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INDIVIDUAL AND HUMAN-ASSISTED COMPUTER SELF-EFFICACY: AN EMPIRICAL EXAMINATION

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Abstract

Researchers have found computer self-efficacy to be important to technology adoption. Past research has treated computer self-efficacy (CSE) as a unitary concept. This study proposes that CSE has two dimensions—individual and human-assisted. Using items drawn from the Compeau and Higgins'[CoHi95b] CSE instrument, the paper examines each dimension's relationship to computer anxiety and perceived ease of use of information technology. The paper contributes to the literature by showing that the Compeau and Higgins instrument measures two CSE dimensions with distinct effects on computer anxiety and perceived ease of use of information technology. Implications for research and practice are offered.

1 Introduction

Successfully adopting technologies is crucial for effective enterprises, and computer self-efficacy is a key factor in adoption. Learning to utilize information technology (IT) rests on the shoulders of individual organizational members. At this individual level of analysis, understanding factors influencing IT use has been of great interest to information systems researchers [CoHH99, Davi89, MaHZ96]. Numerous studies have demonstrated that computer self-efficacy (CSE) plays an important role in influencing IT perceptions and use [HiSM87, IgIi95, MaYJ98]. CSE refers to an individual's "judgment of one's capability to use a computer" [CoHi95b, p. 192]. In general, research suggests that CSE is an important antecedent to beliefs and emotions that influence IT use. For example, CSE positively influences perceptions about the ease of use (EOU) of IT [VeDa96] and negatively impacts computer anxiety [CoHH99].

Although CSE has been frequently researched, critics of the CSE literature suggest that, "the results obtained to date have, in some cases, been either equivocal or contradictory" [MaYJ98, p. 126]. For example, using an established CSE scale, Compeau and Higgins [CoHi95a] found support for a model linking CSE to outcome expectancy, which refers to a person's estimate that a behavior will lead to an outcome [Band77]. However, using a new CSE scale, Johnson and Marakas [JoMa00] found stronger support for CSE exerting a positive influence on outcome expectancy. After examining these contradictions, we feel that the problematic findings are likely rooted in how studies have operationalized the CSE construct [Band77]. Some have employed self-developed measures [Busc95, HeSt95, JoMa00], while others have modified existing measures [TaTo95, WeMa93], creating a lack of consistency in the way CSE has been operationalized. Furthermore, CSE has been treated as a unitary concept, even though, as discussed later in the paper, its measures reflect two distinct concepts. Treating multi-dimensional concepts as unitary constructs can cause empirical problems, as found in other domains[Rubi73]. A lack of conceptual clarity and measurement issues may be responsible for fragmented findings affecting the development of the CSE concept [MaYJ98]. This paper examines two questions: 1) What are the conceptual dimensions of CSE?; and 2) Can the Compeau and Higgins' [CoHi95b] CSE scale be adapted to operationalize these conceptual dimensions?

2 Theoretical Background

Drawing on social cognitive theory [Band77], CSE research brings *self-efficacy* to the domain of IT. Self-efficacy refers to "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" [Band86]. Self-efficacy's implications have been studied extensively in many fields such as education, psychology, social psychology, health, athletics, and management [Band97].

Computer self-efficacy refers to individuals' judgment of their capabilities to use computers [MaYJ98]. Research suggests that individuals who express higher CSE levels are likely to express more positive beliefs about, and more frequently use, IT [CoHH99]. CSE may be conceptualized at two levels – general and task-specific [MaYJ98]. *General CSE* refers to individuals' beliefs about their ability to use a computer across situations or applications. *Task-specific CSE* refers to individuals' beliefs about their ability to use a specific information technology. *Task*-specific CSE may be influenced by training or experience [AgSS00]. General and task-specific CSE do not differ from each other in terms of their conceptual makeup, only in terms of level of specificity. Rather, they are the same basic construct applied to either general or specific technologies. A number of recent studies have examined the construct of computer self-efficacy. Unfortunately a consensus does not seem to have emerged as to how to operationalize CSE. In other research, Compeau and Higgins' ten-item scale has been used in its entirety [GuNd06, Haya04, ShPC03] as well as reduced to a smaller subset [ThCH06, Hasa06, ChLu04]. A number of other scales have also been employed [Hasa06, ReDM05, StHe03, YiIm04, FaNW03].

2.1 Attribution Theory and CSE

Individuals may attribute computer self-efficacy beliefs to internal and external sources [Band88, KeCH99, MaYJ98, SiMG95]. Attribution theory helps explain individuals' causal explanations for events or performance. It suggests that individuals' beliefs about locus of causality influence perceptions about their performance in various situations. Locus of causality refers to whether individuals believe that their ability to perform an action (such as using an IT) rests on external factors or resides within themselves [Mart95, p. 9]. Thus, external attribution relates to human-assisted CSE. When individuals make external attributions, they assess their capability in light of external factors such as peer or technical support. In terms of CSE, external attributions reflect beliefs about one's capability to perform a task on a computer *with* *assistance or support* from an external source. When individuals make internal attributions, they believe that they can exert personal control over performance or other outcomes (i.e., without external help). In terms of CSE, internal attributions reflect individuals' beliefs about their ability to independently accomplish a task using a computer. Hence, internal attribution relates to individual (unassisted) CSE.

Applying attribution theory to CSE terms yields two construct definitions. *Individual CSE* means a belief about one's ability to independently accomplish a task on a computer. A little child demonstrates individual self-efficacy by proudly saying, "Look, Mom, I can do it all by myself". *Human-assisted CSE* means a belief about one's ability to perform a task on a computer with support from another person. This type of CSE reflects the need for help, as when, frustrated at the computer, you ask for help from colleagues or support personnel. Distinguishing between internal and external sources of efficacy beliefs is important because individuals who make internal attributions express more confidence in their ability to perform a task and report more positive beliefs and attitudes than do those who make external attributions [Band77, Schu84, ScGu86, SiMG95]. In this way, splitting CSE along attributional lines extends theory beyond the levels-of-specificity distinction of general and task-specific CSE. Distinguishing between individual and human-assisted CSE is important because it distinguishes the two underlying attributional thought structures that influence how CSE will operate. Because of their attributional differences, individual and human-assisted CSE should apply to both general and task-specific CSE situations.

Rather than develop a new CSE measure, this study focuses on refining an existing instrument to measure the internal and external dimensions of CSE. By doing so, we build on prior empirical research. The Compeau and Higgins' [CoHi95b] instrument was designed to capture the magnitude and strength of CSE across situations. The instrument has received varying support through its wide use in the information systems literature [AgKa00, AgSS00, CoHH99]. Although designed to assess individuals' overall CSE level, we believe that the Compeau and Higgins' items represent distinct attributional sources of CSE. By carefully evaluating the instrument's items in terms of dimensionality, and then validating these dimensions across general and specific CSE, we believe researchers will possess more effective tools to evaluate CSE across settings. Hence, the next section of the paper develops hypotheses that predict the multi-dimensionality of Compeau and Higgins' instrument, and evaluates the nomological network of relationships between the dimensions of CSE and two effects of CSE-computer anxiety and perceived ease of use.

3 Research Model and Hypotheses

The research model was developed as follows (see Figure 1). First, the researchers examined the face validity of the Compeau and Higgins' CSE instrument to determine whether items fell within the internal and external dimensions of efficacy beliefs. Face validity is a method most often used to assess whether measurement items adequately represent the concept they are intended to measure, thereby assuring the important logical link between empirical measures and theoretical concepts, on which the veracity of logical positivist science depends [Schw80]. Face validity was assessed prior to empirical analysis in order to identify *a priori* which items best measured each attributional CSE dimension.

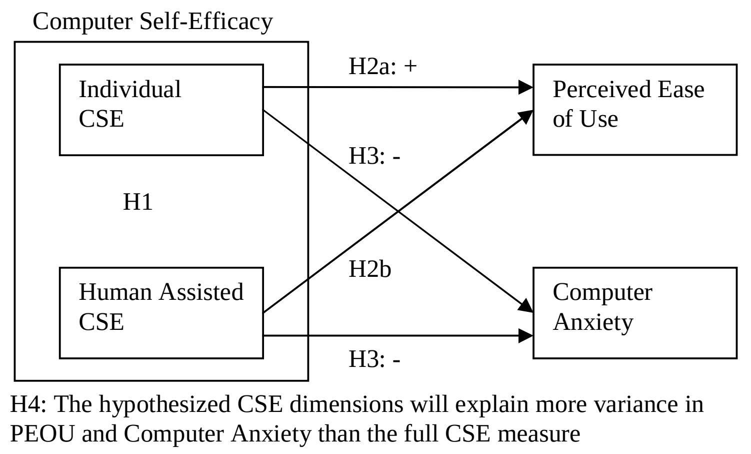

Figure 1: Research Model

Two of the researchers separately examined the wording and phrasing of the instrument in order to identify items that implied different sources of attributional causation. The items were examined in light of: (a) what the researchers knew about attribution theory and (b) the definitions of individual and human-assisted CSE presented in the Theoretical Background section. The researchers consistently identified six items that uniquely represented the two distinct dimensions of CSE – the individual (I) and human-assisted (H). Their coding for items comprising each dimension is shown in Table 1. Overall, the researchers agreed on the placement of all but one of the items (Cohen's Kappa = .92).

Meeting to discuss their item codings, the two researchers agreed that the remaining four items did not have sufficient clarity to be clustered with either dimension or to form a distinct conceptual dimension; rather, these items represented such beliefs as familiarity with the technology, resources such as time required to complete a task, or an automated help facility built into the system. Ignoring these items (coded O in Table 1), the scale appears to have two distinct dimensions representing individual and human-assisted CSE. Thus, an analysis of these measures in light of attribution theory suggests that:

Hypothesis 1. The Compeau and Higgins' [CoHi95b] computer self-efficacy instrument measures two distinct dimensions of efficacy beliefs.

Computer Self Efficacy Items	**Rater 1**	**Rater 2**
I could complete my job using the technology if …		
1. … there was no one around to tell me what to do. (I)	I	I
2. … I had never used a package like it before. (I)	I	I
3. … I had only the software manuals for reference. (I)	I	I
4. … I had seen someone else using it before trying it myself.	H	O
5. … I could call someone for help if I got stuck. (H)	H	H
6. … someone else helped me get started. (H)	H	H
7. … I had a lot of time to complete the job for which the software was provided.	O	O
8. … I had just the built-in help facility for assistance	O	O
9. … someone showed me how to do it first. (H)	H	H
10. … I had used similar packages like this one before to do the job.	O	O
I = Items comprising the individual dimension of CSE. H = Items comprising the human-assisted dimension of CSE. O = Other sources of efficacy such as resource availability or experience. Cohen's Kappa, a measure of interrater reliability, was .92		

Table 1. Compeau and Higgins' (1995) General Self-Efficacy Measure

The Information Systems literature was then reviewed to identify perceptions of IT with which the individual and human-assisted dimensions would demonstrate distinct relationships. In this way, nomological validity of the constructs could be demonstrated. Nomological validity means whether or not the construct does what is expected within its nomological network [Schw80], such as relating to other constructs as theory suggests [WeMa93]. If two constructs perform differently in their nomological network, this provides additional evidence that they are discriminant constructs.

To establish the nomological validity of the CSE dimensions, we examined two well-established correlates of CSE – the perceived ease of use (EOU) of IT and computer anxiety. We selected EOU and computer anxiety as dependent variables for two reasons. First, CSE exhibits distinct relationships with EOU and computer anxiety. When individuals express high levels of CSE, research suggests that they report high levels of EOU [Venk00, VeDa96]. Inversely, when individuals express low levels of CSE, studies consistently show individuals report higher levels of computer anxiety [JoMa00, MaYJ98]. Second, EOU and computer anxiety were used as outcome variables in important CSE research. In an important extension of the technology acceptance model, Venkatesh [Venk00] found that CSE was a significant positive correlate of EOU. Also, in their seminal CSE research, Compeau and Higgins [CoHH99, CoHi95a] found that computer anxiety and general computer self-efficacy were negative correlates. Because EOU and computer anxiety are well established constructs in CSE research, we believe they serve as useful outcome variables for research examining the nomological validity of dimensions of CSE. EOU is defined as "the degree to which the prospective user expects the target system to be free of effort" [DaBW89]. Venkatesh and Davis [VeDa96] found that general CSE was a significant positive correlate of EOU of IT. Since a belief that one can independently accomplish a computer task (individual CSE) will make a system seem simple to use, we believe that the individual CSE dimension will positively affect perceived EOU. In other words, when people have higher levels of individual CSE, they should report higher levels of EOU because they have confidence in their personal ability to use IT.

> **Hypothesis 2a.** The individual dimension of computer self-efficacy will have a significant, positive influence on perceived ease of use.

Human-assisted CSE reflects beliefs about the ability to use IT with external assistance. Although individuals may believe they can perform a task with assistance, they may not believe that a technology will be easy for them to use. Beliefs linked to ability should improve as the sources of successful performances are attributed to internal causes grounded within one's self (e.g., ability or effort) rather than external circumstances [Band77, Band88, GiSR89, HeST95, MaHZ96, SiMG95]. Because perceptions of EOU should be based primarily on beliefs in individuals' capabilities without receiving potential human assistance, we believe that the human-assisted dimension of CSE should not influence the perceived ease of use of IT. EOU perceptions tend to involve ease of use by the unaided person, indicating perceptions about how easy it is for the individual to use the technology without help. The EOU items match this definition of the concept.

> **Hypothesis 2b.** The human-assisted dimension of computer self-efficacy will not significantly affect perceived ease of use.

Computer anxiety reflects negative emotional arousal linked to actual or potential computer use [IgPH89]. Computer anxiety stems from irrational fears about the implications of computer use such as the loss of important data or fear of making other mistakes [Siev88]. Compeau et al. [CoHH99] found that CSE was a significant negative correlate of computer anxiety. Given that computer anxiety reflects irrational fears about IT use, it is reasonable to expect that it will be influenced by individual beliefs about using IT alone or with human assistance. Either type of CSE should influence computer anxiety. A high level of individual CSE should lower anxiety about using the computer because it implies one has personal control over the computer. Human-assisted CSE should lower anxiety because one would feel more assured (and thus less anxious) knowing that help is available. As a result, we expect that the individual and human-assisted CSE dimensions will each demonstrate significant negative relationships with computer anxiety.

> **Hypothesis 3.** Individual and human-assisted computer self-efficacy will demonstrate significant negative relationships with computer anxiety.

Even if hypothesized relationships to EOU and computer anxiety are demonstrated, to be a useful extension of CSE research, the distinction between individual and human-assisted CSE must offer more explanatory power than the original, full CSE instrument. We believe it will. A broad, dual construct will tap both the individual and human-assisted aspects of CSE. Two separate CSE measures should provide more explanatory power than one conflicted measure.

> **Hypothesis 4.** The hypothesized dimensions of computer self-efficacy will explain more of the variance in perceived ease of use and computer anxiety than will the original measure of computer self-efficacy.

4 Method

Stinchcombe [Stin68] argued that two somewhat different tests of a theory provide stronger support for the theory than does one test. To determine the distinction between the two types of CSE, we propose that they must pass two tests. First, they must factor separately, and, second, they must predict at least one related consequent in distinct ways (see Hypotheses 2a, 2b). To add contextual variety, two studies were conducted to assess the dimensionality of the CSE measure and to test the nomological validity of the CSE dimensions. Study 1 focused on general CSE, while Study 2 examined specific CSE. We felt it possible that the model constructs would behave differently under these two conditions. If the proposed dimensions operate as hypothesized under both conditions, this would more strongly support the two-dimension CSE model because it is a more rigorous test.

Study 1 operationalized constructs in terms of general CSE, anxiety, and the perceived ease of use of computers. The sample consisted of undergraduate business students enrolled in a required introductory computing course in the College of Business at a large public university in the Southeastern United States. The male to female ratio was 58% to 42%. Surveys were distributed during the first week of the course. A list-wise deletion yielded 153 usable responses (72.8%). Study 2 operationalized the constructs in terms of task-specific self-efficacy, anxiety and the perceived ease of use associated with Oracle Developer 2000. The sample consisted of senior-level MIS undergraduate students enrolled in an upper division systems analysis and design course in their major at the same university in the Southeastern United States. The male to female ratio was 69% to 31%. One hundred seventy-five surveys were distributed to students in a course that required using Oracle Developer 2000. The initial survey captured task-specific efficacy beliefs. At the conclusion of the Oracle module six weeks later, a second survey was administered that measured anxiety evoked by, and the ease of use of, Oracle Developer 2000. A list-wise deletion yielded 149 usable responses (74.5%). Across both studies, respondents completed questionnaires during regularly scheduled class times. Power analysis suggested that the sample sizes were more than sufficient to detect medium effect sizes based on the number of predictors used in the study [Gree91].

Measures were drawn from the information systems literature. CSE was measured using the ten-item scale developed by Compeau and Higgins [CoHi95b]. Computer anxiety was measured using four items developed by Heinssen, Glass, and Knight [HeGK87]. Four items were used to evaluate ease of use [Davi89]. Consistent with prior CSE research, we controlled for age, gender, and years of computer experience [MaYJ98] in the tests of Hypotheses 2 and 3.

5 Data Analysis and Results

We used Partial Least Squares (PLS), a structural equation modeling (SEM) technique, to assess the dimensionality and nomological validity of the CSE dimensions. This involved predicting EOU and CA with CSE (Hypotheses 2-4). PLS was used for two reasons. It does not require normality and allows researchers to estimate models using ordinal data derived from scales [Wold82]. When determining sample size, Barclay et al. [BaHT95] suggest a "rule of thumb" of ten times the most complex construct's number of indicators or the largest number of paths leading to a latent construct. With more than 140 cases per study, the datasets satisfy suggested guidelines for using PLS [BaHT95]. The model was then evaluated in two steps – measurement (to evaluate the measures' dimensionality) and structural (to examine nomological validity). When using PLS, internal composite reliability (ICR), the average variance extracted (AVE), and items' loadings and cross-loadings are used to evaluate the convergent and discriminant validity of the latent constructs in the research model. Composite reliability is calculated by squaring the sum of loadings, then dividing it by the sum of squared loadings, plus the sum of the error terms. Interpreted like a Cronbach's alpha, an internal composite reliability (ICR) of .70 is sufficient for research [FoLa81]. With the exception of the full CSE measure in Study 2 (ICR = .67), results presented in Tables 3a and 3b suggest that the measures displayed adequate convergent validity. The AVE measures the variance captured by the indictors relative to measurement error [FoLa81]. To demonstrate convergent validity, the AVE should be greater than .50 [BaHT95]. To evaluate discriminant validity, Fornell and Larcker [FoLa81] suggest that the square root of the AVE may be compared with the correlations among the latent variables. To be discriminant, the square root of a construct's AVE should be greater than its correlation with any other construct. Across studies, the AVE square roots presented in Table 2 suggest that the constructs demonstrated adequate discriminant validity. In each study, it is interesting to note that the three-item measures of individual and human-assisted CSE yielded higher AVE's than the 10-item general CSE measure. A second way to evaluate discriminant validity is to examine the factor loadings of each indicator [Chin88]. To be discriminant, each indicator should load higher on the construct of interest than on any other variable. Inspection of loadings and cross-loadings presented in Tables 3a and 3b suggests that the items load on the appropriate constructs. Inspection of the loadings and cross-loadings suggests that the individual and human-assisted CSE items were discriminant. Hence, card sorting and analysis of the measurement model support Hypothesis 1.

PLS results provided mixed empirical support for Hypotheses 2 through 4 (see Table 4). PLS structural model results may be interpreted like a regression analysis. Each R^2 indicates the amount of variance explained in the latent construct [BaHT95]. Path coefficients can be read like standardized betas resulting from ordinary least squares regression. To test the significance of path coefficients, a bootstrapping procedure was used to generate t-statistics [Chin98]. Hypothesis 2, which suggested that individual and human-assisted CSE should demonstrate distinct relationships to the ease of use of IT, was supported. However, analysis provided limited support for Hypotheses 3 and 4. Results will be discussed in more detail below.

Study 1- Full Self-Efficacy Model

	CSE	CA	EOU	Age	Exp	Gen
CSE	**0.75**					
CA	-0.41	**0.89**				
EOU	0.38	-0.35	**0.90**			
Age	-0.04	-0.01	-0.07	-		
Exp.	0.27	-0.27	0.17	0.04	-	
Gen.	0.14	-0.23	0.23	0.23	0.15	-

Study 1 - Dimensions Self-Efficacy Model

	HACSE	ICSE	CA	EOU	Age	Exp	Gen
HACSE	**0.89**						
ICSE	0.53	**0.85**					
CA	-0.38	-0.36	**0.89**				
EOU	0.25	0.42	-0.35	**0.90**			
Age	-0.03	-0.08	-0.01	-0.07	-		
Exp.	0.28	0.21	-0.27	0.17	0.04	-	
Gen.	0.05	0.18	-0.23	0.23	0.23	0.15	-

Study 2- Full Self-Efficacy Model

	CSE	CA	EOU	Age	Exp	Gen
CSE	**0.68**					
CA	-0.31	**0.82**				
EOU	0.27	-0.35	**0.90**			
Age	0.03	0.15	-0.02	-		
Exp.	0.02	0.03	-0.03	-0.16	-	
Gen.	-0.06	-0.07	-0.04	0.25	-0.14	-

Study 2 - Dimensions Self-Efficacy Model

	HACSE	ICSE	CA	EOU	Age	Exp	Gen
HACSE	**0.86**						
ICSE	0.38	**0.80**					
CA	-0.20	-0.38	**0.82**				
EOU	0.11	0.35	-0.35	**0.90**			
Age	0.08	-0.02	0.15	-0.02	-		
Exp.	0.03	-0.05	-0.03	-0.03	-0.16	-	
Gen.	-0.03	-0.06	-0.07	-0.04	0.25	-0.14	-

[a] The diagonal is the square root of the average variance extracted. To be discriminant, the diagonal item should be greater than corresponding off-diagonal elements.

Key: CSE = Computer Self-Efficacy, CA = Computer Anxiety, EOU = Perceived Ease of Use, Exp. = Experience, Gen = Gender, HACSE = Human-Assisted CSE, ICSE = Individual CSE

Table 2 - Correlation of Latent Constructs[a]

Study 1 - Full Self-Efficacy Model

ITEMS	CSE	CA	EOU	Gen	Exp	Age
CSE1	**0.69**	-0.29	0.33	0.12	0.15	-0.10
CSE2	**0.71**	-0.38	0.36	0.15	0.17	-0.08
CSE3	**0.75**	-0.27	0.39	0.19	0.22	-0.02
CSE4	**0.82**	-0.29	0.33	0.19	0.18	0.05
CSE5	**0.80**	-0.34	0.23	0.05	0.23	-0.03
CSE6	**0.77**	-0.30	0.24	0.06	0.29	-0.02
CSE7	**0.77**	-0.29	0.19	0.06	0.20	0.03
CSE8	**0.76**	-0.28	0.31	0.06	0.21	-0.06
CSE9	**0.72**	-0.36	0.18	0.01	0.21	-0.02
CSE10	**0.71**	-0.21	0.17	0.14	0.19	-0.04
CA1	-0.34	**0.89**	-0.39	-0.25	-0.21	0.04
CA2	-0.36	**0.90**	-0.29	-0.17	-0.26	0.02
CA3	-0.36	**0.89**	-0.25	-0.20	-0.25	-0.08
CA4	-0.32	**0.88**	-0.27	-0.22	-0.23	-0.05
EOU1	0.35	-0.33	**0.92**	0.19	0.11	-0.02
EOU2	0.29	-0.29	**0.89**	0.24	0.18	-0.12
EOU3	0.35	-0.32	**0.90**	0.18	0.18	-0.05
EOU4	0.33	-0.30	**0.91**	0.22	0.15	-0.08
Gen	0.14	-0.23	0.23	**1.00**	0.15	0.23
Exp	0.27	-0.27	0.17	0.15	**1.00**	0.04
Age	-0.04	-0.01	-0.07	0.23	0.04	**1.00**
ICR	0.75	0.89	0.90	-	-	-

Study 1 - Dimensions Self-Efficacy Model

ITEMS	HACSE	ICSE	CA	EOU	Gen	Exp	Age
CSE5	**0.92**	0.53	-0.34	0.23	0.05	0.23	-0.03
CSE6	**0.84**	0.49	-0.30	0.24	0.06	0.29	-0.02
CSE9	**0.90**	0.38	-0.36	0.18	0.01	0.21	-0.02
CSE2	0.41	**0.87**	-0.38	0.36	0.15	0.17	-0.08
CSE3	0.52	**0.83**	-0.27	0.39	0.19	0.22	-0.02
CSE1	0.41	**0.87**	-0.29	0.33	0.12	0.15	-0.10
CA1	-0.30	-0.34	**0.89**	-0.39	-0.25	-0.21	0.04
CA2	-0.35	-0.32	**0.90**	-0.29	-0.17	-0.26	0.02
CA3	-0.35	-0.31	**0.89**	-0.25	-0.20	-0.25	-0.08
CA4	-0.34	-0.33	**0.88**	-0.32	-0.22	-0.24	0.03
EOU1	0.24	0.38	-0.33	**0.92**	0.19	0.11	-0.02
EOU2	0.16	0.37	-0.29	**0.89**	0.24	0.18	-0.12
EOU3	0.27	0.38	-0.32	**0.90**	0.18	0.18	-0.05
EOU4	0.19	0.36	-0.34	**0.91**	0.21	0.16	-0.08
Gen	0.04	0.18	-0.23	0.23	**1.00**	0.15	0.23
Exp	0.28	0.21	-0.27	0.17	0.15	**1.00**	0.04
Age	-0.03	-0.08	-0.01	-0.07	0.23	0.04	**1.00**
ICR	0.81	0.89	0.89	0.90	-	-	-

Table 3a - Loadings, Cross Loadings, and Reliabilities

Study 2 - Full Self-Efficacy Model							Study 2 - Dimensions Self-Efficacy Model							
ITEMS	CSE	CA	EOU	Gen	Exp	Age	ITEMS	HACSE	ICSE	CA	EOU	Gen	Exp	Age
CSE1	**0.50**	-0.33	0.41	-0.04	-0.06	-0.03	CSE5	**0.85**	0.35	-0.16	0.15	-0.07	-0.03	0.21
CSE2	**0.54**	-0.24	0.19	0.01	-0.10	0.06	CSE6	**0.87**	0.39	-0.22	0.06	-0.01	0.05	0.09
CSE3	**0.70**	-0.35	0.26	-0.11	0.03	-0.08	CSE9	**0.87**	0.24	-0.14	0.09	-0.01	0.06	-0.08
CSE4	**0.71**	-0.16	0.15	-0.07	-0.03	0.21	CSE2	0.22	**0.81**	-0.33	0.41	-0.04	-0.06	-0.03
CSE5	**0.79**	-0.22	0.06	-0.01	0.05	0.09	CSE3	0.27	**0.81**	-0.24	0.19	0.01	-0.10	0.06
CSE6	**0.74**	-0.14	0.09	-0.01	0.06	-0.08	CSE1	0.42	**0.79**	-0.35	0.26	-0.11	0.03	-0.08
CSE7	**0.67**	-0.11	0.08	0.02	0.07	0.13	CA1	-0.09	-0.35	**0.84**	-0.31	-0.03	0.01	0.15
CSE8	**0.73**	-0.19	0.16	-0.13	0.04	0.00	CA2	-0.17	-0.43	**0.90**	-0.37	-0.02	-0.04	0.17
CSE9	**0.64**	-0.21	0.35	-0.04	0.07	-0.09	CA3	-0.19	-0.23	**0.81**	-0.30	-0.20	-0.01	0.06
CSE10	**0.70**	-0.25	0.23	0.00	-0.03	-0.03	CA4	-0.22	-0.23	**0.73**	-0.17	0.03	-0.05	0.12
CA1	-0.22	**0.84**	-0.31	-0.03	0.01	0.15	EOU1	0.11	0.32	-0.21	**0.89**	-0.03	-0.06	-0.09
CA2	-0.32	**0.90**	-0.37	-0.02	-0.04	0.17	EOU2	0.09	0.28	-0.37	**0.89**	-0.04	-0.03	0.07
CA3	-0.23	**0.81**	-0.30	-0.20	-0.01	0.06	EOU3	0.11	0.33	-0.39	**0.92**	-0.05	-0.03	-0.07
CA4	-0.25	**0.73**	-0.17	0.03	-0.05	0.12	EOU4	0.10	0.35	-0.31	**0.91**	-0.04	0.00	0.03
EOU1	0.27	-0.21	**0.89**	-0.03	-0.06	-0.09	Gen	-0.03	-0.06	-0.07	-0.04	**1.00**	-0.14	0.25
EOU2	0.20	-0.37	**0.89**	-0.04	-0.03	0.07	Exp	0.03	-0.05	-0.02	-0.03	-0.14	**1.00**	-0.16
EOU3	0.25	-0.39	**0.92**	-0.05	-0.03	-0.07	Age	0.08	-0.02	0.15	-0.02	0.25	-0.16	**1.00**
EOU4	0.26	-0.31	**0.91**	-0.04	0.00	0.03								
Gen	-0.06	-0.07	-0.04	**1.00**	-0.14	0.25								
Exp	0.02	-0.02	-0.03	-0.14	**1.00**	-0.16								
Age	0.03	0.15	-0.02	0.25	-0.16	**1.00**								
ICR	0.67	0.82	0.90	-	-	-	ICR	0.86	0.80	0.82	0.90	-	-	-

Table 3b - Loadings, Cross Loadings, and Reliabilities

	Study 1. General Computer Self-Efficacy Dependent Variable				**Study 2. Specific Computer Self-Efficacy Dependent Variable**			
	Ease of Use		**Computer Anxiety**		**Ease of Use**		**Computer Anxiety**	
	Path	**T-Statistic**	**Path**	**T-Statistic**	**Path**	**T-Statistic**	**Path**	**T-Statistic**
Full CSE Model								
Age	-0.11	1.70*	0.02	0.16	0.02	0.25	0.19	2.34*
Gender	0.20	2.52**	-0.16	2.16*	-0.02	0.24	-0.14	1.52~
Computer Experience	0.06	0.61	-0.15	1.97*	-0.04	0.55	-0.02	0.21
Computer Self-Efficacy	0.33	5.63**	-0.34	3.93**	0.36	4.43**	-0.38	4.97**
	(R^2 = 0.19)		(R^2 = 0.22)		(R^2 = 0.13)		(R^2 = 0.18)	
Dimensions Model								
Age	-0.09	1.44~	0.02	0.11	0.00	0.00	0.18	2.17*
Gender	0.17	2.31*	-0.17	2.35*	-0.02	0.26	-0.14	1.71*
Computer Experience	0.07	0.80	-0.14	1.81*	-0.02	0.21	-0.03	0.38
Individual CSE	0.35	4.43**	-0.18	2.73**	0.39	4.33**	-0.37	4.16**
Human-Assisted CSE	0.03	0.32	-0.23	2.49*	0.00	0.36	-0.08	0.81
	(R^2 = 0.21)		(R^2 = 0.23)		(R^2 = 0.14)		(R^2 = 0.20)	

[a] Significance was calculated using a bootstrapping technique. For Study 1, 152 samples were generated. For Study 2, 148 samples were generated. ~ = p<.10, * = p<.05, **= p<.01

Table 4. PLS Results[a]

6 Discussion & Implications

This study suggests that CSE is a multi-faceted construct comprised of two dimensions with distinct attributional sources. In general, results supported the hypotheses. Across independent samples, operationalizations of CSE, and analytic techniques (i.e., card sorting and partial least squares analysis), supported the notion that the Compeau and Higgins' scale provided reliable, distinct measures of individual and human-assisted dimensions of CSE (H1). Even though the results of each study may be deemed anomalous, because it could be a function of the type of specificity of the questions asked, the results of the two studies taken together show a consistent pattern that one would not expect to see by chance. This eliminates the plausible alternative explanation of the study's findings that the results are an artifact of the type of CSE studied. Overall, our findings suggest that IT users may attribute their CSE to individual (i.e., internal) and human-assisted (i.e., external) sources.

Our findings support the notion that the individual CSE dimension correlates with general and specific beliefs about IT. PLS analysis supported Hypotheses 2a and 2b, which state individual CSE should exert a significant positive effect on EOU (Study 1: path = .35, $p \leq .01$, Study 2: path = .39, $p \leq .01$), whereas human-assisted CSE should not affect EOU (Study 1: path = 0.03, n.s., Study 2: path = 0.00, n.s.). This finding is consistent with the self-efficacy construct's foundations in social cognitive theory and attribution theory. These theories suggest that self-efficacy attributable to one's own skill set and/or knowledge base should lead to positive perceptions of ability in a specific context. According to Bandura [Band77], successful performances perceived as resulting from internal causes rather than the circumstance should enhance beliefs about future performance in specific situations such as the ease of use of IT. Additionally, studies in attribution theory [Heid58, Kell71, Mart95, Wein95] have shown that people who perceive themselves as sources of change in their lives should have more stable beliefs across situations [Kloo88, Wein85]. Hence, our findings underscore the importance of individual CSE for encouraging positive perceived ease of use of IT.

Even when organizations offer human support for using information technology, our findings suggest that users will experience anxiety when using a specific IT. Mixed support was found for Hypothesis 3, that states that both individual and human-assisted CSE should negatively affect computer anxiety. At a general level, Study 1 results suggest that both CSE dimensions negatively affect computer anxiety. Human-assisted CSE demonstrated a slightly stronger negative relationship with computer anxiety (path = -.23, $p \leq .01$) than individual CSE did (path

= -.18, $p \leq .01$). This finding implies that at a general level, computer anxiety can be offset by beliefs about one's own capabilities and by forms of human support, and the latter may be very applicable to assisting those experiencing computer anxiety across technologies or software packages. However, when considering specific CSE, Study 2 results suggest that anxiety associated with using a specific IT was diminished solely by individuals' internal judgments of capabilities (path = -0.37, $p \leq .01$); they were not influenced by their awareness of human support for using the software (path = -0.08, $p \leq .01$). Apparently, believing they could do the task with someone's help did not effectively mitigate respondents' anxiety about using Oracle Developer2000. Hence, this finding underscores the importance of building individuals' sense of competence for using software independently of human support. While this finding contradicts Hypothesis 3, it does indicate that for the task specific situation, individual CSE acts different from human-assisted CSE, supporting the overall thesis that these constructs are distinct. Although the individual and human assisted dimensions used fewer items, they offered comparable explanatory power to the full CSE instrument (H4). The CSE dimensions' scales explained only .02 more variance in EOU and computer anxiety than the full CSE instrument. However, because 3-item scales explained approximately the same amount of variance as the full 10-item CSE instrument, this finding suggests that the CSE dimensions' instruments may offer a more parsimonious set of CSE scales for future research.

This paper has implications for Information Systems researchers and practitioners. For research, this paper's findings respond to concerns about the validation of instruments used in Information Systems research [StKa97, ZmBo91]. Our findings clarify CSE's theoretical underpinnings and present parsimonious measures of individual and human-assisted CSE dimensions. Moreover, specifying the dimension(s) of CSE in which researchers are interested can only strengthen the internal, external, and nomological validity of future studies. By identifying reliable, parsimonious measures of CSE and related constructs, results within and across studies may be more effectively interpreted and compared. This is an interesting and difficult issue to comment on, however, since these concerns apply to CSE researchers as well as to the broader community of self-efficacy researchers [Band88]. Coming to a consensus about what CSE means conceptually and how to measure it consistently will take time, requiring practical considerations about the nature of different information technologies, theoretical considerations about the construct's foundations, and communication and debate between CSE researchers.

For applied communities, this research directs attention to how firms evaluate IT training programs. CSE is a frequently used measure of IT training programs' effectiveness. If programs seek to raise participants' overall level of IT competence, trainers should evaluate trainees' general self-efficacy. However, if trainers seek to encourage independent use of IT, our findings suggest trainers should evaluate training programs based on internal (individual) CSE attributions. To build internal efficacy attributions, education research suggests programs emphasize providing positive feedback on prior performance and ability [Schu83, Schu82]. However, because this study does not link training or CSE to performance with IT, additional research is needed which ties specific forms of training and feedback to CSE's dimensions and to outcomes such as IT use in organizations.

7 Conclusion

This present study underscores CSE's multidimensional nature and the associated difficulties with operationalizing its meaning. Rather than a critique of prior research, this study should be interpreted as clarifying CSE's conceptualization and measurement and providing evidence of the usefulness of a refined version of a well-established CSE instrument.

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