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Review

Computer anxiety: Comparison of research from the 1990s and 2000s

Anne L. Powell *

Computer Management and Information Systems Department, School of Business, Southern Illinois University Edwardsville, United States

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ABSTRACT

As computers became ubiquitous in businesses, homes, and schools, there was increasing concern about computer anxiety and its effect on individuals. The first academic articles on computer anxiety were published in the early 1980s. Since that time, hundreds of papers have been published on the topic. Yet, up to this time, no one has done a comprehensive review of computer anxiety. In this article, 276 articles on computer anxiety are reviewed. From a synthesis of the articles and variables studied to date, a framework is developed that outlines the primary topics studied in computer anxiety literature. Nine antecedents, five correlates, and two outcomes of computer anxiety are identified as the most studied variables in the literature. In addition, a statistical comparison is done to compare the distribution of computer anxiety topics and results published in the 1990s to those published in the 2000s. Suggestions for future research in computer anxiety are proposed.

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* Tel.: +1 618 650 2590; fax: +1 618 650 5353.
E-mail address: apowell@siue.edu

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1. Introduction

In the first half of the 20th century, numerous innovations changed people's lives. Radio, submarines, airplanes, television, and antibiotics: all make lists as major innovations of the 20th century (http://www.toptenz.net/top-10-inventions-of-the-20th-century.php). But in the last half of the 20th century, computers and the Internet changed not only the way we lived, but the way we worked. Early on, computers were touted as a way to increase efficiency, accuracy, and productivity (Dockery, 1984), but they came with a downside. The change in the way employees work was so dramatic that it soon became obvious extra attention would need to be paid to employees to overcome their natural resistance to change (Powell Posner, 1978). "Long lasting relief for Computer Anxiety" read the headline of an advertisement from 1982 from Digital Equipment Corporation®. In 1983, Training and Development Journal published a paper titled "Treating Computer Anxiety with Training" (Galagan, 1983) and academic work on computer anxiety had begun. Computer anxiety is defined as "the tendency of individuals to be uneasy, apprehensive, or fearful about current or future use of computers" (Parasuraman & Igbaria, 1990, p. 329). Since 1983, hundreds of articles about computer anxiety have appeared in dozens of academic journals. While a large body of empirical work has accumulated on computer anxiety, no comprehensive review of the work generated has been published. The central purpose in this review is to answer two research questions: What has the empirical academic literature found out about computer anxiety – its antecedents, correlates, and outcomes? What still needs to be researched in the future; what are the gaps in our knowledge about computer anxiety?

In this review, 276 articles from the 1990s and 2000s are reviewed. Articles in the 1980s were not reviewed. The number of articles published on computer anxiety was just beginning in the 1980s; just four articles were published in peer-reviewed, scholarly journals in 1988. By the 1990s, computer anxiety was more established as a topic to be studied. The number of peer-reviewed scholarly research on CA from the 1980s was not as extensive and makes comparisons between decades problematic. By limiting the review to the 1990s and 2000s articles, research conducted in the two decades can be compared. In addition, looking at full decades allows future researchers the ability to more consistently compare CA research in the 2010s to this body of work.

This review contributes to the literature by proposing a framework documenting the most often studied variables of computer anxiety (CA). By comparing literature published in the two decades of the 1990s and 2000s, we are able to examine what we have learned as well as where we are headed in CA research.

This paper is structured as follows. First, the research method used to find and code the articles is explained. In the next section, a framework is presented to show the variables studied in computer anxiety research. Computer anxiety articles published in the 1990s and 2000s are identified and mapped into the framework. Key articles for each piece of the framework are discussed. This review then provides a statistical comparison of the distribution of computer anxiety topics addressed in the 1990s vs. the 2000s as well as any differences in results found between decades or between sample sources used in the studies. Finally, future directions for research on computer anxiety are proposed.

2. Classification methodology and results

The search for published articles on CA was completed primarily through a database search. Three databases were used: ABI Inform, Academic Search Complete, and Business Source Elite. These three databases were searched for matches to "computer anxiety" in the abstract for all articles published in the 1990s and 2000s. In addition, only peer-reviewed scholarly journals were searched. A total of 333 articles were identified. Several of these articles were deemed out of the scope of this paper. For example, articles that only used CA as a control variable or only defined the variable in the paper were not included. After eliminating out-of-scope articles, 276 articles were reviewed. Of these, 128 (46.5%) were published in the 1990s and 147 articles (53.5%) were published in the 2000s.

To create a framework of the work done in CA, the first rater (the author) read through each of the 276 articles, creating a table with variables studied in each article as well as main results. From this review, the primary concepts in CA emerged, and a framework was created. The first rater mapped each article to the framework. For a variable to be included in the framework, at least ten articles had to be identified that examined that variable. Two additional raters were given the framework created by the first rater and they each independently reviewed each article without knowing the results of the first rater's categorizations. Discussion was used to resolve any coding disagreements. After resolving discrepancies, an inter-rater reliability of 100% was achieved.

Fig. 1 depicts the framework created by rater one and used by all raters to categorize each article. Antecedents to computer anxiety fit within two broad categories: personal characteristics and interactions between the individual and computer. Personal characteristics include age, gender, personality, education, profession, and other anxieties (i.e., math anxiety, e-mail anxiety). Interactions between the individual and computer include experience/use, ownership, and training. Correlates to CA include feelings toward computers or affective responses to the computer. Because it is difficult to determine causality of affective response, these are considered correlates to CA rather than an antecedent or outcome. Correlate variables include self-efficacy, attitude, perceived ease of use, perceived usefulness of the computer, and satisfaction. Finally, outcomes of computer anxiety include performance and intent to use. Table 1 provides a list of the 276 articles reviewed along with additional research parameters such as research setting, sample size, sample source, variables examined, CA scale used (if any), and a brief description of results related to CA.

The 276 articles appeared in 90 different journals. However, nearly 60% of the published articles appeared in ten of those journals. A variety of methods were used to capture data including single surveys, pre/post-tests, repeat measures, case studies, interviews, and longitudinal studies. Sample sizes in the 276 articles ranged from 12 to 2456 with an average of 255 subjects. One third of the studies used sample sizes under 125, one third

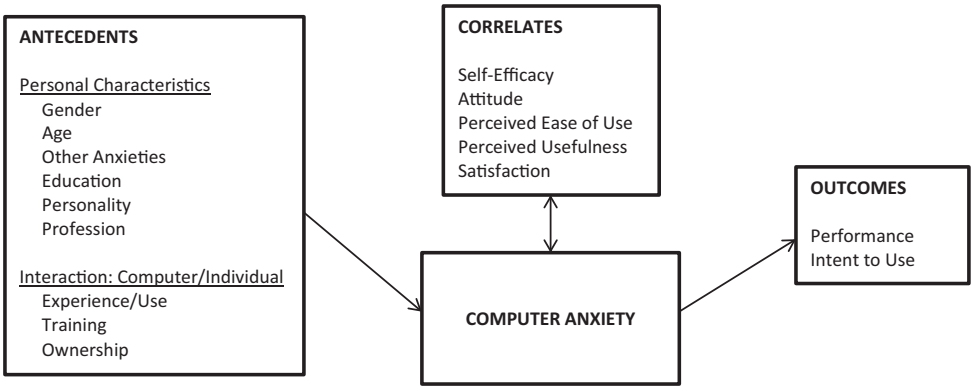

Fig. 1. Framework of CA literature.

used sample sizes between 127 and 275, and the final third used sample sizes greater than 275. Each of these three groupings of studies had the same approximate combination of sample sources, i.e., just over half the studies in each of the three groups used college students, a third used adults (not enrolled in college), and about 12% used either children under the age of 18 or seniors over 50. Table 2 provides the distribution of papers that used the four sample groups in research (children, college students, adults, seniors). Table 3 provides a breakdown of research methods used with each construct. Single surveys were used most often, typically between 65% and 85% of the studies examining a construct used single surveys to collect data. Pre/post-tests, repeat measures, interviews, case studies, and longitudinal studies were also used to study CA.

3. Antecedents in the computer anxiety literature

Personal characteristics and interaction between the individual and computer have generally been considered as antecedents to computer anxiety.

3.1. Personal characteristics

Personal characteristics that were examined by at least ten articles included: gender, age, other anxieties, education, personality, and profession/organizational aspects.

3.1.1. Gender

Eighty articles looked at gender and its effect on CA. Results were split between articles that found no difference in CA between gender and articles that found females to have more CA than males. Thirty-five articles found no difference in CA between genders. Of these, 21 were published in the 1990s (e.g., Parasuraman & Igbaria, 1990) and 14 were published in the 2000s (e.g., Hong & Koh, 2002). Forty articles reported females had more CA than males. Of these, 20 were published in the 1990s (e.g., Igbaria, 1993) and 19 were published in the 2000s (e.g., Mikkelsen, Ogaard, Lindoe, & Olsen, 2002). Some articles found multiple results because they used more than one sample source in the study. See Table 4 for a list of articles examining gender. Five articles found males with more CA than females. For example, males from Hong Kong and Taiwan had more CA than females from the same country (Brosnan & Lee, 1998; Tsai, 2002); 7th, 9th, and 11th grade males were found to have more CA than their female counterparts (King, Bond, & Blandford, 2002); males majoring in elementary education had more CA than their female counterparts (Reed, 1995); and in a survey of unemployed adults, the males were found to have more CA than the females (Chou & Tsai, 2009).

Comparing gender across several years, Popovich, Gullekson, and Morris (2008) found that gender was significant in predicting CA in 1986 but not in 2005. When controlling for experience, gender was not a significant indicator of CA, but if you did not control for experience, females had more CA than males (Busch, 1995). Todman (2000) found the gender gap had widened for CA between 1992 and 1998 because male CA had decreased during that time period, while there had been no difference in the level of CA among females. Defining gender in both biological and psychological terms, it was found that psychological gender would predict CA while biological gender did not (Brosnan, 1998; Todman & Day, 2006).

When comparing the number of published articles between the 1990s and 2000s, no significant difference existed in the number of published articles that examined the variable of gender ($\chi^2 = 1.157$, $p = .289$). Findings between the two decades were also similar, with about half of the articles finding gender and CA had no significant relationship and half finding females exhibit more CA than males.

However, the sample source did appear to influence results. Nearly all studies in both the 1990s and 2000s that used children as subjects found females were more CA than males. While results from studies using adults were more evenly split, the majority still found females more CA than males. Conversely, samples using college students differed. In the college sample, in both decades, results were more likely to find no difference in CA between genders. Overall, two thirds of the studies using college students found no difference in CA between genders. When split by the two decades, this ratio remained the same. Females attending college appear to view computers differently from adult females as a whole (some of whom may have college credit, but not all) and young girls. The population of college women may have greater educational goals or had greater educational opportunities with computers than the general female population. If you compare college students against the other three categories, there is a significant difference in findings between the two groups; college students are more likely to show no difference in CA between genders while children, adults, and seniors are significantly more likely to find females more CA than males ($F = 4.656$, $p = .034$).

3.1.2. Age

Forty of the 276 articles examined age as an antecedent to computer anxiety. Similar to the research on gender and CA, results were evenly split between articles that found age to be positively related to CA ($n = 16$) and articles that found no relationship between age and CA ($n = 16$). In the articles that found age to be positively related to CA, nine of them were published in the 1990s (e.g., Igbaria, 1993) and seven were published in the 2000s (e.g.

Table 1
Articles included in review.

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
Appelbaum and Primmer	Personnel	1990	N/A	–	–	–	–	Conceptual paper. Provides HR solution to computer phobics. Provides three suggestions to minimize anxiety: (1) system design, (2) training and education, (3) user support. Then details a model for training the computer anxious which includes steps of: (1) assessing training needs, (2) accounting for human factor, (3) desensitization, and (4) advanced training
Bandalos and Benson	Education and Psychological Measurement	1990	Scale	375	187 Undergraduate (UG) students, 188 grad. students	–	Loyd and Gressard (1984)	Purpose of paper was to identify the factor structures of the CAS and to test the invariance of this factor structure across two subsamples (M/F and UG/G). 23 of 29 CAS items loaded on three factors labeled liking, confidence, and achievement
Harrington, McElroy, and Morrow	Journal of Educational Computing Research	1990	Pre–post surveys	74	UG students	Training (lecture vs. CBT), personal preference of training, #questions asked, #errors made, intention of future use	Maurer (1983)	CBT less effective for high CA than low CA. CBT does not result in more learning, less CA for high CA (preferred mode does). If preferred method of training received, no difference in intention to use between HI and LOW CA individuals. CA not reduced by CBT. Pre-experiment CA positively related to post CA, #questions asked; negatively related to intention to use. Not having preferred mode of learning increases errors among high CA individuals
Igbaria	OMEGA	1990	SS	187	Part-time MBA students	Training, experience, attitudes toward EUC, effectiveness of EUC	Raub (1981)	CA affected by work/life experiences, training, experience, and IC support. CA affected attitudes towards EUC
Igbaria and Chakrabarti	Behaviour and Information Technology	1990	SS	187	Part-time MBAs	Demographic variables, computer training and experience, mgt support and system quality, computer attitudes	Raub (1981)	Gender correlated with CA; age, education, org level were not. Computer experience, training, mgt support and system quality negatively related to CA. Demographics indirectly affect attitudes through CA
Igbaria and Nachman	Information and Management	1990	SS	104	End users in large companies	End user satisfaction	Raub (1981)	CA negatively related to end user satisfaction
Kernan and Howard	Education and Psychological Measurement	1990	RM (3) weeks 1, 2, 12	Approx. 360 (retest = 85)	Students	State anxiety, trait anxiety, math anxiety, experience, final grade, expected skill level at end	Raub (1981)	CA and attitude should be treated as separate constructs. 66 item factor analysis using items from measures created 5-factor solution, one of which being CA, the others being measures of attitude. None of five factors able to predict course grades or withdrawal behavior
Marcoulides and Wang	Journal of Educational Computing Research	1990	Scale	437	American (225) and Chinese (212) UG students	Country of citizenship	Marcoulides et al. (1985)	Provided support for reliability and validity of CAS in cross-cultural study
Parasuraman and Igbaria	International Journal of Man–Machine Studies	1990	SS	166	Managers/part-time MBAs	Gender, external locus of control, cognitive styles, age, education level, org level, trait anxiety, math anxiety, attitudes	Raub (1981)	Men and women do not differ in level of CA reported and are very similar in their attitudes towards PCs. Gender differences were found in the pattern of relationships of demographic and personality variables.

								For men, education and intuition sensing was negatively related to CA; age, math anxiety, external locus of control was positively related to CA. For women, demographic and personality variables were not related to CA. CA strongest predictor of attitudes among both males and females
Pilotte and Gable	Educational and Psychological Measurement	1990	Scale	270	High school students	–	Created for study	Negative and positive items in a CA scale are indicative of different latent variables
Ray and Minch	Human Factors	1990	SS scale	114	UG and grad. students	Gender, age, major, computer experience, ownership, computer alienation	Raub (81) and Minch and Ray – created for study	Created both a 40-item and 14-item measure of computer anxiety and alienation. Findings show no differences attributed to age or gender but that # of years of computer experience is a significant indicator of the measure. Many of CA items could be reclassified as one of alienation's components
Smith and Kortlik	Journal of Extension	1990	SS	522	Extension agents in southern region	Skill level, typing skills, math ability, hours of computer use	Oetting (1983) (COMPAs)	Overall, agents were mildly anxious. CA was negatively related to computer skill level, typing skills, math ability, and hours of computer use
Williams and Johnson	Education	1990	SS	129	UG students	Major (computer science or education), gender	Montag et al. (1984) (CAIN)	Students majoring in education are significantly more CA than students majoring in computer science. Additionally, female students majoring in CS and all students in education had significantly more CA than male CS majors
Chin and Donn	Educational and Psychological Measurement	1991	SS	105	10th Grade students	Experience	Loyd and Gressard (1984)	No significant relationship found between computer experience and CA as a result of taking a computerized test
Chu and Spires	Computers in Human Behavior	1991	Pre–post after semester class	132	MBAs (took UG sample from Heinssen et al. (87) study)	Level in school, computer experience, comp. ownership, gender, GMAT, cognitive style, computer course taken	Heinssen et al. (1987)	Experience, ownership, verbal GMAT, intuitive style, thinking style all negatively related to CA. Computer course taken and gender were not related to CA. Also factor analyzed CARS into five factors
Farina	Computers in Human Behavior	1991	SS	162	UG students	Trait anxiety, math attitude, experience, impact, gender	Raub (1981)	People who feel computers negatively impact society have more CA. Experience negatively related to CA. Math anxiety and trait anxiety positively related to CA. Females more CA than males
Howard and Mendelow	Decision Sciences	1991	SS	422	Business admin faculty	Computer use	Raub (1981)	8 Themes found to explain computer use. 7 were significant discriminators among non, minimal, or high users. CA was NOT one of them (i.e., CA and use were not related)
Jacobson	Libraries and Information Science Research	1991	Longitudinal 1 year	40	Academically talented seniors in HS	Gender, library anxiety, computer use	Created from Jacobson and Weller (87–88) and Palmer et al. (86)	Girls had higher CA and higher computer use for library research anxiety, boys had higher LA. After year-long class using computers for library/debate class, both boys and girls lessened their anxiety. One exception, girls anxiety on using computers for library research did not decrease
Marcoulides	Computers in Human Behavior	1991	Scale	437	UG students in US and China	–	Marcoulides et al. (1985)	–
George, Lankford, and Wilson	Computers in Human Behavior	1992	SS	97	UG students	Mode of test, Beck Depression Inventory (BDI); State-Trait Anxiety Inventory (STAI)	Heinssen et al. (1987)	Although trait anxiety was equal between 2 groups, it was found that CA artificially inflated negative affect scores for those

(*continued on next page*)

Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
								completing personality test via computer vs. those taking test by paper-and-pencil. BDI increased as CA increased
Harrison and Rainer (a)	Education and Psychological Measurements	1992	Scale	693	University personnel	Computer attitude, computer self-efficacy	Heinssen et al. (1987)	Evaluated factor structures and concurrent validity of the CAS, CARS, and CSE scales. Each instrument exhibited construct and concurrent validity and reliability. High CA correlated positively with: negative attitudes, lack of understanding, negative feelings. High CA correlated negatively with all factors of CSE
Harrison and Rainier (b)	JMIS	1992	SS	776	University knowledge workers	Computer self-efficacy	Heinssen et al. (1987)	CA and self-efficacy negatively related
Leso and Peck	Journal of Educational Computing Research	1992	Pre/post 15 weeks	60	UG students	Class enrollment	State-Trait Anxiety Inventory (pre-test), anxiety subtest (post-test)	Students in the 'tools software application' course (no programming) had significantly lower post-test CA than students enrolled in the 'problem-solving and programming' course. Initial levels were not different between groups
Martocchio	Personnel Psychology	1992	Study 1: SS, study 2: pre/post 4 h class	79	Non-academic university employees enrolled in training course	Training context (opportunity or neutral), computer experience, pre-training expectations	Heinssen et al. (1987)	Trainees in opportunity condition had lower CA than those in neutral condition. Experience and pre-training expectations were significant covariates in explaining post-training anxiety
Reed	Computers in Human Behavior	1992	RM weeks 5, 8, 11, 14	48	UG students	Ability level, type of essay, task sequence, quality, writing apprehension	Spielberger's self-evaluation questionnaire	CA: those with low ability had the highest CA. Type of essay being written affected level of CA (persuasive essay had highest CA, narratives lowest CA)
Reed and Palumbo	Journal of Educational Computing Research	1992	RM at weeks 0, 4, 9, 16	12	UG students	Language competency (performance), problem solving skills	Spielberger self-evaluation questionnaire	Need to accommodate CA before learning can take place. Surveyed students at weeks 0, 4, 9, and 16 weeks. Significant decrease in CA between weeks 0 and 4 (no other sig change between surveys)
Rosenbluth and Reed	Computers in Human Behavior	1992	RM (3) remedial vs. accel day 2, 28, 80 or day 2, 17, 80	67	11th Graders	Ability level, mode of test	Spielberger's self-evaluation questionnaire (Reed & Palumbo, 1988)	CA of both remedial and accelerated writers using computer decreased. The CA of those not using computers in both ability groups did not change
Todman and Lawrenson	British Educational Research Journal	1992	SS	96 (65 Grade 5, 31 univ. students)	1st year psychology students and 9-year olds	Age, math anxiety, computer experience	Cambell and Dobson (1987)	Children less CA than university students. Math anxiety and CA are distinct variables
Torkzadeh and Angulo	Behaviour and Information Technology	1992	N/A	–	–	Training, math anxiety, gender, trait anxiety, knowledge of computer, locus of control, cognitive style	–	Describes nature and correlates of CA and assesses training as a mechanism for reducing the impact of CA. Correlates examined include: math anxiety, gender, trait anxiety, knowledge of computer, locus of control, and cognitive style
Webster and Martocchio	MIS Quarterly	1992	1 Group: Pre/post 3 groups: SS	423	77 Employees, 32 grad. students, 314 UG	Playfulness, involvement, positive mood, satisfaction, learning	Heinssen et al. (1987)	Negative relationship between CA and playfulness. Playfulness exhibits discriminant validity from CA. Playfulness has greater predictive power than CA for involvement, positive mood, satisfaction, and learning

Wilson and Daubek	Journal of Marketing Education	1992	SS		Undergraduate students in marketing class	Age, gender, class standing, # of computer-using courses taken, course enrolled in, GPA	Loyd and Loyd (1985)	No significant relationship between CA and age or CA and gender. Class standing, course, # of computer-using courses, and GPA positively related to CA
Carlson and Wright	Journal of Educational Computing Research	1993	Pre/post week 1, final	181	UG students	Course taken (speech or CS), prior computer experience, year in school, communication apprehension	Loyd and Gressard (1984)	Small significant positive relationship between CA and comm app. completion of basic computer course increased CA. More computer experience led to less CA
Gardner, Descenza, and Dukes	Journal of Educational Computing Research	1993	Scale	244	UG students	–	Raub (1981); Loyd and Gresard (1984); Maurer et al. (1983); Ericksson (1987)	Empirically compared four measures of attitudes toward computers. All measures equal in terms of reliability and validity. Attempts to derive improved scales were unproductive. Intended use should be main criterion in deciding scale to use. CAS and BELCAT easier to read. Raub and CAIN had items that crossloaded more substantially. CAS becoming measure of choice in research
Henry	American Archivist	1993	N/A	–	–	Use	–	Conceptual paper on why archivists may not use or feel comfortable using computers. Reasons given: age, gender, CA, ways of thinking, extrinsic knowledge
Igbaria	OMEGA	1993	SS	519	Managers	Age, gender, training, experience, IC support, mgt support, perceived usefulness, attitudes, intentions, user acceptance	Raub (1981)	Experience had strong direct and indirect effects on CA. User training and IC support had strong negative effects on CA. CA had strong negative effect on perceived usefulness and intentions, indirect effects on attitudes, intentions, and user acceptance (via perceived usefulness). Age positively related to CA. Females more CA than males
LaLomia and Sidowski	International Journal of Human–Computer Interaction	1993	N/A	–	–	–	Several	A review of the most used CA scales used in research during the 1980s
Okebukola	Educational Research	1993	SS	281	High school students (grade 11) in Australia	Gender	Created from Fraser, Nash, and Fisher's (1983) science anxiety scale	Girls had higher CA
Rosen, Sears, and Weil	Computers in Human Behavior	1993	RM (3) pre/post 6 months	162	UG students (16–62 years)	Treatment group, dropout group, cognitions, attitude, dropout rate, performance	Rosen et al. (1987)	Used a psychological program to measure reduction in CA. No computers were used in course. All treatment modules were successful in reducing CA, increasing cognitions and attitudes
Brown and Coney	Journal of the American Medical Informatics Association	1994	Pre/post initial, 3 months	51	Medical interns	Skills, typing ability, attitudes, age, gender, ownership, perceived stress, prior computer course, awareness of computer program, computer experience, attitudes	Cohen and Waugh (1989)	Variables correlated with high CA included: low self-rated computer skills, low frequency of prior computer use, worse attitudes, female, not owning a computer, lower typing skills. Age was not related to CA. After 3 months, CA had not changed for group
Colley, Gale, and Harris	Journal of Educational Computing Research	1994	SS	144	UG students	Gender, prior experience, parent and sibling use, prior course	Loyd and Gressard (1984)	When effects of prior experience and gender stereotyping were removed, no significant gender differences found. For both M and F: experience at home and prior courses negatively related to CA; for M: father's and brother's use negatively related to CA. For F: mother's and brother's use negatively related to CA

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
Crable, Brodzinski, Scherer, and Jones	Journal of Educational Computing Research	1994	SS	425	UG and grad. students	Locus of control, prior experience, cognitive appraisal (benefit, harm, threat, challenge to use)	Created for study – computer concerns questionnaire (35 item – self-developed)	Cognitive appraisal and experience significantly related to CA. Benefit, challenge, experience negatively related to CA; threat, harm positively related to CA. Locus of control not significantly related to CA
Dyck and Smither	Journal of Educational Computing Research	1994	SS	422	Younger adults: undergrads older adults: Sr. citizen centers	Age, gender, experience	Marcoulides et al. (1985, 1989)	Older adults had less CA. For both groups, greater computer experience led to less CA and more positive attitudes. No difference in CA between genders
Francis	Computers and Education	1994	SS	378	UG students	Gender	Gressard and Loyd (1986)	No significant gender differences found in CA
Igbaria, Schiffman, and Wieckowski	Behaviour and Information Technology	1994	SS	471	Managers and professionals (variety of orgs)	Usage, satisfaction, perceived usefulness, perceived fun	Raub (1981)	CA direct and negative impact on usefulness and fun. CA direct, negative impact on satisfaction. CA direct and indirect (thru usefulness and fun), negative impact on usage
Kluever, Lam, Hoffman, Green, and Swearingen	Journal of Educational Computing Research	1994	Pre–post after training class	265	Elementary/HS teachers	Efficiency, liking, instructional usefulness	Loyd and Loyd (1985)	CAS reliable concerning attitudes and impressions of teachers
Lankford, Bell, and Elias	Computers in Human Behavior	1994	SS	131	UG students	Method of exam, BDI, purpose in life	Heinssen et al. (1987)	High CA scores were associated with higher BDI scores and lower PIL scores for those who took the personality test via computer (vs. paper-and-pencil) even controlling for state, trait, and math anxiety
Martocchio	Journal of Applied Psychology	1994	Pre/post 3 h train two groups	76	University employees	Acquisition of knowledge, pre-training expectations, training group, declarative knowledge	Heinssen et al. (1987)	Those in the 'acquirable skill' condition had significant decrease in CA. Those in 'fixed entity' condition, CA did not change significantly. No CA difference between groups before training. Pre-training expectation negatively related with CA. CA negatively correlated with declarative knowledge/performance
Maurer	Computers in Human Behavior	1994	N/A	–	–	Experience, gender, age, major, academic achievement, other anxieties, personality traits	NA	Conceptual paper. Provides model of the development of CA based on research on the listed variables
McInerney, McInerney, and Sinclair	Journal of Educational Computing Research	1994	Pre/post week 2 week 12 two groups (Ed comp class or no)	101	UG students	Age, gender, ownership, ethnicity, high school type, perceived computer competence/experience	Heller and Martin (1987)	Findings support need for increasing experience to reduce CA. Self-ranked competence and experience negatively related to CA. CA not correlated with age, gender, ethnicity, or high school type. Ownership correlated with CA only at post-test
Szajna	Educational and Psychological Measurement	1994	SS	162	UG students	Computer experience, performance, aptitude	Bandolas and Benson (1990); Kernan and Howard (1990)	Effects of CA on performance were inconsistent. CAF associated with computer aptitude. CA had association with performance only early in intro course, not at all in intermediate course. Reliability of CAF low
Todman and Monaghan	Computers in Human Behavior	1994	SS	180	UG students	Gender, age, age-1st experience, perception of experience, computer competence, use	Campbell and Dobson (1987)	Age negatively related to CA. How relaxed first experience was negatively related to CA. How in control indv felt during first experience negatively related to CA. CA

								negatively related to expected and future use. Gender not related to any variable tested
Vogel	Journal of Educational Computing Research	1994	SS	40	UG students	Personality (neuroticism, extroversion), test type (P&P vs. computer), GRE performance	Loyd and Gressard (1984)	Significant interaction between CA, extroversion and test mode. Surprising result: Extroverts with low CA obtained LOWER scores on computer version of GRE. Introverts did better on computer GRE than extroverts
Bohlin and Hunt	Journal of Educational Computing Research	1995	SS	381	UG and grad. students in teacher education	Course length, course meeting frequency	Loyd and Gressard (1984)	Greatest changes in CA occurred in classes that met more times per week and met over longer time periods
Busch	Journal of Educational Computing Research	1995	SS	147	UG students	Gender, experience, encouragement	Gressard and Loyd (1986)	Part I: Males: less CA. Part II: Prior experience and encouragement from friends greatest effect on CA. When controlling for experience and encouragement, no gender differences in computer attitudes
Charlton and Birkett	Journal of Educational Computing Research	1995	Scale	380	UG students	–	Created computer apathy and anxiety scale	Development and validation of new scale. CAAS composed of three constructs: Apathy (behavioral), anxiety (affective), and societal overemphasis of computers (cognitive)
Deane, Henderson, Mahar, and Saliba	Interacting with Computers	1995	N/A	–	–	–	–	Conceptual paper examine effects CA might have on behavioral biometric security systems
Dyck and Smither	Computers in Human Behavior	1995	Pre/post W2 and W8	28	Older adults (avg. age = 68.7)	Gender, cognitive abilities, computer experience, performance	Loyd and Gressard (1984)	More experience led to less CA. Females had more CA. CA correlated with matching test results but not keyboard test
Frey	Perceptual and Motor Skills	1995	Pre/post W1, W16	63	Students	Computer use, computer experience, enrollment in elective CAD course	Created 14-item CAD anxiety scale (modified from Heinssen et al. (87))	Those NOT in CAD course: CA significantly correlated with use, experience, future enrollment expectation in CAD; greater use led to lower CA; greater # courses led to lower CA
Gonzalez, Spiteri, and Knowlton	Computers in Human Behavior	1995	SS	68	University students	Method of taking CES-D, test score	Rosen et al. (1987)	Comparing paper-and-pencil to computer versions of test-taking. CA level did not effect results
Henderson, Deane, and Ward (a)	Behaviour and Information Technology	1995	SS	103	Health care professionals	Occupational differences (nurse vs. admin), self-efficacy, education, experience	Gressard and Loyd (1986)	Self-efficacy best predictor of CA. Although nurses had higher education, they had more CA
Henderson, Deane, Barrelle, and Mahar (b)	Interacting with Computers	1995	SS	253	Healthcare and banking professionals	Psychological distress, age, gender, experience	Loyd and Gressard (1984)	Levels of anxiety and liking similar in healthcare and banking professionals when compared to prior articles examining students. Significant, positive relationship found between distress and anxiety. Significant, negative relationship found between experience and anxiety. No significant relationship found between: CA and age; CA and gender
Igbaria and Iivari	OMEGA	1995	SS	450	PC users in Finland	Computer usage, trait anxiety, state anxiety	Raub (1981)	CA negatively related to computer usage. CA can be divided into two constructs – trait anxiety (stable) and state anxiety (response to specific situation)
Keeler and Anson	Journal of Educational Computing Research	1995	Pre–post beginning and end of semester	44	UG students	Section (cooperative learning vs. indv learning), age, working status, computer experience, performance retention	Heinssen et al. (1987) (shortened to 7-items)	All high CA individuals had significant decrease in CA at end of class, but those high in CA and in cooperative learning section had sig greater decrease. Also,

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
								those with high CA had much better performance if in cooperative learning section than those in indv learning section. Age positively related to CA, computer experience negatively related to CA
Kelley and Charness	Behaviour and Information Technology	1995	N/A	–	–	Age, attitudes, cognitive abilities, use, learning	–	Conceptual paper. Asking: what is source of age difference difficulties with computer learning? Summarizes findings from past research. Primarily found generalizability low – could not find effects of age
Marcoulides, Mayes, and Wiseman	Educational and Psychological Measurement	1995	SS	578	College students and members of law enforcement	Profession, age, training	Marcoulides et al. (1985)	Validity of CA construct can be generalized to different groups. Police officers CA was lower than students despite older age and less computer classroom training
Miller and Rainer	Educational and Psychological Measurement	1995	Scale	776	University employees	–	Heinssen et al. (1987)	Used CFA to assess and improve the unidimensionality of the two constructs underlying CARS. 7-item model found to be better fit than full 19-item scale. Suggests CA may be measured by a parsimonious form of CARS
Reed et al.	Journal of Computing in Childhood Education	1995	SS		UG students	Gender, year of program, experience	Spielberger's	Gender, year-of-program entry, and experience all had main effect on CA. Males with no experience had higher CA than females with no experience
Rosen and Weil (a)	Computers in Human Behavior	1995	SS	488	Elementary and secondary teachers	Computer experience, current computer use, computer availability, gender, teaching experience, teaching level, ethnicity, school socioeconomic status	Rosen et al. (1987) (modified)	Computers are available at all schools, but are not being used by many teachers. Many teachers are technophobic. Teachers are most worried about dealing with actual computer HW, errors, and learning to use. Predictors of technophobia varied between elementary and secondary teachers. But, experience and current use negatively related to CA for all groups; teaching experience positively related to CA for all groups. Computer availability negatively related to CA for secondary teachers (not elementary). Gender, school socioeconomic status not related to CA
Rosen and Weil (b)	Computers in Human Behavior	1995	Scale	2456	UG students from 10 countries	–	Rosen et al. (1987) (modified for different countries)	Each country possessed a unique culture. A dependent model of CA was found for each country
Szajna and Mackay	International Journal of Human–Computer Interaction	1995	SS	63	UG students	Computer aptitude, computer experience, learning performance	Loyd and Gressard (1984)	CA was not related to performance. Experience not related to CA. Aptitude negatively related to CA
Al-Jabri	Journal of Computer Information Systems	1996	SS	187	Saudi Arabian secondary students	Gender	Loyd and Gressard (1984)	Among Saudi Arabian school children, gender is significantly related to CA. Females have higher CA than males. Author acknowledges this could be because of culture and lack of opportunities for women in the country
Anderson	Computers in Human Behavior	1996	SS	64	UG students	Experience, knowledge of computers, gender, success	Raub (1981)	Perceived knowledge rather than experience was better predictor of CA.

								Higher CA is accompanied by less experience and less perceived knowledge. Students who failed test had greater CA. Gender not related to CA
Ayersman	Computers in the School	1996	Pre/post 15 week class	106	Mostly UG students, some grad. students	Type of course, learning style, experience, gender, class intensity (1-h vs. 3-h class)	Spielberger's	CA went down after course. No sig difference in CA for learning style pre-class. Post-class there were sig differences in CA between assimilators and convergers; and between divergers and convergers. Computer experience negatively related to CA. Gender and class intensity (1-h vs. 3-h) not related to CA
Bowers and Bowers	Social Science Computer Review	1996	Pre/post UG class	Not given	Students	Age, gender, race, class taking, total hours, GPA, ACT score, familiarity with computers, computer ownership	Heinssen et al. (1987)	CA not related to gender, race, or ownership. Age not related to CA in research methods class, but was positively related to CA in intro class. Total hours and GPA not related to CA. Familiarity with computers negatively related to CA. First time survey given, ACT score had no relationship with CA. Second time, ACT score was negatively related to CA
Bozionelos	Psychological Reports	1996	SS	235	British managers and professionals	Gender, self-training	Heinssen et al. (1987)	21.3% Prevalence of CA (21.3% above midpoint on CA scale). Prevalence among women double that among men. Those with high CA half as likely to engage in self-training
Ford, Vitelli, and Stuckless	Computers in Human Behavior	1996	SS	52	Prisoners	Method of test-taking, test score	Heinssen et al. (1987)	Found that computer version of test taking is equivalent to pencil-and-paper when testing personality, anger, and vengeance. CA scores did not effect results. CA scores were lower than those found in male student populations. High social desirability results leads to questions about reliability of findings
Gos	The Clearing House	1996	1. Case, 2. SS	185	UG students	Computer experience and quality-of-experience	Simonson, et al. (1987)	CA will not necessarily disappear as computer experience increases. Quality of pleasantness or unpleasantness of a student's prior experience determines computer anxiety. Bad prior computer experience made for more computer anxious students than NO prior computer experience
Harrison and Rainer	Computers in Human Behavior	1996	SS	653	Knowledge workers at university	Satisfaction	Heinssen et al. (1987)	CA negatively related to satisfaction
Houle	Journal of Educational Computing Research	1996	SS	221	UG students	Gender, college major, HS computer courses, computer job experience, cognitive style	Heinssen et al. (1987)	Gender, HS programming classes, cognitive style, and college major not related to CA. Ownership, computer job experience and some high school computer courses are significantly related to CA
King and Bond	Journal of Educational Computing Research	1996	Scale	372	11, 12 year olds	–	Montag (1984) (CAIN)	Tested dimensionality of CAIN instrument by Rasch analysis. 6 of 26 items did not measure same underlying trait. Shortened 20-item measure recommended
Necessary and Parish	Education	1996	SS	157	UG students	Computer experience, computer usage	Loyd and Gressard (1984)	Experience and usage were negatively related to CA
Owen	Information World Review	1996	N/A	–	–	–	–	Conceptual paper that briefly reported on a psychology survey that found younger

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
								people introduced to computers at school had higher CA than older colleagues who had new technology forced upon them in the workplace
Reznich	Computers in Human Behavior	1996	Pre/post 1 month	105	University students	Type of training (minimalist or traditional)	Marcoulides (1989)	Those receiving minimalist training had significantly lower CA after first instructional treatment. Those receiving traditional training had lower CA, but it occurred after second instructional treatment (1 month later)
Schuh	Journal of Educational Computing Research	1996	Pre/post semester class	610	UG students	Pre-class: age, experience, quality of experience, gender, course required, year in college; post-class: #assignments, #hours spent; amt lab time, assistance from instructor, assistance from other sources, classroom environment, what instructor said	Loyd and Gressard (1984)	Pre-class: experience, quality of experience, gender, and whether course required related to CA. Post-class: Significant changes in CA for individuals who: sought assistance from professor, said instructor said or did something to alleviate fear
Williams and Zahed	Journal of Business and Psychology	1996	CA measured as SS only followed by training. CA not measured at time 2 or time 3	54	Chemical processers	Learning method, educational level, retention, level of learning, satisfaction	Maurer (1983) (CAIN – CBT group only)	No correlation between CA and learning, no correlation between CA and retention. No difference between groups (CBT or lecture) in satisfaction. Retention higher in CBT group. Both groups demonstrated sig learning.
Al-Jabri and Al-Khaldi	JEUC	1997	SS	238	UG students	Computer experience, access, ownership; age, GPA, #classes using computer	Loyd and Gressard (1985)	Experience, access and ownership negatively related to CA. GPA, courses, and age not related to CA
Bozionelos and Bozionelos	Psychological Reports	1997	SS	265	UG and graduate students	Experience, characteristics: playfulness, spontaneous, expressive, fun, creative, silly	Bozionelos (1996) (modified from Heinssen et al.)	Scores on CA correlated negatively with playfulness, fun, and creative. Only correlation with scores on creative remained significant when controlling for computer experience. In absence of computer experience, more playfulness results in lower CA
Bozionelos (a)	Perceptual and Motor Skills	1997	SS	204	British managers and professionals enrolled in post-grad. course	Kolb's learning style, computer experience	Bozionelos (1996) (modified from Heinssen et al.)	Experience strongly correlated with CA. Convergers performed better in a computer-training program. Convergers reported lower CA scores than did divergers. Scores on CA correlated negatively with scores on the active-reflexive index
Bozionelos (b)	Psychological Reports	1997	SS	178	Graduate students	Cognitive spontaneity, experience, attitudes	Bozionelos (1996) (modified from Heinssen et al.)	Negative relationship between CA and attitudes. Negative relationship found between CA and experience. Negative relationship found between cognitive spontaneity and CA. Correlation remained significant even when computer experience controlled for
Bradley and Russell	EP	1997	SS	350	School teachers	Gender, ownership, computer education, age, subject taught, grade level taught, school location, school sector, school size, computer training at work, math anxiety, preference for stable lifestyle, quality of learning experience, comfort with new technology, mechanical ability, preference for a "high tech" holiday	Mix from Heinssen et al. (87); Loyd and Loyd (85); Meier (88); Reece and Gable (82); Dambrot et al. (85)	Variables correlated with CA included: gender (females had greater CA), ownership, computer course training at university, math anxiety, preference for a stable lifestyle, quality of learning experience, comfort with new technology, mechanical ability, and preference for a "high tech" holiday. Variables with not correlation to CA included: age, subject

								taught, grade level taught, school location, school sector, school size, computer training at work
Emanuele, Dale, and Klions	Perceptual and Motor Skills	1997	Pre–post	40	UG students	Condition (problem solving 1st or jokes 1st), experience, self-esteem, locus of control, smiles, depression, skin conductance	Loyd and Gressard (1984)	Computer anxious group had less experience, lower scores on self-esteem than non-anxious group. Scores on anxiety decreased after problem condition but increased after the joke condition for anxious subjects – reverse true for non-anxious subjects. Scores on depression increased after joke condition for anxious subjects
Ferguson	Accounting and Finance	1997	SS	157	Big 6 accounting professionals	EOU, usefulness, attitudes	Howard (1986)	Perceived usefulness and perceived ease of use both negatively related to CA, CA negatively related to attitudes toward computers
Fitzgerald, Hardin, and Hollingsead	Journal of Educational Computing Research	1997	Qualitative interviews + students kept logs	35	26 UG, 9 grad. students – special education majors	Prior computer experience, prior classroom experience, school rank (UG, G)	Spielberger self-evaluation questionnaire (20-item)	Decrease in CA through involvement in class. Those with lowest CA were graduates and those with prior teaching experience
Gopal, Maranda, Robichaux, and Bostrom	Small Group Research	1997	SS 2 manip	Study 1: 296, study 2: 234	UG students	Gender, typing ability, attitude toward GSS (ease of use, perceived usefulness)	Heinssen et al. (1987)	Primarily looked at gender. Females more CA. Typing ability and CA negatively related. CA and attitudes negatively related. Indirect effect of gender on attitudes through CA. (Note attitudes was defined as perceived ease of use and perceived usefulness)
Laguna and Babcock	Computers in Human Behavior	1997	SS, prior to that was 75 trials of computer task	40	1/2 Seniors, 1/2 UG students	Age, performance, time to complete	Montag et al. (1984) (CAIN)	Older adults had significantly higher CA than younger adults. CA was not related to per cent correct, but was related to performance as measured by decision time
Mahar, Henderson, and Deane	Personnel Differences	1997	SS, students completed computer task first	229	UG students	State trait anxiety, computer avoidance, experience, performance	Gressard and Loyd (1984)	CA is associated with higher levels of computer avoidance and state anxiety. CA is positively related to completion time of task independent of experience and state trait anxiety
Marcolin, Munro, and Campbell	JEUC	1997	SS	264	End-users in banking, utilities, charitable activities	End user ability	Raub (1981)	CA negatively related to end-user ability
Nash and Moroz	Journal of Educational Computing Research	1997	Scale	208	Educators	-	Loyd and Loyd (1985)	Looked at factor structures of CAS. Found confidence and anxiety scales are a continuum. 34-item with following factors: liking, perceived usefulness, confidence/anxiety, attitudes toward academic endeavors associated with computer training
Scott and Rockwell	Communication Education	1997	SS	178	UG students	Communication apprehension, writing apprehension, future use of new technologies	Raub (1981)	CA negatively related to future use. Comm. app., writing app. did not add to prediction capability over what CA does
Tseng, Macleod, and Wright	Computers in Human Behavior	1997	SS	108	UG students	Administration of test, self ratings of mood	Heinssen et al. (1987)	Correlation between self-ratings of mood and CA was greater in the computer group than the paper-and-pencil group
Al-Khaldi and Al-Jabri	Computers in Human Behavior	1998	SS	238	Saudi Arabian UG students	Use	Loyd and Gressard (1984)	CA was not predictor of use
Brosnan and Lee	Computers in Human Behavior	1998	SS	493	UG students	Nationality (UK, HK), gender, experience	Marcoulides et al. (1985)	UK reported less anxiety over Hong Kong students. In UK, no gender differences in

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
								CA, but males had more positive attitudes. In Hong Kong, no gender differences in attitudes, but MALES had higher CA
Brosnan (a)	Journal of Computer Assisted Learning	1998	SS followed by task	50	UG students	Perceptions of self-efficacy, performance	Heinssen et al. (1987)	CA directly, negatively influences # of correct responses. CA negatively related to self-efficacy and number of look-up tables used
Brosnan (b)	Journal of Educational Computing Research	1998	SS	119	UG students	Psyc gender, gender-related perceptions, age when tech introduced, avg hours used, ownership, sig. others' use	Marcoulides (1985)	Females: higher CA, more likely to view computing as a male activity. Age when technology introduced, and having male friend who used computer significantly related to CA
DeSai and Richards	JISE	1998	Meta-analysis		Review of numerous papers	Performance	Created qualitative scale for this study	Propose that relationship between CA and performance is inverted cup. Very low and very high levels of CA produce low levels of performance. Moderate levels of CA provide best performance
Dyck, Gee, and Smither	Computers in Human Behavior	1998	SS	635	311 Younger adults; 324 older adults from senior citizens centers	–	Marcoulides et al. (1985)	Revalidating prior scale. Found that two constructs still emerged, but were different. Two new factors were: Direct and indirect involvement with computers. Factor structure similar for older and younger adults, although some items loaded differently
Hemby (a)	Computers in Human Behavior	1998	SS	431	UG students	9 Demographic variables, 3 variables pertaining to learning	Oetting (1983)	Male gender, lower age, higher socioeconomic status, and greater self-directedness led to lower CA
Hemby (b)	Journal of Business and Technical Communication	1998	SS	431	UG students	Age, gender, prior experience, ethnicity, student classification, keyboarding skill, self-direction, socioeconomic status	Oetting's computer anxiety scale (COMPAS)	Gender, keyboarding skill, age, socioeconomic status, and self-directedness were predictors of CA. Since several of these predictors are not controllable by an instructor, the paper went onto give suggestions for alternative teaching strategies to minimize CA
Presno	Journal of Educational Computing Research	1998	Interviews	17	Adult students taking internet class	Instructional techniques	Qualitative analysis (observation, semi-structured and unstructured interviews, documents)	9 Beneficial and 2 negative instructional techniques identified to reduce CA
Shelley	Computers in Human Behavior	1998	SS	128	K-12 teachers	E-mail use	Simonson et al. (1987)	CA significant predictors of e-mail use
Shermis and Lombard	Computers in Human Behavior	1998	SS	72	UG students	Personality, gender, performance on Math, English essay, reading test, test anxiety	Heinssen et al. (1987)	Thinkers more CA than feelers. CA negatively related to reading test results. Gender and CA not related. Test anxiety and CA not related
Tseng, Tiplady, MacLeod, and Wright	British Journal of Psychology	1998	SS	136	Students and university employees	Medium effects (PDA, traditional computer, pen and paper), cognitive function, mood ratings	Heinssen et al. (1987)	CA can affect results of assessments of cognitive function as well as of mood ratings. High CA related to low positive and high negative ratings of mood
Yaghi and Abu-Saba	Computers in Human Behavior	1998	SS	308	Lebanese teachers	Culture, gender, computer experience, teaching experience, subject, levels of, and language of teaching	Rosen and Weil (1995)	Performance of tool was similar to results from other cultures. CA was negatively related to experience and usage of computers. Teachers who use French and Arabic languages had higher CA than teachers who use English. CA and gender not related

Brosnan	Computers in Human Behavior	1999	Pre/post 13 weeks	147	UG students	Gender, current usage, expected usage, perceived ease of use, self-efficacy, perceived fun, perceived usefulness	Heinssen et al. (1987)	Dealt with use of a word-processing package. Usage was predicted by levels of usage at the beginning of the semester, expected usage, and perceived usefulness. Level of CA helped predict: Current WP usage, perceived usefulness, perceived ease of use. Gender and CA not related. CA and expected use not related. Fun and CSE correlated with CA
Chua, Chen, and Wong	Computers in Human Behavior	1999	Meta-analysis	–	–	Gender, prior experience	–	Meta-analysis examining three common correlates of CA. Examined published articles from the 1990s (# not given). Results found: (1) female UG students generally more anxious than male UG, (2) CA is inversely related to Computer experience, and (3) instruments measuring CA are generally reliable, but not compatible with one another
Cody, Dunn, Hoppin, and Wendt	Communication Education	1999	Pre/post 4-month	292	Older adults (average age = 80)	Health limitations, time on line	Gressard and Loyd (1986)	Health limitations positively related to CA. More time spent online when CA low. Participation in 4-month program associated with reduced CA
Compeau, Higgins, and Huff	MIS Quarterly	1999	Longitudinal 1 year apart	394	Subscribers to a Canadian business periodical	Self efficacy, usage	Heinssen et al. (1987)	Self-efficacy negatively related to CA. CA not significantly related to usage
Dansky, Gamm, Vasey, and Barsukiewicz	Journal of Healthcare Management	1999	SS	85	MDs, PAs, nurse practitioners	Perceived usefulness, age, gender, PC use/ experience, ownership	Raub (1981)	CA predicted attitude toward implementing electronic medical records after controlling for age, gender, and experience. Also found female gender, not owning a computer, and little computer use was positively related to CA. CA negatively related to perceived usefulness
Drury	International Journal of Computer Applications in Technology	1999	SS	125	Knowledge workers	Perceived usefulness, alienation, conflict, satisfaction	Ferguson (1997)	Alienation and CA are positively related. CA and intragroup conflict negatively related. Perceived usefulness and CA not related. CA not directly related to satisfaction, conflict moderates relationship between CA and satisfaction
Ellis and Allaire	Human Factors	1999	SS	330	Older adults (avg. age 78)	Computer knowledge, computer interest, age, education	Raub (1981)	Age positively related to CA. Education negatively related to CA. CA negatively related to interest. Knowledge negatively related to CA. CA and age account for 49% of variance in interest. Education, age, and knowledge accounted for 52% of variance in CA
Harris	Behaviour and Information Technology	1999	SS	927	Accountants, university lecturers and staff	Personality, product involvement, task characteristics, education, attitudes toward EUC	Igbaria (1990)	Negatively related to CA: Dependence-autonomy, product involvement, task variety, education, attitude. Risk-taking personality trait not related to CA
Harris and Davison	JGIM	1999	SS	279	UG students from 6 countries	Culture, age, experience, involvement, gender, father's occupation	Igbaria (1990)	Correlated with CA: culture, gender, experience, involvement. Not related to CA: father's occupation, age, computer availability
Hemby	Information Technology, Learning and Performance Journal	1999	SS then typing to get WPM	90	UG students enrolled in freshmen level course	Keyboarding skill, type of student	Oetting's computer anxiety scale (COMPAS)	No significant relationships found between keyboarding skill and CA. No significant relationship found between type of student (traditional vs. non-traditional) and CA

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
McInerney, Marsh, and McInerney	Educational and Psychological Measurement	1999	Scale	794	UG students		Created CALM (computer anxiety and learning measure)	Discusses the creation and validation of the CALM instrument to measure the multiple dimensions of CA in training situations. Final scale can be used with 12 factors, or a more parsimonious five factors
Safford and Worthington	Computers in Human Behavior	1999	RM initial, 1 month, 3 months enrolled in training	65	30 Mentally ill patients, 35 community college students	Type of subject (student vs. mentally ill), training	Heinssen et al. (1987)	Mentally ill had higher CA – but they also had less experience, and more general trait anxiety than those not mentally ill. Training did not reduce CA in either group
Scull	Computers in Human Behavior	1999	Case – discussion groups	12	Graduate students	Situation, computer, information support	–	12 Graduate students (labeled high CA, moderate CA, or low CA) were interviewed for their perspective. Interviews revealed three levels of analysis: situation, computer, and information-support. Time and goal pressures aggravated CA at the level of the situation. Unreliability and poorly depicted filing processes aggravated CA at the level of the computer. Pro-active strategies were taken to reduce CA at the information-support level
Worthington and Zhao	Journal of Educational Computing Research	1999	N/A	–	–	–	–	Conceptual piece stating existing literature has neglected two issues: (1) existential anxiety and (2) changes in computer technology. States CA literature is inconsistent and of little practical or theoretical value without including these issues. Suggests ways in which attention to two issues can help in development of meaningful theory
Althaus and Tewksbury	Political Communication	2000	SS	520	UG students	WWW use for news	Heinssen et al. (1987)	Higher levels of desirability for control and political knowledge are associated with greater web use over TV or newspapers. CA negatively related to use of web for information. Evidence that use of web for news information supplements traditional news media
Anthony, Clarke, and Anderson	Computers in Human Behavior	2000	SS	176	South African UG students	Big-5 personality factors, age, experience, gender	Rosen and Weil (1992)	Positive correlation between CA and neuroticism. Negative correlation between CA and openness, experience. No significant relationship between age or gender and CA
Gaudron	European Review of Applied Psychology	2000	SS	94	UG students	Form of test, Big 5 personality dimensions	Gaudron (1998)	CA did not artificially modify personality scores for those taking the test through a computer vs. paper-and-pencil. However, they did find those more CA were more introverted, less open to experience, and less emotionally stable than those with low CA
Johnson and Marakas	Information Systems Research	2000	RM initial, 75 min training, time 1, 15 min practice, time 2, 25 min test, time 3	146	UG students	Computer self-efficacy, performance	Heinssen et al. (1987)	Students with lower levels of CA had higher levels of CSE. Students with higher levels of CSE had lower levels of CA. Students with lower levels of CA performed better than those with higher levels of CA

Laguna and Babcock	Experimental Aging Research	2000	SS	141	Adults	Computer-tested working memory, computer experience, self-efficacy, computer attitudes, age, education, medications, health rating	Montag et al. (1984)	CA mediated the relationship between age and computer-tested working memory performance. CA not significantly correlated with education, medications, or health ratings. CA positively correlated with age and attitudes. CA negatively correlated with experience, age, and working memory. Experience mediated the relationships between CA and working-memory. After adding both experience and self-efficacy into the model, CA did not contribute unique variance to the model
Maki, Maki, Patterson, and Whittaker	Behavior Research Methods Instruments and Computers	2000	Pre/post UG course	218	UG students	Class delivery (on-line vs. lecture)	Cohen and Waugh (1989)	On-line classes had increased content knowledge, exam performance, increased computer usage, and decreased computer anxiety. Lecture classes had greater satisfaction
Mitra, Lenzmeier, Steffensmeier, Avon, Qu, and Hazen	Journal of Educational Computing Research	2000	4-year study, annual surveys	300	UG students	Gender, use level	Does not provide	Longitudinal study using students issued laptops by the university they attended. Women were more apprehensive, and used the computer less than men. As all students had access to laptop over years, positive attitude increased, apprehension decreased
Todman	Computers and Education	2000	Longitudinal SS each year	1051	UG students	Year data gathered, gender, age, class taking	Campbell and Dobson (1987)	CA decreased over years 1992–1998 for psychology students. Add in interaction of gender, and males' CA has significantly decreased between 92 and 98, but females' CA has not changed significantly. IT students had lower CA than psychology students
Venkatesh	Information Systems Research	2000	RM initial, 1 month, 3 months	246	Org employees	Ease of use	Brown and Vician (1997)	At three different time periods, CA was negatively related to perceived ease of use
Beckers and Schmidt	Computers in Human Behavior	2001	Scale	409	UG Dutch psychology students	6 Factors of CA measured: computer literacy, self-efficacy, physical arousal, affective feelings, negative beliefs about computers, positive beliefs about computers	Heinssen et al. (1987)	Overview of factor models of CA scales provided. Created new 6-factor scale based on three other scales. CA can be described as a conglomerate of six correlated dimensions. Confirms importance of computer literacy in emergence of CA. Model predicts directional influences among six variables
Bozionelos	Computers in Human Behavior	2001	Longitudinal 1 year apart	515	228 Professionals, 67 grad students, 220 UG students	Subject type, computer experience, gender	Bozionelos (1996)	UG students had highest CA. Logarithmic values of scores on computer experience better predicted CA than raw scores of computer experience. Experience and CA negatively related. Gender not significant
Chou	Computers in Human Behavior	2001	CA measured as SS only	92	High school students	Training method, gender, computer self-efficacy, learning performance	Marcoulides and Wang (1990) (translated to Chinese)	Instruction-based training method best for high CA students to gain computer self-efficacy (significant, positive correlation). Students with low CA scored higher on learning performance and had higher computer self-efficacy. Females more computer anxious than males. 3-way interaction found between anxiety, training, and gender
Desai	Journal of Instructional Psychology	2001	Pre/post mid-term and final	15	Students	Test anxiety, change process, performance	DeSai and Richards (1998) (qualitative scale)	Computer anxiety decreased between mid-term and final (does not mention if the decrease is significant). Test anxiety

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
								did not decrease. While CA decreased, performance also decreased
Green	Journal of Social Work Education	2001	SS	149	Graduate students	Research anxiety, research importance	Graduate student computer anxiety scale (GCAS)	CA and research anxiety were moderately, positively correlated
Gunter	Educational Media International	2001	Pre/post week 1, last week of class	171	UG education majors	Course training	Loyd and Gressard (1984)	Students had significantly less CA after completing a technology course
Lee and Weerakoon	Medical Teacher	2001	SS took paper exam, then could take computer exam	55	UG students	Performance	Rosen and Weil (1992)	Neither CA nor experience correlated significantly with performance in the computer vs. paper-and-pen tests
Martin, Stewart, and Hillison	Journal of Extension	2001	SS	402	Field personnel	Profession, age, time spent using computer, years in extension, education, gender	Oetting (1983)	Secretaries had lowest CA, technicians had highest CA. 20% of total employees had CA. Time spent using computer negatively related to CA. Years in extension and age positively related to CA. Gender and education not related to CA
McIlroy, Bunting, Tierney, and Gordon	Computers in Human Behavior	2001	SS	193	UG students	Gender, access, 1st computer instructor, first experience, GCSE pass	Rosen and Weil (1992)	Positive first experience correlated with lower computer learning anxiety. Male gender, positive first experience, and GCSE pass correlated with lower consumer technology anxiety. Positive first experience correlated with lower observational computer learning anxiety
Orr, Allen, and Poindexter	Journal of End User Computing	2001	Pre/post semester class	214	UG students	Beginning/end of course, experience, prior courses, ownership, class status, interest, credit hours taken, age	Loyd and Gressard (1984)	Anxiety decreased throughout a semester class on computer literacy. At beginning of class: CA negatively related to prior computer courses, computer work experience, and owning a PC. At end of class, CA only significantly related to owning a PC. At beginning of class: lower class status, greater interest in class, and more credit hours taken related to lower CA. More hours spent working on class related to greater CA. At end of class: lower class status, older students, and greater interest in class were all related to lower CA
Shermis, Mzumara, and Bublitz	Journal of Educational Computing Research	2001	SS – different treatment groups	623	UG students	Form of test, feedback on test answers	Heinssen et al. (1987)	Nothing significant with regards to CA. No loss in efficiency in using computer-adaptive testing rather than self-adaptive testing
Smith and Caputi	Behaviour and Information Technology	2001	SS	149	UG psychology students	Self-statements about computers (on-task, off-task, positive, negative)	Heinssen et al. (1987)	CA positively related to negative evaluation and off-task thoughts; positively related to positive evaluation and on-task thoughts
Stephens	Education for Information	2001	SS	46	Freshmen UG students	Gender, form of test, performance on test	Not provided	No statistical differences between those who took the paper-and-pencil test vs. those taking the exam with on the computer. No apparent disadvantage to females by using computer tests
Wexler	SMR	2001	N/A	–	–	–	NA	Conceptual paper discussing the Venkatesh (2000) paper
Christensen	Journal of Research on Technology in Education	2002	Pre–post different trtmt groups 1 semester	60	Elementary school teachers	Type of education, attitude towards computers	Loyd and Gressard (1984)	Teachers who received technology-integration education had less anxiety toward computers than teachers who did not. Positive attitudes about computers by teachers led to more positive attitudes toward computers for the students

Durndell and Haag	Computers in Human Behavior	2002	SS	150	Romanian university students	Gender, self-efficacy, attitude to Internet	Heinssen et al. (1987)	Males had lower CA. Attitude toward Internet and self-efficacy both significantly related to CA
Gaudron and Vignoli	Computers in Human Behavior	2002	SS for CA measure	151	UG psychology students in France	State anxiety	Several	Greater CA is associated with greater state anxiety
Goldstein, Dudley, Erickson, and Richer	Computers in Human Behavior	2002	SS	127	Adults taking evening education courses	Y2K anxiety	Loyd and Gressard (84), Nash and Moroz (97)	CA associated only marginally with Y2K anxiety. While CA correlated with Y2K anxiety, if was not a significant predictor
Hong and Koh	Journal of Research on Technology in Education	2002	SS	200	Secondary school teachers in Malaysia	Gender, computer ownership, access to school computers, perceived school support, experience, attitudes	Created for study. Taken from Igbaria (90), Gressard and Loyd (86), Griswold (83), Reece and Gable (82), Stevens (82), Selwyn (97)	Lower CA corresponded to positive attitudes. No sig difference for gender. Ownership negatively related to CA. Access and perceived school support did not significantly correspond to CA. Teachers with more than 3 years computing experience had lower CA
Karahanna, Ahuja, Srite, and Galvin	Decision Support Systems	2002	SS field study had training on GSS first	46	University employees	Relative advantage of GSS	Heinssen et al. (1987)	CA not related to perception of relative advantage of GSS
King, Bond, and Blandford	Computers in Human Behavior	2002	SS	910	Students in 7th, 9th, and 11th grades	Gender, grade	Montag et al. (1984)	Most students had low levels of CA; males had GREATER CA, 7th and 9th graders had higher CA than 11th graders
Mikkelsen, Ogaard, Lindoe, and Einar Olsen	Computers in Human Behavior	2002	SS after project	342	Norwegian employees	Demands, decision authority, social support, learning opportunities, training, active coping, age, education, gender, job level	Heinssen et al. (1987)	Negatively related to CA: Decision authority, training, education, job level (managers less likely to be CA). Positively related to CA: age, female gender. Other IVs not significantly related to CA
North and Noyes	Computers in Human Behavior	2002	SS	104	11 and 12 year olds	Gender, sex-role groups	Rosen and Weil (1992)	Gender and sex role were not significantly related to CA
Rovai and Childress	Journal of Research on Technology in Education	2002	Pre–post computer literacy course	86	UG education majors	Class, confidence, trait anxiety, knowledge, liking, experience, usefulness, locus of control	Oetting (1983); Gresard and Loyd (1984)	Computer literacy class reduced CA. Significant predictors of post-class CA were: computer confidence, trait anxiety, computer knowledge, and computer liking. Experience, usefulness, and locus of control were not significant
Stewart and Segars	Information Systems Research	2002	SS	355	Consumers	Concern for information privacy, intent to use	Parasuraman and Igbaria (1990)	Concern for information privacy mediates relationship between CA and intent to use
Thatcher and Perrewe	MIS Quarterly	2002	SS	280	UG students	Negative affect, trait anxiety, personal innovativeness, self-efficacy	Heinssen et al. (1987)	CA negatively related to self-efficacy, personal innovativeness in IT; trait anxiety positively related to CA. Negative affect was not related to CA
Tsai	Journal of Educational Computing Research	2002	Pre–post 4 trtmt groups 6 week class	155	Taiwanese 8th graders	Gender, learning group	Heinssen et al. (1987)	Boys had higher CA than girls. Students in cooperative learning group had higher CA than students in control group
Vician and Davis	Journal of Computer Information Systems	2002	SS	108	University students	Performance	Heinssen et al. (1987)	CA significantly, negatively related to performance
Vincent, Meche, and Ross	Journal of Information Systems Education	2002	SS	124	UG students	Major, rank (year in school), frustration, listening, obsession	Not provided	92% Enjoyed working with computers; 77% believed computer and people skills are important; non-business majors experienced more CA at beginning of course; rank (year in school) and CA positively correlated. Listening, obsession, frustration all correlated with CA. Beginning CA correlated with ending CA

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
Wood, Willoughby, Specht, Stern-Cavalcante, and Child	Journal of Educational Psychology	2002	Pre–post 3 h workshop on computers	133	Early childhood educators	Type of workshop (direct, guided discovery, or no-exposure)	Not provided	Direct instruction participants experienced lower CA
Beckers and Schmidt	Computers in Human Behavior	2003	SS	Study 1: 184; study 2: 225	First and third year psychology students	Experience, gender, perceived necessity of use	Beckers and Schmidt (2001)	Basic model using experience showed a fit (experience influenced CA), but adding variables of gender and perceived necessity of use improved the fit of the model
Campbell and Webb	Internet Journal of Health	2003	Pre–post 5-week training	28	65+ in age	Training	Gressard and Loyd (1986)	CA decreased after training
Chou	Computers in Human Behavior	2003	SS + interview of 12 respondents	136	High school teachers in Taiwan	Gender, age, school type, degree, major, teaching computer classes, experience	Heinssen et al. (1987); internet anxiety scale	Positive relationship between Internet anxiety and: female gender, age, humanities/social science major (as opposed to a science/technology major). Negatively related to internet anxiety: teaching computer-related classes, experience. Not related to Internet anxiety: school type, degree
Compton, Burkett, and Burkett	Psychological Reports	2003	SS	697	UG students	Gender	Meier (1990)	Gender differences not found
Fagan, Neill, and Wooldridge	Journal of Computer Information Systems	2003	SS	469	University business students	Self-efficacy, experience, organizational support, usage	Cohen and Waugh (1989)	Significant relationships: Experience and self-efficacy negatively related to CA. No significant relationship between organizational support and CA found. CA and computer usage had a significant, positive relationship. Explanation for last finding: use measured by amount of time in lab, anxious students may take longer to complete task
Gilbert, Lee-Kelley, and Barton	European Journal of Innovation Management	2003	SS	161	Convenience sample	Age, gender, academic qualifications	Popovich et al. (1987)	Age, gender, and academic qualifications are all correlated with technology anxiety
Gordon, Killey, Shevlin, et al.	Computers in Human Behavior	2003	SS	661	UG students	–	Rosen and Weil (1992)	Comparison of two surveys. The CARS was judged to be a poor explanation of data. The CTS was judged to be an acceptable description of the data
Hackburth, Grover, and Yi	Information and Management	2003	SS	116	Graduate students and upper-level undergrads	Experience, ease of use	Bandalos and Benson (1990)	Experience and CA negatively related. CA and Ease of use negatively related. CA mediates relationship between experience and ease of use
Havelka	Journal of Information Systems Education	2003	SS	324	UG business students	Self-efficacy	Heinssen et al. (1987)	CA was negatively correlated with self-efficacy
Lemmon and Caltabiano	Psychological Reports	2003	SS	37	Non-computer users	Negative label (i.e.: "computer dummy"), ability, training, outcomes	Garnder, Discenza, and Dukes (1993)	Belief about ability and training associated with CA. Majority of non-computer users included themselves in category of "computer dummy" rather than "no ability"
Meuter, Ostrom, Bitner, and Roundtree	Journal of Business Research	2003	SS	823	Consumers	Technology anxiety, use, satisfaction, repeat use, word-of-mouth intentions	Raub (1981) (modified)	As technology anxiety increases, use of self-service technology decreases. Technology anxiety negatively related to satisfaction, repeat use, positive-word-of-mouth

Namlu	Computers in Human Behavior	2003	Pre–post 14–1 h sessions	37	Students	Learning group/training	Ceyhan and Namlu (2000)	Decrease in CA for those in the experimental group who received more instruction on learning strategies
Suri, Lee, Manchanda, and Monroe	Psychology and Marketing	2003	SS for CA measure – then followed with experiment	319	UG students	Motivation, price perceptions	Heinssen et al. (1987)	In high-motivation condition, greater CA individuals viewed high prices as meaning high values; lower CA individuals viewed low price as better value. In the low-motivation condition, both high CA individuals and low CA individuals linked high price with higher perceived quality
Tsai and Tsai	Journal of Educational Computing Research	2003	SS	75	Taiwanese 8th graders	Learning strategies	Heinssen et al. (1987)	CA best predicted by self-testing and study aids strategies. Students with higher abilities to test themselves and to utilize study aids have lower CA
Barbeite and Weiss	Computers in Human Behavior	2004	Scale	Study 1: 226, study 2: 227	Members of an online standing research panel	–	Marcoulides (1989); Heinssen et al. (1987); Loyd and Gressard (1984)	Investigated validity of CA scales when administered to an Internet sample. In 2nd study, items were adapted and new items added. In the 2nd study, computer confidence and aversion were related to computer and Internet use
Bozionelos	International Journal of Human–Computer Studies	2004	SS	267	UG students	Socio-economic background, experience, use	Rosen and Weil (1992)	Socio-economic status not significantly related to CA. Experience and CA negatively related. CA and use negatively related
Brown, Fuller, and Vicien	Journal of the AIS	2004	SS for CA measure	193	UG students	CMC anxiety	Created from Heinssen et al. (1987) and Loyd and Gressard (1984)	CA and CMC anxiety are positively related. Two levels of CA – general CA and app specific CA
Havelka, Beasley, and Broome	Mid-American Journal of Business	2004	SS	331	UG business students	Major, experience, ACT, gender	Heinssen et al. (1987)	Accounting and MIS majors had lower CA than other business majors; experience was negatively related to CA; no significant difference between genders; ACT was negatively related to CA
Marcoulides, Stocker, and Marcoulides	Educational and Psychological Measurement	2004	Scale	218	German UG students	–	Marcoulides (1985, 1989); Marcoulides et al. (1985)	Provided validity of two-factor CA model on a sample of German university students
Schottenbauer, Rodriguez, and Glass	Computers in Human Behavior	2004	SS	1500	Self-selected response to website	Gender, Y2K anxiety, negative attitudes	Nickell and Pinto (1986)	Gender significantly predict CA. Women's higher level of CA did not explain higher Y2K anxiety. CA predicted negative attitudes toward computers. Trait anxiety was positively correlated with CA
Todman and Drysdale	Computers in Human Behavior	2004	SS	154	1st year psychology students	Experience type	Cambell and Dobson (1987)	Few good later experiences resulted in higher CA than many good later experiences. Effects of good early and later experiences are additive
Broos	CyberPsychology and Behavior	2005	SS	1058	Flemish adults – 18–91 years	Gender, use, experience	4 Items	Males had lower CA. Longer use and higher self-perception of experience were negatively related to CA. Experience has a positive impact on decreasing CA for males, but not for females
Chang	Computers in Human Behavior	2005	SS	307	UG computer Science students	User perception of task complexity	Loyd and Gressard (1984)	Individuals at low task levels had less understanding of task complexity and more CA. Understanding task complexity can lower CA
Hogan	Irish Journal of Management	2005	SS	160	Older adults in Ireland	Gender, use, experience, CA	Rosen et al. (1992)	Women more CA than men, increased CA had no impact on computer use, greater experience with computers had no impact on CA

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
Johnson	International Journal of Human–Computer Studies	2005	SS after learning database principles	313	UG business students	Application specific computer self-efficacy	Heinssen et al. (1987) (modified)	CA is negatively related to AS-CSE
Karavidas, Lim, and Katsikas	Computers in Human Behavior	2005	SS	222	Older adults aged 53–88	Computer knowledge, gender, life satisfaction	Lim et al. (2001)	Females reported more CA. Computer knowledge negatively related to CA. CA negatively related to life-satisfaction
Knight and Pearson	Journal of Organizational and End User Computing	2005	SS	292	Knowledge workers	Age, gender, use	Compeau et al. (1999)	CA a moderator in the gender–use relationship. CA a moderator in the age–use relationship
Korukonda	Information Sciences	2005	SS	242	UG and grad. students	Cognitive processing skills; personality variables; gender	Weil et al. (2000)	Negatively correlated with technophobia: extraversion, math and logic skills; positively correlated with CA: Neuroticism. No correlation: gender
Lamberton, Fedorowicz, and Roohani	Journal of Information Systems	2005	SS	123	UG accounting and AIS majors	Chosen major	Selwyn (1997)	CA did not explain chosen major
Lester, Yang, and James	Perceptual and Motor Skills	2005	Scale	48	American students	–	Created for study	CA scale developed and validated
Pijpers and van Montfort	International Journal of Management	2005	SS	87	Senior executives	Perceived ease of use	Not provided	CA significantly related to ease of use
Tu, Wang, and Shu	Communications of the ACM	2005	SS	437	Employees of large companies in China	Age, computer literacy, task complexity, company reward, effect on productivity	Ragu-Nathan, Ragu-Nathan, and Tu (2004)	Overall CA had no effect on productivity. Age and task complexity positively related to overall CA. Those in no-reward group had less CA than those in moderate reward group. Computer literacy not related to overall CA
Arigbabu	Psychological Reports	2006	SS	162	Nigerian UG in education	Gender, age, year in school, major	Marcoulides (1989)	While 2/3 had high CA, there was no relationship found between CA and age, gender, year in school, or major
Beckers, Rikers, and Schmidt	Computers in Human Behavior	2006	SS	75	UG students	Grade prediction, skills perception, actual performance	Beckers and Schmidt (2001)	CA had no effect on actual performance. However, CA is correlated with students' prediction of their final grade and their perception of their skills
Brosnan and Thorpe	Computers in Human Behavior	2006	Pre–post	89	Returning, non-traditional students	Treatment for CA – technophobia reduction programme	Brosnan and Rosen (2001)	Treatment for technophobia reduced technophobia (CA). Reduction in CA was three times greater in treatment group than in non-treated group
Ceyhan	Computers in Human Behavior	2006	SS	690	Teacher trainees	Irrational beliefs, optimism, self-disclosure, learned resourcefulness	Ceyhan and Namlu (2000)	There was a positive relationship between CA and irrational beliefs, and between CA and self-disclosure. There was a negative relationship between CA and optimism. There was no significant relationship between CA and learned resourcefulness
Christopherson and Weatherly	Computers in Human Behavior	2006	SS – then played online games	30	University students over 21	# of games played	Heinssen et al. (1987)	CA not related to # of games gambled
Cooper	Journal of Computer Assisted Learning	2006	Does not provide	Not given	High school students	Gender stereotypes, attribution patterns, stereotype threat, attitudes, performance	Not provided	Gender stereotypes lead females to higher CA. Higher CA leads to negative attitudes and lower performance
Fuller, Vician, and Brown	The Journal of Computer Information Systems	2006	SS for CA	89	UG students	E-mail anxiety	Created from Heinssen et al. (1987) and Igabaria and Chakrabarti (1990)	CA positively related to e-mail anxiety

Hasan	Journal of Organizational and End User Computing	2006	SS after hour of training	78	UG students	Self-efficacy	Venkatesh (2000) (four items)	Both general self-efficacy and application specific self-efficacy were negatively related to CA
McFarland and Hamilton	Computers in Human Behavior	2006	SS	108	Employees of mid-to large for-profit companies	Efficacy, EOU, usefulness, use	Several scales were used	CA was negatively related to all four DVs
Phang, Sutanto, Kankanhalli, Li, et al.	IEEE Transactions on Engineering Management	2006	Demo of website (but not trying), then SS	139	Chinese senior citizens	Perceived ease of use	Created for study	CA was negatively related to perceived ease of use
Saade and Kira	Issues in Informing Science and Information Technology	2006	SS after class completed	114	UG students	Perceived usefulness, perceived ease of use	Venkatesh (2000) (four items)	CA and PEOU negatively related. CA and PU positively related
Teo	Interactive Learning Environments	2006	SS	183	Post-secondary students	Gender, ownership	Knezek et al. (1998)	Ownership negatively related to CA. No significant difference in CA between males and females
Todman and Day	Computers in Human Behavior	2006	SS	138	UG students	Biological gender, psychological gender	Campbell and Dobson (1987)	Psychological gender predicted CA while biological gender did not
Torkzadeh, Chang, and Demirhan	Information and Management	2006	Pre–post semester	347	UG introductory computer class students	Self-efficacy	Heinssen et al. (1987)	CA influences outcome of post-training computer self-efficacy; but does not influence outcome of post-training Internet self-efficacy. Low CA individuals improve computer and Internet self-efficacy significantly more than individuals with high CA
Wilfong	Computers in Human Behavior	2006	SS	242	University students	Use, experience, self-efficacy	Spielberger (1983)	Use, experience, and self-efficacy all negatively related to CA. Self-efficacy had most significant impact on CA
Williams and McCord	Computers in Human Behavior	2006	Pre–post approx 53 days four groups	50	UG students	Treatment group, performance	Heinssen et al. (1987)	CA not significantly related to performance. Whether a student took the exam over the computer or pen-and-paper made no difference on performance
Beckers, Wicherts, and Schmidt	Computers in Human Behavior	2007	SS	2 Studies: $n = 459$, $n = 366$	First year psychology students	State anxiety, trait anxiety	Beckers and Schmidt (2001)	CA more strongly related to state anxiety than to trait anxiety. State anxiety and CA only related when test over computer (rather than pen-and-paper). Suggest that state anxiety while using computer is caused by pre-existing CA
Buche, Davis, and Vician	Journal of Information Systems Education	2007	Pre–post semester	69	UG students	Learning environment, performance	Heinssen et al. (1987)	CA changed after exposure to computer-intensive learning environment; if individual went from high anxiety to low anxiety, performance improved; if individual went from high anxiety to higher anxiety, performance declined
Bunz, Currey, and Voon	Computers in Human Behavior	2007	SS for CA; lab experiment to obtain actual CEW	61	UG students	Perceived computer-e-mail-web (CEW) fluency, actual CEW fluency	Heinssen et al. (1987)	While CA is negatively related to perceived CEW, it was not significantly related to actual CEW
Korukonda	Computers in Human Behavior	2007	SS	242	UG and grad. students	Personality, math skills, verbal skills, cognitive orientation, computer experience (measured as number of courses taken)	Weil et al. (2000)	High neuroticism, low openness, and low agreeableness are related to high CA. Conscientiousness and extraversion had no relationship to CA. Verbal scores negatively related to CA. SAT math scores negatively related to CA. Number of college computer courses negatively related to CA; number of high school computer classes not related to CA

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
Lester and Yang	Psychological Reports	2007	SS	71	UG students	Buying textbooks online	Yang and Lester (2002)	Buying textbooks online significantly, negatively related to CA
McIlroy, Sadler, and Boojawon	Computers in Human Behavior	2007	SS	363	UG students	Use, self-efficacy, computer thoughts, experience	Rosen and Weil (1992)	20% of students were moderately to highly CA. CA negatively correlated with self-efficacy and computer thoughts. Those with high computer phobia were less likely to use computer facilities. CA was negatively related to experience
Mohamad and El-Ragal	Journal of American Academy of Business	2007	Scale	344	UG students	–	Woszczyski (2001)	Four constructs found with Woszczyski's scale: future ambition about computers, technical anxiety, personal anxiety, and experience anxiety
Niemela-Nyrhinen	The Journal of Consumer Marketing	2007	SS	620	Finnish Baby Boomers ages 50–60	Age, experience	Meuter et al. (2003) (adapted from Raub (1981))	Age and technology anxiety not related; experience and TA negatively related
Norris, Pauli, and Bray	Computers in Human Behavior	2007	RM (three time points)	51	UG students	State/trait anxiety, grade	Heinssen et al. (1987)	CA only related to SA prior to getting grade
Oyedele and Simpson	International Journal of Service Industry Management	2007	SS	186	UG students	Self-service technologies (SST)	Meuter et al. (2003) (adapted from Raub (1981))	Technology anxiety negatively related to SST usage
Rees and Noyes	CyberPsychology and Behavior	2007	SS	129	High school juniors (year 11)	Gender	Heinssen et al. (1987)	Over 95% of students had access to computers at home. Females had greater CA than males
Saade and Kira	Computers and Education	2007	SS after semester of using learning tool	114	UG students	Computer/Internet experience, perceived ease of use	Venkatesh (2003)	While CA is negatively related to PEOU, there is no significant relationship between CA and experience. CA did not mediate relationship between experience and PEOU
Smith and Caputi	Computers in Human Behavior	2007	N/A	–	–	–	NA	Cognitive interference model of CA is introduced as a theoretical framework
Srite, Galvin, Ahuja, and Karahanna	Information and Management	2007	GSS used, then SS	46	University employees	Satisfaction with GSS meetings	Heinssen et al. (1987)	CA was not related to satisfaction with GSS meetings
Teo	Psychological Reports	2007	SS	138	UG students from Singapore	Gender	Knezek, et al. (1998)	No significant difference in CA between males and females
Thatcher, Loughry, Lim, and McKnight	Information and Management	2007	SS after semester project working on Internet	99	Senior MIS students	Internet anxiety	3 Questions	CA is positively related to Internet anxiety. Two different constructs – general CA and app specific CA
Thorpe and Brosnan	Computers in Human Behavior	2007	SS	2 Studies: $n = 185$, $n = 164$	Variety of sources	Spider anxiety, other types of anxiety, DSM IV criteria	3-Item survey	CA may reach clinical levels. CA more like social or test anxiety than a specific phobia
Tung and Chang	CyberPsychology and Behavior	2007	SS	263	Taiwanese adolescents	Self-efficacy, intent to use	Not provided	CA had negative effect on computer self-efficacy and intent to use online classes
Wang	British Journal of Educational Technology	2007	Scale	287	Employees at various Taiwanese organizations	Self-efficacy, intent to use	Various scales used to create one	Development and validation of scale to measure mobile computer anxiety. Nomological validity supported the negative relationship between MCA and MCSE and MC Intent to use
Whitaker	Computers in Human Behavior	2007	N/A	$n = 117$	MBA and PhD students	Gender, mode of test, test results	None – CA not measured	Assumed females would be more CA, so wanted to see if type of test mode would impact scores. Scores on computer tests were not significantly different for females (or males) than test scores on paper–pencil

Ball and Levy	Journal of Information systems Education	2008	SS	56	Instructors	Using new technology	Fuller (2006) (adapted from Heinssen (87))	CA not significantly related to whether instructor plans to use new technology
Baloglu and Cevik	Computers in Human Behavior	2008	SS	715	High school students	Gender, ownership, frequency of use	Ceyhan and Namlu (2000)	Male gender, ownership, and frequency of use all negatively related to CA. Trait anxiety a covariate
Barcy and Barcy	Journal of Technology in Human Services	2008	SS	27	Social workers and nurses at private hospital	Self-reported usage, observed behavioral proficiency	Johnson (2005) (adapted from Harrison and Rainer (1992))	No significant relationship between CA and usage, consistent with findings from Venkatesh and Morris that after 6 months of use, usage and CA no longer correlate; no relationship between CA and observed proficiency of the patient care system; negative relationship between CA and observed proficiency of the resource directory
Downey, Rainer, and Bartczak	Journal of Organizational and End User Computing	2008	SS	310	Midshipmen in naval reserve officers training corps	General self-efficacy, specific self-efficacy	Loyd and Gressard (1984)	General self-efficacy, graphic programs self-efficacy, and e-mail self-efficacy related to CA. Specific self-efficacies of work processing, spreadsheets, databases, and web were not related to CA
Kim and Forsythe	Journal of Interactive Marketing	2008	Focus interviews (did not concentrate on CA), then SS	491	National panel of online shoppers	Intended use of virtual try-on	Not provided	Technology anxiety was not significantly related to intended use of virtual try-on
Kim and Forsythe	Psychology and Marketing	2008	Focus interviews (did not concentrate on CA), then SS	354	Respondents to online survey	Intended use of sensory-enabling technology	4 Items	Technology anxiety was not significantly related to intended use of sensory-enabling technology
Korzaan and Boswell	Journal of Computer Information Systems	2008	SS	230	UG students	Conscientious, neuroticism, intellect, concern for information privacy, behavioral intent	Stewart and Segars (2002)	Neuroticism has a positive influence on CA; intellect had negative relationship with CA; conscientiousness had no significant relationship with CA; concern for privacy had not significant relationship with CA; CA not related to behavioral intent
Kumar, Mohan, and Holowczak	Decision Support Systems	2008	SS	130	University students	Perceived EOU, awareness of security measures available	Thatcher and Perrewe (2002)	CA negatively related to perceived EOU and awareness of security measures
Long, DuBois, and Faley	Journal of Workplace Learning	2008	Pre–post 11-week online class	75	UG and MBA students	Pre-training motivation	Kernan and Howard (1990)	Small, but significant relationship found between CA and pre-training motivation
Marcoulides, Emrich, and Marcouldies	Educational and Psychological Measurement	2008	Scale	207	UG students in Germany	–	Various Marcolides scales	Construct of CA as measured by CAS (Marcoulides) has not changed
Pearson and Pearson	Journal of Computer Information Systems	2008	SS	361	UG students	Website usability criteria	Compeau, Higgins, and Huff (1999)	Both those with high CA and those with low CA consider PEOU to be the most important criteria when evaluating website's usability. Two groups (high CA and low CA) do not differ in evaluating criteria
Popovich, Gullekson, Morris, and Morse	Computers in Human Behavior	2008	SS	254	UG students	Gender, attitude	Popovich et al. (1987)	Compared CA in undergraduates from 1986 to 2005. Gender was significant in 1986, not in 2005. Attitude negatively related in both '86 and '05, but different factors of attitude were significant in the two time periods
Schulenberg and Melton	Computers in Human Behavior	2008	Scale	293	University students	–	CAAFI (computer aversion, attitudes, and familiarity index)	Aversion used rather than anxiety, but both were defined the same way in the study. Study examined the CAAFI scale. Factor structure was supported, but

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Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
								decision made to remove the fourth factor of the CAAFI
Srite, Thatcher, and Galy	Journal of Global Information Management	2008	SS	350	UG students	Cultural values, usefulness, ease of use	Heinssen et al. (1987)	CA has negative effect on perceived usefulness; CA has negative effect on perceived ease of use; individuals higher in masculinity reported lower CA; individualism/collectivism had no relationship with CA
Sun, Tsai, Finger, Chen, and Yeh	Computers and Education	2008	SS	295	University students	e-Learning satisfaction	Barbeite and Weis (2004)	CA negatively related to e-learning satisfaction. Other IV s also investigated
Tekinsarslan	Computers in Human Behavior	2008	SS	106	UG and grad. students	Nationality (Turkish, Dutch), gender, experience and ownership	Heinssen et al. (1987)	Turkish students more CA than Dutch students. Experience and ownership negatively related to CA. Gender not significantly related to CA, however, Turkish female students have more CA than Dutch female and Dutch male students
Teo	Computers in Human Behavior	2008	SS	183	University students	Ownership	Knezek et al. (1998)	Ownership negatively related to CA
Thatcher, Zimmer, Gundlach, and McKnight	IEEE Transactions on Engineering Management	2008	Multistudy meta-analysis	1167	Student groups from 6 studies	Internal computer self-efficacy (CSE), external CSE	Heinssen et al. (1987)	Internal CSE is negatively related to CA. External CSE is negatively related if examining computers in general, but not related if examining a specific technology
Tung and Chang	International Journal of Nursing Studies	2008	SS	228	Taiwanese nursing students	Intent to use	Compeau and Higgins (1995)	CA had significant, negative effect on intent to use online classes
van Raaij and Schepers	Computers and Education	2008	SS after 3 months training pgm	40	Executive MBA	Personal innovativeness, PEOU	Venketesh (2003)	Personal innovativeness negatively related to CA. CA negatively related to PEOU
Wang and Wang	British Journal of Educational Technology	2008	SS	281	MMORPG players	Gender, intent to play online games, perceived playfulness	Heinssen et al. (1987)	Females had more CA than males. CA and intent to play was not significant for males. CA and intent to play was significantly, negatively related for females. CA was not related to perceived playfulness for males or females
Zhao, Mattila, and Tao	International Journal of Service Industry Management	2008	SS after training – two training groups	131	UG students	Post-training self efficacy, ease of use, technology anxiety, technology anxiety, satisfaction, behavioral intent	Meuter et al. (2003)	Ease of use was negatively related to technology anxiety. Post-training self-efficacy, satisfaction, and behavioral intent were not related to technology anxiety
Al-Busaidi	International Journal of Global Management Studies	2009	SS	99	University students and instructors	Intent to use	2 Items, not provided	CA negatively related to use for both students and instructors
Arigbabu	Computers in Human Behavior	2009	Scale	181	PreService teachers in Nigeria	–	Marcoulides (1985, 1989); Marcoulides et al. (1985)	Results verified scale for use in a different society
Baloglu and Cevik	Computers in Human Behavior	2009	SS	584	School principals	Title	Ceyhan and Namlu (2000)	3 Dimensions of CA. Candidates had higher levels of affective and learning anxiety than tenured principles

Baloglu, Abbasi, and Cevik	Psychological Reports	2009	SS	700	Turkish high school students	Course grade	Ceyhan and Namlu (2000)	High school students reported high CA. Course grade negatively related to CA. CA had more detrimental effect on students with low academic ability
Chatzoglou, Sarigiannidis, Vraimaki, and Diamantidis	Computers and Education	2009	SS	287	Employees	Self-efficacy, enjoyment, usefulness, EOU	Compeau et al. (99), Igbaria (93), Raub (81)	Self efficacy negatively related to CA. CA negatively related to enjoyment, EOU. CA not related to usefulness
Chou and Chen	International Journal of Human–Computer Studies	2009	SS	305	Members of Chinese enterprise resource planning society	Personal innovativeness, satisfaction, continuance intention, self-efficacy	Marakas et al. (2000); Thatcher and Perrewe (2002)	Personal innovativeness not related to CA. CA negatively related to continuance intention and self-efficacy. CA not related to satisfaction
Chou and Tsai	Information Processing and management	2009	SS after computer class	115	Unemployed adults	Education, gender, age	Beckers and Schmidt (2001)	Education negatively related to CA. Age positively related to CA. Male gender MORE CA than females
Conti-Ramsden, Durkin, and Walker	Computers and Education	2009	SS	127	17-year olds	Language impairment (or not), gender	Knezek, et al. (1998)	Females more CA than males. Teens with language impairment more CA than typically developing teens
Davis, Lee, and Yi	American Journal of Business	2009	SS	102	University students	Playfulness, computer polychronicity, usefulness	Not provided	CA had negative relationship with playfulness; CA had negative relationship with polychronicity; CA had no direct relationship with Usefulness. However, CA had relationship with construct that did have impact on usefulness
Erdogan	British Journal of Educational Technology	2009	Pre/post	77	Turkish 8th graders	Test scores, teaching methods	Ceyhan and Namlu (2000)	CA did not relate to differences in pre-test and post-test scores
Fakun	Behavior and Information Technology	2009	Completed six scenarios then SS	4 Studies: 1 and 2 = *n* of 18; 3 = *n* of 20; 4 = *n* of 30	Assembly plant employees at two large corporations	Ease-of-use	Kernan and Howard (1990) (four items)	Studies 2, 3, and 4: CA had significant, negative effect on perceived ease of use. Study 1: CA not significantly related to perceived ease of use. In study 1, users participated in the process and were able to try the application prior to evaluation. In study 1, there was a one-on-one interaction between developers and users
Govindarajulu	Journal of Advances in Management Research	2009	NA	–	–	Prior experience, computer self-efficacy	–	No empirical work done – propositions only; proposing that CA is antecedent to CSE rather than other way around
Lee, Choi, and Kang	Expert Systems with Applications	2009	SS – thinking about website where they made purchase	274	UG students and company employees	Website information satisfaction, website system satisfaction, e-satisfaction	Thatcher and Perrewe (2002)	CA significantly reinforced the positive relationship between website information satisfaction on e-satisfaction. But, CA had no impact on the relationship between website system satisfaction and e-satisfaction

(*continued on next page*)

Table 1 (*continued*)

Author(s)	Journal	Year	Research type[a]	*n*	Sample source	Variables examined	CA scale used	Main/significant findings on CA
Nov and Ye	Journal of the American Society for Information Science and Technology	2009	SS after 1-h in-class instruction	271	UG students	Resistance to change, effort expectancy	Venkatesh et al. (2003)	Resistance to change positively related to CA. CA negatively related to effort expectancy
Ryu, Kim, and Leee	Computers in Human Behavior	2009	SS	290	Koreans online users over 50 years of age	Perceived benefits, compatibility, perceived enjoyment, perceived ease of participation	Phang et al. (2006), Venkatesh (2000)	Only perceived ease of participation showed a significant relationship with CA (negatively related)
Saade and Kira	Journal of Information Technology Education	2009	SS at end of semester using LMS	645	UG students	Perceived ease of use, computer self-efficacy	Venkatesh (2000)	CA negatively related to PEOU. CA and self-efficacy significantly related. Self-efficacy mediates the relationship between CA and PEOU
Scott and Walczak	Information and Management	2009	SS	234	UG and grad. students	Computer self-efficacy	Not provided	CA negatively related to CSE. States CA becoming non-issue
Xie and Bugg	Libraries and Information Science Research	2009	Pre–post-training	100	Older adults (mean age = 68.9)	Pre-training, post-training	Gressard and Loyd (1986)	CA decreased from per-training to post-training

[a] SS = single survey; RM = repeat measure; P/P = pre/post-test measure.

Table 2
Sample sources used.

	# Articles (%)
Children	21 (8.17)
College students	149 (57.98)
Adults	86 (33.46)
Seniors	13 (5.06)

Does not include conceptual articles, some articles used samples from more than one group.

Mikkelsen et al., 2002). In the articles that found no relationship between age and CA, thirteen were published in the 1990s (e.g., Henderson, Deane, Barrelle, & Mahar, 1995) and three were published in the 2000s (e.g., Todman, 2000). Table 5 lists articles examining age and CA.

A small minority of articles found CA negatively related to age; for example, CA was negatively related to age after a course on computer literacy (Orr, Allen, & Poindexter, 2001). Some articles also examined interactions when investigating age. For women, age has been found to be positively related to CA, while for men, age was not related to CA (Parasuraman and Igbaria (1990). In an article looking at instruction, age was positively related to CA in an introductory class, but not related to CA in a research methods class (Bowers & Bowers, 1996). Of the 40 articles examining age, 27 were published in the 1990s and 13 were published in the 2000s. A significantly larger emphasis was placed on researching the relationship between age and CA during the 1990s than 2000s ($\chi^2 = 7.091$, $p < .01$). While articles in the 2000s were more likely to find a positive relationship between age and CA and articles in the 1990s were more likely to find no relationship between age and CA, the difference in results between the decades was not significant. Likewise, there were no significant differences in results when comparing across the different sample sources, i.e. college students were no different from adults, who were no different from seniors. However, when examining by both decade and sample source, a significant difference in results was found between adults of the 1990s and adults of the 2000s ($F = 12.8$, $p = .003$). In the 1990s, age was not related to CA in adults. Conversely, in the 2000s, age was found to be significantly, positively related to CA. In the 1990s, many adults in the workplace had not been exposed to computers during their school years or at work. Even for the young adults of the time, computers had likely not been introduced in large numbers during their education. It is feasible to believe that by the 2000s, young adults were more likely to have been exposed to computers through school, thus they were more likely to have lower CA than older working adults who did not have the same level of education and experience on computers.

3.1.3. Other anxieties

Other anxieties include such anxieties as state, trait, math, e-mail, Internet, and computer mediated communication. Also included in this category is depression and general distress. Thirty papers dealt with some form of anxiety and its relationship to CA (see Table 6). Not surprisingly, CA was positively correlated with depression (Lankford, Bell, & Elias, 1994), computer-mediated communication (Brown, Fuller, & Vician, 2004), e-mail (Fuller, Vician, & Brown, 2006), Internet (Thatcher, Loughry, Lim, & McKnight, 2007), and distress (Henderson, Deane, Barrelle, et al., 1995). Math anxiety was positively related to CA for women but not men (Parasuraman & Igbaria, 1990). While at least one article divided CA into two constructs of trait anxiety (stable) and state anxiety (response to a specific situation) (Igbaria & Iivari, 1995), other studies compared state and trait anxiety to CA. Both state and trait anxiety were typically found to be positively related to CA (e.g., Gaudron & Vignoli, 2002; Thatcher & Perrewe, 2002).

Of the articles that examined other anxieties, 16 articles were published in the 1990s and another 14 articles were published in the 2000s. Given these numbers, it is not surprising that there was no significant difference in the amount of research done on other anxieties when comparing the two decades ($\chi^2 = .558$). While no comparisons can be made on results found between decades or between sample source (because a variety of other anxieties were examined), it is worth noting that no studies have been conducted using seniors when studying the relationship of other anxieties and CA.

3.1.4. Education

Twenty-six articles covered education level and its relationship to computer anxiety. Twelve of these papers were published in the 1990s and 14 in the 2000s (see Table 7).

Table 3
Number and (per cent) of articles using research method for each construct.

	Single survey # (%)	Pre/post-tests # (%)	Other # (%)	Repeat measures # (%)	Longitudinal # (%)	Interviews # (%)	Case # (%)
Antecedents							
Gender	61 (76.25)	9 (11.25)	6 (7.50)	0	4 (5.00)	1 (1.25)	0
Age	29 (72.50)	6 (15.00)	4 (10.00)	0	1 (2.50)	1 (2.50)	0
Other anxieties	23 (76.67)	2 (6.67)	3 (10.00)	2 (6.67)	0	0	0
Education	20 (76.92)	2 (7.69)	1 (3.84)	0	2 (7.69)	2 (7.69)	0
Personality	22 (84.62)	3 (11.54)	2 (7.69)	0	0	0	0
Profession	12 (85.71)	1 (7.14)	0	0	0	1 (7.14)	0
Experience	63 (70.79)	17 (19.10)	4 (4.50)	1 (1.12)	2 (2.25)	2 (2.25)	1 (1.12)
Training	16 (39.02)	23 (56.10)	1 (1.12)	2 (2.25)	1 (1.12)	0	0
Ownership	11 (68.75)	5 (31.25)	0	0	0	0	0
Correlates							
Self-efficacy	19 (67.86)	2 (7.14)	5 (17.86)	1 (3.57)	1 (3.57)	0	0
Attitude	13 (65.00)	2 (10.00)	4 (20.00)	1 (5.00)	0	0	0
PEOU	17 (85.00)	1 (5.00)	1 (5.00)	1 (5.00)	0	0	0
Perceived usefulness	12 (80.00)	3 (20.00)	0	0	0	0	0
Satisfaction	11 (100.00)	0	0	0	0	0	0
Outcomes							
Performance	19 (54.29)	10 (28.57)	2 (5.71)	4 (11.43)	0	0	0
Intent to use	21 (91.30)	1 (4.35)	0	0	1 (4.35)	0	0
Overall	180 (65.22)	36 (13.04)	42 (15.22)	10 (3.62)	5 (1.81)	3 (1.09)	2 (.72)

Articles may have used more than one research method.
Other: Includes meta-analyses, conceptual papers, and papers that created or validated scales.

Table 4
Articles examining gender.

Gender (y = sig. diff. found; n = no sig. diff found)		
Subjects	1990s	2000s
Children	Jacobson (91) y Okebukola (93) y Al-Jabri (96) y	Chou (01) y Tsai (02) y-M Chou (03) y Cooper (06) y Rees and Noyes (07) y Baloglu and Cevik (07) y Conti et al. (09) y King et al. (02) y-M North and Noyes (02) n
College students	Williams and Johnson (90) y Farina (91) y Reed (95) y-M Schuh (96) y Gopal et al. (97) y Hemby (98a) y Chua et al. (99) y Harris and Davison (99) y Ray and Minch (90) n Wilson and Daubek (92) n Colley et al. (94) n Dyck and Smither (94) n Francis (94) n McInerney et al. (94) n Todman and Monaghan (94) n Anderson (96) n Ayersman (96) n Bowers and Bowers (96) n Houle (96) n Brosnan (98b) n Shermis and Lombard (98) n Brosnan (99) n Busch (95) n, y Brosnan and Lee (98) n, y-m Hemby (98b)	Mitra et al. (00) y McIlroy et al. (01) y Durndell and Haag (02) y Beckers and Schmidt (03) y Todman and Day (06) y Anthony et al. (00) n Bozionelos (01) n Stephens (01) n Compton et al. (03) n Havelka et al. (04) n Korukonda (05) n Arigbabu (06) n Teo (06) n Teo (07) n Tekinsarslan (08) n Popovich (08) n, y Todman (00)
Adults – (working, non-working, grad students)	Igbaria and Chakrabarti (90) y Igbaria (93) y Brown and Coney (94) y Bozionelos (96) y Bradley and Russell (97) y Dansky et al. (99) y Parasuraman and Igbaria (90) n Chu and Spires (91) n Henderson et al. (95b) n Yaghi and Abu-Saba (98) n Rosen and Weil (95a) n, y	Mikkelson et al. (02) y Gilbert et al. (03) y Schottenbauer et al. (04) y Broos (05) y Wang and Wang (08) y Chou and Tsai (09) y-m Bozionelos (01) n Martin et al. (01) n Hong and Koh (02) n Knight and Pearson (05) Whitaker (07)
Seniors	Dyck and Smither (94) n Dyck and Smither (95) y	Hogan (05) y Karavidas et al. (05) y
Conceptual or meta-analysis	Ray and Minch (90) Torkzadeh and Angulo (92) Maurer (94) Chua et al. (99)	Cooper (06)

Literature on education fell into two broad categories: level of education and major. The majority of papers that examined the relationship between level of education and CA found education level to be negatively related to CA; the more education a person has, generally the lower his/her CA (e.g., Chou & Tsai, 2009; Harris, 1999). Graduate students have less CA than undergraduate students (Bozionelos, 2001; Fitzgerald, Hardin, & Hollingshead, 1997). Contrary to these findings, one study found seniors with more CA than freshmen (Vincent, Meche, & Ross, 2002). In addition, studies that examined students at the same level of education (i.e., comparing college students with each other) found no significant relationship. Year in the MBA program was not related to CA (Chu & Spires, 1991), and year of study among undergraduates was not related to CA (Al-Jabri & Al-Khaldi, 1997; Arigbabu, 2006). One article examined the role of gender and education on CA, finding that for men, education was negatively related to CA, but for women there was no relationship (Parasuraman & Igbaria, 1990).

A smaller number of articles explored the relationship of major to CA. Some found that college major/degree were not related to CA (e.g., Arigbabu, 2006; Chou, 2003). Others, not surprisingly, found some majors had lower CA than others: e.g., computer science majors had less CA than education majors (Williams & Johnson, 1990); IT majors had lower CA than psychology majors (Todman, 2000); and science/technology majors had lower CA than humanities/social sciences majors (Chou, 2003).

Given the near equal number of articles published on education and CA in the 1990s and 2000s, there was no statistical difference in published articles between the decades ($\chi^2 = .001$). No significant differences in results between decades or between sample

Table 5
Articles examining age.

Age (n = no sig diff found; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children	Todman and Lawrenson (92) +	Chou (03) +
College students	Ray and Minch (90) n Wilson and Daubek (92) n McInerney et al. (94) n Schuh (96) n Al-Jabri and Al-Khaldi (97) n Harris and Davison (99) n Todman and Lawrenson (92) + Keeler and Anson (95) + Laguna and Babcock (97) + Hemby (98a) + Hemby (98b) + Bowers and Bowers (96) +, n Dyck and Smither (94) – Todman and Monaghan (94) – Marcoulides et al. (95) – Brosnan (98b)	Anthony et al. (00) n Arigbabu (06) n Orr et al. (01) – Todman (00)
Adults	Igbaria and Chakrabarti (90) n Brown and Coney (94) n Henderson et al. (95b) n Bradley and Russell (97) n Dansky et al. (99) n Parasuraman and Igbaria (90) +, n Igbaria (93) + Marcoulides et al. (95) –	Languna and Babcock (00) + Martin et al. (01) + Mikkelson et al. (02) + Gilbert et al. (03) + Tu et al. (05) + Chou and Tsai (09) + Knight and Pearson (05)
Seniors	Laguna and Babcock (97) + Ellis and Allaire (99) + Dyck and Smither (94) –	Niemela-Nyrhinen (07) n
Conceptual or meta-analysis	Ray and Minch (90) Maurer (94) Kelly and Charness (95) Owen (96)	

Table 6
Articles examining other anxieties.

Other anxieties		
Subjects	1990s	2000s
Children	Todman and Lawrenson (92)	Baloglu and Cevik (08)
College students	Kernan and Howard (90) Farina (91) George et al. (92) Todman and Lawrenson (92) Carlson and Wright (93) Lankford et al. (94) Gonzalez et al. (95) Mahar et al. (97) Shermis and Lombard (98)	Goldstein et al. (02) Rovai and Childress (02) Thatcher and Perrewe (02) Vician and Davis (02) Brown et al. (04) Fuller et al. (06) Beckers et al. (07) Mohamad and El-Ragal (07) Norris et al. (07) Thatcher et al. (07)
Adults – (working, non-working, grad students)	Parasuraman and Igbaria (90) Henderson et al. (95b) Igbaria and Iivari (95) Bradley and Russell (97)	Green (01) Guadron and Vignoli (02) Schottenbauer et al. (04) Thorpe and Brosnan (07)
Seniors		
Conceptual or meta-analysis	Torkzadeh and Angulo (92) Maurer (94) Worthington and Zhou (99)	

sources were found. Although the adult samples in the 1990s were more likely to report no relationship between education level and CA and the adult samples in the 2000s were more likely to report a negative relationship between education and CA, these differences were not significant. Although not significant, the difference in findings parallels the results found with the construct of age. Adults with greater education in the 2000s were more likely to have been exposed to computers in their college courses.

Table 7
Articles examining education/major.

Education/major (m = looked at major; n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		King et al. (02) − Chou (03) m
College students	Williams and Johnson (90) m Houle (96) m Al-Jabri and Al-Khaldi (97) n Wilson and Daubek (92) + Fitzgerald et al. (97) −	Todman (00) m Havelka et al. (04) m Fedorowicz (05) m Lamberton and Arigbabu (06) n Vincent et al. (02) m, + Bozionelos (01) −
Adults – (working, non-working, grad students)	Igbaria and Chakrabarti (90) n, − Parasuraman and Igbaria (90) n Chu and Spires (91) n Williams and Zahed (96) n Harris (99) −	Christensen (02) m Laguna and Babcock (00) n Martin et al. (01) n Bozionelos (01) − Mikkelson et al. (02) − Gilbert et al. (03) − Chou and Tsai (09) −
Seniors	Ellis and Allaire (99) −	
Conceptual or meta-analysis	Maurer (94)	

Table 8
Articles examining personality.

Personality		
Subjects	1990s	2000s
Children		
College students	Webster and Martocchio (92) Crable et al. (94) Lankford et al. (94) Vogel (94) Houle (96) Bozionelos and Bozionelos (97) Emanuele et al. (97) Hemby (98a) Hemby (98b) Shermis and Lombard (98)	Anthony et al. (00) Gaudron (00) Thatcher and Perrewe (02) Korukonda (05) Korukonda (07) Korzaan and Boswell (08) Srite et al. (08)
Adults	Parasuraman and Igbaria (90) Chu and Spires (91) Webster and Martocchio (92) Bozionelos (97a) Harris (99)	Ceyhan (06) Van Raaij and Schepers (08) Chou and Chen (09)
Seniors		
Conceptual or meta-analysis	Torkzadeh and Angulo (92) Maurer (94)	

3.1.5. Personality

Sixteen articles on different personality traits were identified from the literature published in the 1990s. Ten articles on personality traits were published in the 2000s (see Table 8). Articles published in the 2000s were more likely to focus on the Big 5 personality traits. Those published in the 1990s were more diverse, examining variables such as locus of control (Emanuele, Dale, & Klions 1997), learning style (Shermis & Lombard, 1998), silliness (Bozionelos & Bozionelos, 1997), spontaneity (Bozionelos & Bozionelos, 1997), and self-directedness (Hemby, 1998a, 1998b). Most of these variables were found to have no significant relationship with CA.

Openness and CA were found to be negatively correlated (Anthony, Clarke, & Anderson, 2000; Korukonda, 2007). Other personality constructs similar to openness that were found to be negatively related to CA included creativity (Bozionelos & Bozionelos, 1997), personal innovativeness in IT (Chou & Chen, 2009; Thatcher & Perrewe, 2002), and microcomputer playfulness (Bozionelos & Bozionelos, 1997; Webster & Martocchio, 1992).

Conscientiousness was not found to be significantly related to CA (Anthony et al., 2000; Korukonda, 2007; Korzaan & Boswell, 2008). Results on extraversion were split, with a couple articles finding no relationship between extraversion and CA (Anthony et al., 2000; Korukonda, 2007), and a couple articles finding a negative correlation between CA and extraversion (Korukonda, 2005; Vogel, 1994). Similarly, results on agreeableness were mixed, finding both no correlation with CA (Anthony et al., 2000) and a negative relationship (Korukonda, 2007).

Research on neuroticism and CA found a positive relationship (Anthony et al., 2000; Korukonda, 2005, 2007; Korzaan & Boswell, 2008) between the two constructs. In addition, similar constructs that have been found to be negatively related to CA include optimism (Ceyhan, 2006) and self-esteem (Emanuele & Dale, 1997).

Table 9
Articles examining Profession/Organization.

Profession/organization		
Subjects	1990s	2000s
Children		
College students	Keeler and Anson (95) Marcoulides et al. (96) Fitzgerald et al. (97) Harris and Davison (99)	
Adults – (working, non-working, grad students)	Igbaria (90) Igbaria and Chakrabarti (90) Parasurman and Igbaria (90) Igbaria (93) Henderson et al. (95a) Rosen and Weil (95a) Marcoulides et al. (96) Fitzgerald et al. (97) Yaghi and Abu-Saba (98)	Martin et al. (01) Mikkelson et al. (02) Baloglu and Cevik (09)
Seniors		
Conceptual or meta-analysis		

A positive relationship was found between irrational beliefs and CA (Ceyhan, 2006).

No significant difference in number of articles published on personality was found between the 1990s and 2000s ($\chi^2 = 2.364$). However, as noted earlier, there has been a greater tendency for researchers in the 2000s to focus on the Big 5 Personality traits.

3.1.6. Profession/organizational aspects

The final category of personal characteristics with a significant number of articles was profession and/or organizational aspects. Fourteen articles were found that examined the relationship between a person's profession or some other organizational aspect and CA (see Table 9). Some of these articles examined specific professions. For example, nurses had higher CA than hospital administrators, despite having higher education levels (Henderson, Deane, & Ward, 1995). In a study using field personnel, secretaries had lower CA than technicians (Martin, Stewart, & Hillison, 2001). Other articles looked at varying levels within an organization. The majority of these articles found no relationship between organizational level and CA (e.g., Parasuraman & Igbaria, 1990). Management support within the organization and Information Center support were both found to be negatively related to CA (Igbaria, 1993).

With 11 articles from the 1990s and only three from the 2000s that examined the profession, there was a significant difference between decades on the study of the profession ($\chi^2 = 5.788$, $p < .02$). Researchers may believe that because computers have become more widespread in organizations and employees from vastly different areas within the company using computers, the need to study CA as it relates to professions is no longer necessary. However, there are still organizational aspects still relevant that need to be explored, one example being management support. It is somewhat surprising how few articles examined organizational aspects as they relate to CA in the 2000s.

3.2. Interactions with the computer

The second major category of antecedents examined were interactions with the computer. Variables studied under this category included experience/actual use, ownership, and training.

3.2.1. Experience/actual use

The largest amount of work examined the relationship between experience/actual use and CA. Eighty-nine articles were found that examined this relationship, with about 65% of those appearing in the 1990s (see Table 10). The vast majority (approximately 80%) of these studies found experience/use to be negatively related to CA (e.g., Al-Jabri & Al-Khaldi, 1997; Orr et al., 2001). A smaller number found no correlation between experience/use and CA (e.g., Henderson, Deane, Barrelle, et al., 1995; Saade & George, 2007). Several articles also delved into the experience construct more finely by examining the type of experience and its relationship to CA. For example, a positive, relaxed first experience was associated with lower CA (e.g., Gos, 1996; McIlroy, Bunting, Tierney, & Gordon, 2001).

A significant difference in the number of articles published on experience/use was found between the two decades of the 1990s and 2000s ($\chi^2 = 14.014$, $p < .001$). However, results between the two decades were very similar. The vast majority of articles in both decades found a negative relationship between CA and experience/use with a much smaller number finding no relationship between the two constructs. There were also no differences in results based on sample source. Because such a high per cent of these studies found a negative relationship between experience and CA, there was no significant difference in results found between sample sources. While the single survey method for collecting data was still the most popular (with 71% of studies employing a single survey), 21% of the studies investigating experience/use used a pre and post-test measure. Given the nature of the experience construct, it makes sense that more studies examining this construct used a pre/post-test method than in the prior constructs reviewed. The majority of these studies that used a pre/post-test method gave the post-test approximately 10–15 weeks after the pre-test. Again, looking specifically at the studies that used a pre/post-test method, no significant differences were found in the results.

3.2.2. Training on computers

Forty-one articles were found that examined the relationship between training and CA (see Table 11). Papers that were placed in this category dealt with actual training on computers; it did not include papers that covered education level. Two-thirds of the papers published in the category were published in the 1990s. As one would expect, the majority of the studies found training decreased CA (e.g., Igbaria, 1993; Orr et al., 2001). A small minority (just over 10%) of articles found no significant relationship between training and CA (e.g., Chu & Spires, 1991). Online courses decreased CA more than lecture classes (Maki, Maki, Patterson, & Whittaker, 2000) and students whose classes met more

Table 10
Articles examining experience/actual use.

Experience/use (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children	Chin and Donn (91) n Todman and Lawrenson (92) n	Chou (03) – Baloglu and Cevik (08) –
College students	Todman and Lawrenson (92) n Szajna and Mackay (95) n Brosnan and Lee (98) n, + Hemby (98b) n Brosnan (99) n Ray and Minch (90) – Farina (91) – Carlson and Wright (93) – Crable et al. (94) – Dyck and Smither (94) – McInerney et al. (94) – Szajna (94) – Busch (95) – Frey (95) – Keelor and Anson (95) – Reed (95) – Ayersman (96) – Bowers and Bowers (96) – Gos (96) – Houle (96) – Necessary and Parish (96) – Schuh (96) – Al-Jabri and Al-Khaldi (97) – Bozionelos and Bozionelos (97) – Emanuele et al. (97) – Fitzgerald et al. (97) – Mahar et al. (97) – Al-Khaldi and Al-Jabri (98) – Harris and Davison (99) – Safford and Worthington (99) – Colley et al. (94) Todman and Monaghan (94) Anderson (95) Brosnan (98b)	Rovai and Childress (02) n Saade and Kira (07) n Althaus and Tewksbury (00) – Anthony et al. (00) – Maki et al. (00) – Mitra et al. (00) – Bozionelos (01) – Orr et al. (01) – Beckers and Schmidt (03) – Fagan et al. (03) – Hackburth et al. (03) – Bozionelos (04) – Havelka et al. (04) – Wilfong (06) – McIlroy et al. (07) – Tekinslarsan (08) – McIlroy et al. (01) Todman and Drysdale (04)
Adults – (working, non-working, grad students)	Howard and Mendelow (91) n Henderson et al. (95a) n Brown and Coney (94) n, – Igbaria (90) – Igbaria and Chakrabarti (90) – Smith and Kortlik (90) – Chu and Spires (91) – Martocchio (92) – Igbaria (93) – Igbaria et al. (94) – Henderson et al. (95b) – Igbaria and Iivari (95) – Rosen and Weil (95a) – Bozionelos (97a) – Bozionelos (97b) – Shelley (98) – Yahgi and Abu-Saba (98) – Dansky et al. (99) – Safford and Worthington (99) – Bradley and Russell (97)	Barcy and Barcy (08) n (after 6 mo) Laguna and Babcock (00) – Bozionelos (01) – Martin et al. (01) – Hong and Koh (02) – Meuter et al. (03) – Broos (05) – McFarland and Hamilton (06) – Knight and Pearson (05)
Seniors	Dyck and Smither (94) – Dyck and Smither (95) – Cody et al. (99) –	Hogan (05) n Niemela-Nyrhinen (07) –
Conceptual or meta-analysis	Ray and Minch (90) Henry (93) Maurer (94) Chua et al. (99)	

times per week and for a longer duration had greater change in CA than those whose classes met fewer times for a shorter duration (Bohlin & Hunt, 1995). It was also found that belief about ability and training were associated with CA (Lemmon & Caltabiano, 2003), and if taking a computer course was labeled as an "opportunity", lower CA resulted than if the class was not labeled (Martocchio, 1992). Pre-training motivation was negatively related to CA (Long, DuBois, & Faley, 2008). Finally, instruction-based training (as opposed to behavior-modeling training) was better for students with high CA to gain self-efficacy (Chou, 2001).

Table 11
Articles examining training.

Training (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children	Jacobson (91) −	Chou (01)
College students	Harrington et al. (90) n Al-Jabri and Al-Khaldi (97) n Safford and Worthington (99) n Rosen et al. (93) − Colley et al. (94) − Frey (95) − Houle (96) − Schuh (96) Carlson and Wright (93) + Leso and Peck (92) Szajna (94) Bohlin and Hunt (95) Bowers and Bowers (96) Reznich (96)	Maki et al. (00) − Gunter (01) − Orr et al. (01) − Rovai and Childress (02) − Buche et al. (07) − Korukonda (07) − Namlu (03) Torkzadeh et al. (06) Long et al. (08) Zhao et al. (08)
Adults – (working, non-working, grad students)	Chu and Spires (91) n Brown and Coney (94) n Safford and Worthington (99) n Igbaria (90) − Igbaria and Chakrabarti (90) − Igbaria (93) − Bradley and Russell (97) − Martocchio (92) Martocchio (94) Bozionelos (96)	Mikkelson et al. (02) − Wood et al. (02) Lemmon and Caltabiano (03)
Seniors	Cody et al. (99) −	Campbell and Webb (03) − Xie and Bugg (09) −
Conceptual or meta-analysis	Applebaum and Primmer (90)	

Table 12
Articles examining ownership.

Ownership (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		Baloglu and Cevik (08) −
College students	McInerney et al. (94) n Busch (95) n Bowers and Bowers (96) n Brosnan (98b) n Al-Jabri and Al-Khaldi (97) − Houle (96) −	Orr et al. (01) − Teo (06) − Tekinsarslan (08) − Teo (08) −
Adults – (working, non-working, grad students)	Chu and Spires (91) − Brown and Coney (94) − Bradley and Russell (97) − Dansky et al. (99) −	Hong and Koh (02) −
Seniors		
Conceptual or meta-analysis		

Significantly more work was conducted on training and its impact on CA in the 1990s ($\chi^2 = 5.341$, $p < .02$). In addition, different results were found in the two decades. Studies in the 2000s were significantly more likely to find a negative relationship between training and CA ($F = 4.75$, $p = .042$). While several of the 1990s studies also found a negative relationship, all the studies finding no relationship between training and CA occurred in the 1990s – half had college samples sources and half had adult sample sources. It is not surprising that so many articles in the 1990s would concentrate on training because computers were still new to many people at that time. Now that the subject has matured, it is surprising that the 2000s did not see more studies targeting specific training for specific technologies.

The training construct was the only construct studied in which the primary research method was not the single survey. Pre/post-tests and repeat-measures were used in nearly 60% of the studies. Single survey method was used in just over 35% of the studies.

3.2.3. Ownership

Ownership of a computer is the final category within the Interaction between Individual/Computer antecedents. Sixteen articles investigated the relationship between CA and ownership (see Table 12). As one would expect, the vast majority found a negative relationship between CA and computer ownership (e.g., Chu & Spires, 1991; Orr et al., 2001).

Table 13
Articles examining CSE.

Computer self-efficacy (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		Chou (01)
College students	Brosnan (98a) – Brosnan (99) –	Johnson and Marakas (00) – Beckers and Schmidt (01) Durndell and Haag (02) – Thatcher and Perrewe (02) – Fagan et al. (03) – Havelka (03) – Johnson (05) – Hasan (06) – Torkzadeh et al. (06) Wilfong (06) – McIlroy et al. (07) – Thatcher et al. (08) – Zhao et al. (08) n Saade and Kira (09) – Scott and Walczak (09) –
Adults – (working, non-working, grad students)	Harrison and Rainer (92a) – Harrison and Rainer (92b) – Henderson et al. (95a) – Compeau et al. (99) –	Laguna and Babcock (00) – McFarland and Hamilton (06) – Downey et al. (08) – , n Chatzoglou et al. (09) – Chou and Chen (09) –
Seniors		
Conceptual or meta-analysis		Govindarajulu (09)

Ten articles on ownership were published in the 1990s and the remaining six published in the 2000s. There was no significant difference between the decades on the number of articles published ($\chi^2 = 1.646$). There also was not a significant difference in results between the two decades, despite the fact that all studies from the 2000s found a negative relationship and in the 1990s one third found a negative relationship with the remaining two thirds finding no relationship between ownership and CA. All studies from both decades using adult samples found a negative relationship between ownership and CA. However, in studies using samples sources of college students, there was a significant difference in findings between the two decades ($F = 6.400$, $p = .035$). In the 1990s, no significant relationship was found between ownership and CA for college students. In the 2000s, a negative relationship was found between ownership and CA for college students. Ownership in the 1990s may have meant the family/parents owned a computer, but the student himself/herself did not. The student, although reporting ownership of a computer, may not have had one to use personally on a regular basis. By the 2000s, ownership of personal computers was more ubiquitous among college students. Thus, if ownership was indicated, it was more likely the college student not only owned the PC, but used it regularly for school work.

3.3. Antecedents summary

The constructs of experience/use, age, profession, and training were all investigated predominately in the 1990s. Research on those four constructs diminished significantly in the 2000s as compared to the amount of work conducted in the 1990s. Generally, research on antecedents to CA has found openness to new experiences, amount of education, ownership, training, and experience/use to be antecedents negatively related to CA. Neuroticism and other anxieties are two antecedents found to be positively related to CA. No conclusive results have been found with respect to gender or age. Either there is no relationship between CA and age and CA and gender, or the female gender and older age are more likely to have CA than younger age groups and the male gender.

When comparing results of the constructs between decades, training was significantly more likely to have a negative relationship with CA in the 2000s than in the 1990s. Other than training, results from other constructs were not significantly different between decades. However, the interaction of sample source and decade provided additional differences in results. Adult samples in the 2000s were significantly more likely to show a positive relationship between age and CA; adult samples in the 1990s were more likely to have no relationship between age and CA. With the ownership–CA relationship, the college student sample showed no significant relationship between the two variables in the 1990s, but there was a significant negative relationship between ownership and CA in the 2000s.

Giving a single survey to study participants was the primary research method used when studying eight of the nine antecedents of CA. Only the construct of training used another research method more often – using pre/post-tests in 56% of the studies. Repeat measures, longitudinal studies, interviews and case studies were used much less often than either single surveys or pre/post-test methods.

4. Correlates in the computer anxiety literature

Several variables were examined as both antecedents and outcomes of CA. These variables are considered correlates of CA in this paper because causal precedence is difficult to specify for affective responses. Affective responses can be characterized as an experience of a feeling, an emotion, or a psychological reaction to the computer. Computer self-efficacy, attitude toward computers, perceived ease of use, and perceived usefulness of computers are correlates that were examined in at least ten studies over the last two decades.

4.1. Self-efficacy

Computer self-efficacy (CSE) is defined as "an individual judgment of one's capability to use a computer" (Compeau & Higgins, 1995, p. 192). Twenty-eight articles were found that examined

Table 14
Articles examining attitude.

Attitude (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		Cooper (06) −
College students	Rosen et al. (93) − Gopal et al. (97) − Brosnan and Lee (98) n, −	Beckers and Schmidt (01) Durndell and Haag (02) − Popovich et al. (08) −
Adults – (working, non-working, grad students)	Igbaria (90) − Parasuraman and Igbaria (90) − Harrison and Rainer (92a) − Igbaria (93) − Brown and Coney (94) − Ferguson (97) − Harris (99) − Igbaria and Chakrabarti (90) Kluever et al. (94)	Laguna and Babcock (00) − Hong and Koh (02) − Schottenbauer et al. (04) −
Seniors		
Conceptual or meta-analysis	Kelly and Charness (95)	Cooper (06)

Table 15
Articles examining perceived ease of use.

Perceived ease of use (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		
College students	Gopal et al. (97) − Brosnan (99) −	Hackburth et al. (03) − Saade and Kira (06) − Saade and Kira (07) − Kumar et al. (08) − Zhao et al. (08) − Saade and Kira (09) − Pearson and Pearson (08)
Adults – (working, non-working, grad students)	Ferguson (97) −	Venkatesh (00) − Pijpers and van Montfort (05) − McFarland and Hamilton (06) − Srite et al. (08) − Van Raaij and Schepers (08) − Chatzoglou et al. (09) − Fakun (09) −, n
Seniors		Phang et al. (06) − Ryu et al. (09) −
Conceptual or meta-analysis		Wexler (01)

Table 16
Articles examining perceived usefulness.

Perceived usefulness (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		
College students	Gopal et al. (97) − Brosnan (99) −	Rovai and Childress (02) n Davis et al. (09) n Srite et al. (08) − Saade and Kira (06) +
Adults – (working, non-working, grad students)	Drury (99) n Igbaria (93) − Igbaria et al. (94) − Kluever et al. (94) Ferguson (97) − Dansky et al. (99) −	Chatzoglou et al. (09) n McFarland and Hamilton (06) −
Seniors		Ryu et al. (09) n
Conceptual or meta-analysis		

the relationship between CSE and CA (see Table 13). The majority of these articles, close to 80%, were published in the 2000s. Results were almost identical in finding that CSE is negatively related to CA (e.g., Henderson, Deane, & Ward, 1995; Thatcher & Perrewe, 2002).

CSE was also identified as being the best predictor of CA (Henderson, Deane, & Ward, 1995). As the CSE topic matured, more papers differentiated between general CSE and application-specific CSE. The majority of articles differentiating CSE into the two constructs found both types of CSE to be negatively related to CA (e.g., Hasan, 2006). Also, individuals with low CA were able to improve CSE significantly more than individuals with high CA (Torkzadeh, Chang, & Demirhan, 2006). Finally, just two articles did not find a negative relationship between CSE and CA; post-training self-efficacy was not found to be related to CA (Zhao, Mattila, & Tao, 2008) and specific self-efficacies of word processing, spreadsheets, databases, and the web were not related to CA (Downey, Rainer, & Bartczak, 2008).

Similar to CSE, other variables studied and found to have a negative relationship with CA included ability (Reed, 1992), intellect (Korzaan & Boswell, 2008), knowledge of computers (Anderson, 1996), literacy (Tu & Wang, 2005), and math and logic skills (Korukonda, 2005).

CA researchers turned their attention to CSE in the 2000s. There has been a significant increase in the work done on CSE and CA since the 1990s ($\chi^2 = 7.075$, $p < .01$). The smaller number of papers examining CSE in the 1990s found the same results as those articles examining CSE in the 2000s – CSE and CA are negatively related. While the 2000s saw a significant increase in the number of published articles examining CSE and CA, most of these articles used student samples. In the 1990s, 2/3 of the articles published used adult samples, in the 2000s, more than 2/3 of the published articles used college student samples. As mentioned, the difference in sample sources did not change the results; CA and CSE are negatively related.

4.2. Attitude

Twenty articles examined the relationship between attitude and CA (see Table 14). The vast majority of articles, 70%, found CA negatively related to attitudes toward computers (e.g., Brosnan & Lee, 1998; Hong & Koh, 2002). The greater the CA of a person, the more negative attitudes they had about computers. As CA is reduced, attitudes increased (Rosen, Sears, & Weil, 1993). One article found CA to be the strongest predictor of attitudes for both men and women (Parasuraman & Igbaria, 1990). Finally, the relationship between CA and attitudes was found to be twice as strong in 2005 as it was in 1986, at both time, there was a significant negative relationship (Popovich et al., 2008). In the only article that found a negative relationship between attitude and CA, 2 samples were used. Undergraduates from the United Kingdom had a negative correlation between the two variables, but undergraduates from Hong Kong did not. This finding was attributed to the Hong Kong males having more anxiety over anticipated computer use than Hong Kong females (Brosnan & Lee, 1998).

While the 2000s had fewer articles published on attitude than the 1990s, the difference was not significant at the .05 level ($\chi^2 = 2.751$). Like the construct of CSE, results of the attitude–CA relationship were so similar that there were no differences between decades or sample sources.

4.3. Perceived ease of use

Perceived ease of use (PEOU) is the extent "to which a person believes that using a technology will be free of effort" (Venkatesh, 2000, p. 344). Like CSE and attitude, results on the relationship between PEOU and CA were consistent. Twenty articles were found that looked at PEOU (see Table 15), and all of them found a negative relationship between PEOU and CA (e.g., Saade & Kira, 2007; Venkatesh, 2000). The only exception to finding a negative relationship between PEOU and CA was in a study that used four sample groups. In one of the four sites, the user interface exceeded the expectations of the end users and the end users had a chance to try out the software in a non-pressure context. These two aspects were unique to the one site and given as the explanation as to why the CA of the users at that site did not correlate with the PEOU of the software used (Fakun, 2009).

Nearly 85% of the articles examining PEOU were published in the 2000s. Thus, there was a significant difference in number of articles published in the 2000s that examined PEOU ($\chi^2 = 7.977$, $p < .01$). Not only was there very little diversity in results found, but there was very little diversity in research methods to measure the relationship between CA and PEOU – 85% of the studies used a single survey method to collect data. About half the studies used student samples and approximately half used adult samples in both the 1990s and the 2000s.

4.4. Perceived usefulness

The perceived usefulness of a computer was found to be negatively related to CA in most studies (e.g., Igbaria, 1993). But, approximately one-third of studies examining perceived usefulness and CA found no relationship between the two constructs (e.g., Chatzoglou, Sarigiannidis, Vraimaki, & Diamantidis, 2009). Similar to usefulness, perceived benefits was not significantly related to CA (Ryu, Kim, & Lee, 2009). A total of fifteen articles were found that examined perceived usefulness (see Table 16). Eight of these articles came from the 1990s, and seven came from the 2000s. No significant difference was found in the number of published articles between decades ($\chi^2 = .281$). Because of the small number of articles looking at perceived usefulness, the statistical

Table 17
Articles examining satisfaction.

Satisfaction (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		
College students		Sun et al. (08) – Zhao et al. (08) n Lee et al. (09)
Adults – (working, non-working, grad students)	Igbaria and Nachman (90) – Igbaria et al. (94) – Harrison and Rainer (96) – Drury (99) n	Meuter et al. (03) – Srite et al. (07) – Chou and Chen (09) n Lee et al. (09)
Seniors		Karavidas et al. (05) –
Conceptual or meta-analysis		

Table 18
Articles examining performance.

Performance (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		Chou (01) – Cooper (06) – Baloglu and Abbasi (09) – Erdogan (09)
College students	Kernan and Howard (90) n Gonzalez et al. (95) n Szajna and Mackay (95) n Al-Jabri and Al-Khaldi (97) n Szajna (94) −, n Bowers and Bowers (96) −, n Laguna and Babcock (97) −, n Brosnan (98a) −, n Shermis and Lombard (98) −, n Harrington et al. (90) – Anderson (96) – Mahar et al. (97) – Tseng et al. (98) – Reed and Palumbo (92) Webster and Martocchio (92) Rosen et al. (93) Martocchio (94) Keeler and Anson (95)	Lee et al. (01) n Stephens (01) n Williams and McCord (06) n Johnson and Marakas (00) – Beckers et al. (06) −, n Buche et al. (07) – DeSai (01) +
Adults – (working, non-working, grad students)	Ford et al. (96) n Williams and Zahed (96) n Tseng et al. (98) – Webster and Martocchio (92)	Tu et al. (05) n Laguna and Babcock (00) −
Seniors	Dyck and Smither (95) −, n Laguna and Babcock (97) −, n	
Conceptual or meta-analysis	DeSai and Richards (98)	Cooper (06)

Table 19
Articles examining intent to use.

Intent to use (n = no diff; +/− pos or neg diff found)		
Subjects	1990s	2000s
Children		Tung and Chang (07) −
College students	Al-Khaldi and Al-Jabri (98) n Harrington et al. (90) −, n Todman and Monaghan (94) – Scott and Rockwell (97) −	Korzaan and Boswell (08) n Zhao et al. (08) n Lester and Yang (07) – McIlroy et al. (07) – Oyedele and Simpson (07) – Tung and Chang (08) – Al-Busaidi (09) −
Adults – (working, non-working, grad students)	Howard and Mendelow (91) n Compeau et al. (99) n Igbaria (93) – Shelley (98) −	Ball and Levy (08) n Kim and Forsythe (08) n Kim and Forsythe (08) n Wang and Wang (08) −, n Meuter et al. (03) – Al-Busaidi (09) – Chou and Chen (09) – Stewart and Segars (02)
Seniors		
Conceptual or meta-analysis	Compeau et al. (99)	

comparison of results is questionable. While there was no statistical difference in the results between the decades, it appears that studies from the 1990s were more likely to find a negative relationship between CA and perceived usefulness while studies from the 2000s were more likely to find no relationship between CA and perceived usefulness. That more studies would find no relationship in the 2000s aligns with the increased use of computers in that decade. Even if a person is CA, by the 2000s a greater number of people likely recognized the usefulness of technology and its impact on work and everyday life. The one article that found a positive relationship between CA and PU sampled undergraduate students assessing an online learning system. The authors attributed this finding to the "concept of 'I like it but I am anxious'" and "'If I have anxiety in using the online learning system then it must be useful'" (Saade & Kira, 2006, p. 536). Articles finding no relationship between CA and PU also have noted that PU often has a weak, negative influence on CA indirectly through some other variable (Chatzoglou et al., 2009).

4.5. Satisfaction

Just 12 articles reviewed examined the relationship between satisfaction and CA (see Table 17). CA has been found to be negatively related to satisfaction (Igbaria, Schiffman, & Wieckowski, 1994), as well as the similar e-learning satisfaction (Sun & Tsai, 2008). About one third of the articles found no relationship between satisfaction and CA (e.g., Chou & Chen, 2009; Zhao, Mattila, & Tao, 2008). In the few studies that found no relationship between satisfaction and CA, a third variable was found that mediated the relationship. For example, in Chou and Chen (2009), general CSE mediated the relationship between CA and satisfaction.

There was no significant difference in the number of articles published between decades ($\chi^2 = .454$). No difference was found in results between decades, nor was there a difference between sample sources. With a sample size so small, it is difficult to make comparisons with certainty. One difference between the decades is the sample sources used. In the 1990s all studies used adults. In the 2000s, there were samples using college students, adults, and seniors. There was no diversity in how data was collected between decades or between sample sources. All studies used a single survey to collect data.

4.6. Summary of correlates

The constructs of perceived ease of use and computer self-efficacy were both studied more frequently in the 2000s than in the 1990s. Both of these constructs were consistently found to be negatively related to CA, as was attitudes toward computers. The construct of perceived usefulness had mixed results, with negative relationships to CA found more often in the 1990s and no relationship to CA found more often in the 2000s, although this difference was not significant. Studies that examined self-efficacy in the 1990s were most likely to use adult source samples while studies in the 2000s were more likely to use college student samples. Likewise, the constructs of attitude and satisfaction found different sources being primarily used depending on the decade. With both attitude and satisfaction, adult sample sources were primarily used in the 1990s, while an even mix of adults and college students were used in the 2000s. The research method used to collect data when examining correlates was consistently single surveys. Single surveys were used between 65% and 100% of the time, with all studies on satisfaction employing a single survey data collection method.

5. Outcomes in the computer anxiety literature

Two outcomes of CA have been studied on a regular basis – performance and intent to use (as opposed to actual use of the computer). While many studies have used a generic performance construct when studying CA, other studies have specifically detailed what type of performance is being measured.

5.1. Performance

Approximately half of the 35 articles examining performance as a consequence of CA found no relationship between the two (see Table 18). Performance constructs not found to have a relationship with CA included course grades and withdrawal behavior (Kernan & Howard, 1990), level of learning and retention (Williams & Zahed, 1996), performance on math and English tests (Shermis & Lombard, 1998), productivity (Tu & Wang, 2005), and generic performance (Williams & McCord, 2006). The other half of the articles focusing on performance found a negative relationship between performance and CA. CA was negatively related to test performance (Anderson, 1996), grades (Bowers & Bowers, 1996), lower completion time of simple computer tasks (Mahar, Henderson, & Deane, 1997), performance on reading tests (Shermis & Lombard, 1998), working memory (Laguna & Babcock, 2000), learning (Chou, 2001), and generic performance (e.g., Cooper, 2006).

In an article comparing changes in CA, performance improved for individuals who went from high CA to low CA, but for individuals whose CA went from high to higher, performance decreased (Buche, Davis, & Vician, 2007). In addition, another study examining performance found that CA had an impact on performance in an introductory course, but not an intermediate course and that CA was not related to performance when more experienced subjects were used (Szajna, 1994). Students with high CA perform better in cooperative learning courses rather than individual learning courses (Keeler & Anson, 1995). DeSai and Richards (1998) showed the relationship between CA and performance as an inverted cup: those with very low or very high CA performed the worst.

Slightly more articles were published in the 1990s than would be expected ($\chi^2 = 3.764$, $p < .05$). No significant differences in results across the decades were found. In both decades approximately half the studies found no correlation between performance and CA, and half found a negative relationship between performance and CA. There were also no significant differ-

Table 20
Articles creating or validating CA scales.

Scales		
Subjects	1990s	2000s
Children	Pilotte and Gable (90) King and Bond (96)	
College students	Bandalos and Benson (90) Marcoulides and Wang (90) Gardner et al. (93) Charlton and Birkett (95) McInerney et al. (99)	Beckers and Schmidt (01) Gordon et al. (03) Marcoulides et al. (04) Lester et al. (05) Mohammod and El-RAgal (07) Schulenberg and Melton (08) Marcoulides et al. (08) Arigbabu (09)
Adults – (working, non-working, grad students)	Harrison and Rainer (92a) Miller and Rainer (95) Nash and Moroz (97) Dyck et al. (98)	Barbeite and Weiss (04) Wang (07)
Seniors	Dyck et al. (98)	
Meta-analysis	Lalomia (93)	

ences in results between sample sources. Forty per cent of the articles examining performance used either pre/post-test methods or a repeat-measures method of collecting data. While still more than half of the studies used single survey (54%), only the training construct saw a smaller per cent use of single survey.

5.2. Intent to use

While one could reasonably expect that if someone had high CA, they might still put in the effort for the required performance, it is not as obvious why someone with high CA would voluntarily choose to use a computer again in the future. Yet, research showed that in about 40% of the 23 articles examining intent to use, CA was not related to intent to use (see Table 19). CA was not related to faculty or instructors' intent to use computers (Ball & Levy, 2008; Howard & Mendelow, 1991), it was not significantly related to a subject's intent to use a virtual try-on software (Kim & Forsythe, 2008b), and CA was not related to behavioral intent (Zhao et al., 2008). About 60% of the articles found CA to be negatively related to intent to use (e.g., Chou & Chen, 2009; Todman & Monaghan, 1994). Wang and Wang (2008) found CA and intent to use were negatively related for females but the two constructs were not related for males. Stewart and Segars (2002) found concern for privacy mediated the relationship between CA and intent to use, but Korzaan and Boswell (2008) found the opposite – privacy did not mediate the relationship between CA and intent to use.

There was no significant difference in the number of articles between the 1990s and 2000s looking at intent to use ($\chi^2 = 1.269$). In addition, no significant difference in results between decades was found and no significant differences in results between sample source. Given the construct is measuring an action that might occur in the future, it is not a surprise that over 90% of the studies used a single survey to collect data.

6. Measures/scales used in computer anxiety literature

More than a dozen different computer anxiety scales have been created and used in the study of CA. From Table 20, over twenty articles published on CA have focused primarily on the creation or modification of CA scales. Some of these have been for a specific subgroup of people, for example, CA in adults in training situations (McInerney, Marsh, & McInerney, 1999) or a specific type of computer anxiety, for example, mobile computer anxiety (Wang, 2007). Most, however, were scales created to measure general computer anxiety with no specific group or type of anxiety intended. By far, the most used during the 1990s and 2000s have been the CARS (Heinssen, Glass, & Knight, 1987), CAS (Gressard & Loyd, 1984; Loyd & Gressard, 1984); ATC (Raub, 1981), and the Marcoulides CAS (Marcoulides, 1989). Of the scales used most frequently in the two decades surveyed, all were created in the 1980s. Several articles validated these scales (i.e., Arigbabu, 2009; Bandalos & Benson, 1990; Harrison & Rainer, 1992) in the 1990s and 2000s. Use of two of these scales decreased dramatically in the 2000s. The ATC (Raub, 1981) is a 3-factor scale with factors of "appreciation of computers", "computer usage anxiety", and "computers' negative impact on society". Seventeen articles used this scale in the 1990s but only one used it in the 2000s. Items on this scale were not modified as much as other scales and some questions have become outdated. The CAS scale (Gressard & Loyd, 1984; Loyd & Gressard, 1984) has predominantly been tested and validated with college samples. It consists of three factors: computer liking, computer confidence, and computer anxiety. While being used in six papers in the 2000s, in the 1990s it was used in 18 papers.

If we look at the scales that have been used most often in the last 5 years of the 2000s, some of the early scales have "stood the test of time" and are still frequently used. Because of the changes in technology and the increased ubiquity of computers, it is possible that people have a different form of computer anxiety than they had in the past. For that reason, scales to measure CA must be continuously validated. In some scales, constructs became outdated with time or because of technology changes. The most often used scales between 2005 and 2009 include Heinssen, Glass, & Knight (1987), Venkatesh, Morris, Davis, and Davis (2003), Ceyhan and Namlu (2000), and Marcoulides (1989). Heinssen et al. (1987) has proven to be most popular, being used more than twice as often as the second most used scale. It is a 19-item, 2-factor scale (anxiety and confidence) that has been validated using a variety of sample sources since its creation. Seven articles from 2005 to 2009 cite using the 4-item scale from Venkatesh et al. (2003). The Venkatesh et al. (2003) scale is different from most CA scales of the 1980s and 1990s because it used just four items. The four items used in Venkatesh et al. (2003) are replicas of four items used in the Heinssen et al. (1987) scale and the same four items are used in Thatcher and Perrewe (2002). Additionally, there were several articles in the late 2000s that reported using the Thatcher and Perrewe (2002) scale. This 4-item scale has been used when researching a large variety of sample sources. Ceyhan and Namlu (2000) is a 26-item, 3-factor scale (affectional, damaging, learning) that has primarily been validated using school children. Two articles that used the Ceyhan and Namlu scale that did not use children, examined high school principals and teacher trainees (Baloglu & Cevik, 2009; Ceyhan, 2006). Finally, the Marcoulides (1989) scale is a 20-item, 2-factor scale (general CA, equipment anxiety) that has been used extensively with a wide variety of sample sources from several different countries. The Marcoulides (1989) scale has been validated numerous times since its creation.

7. Conclusion

Table 21 provides the results of the chi-square goodness of fit calculation for variables with a significant difference in number of articles published between the 1990s and 2000s. Table 22 provides the chi-square results for variables with insignificant differences in the number of articles published between decades. The 1990s saw significantly more work on the antecedents of age, experience, profession, and training, as well as the performance outcome. The 2000s had significantly more work published on the correlate variables of computer self-efficacy and perceived ease of use. Finally, Table 23 provides the results of differences found in results within the constructs used most frequently in CA research. The constructs of gender, age, training, and ownership all saw significant differences in results based on sample source, decade, or the combination of source and decade.

7.1. Limitations

This literature review has created a framework to categorize the research on computer anxiety over the past 20 years. The principle limitation, as with many literature reviews, is the possibility of missing published articles on the topic. When articles were first being reviewed, search engines and databases were more limited. At the time, if a search was conducted looking for "computer anxiety", articles were only found if the two words followed one another. There are certainly some articles that were not included because the words computer and anxiety were separated by one or more words in the abstract. In addition, only three databases were used: ABI Complete, Business Source Elite,

Table 21
Chi-square results of significant differences.

Variable	# of articles 1990–1999 (n = 128)	# of articles 2000–2009 (n = 147)	χ^2 (df = 1)	Significance level
Antecedents				
Age	28	13	7.827	.01**
Profession/organization	11	3	5.788	.02*
Experience	59	30	14.014	.001***
Training	27	15	5.341	.02*
Correlates				
Self-efficacy	6	22	7.075	.02**
Perceived ease of use	3	17	7.977	.01**
Outcomes				
Performance	22	13	3.764	.05*

* p <= .01
** p <= .05
*** p <= .001

Table 22
Chi-square results of insignificant differences.

Variable	# of articles 1990–1999 (n = 128)	# of articles 2000–2009 (n = 147)	χ^2 (df = 1)	Significance level
Antecedents				
Gender	42	38	1.158	.282
Other anxieties	16	14	.558	.453
Education	12	14	.001	.972
Personality	16	10	2.364	.124
Ownership	10	6	1.647	.177
Correlates				
Attitude	13	7	2.752	.088
Perceived usefulness	8	7	.282	.541
Satisfaction	4	7	.454	.480
Outcomes				
Intent to use	8	15	1.269	.249

Table 23
Significant differences in results.

Variable	Significant difference in results	F	p
Gender	College student sample significantly different from children/adults/seniors College students: NO relationship between CA and gender Children/adults/seniors: Females more CA than males	4.656	.034
Age	Adults only between decades Adults in 1990s: No relationship between age and CA Adults in 2000s: Positive relationship between age and CA	12.800	.003
Training	1990s results differed from 2000s results 1990s: NO relationship between training and CA 2000s: Negative relationship between training and CA	4.750	.042
Ownership	College students only differed between decades 1990s: NO relationship between ownership and CA 2000s: Negative relationship between ownership and CA	6.400	.035

and Academic Search Complete. If a greater variety of search engines were used, the number of articles found, particularly in the education field, would increase. Finally, journals that may now be covered in one of the three databases searched may not have been included in that database in all the years that it was searched. For example, a journal that is now covered in ABI Complete may not have been covered in the 1990s, and therefore, some articles would have been missed because they did not show up when a search was done in the 1990s. Conversely, an article may be included in this review because the journal was included in one of the three databases in an earlier year even though the journal is no longer covered in that database. Despite the fact that some CA articles have likely been missed, this initial literature review provides a first step in creating a framework on CA research that will benefit researchers interested in furthering the knowledge of CA.

7.2. Future research directions

This article has reviewed and summarized the articles published on computer anxiety over the past 20 years. The goal of the paper has been to organize the hundreds of articles published on CA, create a framework, and provide information on what has been found regarding CA and what questions remain today.

With nearly everyone using a computer for work today, surprisingly few articles examined the role of management support to CA. Although two articles from the early 1990s found a negative relationship between support and CA (Igbaria, 1993; Igbaria &

Chakrabarti, 1990), this area should be revisited. Is there anything new that can be done to provide support to computer users to reduce their anxiety? What type of organizational support is wanted by computer users today? Technology is changing faster than ever today, working in virtual teams in organizations is becoming more prevalent, and this ever changing work environment heightens anxiety. As technology changes are implemented, what can an organization do to reduce anxiety among computer users? Or should they? Have computers become so ubiquitous that employees expect to work with computers regardless of their CA? Are employees managing to be productive while dealing with CA? This leads to future research that examines more closely the constructs identified in this literature review. If employees are managing to perform despite the presence of CA, why? In the review of the performance–CA relationship, what was different about the studies that found no relationship and those that found a negative relationship?

The changing technology is also affecting how schools teach. At the university level, more and more classes are being offered online or in hybrid formats. How does this affect the student who is high CA? How do they cope? Does just the idea of having to take a class online raise CA? Very few research articles have investigated the mandatory vs. voluntary nature of using computers. Looking at CA and mandatory vs. voluntary use of the computer from the perspective of a student who has a choice between a traditional face-to-face section of a class and an online class may be a way to investigate how the mandatory vs. voluntary aspect of computers relates to CA and other constructs. While the role of gender on CA has been researched heavily, how does CA influence the female's perception of IT as a career field? The number of female students has been declining in IT majors, does CA have anything to do with this phenomenon?

What is it about computers that make a person feel anxious today? One construct influencing CA may be a concern for privacy and security when using computers. Yet, few studies on CA have examined the relationship between CA and the potential loss of privacy or security. More work and personal business is done online today; how does this increase affect individuals and organizations? If security concerns make a person more CA, will this impact the amount of business they'll conduct online? Is there anything organizations can do to lessen the impact of CA among their customers?

A big gap in the research from the last 20 years seems to be the primary reliance on a single research methodology. Nearly 2/3 of the studies reviewed in this paper utilized a single survey to capture data. Seventeen per cent used a pre/post-test method or repeat measures method to collect data. Only two articles used case studies; three articles used interviews. Five of the 276 articles were longitudinal in nature. Of the constructs identified as those most often studied in CA research, only articles examining Training used a method other than single survey as its primary method. The study of CA is mature enough to warrant a look at it in a different way, through different research methodologies. Future researchers should consider methods other than a single survey when conducting research on CA.

With computers more ubiquitous now than they were in the 1980s, a thorough study of the measures used for computer anxiety is needed. The majority of the CA studies use measures developed in the 1980s. Without a doubt, concerns about computers have changed and evolved over the past 20 years. Is the construct of CA a multi-dimensional one as long asserted? Or can the increasingly popular 4-item measurement scale employed by Venkatesh et al. (2003) and Thatcher and Perrewe (2002) measure CA as accurately as the more traditional Heinssen et al. (1987) and Marcoulides (1989) scales? Perhaps both are needed, for different reasons. Should there be more than one scale used to assess CA? More and more CSE research is divided between general CSE and application specific CSE. Is there a need to develop CA scales for both general CA and application specific CA?

7.3. Conclusion

The aim of this paper is to highlight the variables most often studied in computer anxiety over the past 20 years. Literature on CA has been categorized to provide easy reference for researchers to analyze previous work and guide future work. General findings from CA research have been documented. Future research areas and specific questions have been identified to stimulate future research. To date, no comprehensive review of the CA construct has been done. This is a first step in creating a framework of the work done and results found over the past 20 years.

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