLACE SETTINGS

Principal Investigator(s): Gary Oakley, Edward K. Ruth

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

APPROVAL STATUS SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING.
APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature: John H. Wycoff
Chair of Institutional Review Board

Date: May 25, 1995

VITA

Edward K. Ruth

Candidate for the Degree of

DOCTOR OF EDUCATION

Thesis: A MULTIVARIATE ANALYSIS OF GENDER, AGE, AND ETHNICITY AS ELEMENTS SHAPING TECHNOLOGICAL ATTITUDES, ANXIETY, AND SELF-EFFICACY IN WORKPLACE SETTINGS

Major Field: Occupational and Adult Education

Biographical:

Personal Data: Born in Louisville, Kentucky, June 28, 1960, the son of William E. and Loretta Ruth.

Education: Graduated from R. H. Watkins High School in Laurel, Mississippi, June, 1978; received Bachelor of Science degree from William Carey College, Hattiesburg, Mississippi, 1982; received Bachelor of Arts degree from William Carey College, Hattiesburg, Mississippi, 1982; received Master of Business Administration, Oklahoma City University, Oklahoma City, Oklahoma in 1990; completed the requirements for the Doctor of Education degree from Oklahoma State University, Stillwater, Oklahoma in May, 1996.

Professional Experience: Graduate Research Associate, Oklahoma State University, January 1994-May 1995; Software Engineer, Teubner and Associates, Stillwater, Oklahoma, June 1992-December 1993; Systems Manager, Acxiom, Conway, Arkansas, September, 1990-July 1991.