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Computer Self-Efficacy

39.1 Introduction

Every year, both organizations and their employees invest a significant amount of resources in training and development programs, in the hope that these will have an important impact on employee growth and ultimately on organizational performance. Among the many skill sets, computer skills are the most frequent type of training provided by organizations (Yi and Davis, 2003). Rooted in Social Cognitive Theory (SCT) (Bandura, 1997), computer self-efficacy (CSE), generally defined as a “judgment of one’s capability to use a computer” (Compeau and Higgins, 1995b), has been repeatedly identified as a key outcome of training, mediating the effects of a number of influences on performance, such as training treatments, past experience and demographic variables (Marakas et al., 1998), or personality characteristics and other individual differences (Johnson, 2005), and affecting performance both directly and through its impacts on different motivational and affective mechanisms. Individuals displaying high levels of CSE are expected to be more focused and persistent, put more effort into their endeavors and be more committed to achieving their goals, be more able to cope with negative feedback, and be generally less anxious about completing the task (Marakas et al., 1998).

In addition, there is an important literature base, both in information systems and in other reference and related disciplines, bearing on the issue of self-efficacy modification and development. Among those examined, programs based on behavior modeling, i.e., observing someone perform a target behavior and then attempting to reenact it, have been shown to be particularly effective (Johnson and Marakas, 2000). Further, such research has become the focus of more detailed examinations into the processes by which learning is affected (Yi and Davis, 2003). Research has also focused on collaborative learning, either by itself or in combination with other approaches, such as behavior modeling (Davis and Yi, 2004; Keeler and Anson, 1995). Overall, this rich and growing stream of research has made CSE an attractive target for the implementation of treatments and interventions.
In general, it is then possible to build a theoretical chain of reasoning connecting computer training interventions with ultimate task performance. Indeed, researchers from both the academic and applied communities often use this presumed state of affairs as justification for the importance of furthering our understanding in this realm. For example, Compeau and Higgins (1995a) argued that user training was a widely recognized factor contributing to productive use of information systems in organizations. Yi and Im (2004) highlighted computer task performance as a major contributor to end-user productivity, while Yi and Davis (2003) remarked that effective computer training is a major contributor to organizational performance.

Given the ubiquitous nature of computers in the workplace, the home, and our daily lives, it may be tempting to assume that because we are immersed in using computers and their associated technologies, we all possess the appropriate level of CSE—that is to say, “we all have it.” As such, this temptation results in a declaration that while CSE was important 15–20 years ago, it is far less so today. It is our belief that as computers, and IT in general, become more and more pervasive, CSE stands to become more, and not less, important in the future. Both the academic and applied communities are far from being done with their focus on CSE. Both stand at a threshold where academic research can now begin to bring useful understanding to the goal of achieving a high computer literacy and skill set in the workplace and our society.

39.2 Underlying Principles

The primary foundation for the CSE construct is rooted in SCT (Bandura, 1997) and its major theoretical concepts and relationships. Given the very rich and complex nature of this framework, it is unlikely that this brief summary will do it justice. Thus, the reader is referred to the work of Bandura (1986a, 1997) himself for a full account. SCT and its central variable, self-efficacy, have proven to be an extremely popular basis for research in a number of distinct areas, such as academic and health behaviors, management and organizational psychology, leadership, training, negotiation, and career development, to name just a few. By one account, more than 10,000 investigations involving this theory have been conducted since it was first formulated more than 25 years ago (most notably, in 2004 alone, an average of 1.67 articles per day were published on self-efficacy) (Judge et al., 2007).

In contrast to unidirectional models of causality that attempt to explain human behavior as being controlled either by environmental influences or by internal dispositions, SCT explains functioning in terms of a triadic reciprocal causation between behavior, cognitive and other personal factors, and the external environment. This model of reciprocal determinism is depicted in Figure 39.1.

The model is argued to be deterministic in the sense of the production of effects by events, rather than suggesting that actions are completely determined by a prior sequence of causes independent of the individual and his or her actions. Given that behavior is jointly determined by a number of factors operating interactively, effects produced by particular events are considered to be probabilistic, rather than inevitable, in this conceptual system.

Another important aspect of Figure 39.1 is the postulated reciprocity between the environment, cognitive and personal factors, and behavior. While the underlying logic states that these three factors influence each other in a bidirectional relationship, it neither does assign equal strength to the different sources, nor does state that influences occur simultaneously. Rather, time is involved in the activation of causal factors, their influence on others, and the emergence of reciprocal influences. Given this bidirectionality, individuals are considered to be both the products and the producers of their environment (Wood and Bandura, 1989b).

Self-efficacy beliefs are thus concerned with an individual perception of capability to mobilize the motivational and cognitive resources and courses of action needed to exert control over events of personal relevance. This complements true skills and capabilities, in that it stimulates their use under difficult and stressing circumstances. Individuals with the same level of skill may then perform poorly, adequately, or extraordinarily depending on the effects their personal efficacy beliefs have on their motivation and problem-solving efforts (Wood and Bandura, 1989b). Thus defined, perceived self-efficacy is
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a generative capability in which a number of subskills involving cognitive, social, emotional, and behavioral aspects of functioning must be organized and orchestrated effectively to serve certain purposes.

39.2.1 Dimensions of Self-Efficacy Beliefs

All self-efficacy beliefs vary along three important dimensions (Bandura, 1997). First, they differ in **level**; efficacy beliefs of individuals may be limited to simple task demands, extend to moderately complex ones, or encompass the most taxing performance demands within a particular domain of functioning. Thus, efficacy beliefs are not decontextualized traits upon which situational demands operate. Rather, they represent the actual performance requirements for the context under consideration against which efficacy is judged.

Second, efficacy beliefs vary in **generality**. Individuals may judge themselves to be efficacious across a wide range of activities and domains or only within certain specific activities and domains of human functioning. This assessment of generality itself can vary along different dimensions, such as the degree of perceived similarity present in activities, the mode in which capabilities are expressed (e.g., cognitive, affective, behavioral), qualitative features of different situations, and also characteristics of individuals toward whom behaviors are directed.

Finally, self-efficacy beliefs also vary in **strength**; whereas weak beliefs are easily negated by discomfiting experiences, individuals possessing strong convictions will persevere in the face of obstacles and difficulties, and will not be easily overwhelmed by adversity. Strength of self-efficacy, however, is not linearly related to choice behavior, since it is postulated that a certain threshold level must be crossed in order to even attempt a certain course of action, and higher levels of self-efficacy would also result in the same behavior being attempted. Strength of efficacy beliefs manifests itself in the greater perseverance, and thus likelihood of success, in the chosen activity.

39.2.2 Primary Sources of Efficacy Beliefs

Following SCT, beliefs of personal efficacy are constructed from four main sources of information relevant for the formation of a judgment about capability for performing a task. Moreover, these sources

![Triadic reciprocal determinism](image-url)
are not exclusive of each other, and thus any given influence may operate through one or more of them. However, information that is available but neither processed nor integrated into cognitive thought is unlikely to have any effect on self-referent perceptions. In general, the processing of self-efficacy information depends on two separable functions. The first one relates to the types of information people attend to and use; each of the four sources of efficacy beliefs has a distinctive set of indicators and cues. The second function refers to the rules, processes and heuristics that people use to weight and integrate the different sources of information (Bandura, 1997).

The most influential source of information affecting efficacy beliefs is enactive mastery, e.g., repeated performance accomplishments. While positive mastery experiences serve to increase self-efficacy, negative ones are more likely to debilitate it. These experiences provide the most authentic evidence of whether an individual is able to orchestrate the capacities required to succeed in a particular endeavor. Enactive mastery has a stronger and more generalized effect on efficacy beliefs than any of the other three sources of information. Despite this strength, performance alone does not provide oneself with enough information to judge levels of capability, since many factors having little to do with the latter can have an important effect on performance. Thus, changes in self-efficacy result from cognitive processing of diagnostic information that past performances convey about the capability to effect them rather than the mere act of carrying out an activity. The extent to which performance experiences alter beliefs of self-efficacy also depends on a host of factors such as preconceptions of capability, perceptions of task difficulty, the amount of external aid received, the circumstances of the performance, the temporal pattern of failures and successes, and the process by which these experiences are organized and reconstructed in memory (Bandura, 1997).

Second, people not only do rely on past experience as the only source of information about their performance capabilities, but also are influenced by vicarious experiences obtained from various modeled attainments. Models build beliefs of efficacy by conveying and exemplifying effective strategies to manage a variety of situations. Social comparison processes, such as watching a similar person perform the same or similar task under consideration, also play a role in the effects modeling obtains on self-efficacy, given that human beings partially judge their capabilities in comparison with others. Given that, for most activities, there are no objective measures of adequacy, referential comparisons become very salient. In some cases, performance or social standards are available such that individuals may judge where they stand in comparison with some expected outcome. In others, people seek to compare themselves with similar others, such as coworkers, classmates, competitors, etc., to inform their efficacy beliefs.

Wood and Bandura (1989b) commented extensively on different mechanisms governing modeling processes and on their primary importance for the development of competencies through targeted training interventions. Indeed, a significant portion of research involving self-efficacy, and CSE in particular, as reviewed later, has been conducted in the context of training programs. In reference specifically to vicarious experience, four different processes govern this source of efficacy belief formation.

First, attentional processes play an important role in determining what people selectively observe in the large variety of modeling influences available to them and what information is extracted from those that are observed. The logic is that people cannot be influenced by observed performances if those cannot be remembered. Next, representational processes involve the transformation and restructuring of remembered information about events into the form of rules and conceptions. Retention of this information is greatly improved when individuals symbolically transform the modeled information into mental codes and then rehearse the coded information. During the third component of behavior modeling, behavioral production processes, those symbolic conceptions are now translated into appropriate courses of action, through a matching process in which guided patterns of behavior are enacted and the adequacy of these actions are contrasted against the conceptual model, leading to an iterative process by which individuals adjust their behavior in order to achieve correspondence between actions and conceptions. Finally, motivational processes involve three major types of incentive motivators. Individuals are more likely to enact modeled strategies
that produce valued outcomes and set aside those with unrewarding or punishing effects. People are also motivated by the success of similar others, but are discouraged from pursuing behaviors that have been known to result in negative consequences. Personal, self-produced standards provide yet another source of performance motivation.

Verbal persuasion represents the third important source of information involved in the development of efficacy belief, but lags behind enactive mastery and vicarious experiences with regard to the strength by which it is able to do so. While verbal persuasion alone may have a limited effect in creating enduring efficacy beliefs, faith in one's capabilities as expressed by significant others, particularly during times of doubt or despair, can have a substantial effect with respect to the mobilization and maintenance of effort. Persuasion has its greater impact on those individuals that, for whatever reason, already believe they can produce certain effects through their actions. The raising of efficacy beliefs to unrealistic levels, however, is likely to result in a failure that would not only undermine future conceptions of self-efficacy, but also discredit the source of information. The degree of appraisal disparity, i.e., how different one's own beliefs are from what people are told, is an important contingency on the effects of social persuasion. While social appraisals that differ markedly from judgments of current capability may be considered believable in the long run, they are unlikely to be acted upon on the short term. Persuasive appraisals are more likely to be believed when they are only moderately beyond what individuals can do at the time.

Lastly, people rely on the information provided by physiological and emotional states in assessing their capabilities. They read their emotional arousal and tension as signs of vulnerability to poor performance. Even before CSE had become the subject of focused research, computer anxiety (Heinssen et al., 1987) had already attracted the interest of the information systems community. Because high arousal can debilitate performance, people are more inclined to expect success when they are not undermined by aversive arousal. Treatments that reduce emotional reactions to subjective threats through mastery experiences can help increase beliefs in coping efficacy and correspondingly improvements in performance. Thus, the fourth major way of altering efficacy beliefs is to enhance physical status, reduce stress levels and negative emotional influences, or alter dysfunctional interpretations of bodily states.

39.2.3 Cognitive Processes

Efficacy beliefs affect thought patterns that can either enhance or undermine performance, and these influences take various forms. People with a high sense of efficacy tend to take a future time perspective in structuring their lives, and since most courses of action take initial shape in thought, these cognitive constructions then serve as guides for future actions. Strong efficacy beliefs also affect perceptions of situations as presenting realizable opportunities.

Those who judge themselves inefficacious, on the other hand, construe uncertain situations as risky and visualize scenarios involving failure. Perceived self-efficacy, and this process of cognitive simulation, also affects each other bidirectionally, positive cognitive constructions in turn strengthening efficacy beliefs. A major function of thought is to enable people to both predict the likely outcomes of different courses of action and create the means to exert some degree of control over those (Bandura, 1997).

People draw on their existing knowledge in order to construct and weigh options, integrate predictive factors into rules, test and revise judgments against the results of actions, and also remember which factors were tested and how well those performed. A strong sense of efficacy exerts a powerful influence on self-regulatory cognitive processes and supports the ability to remain task oriented in the face of causal ambiguity, personal and situational demands, and judgment failures that can potentially have important repercussions for the individual. Results from a series of experiments provide strong support for the diverse set of influences that alter efficacy beliefs, and those in turn influence performance attainments through their effects on goals and efficiency of analytic thinking.
39.2.4 Motivational Processes

Bandura (1997) argued that most human motivation is cognitively generated, e.g., people motivate themselves and guide their actions through exercise of anticipation and forethought. Human beings form beliefs about what they can and cannot do, anticipate the likely positive or negative consequences of different courses of action, and then set goals and make plans to realize valued outcomes and avoid the unpleasant ones. It is possible to distinguish three different bodies of theory on motivational processes, built around causal attributions, outcome expectancies, and cognized goals. Efficacy beliefs play a central role in all of them.

Retrospective judgments of the causes of past performances are postulated to have a motivational effect according to attribution theory. Individuals who attribute past successes to personal capability and failure to insufficient effort will undertake more difficult tasks and persist longer in the face of negative feedback, since they perceive outcomes as being a function of how much effort is spent in pursuing them. In contrast, those who ascribe failures to situational determinants will display reduced interest and abandon courses of action in the face of difficulties. Results from extensive research indicate that causal attributions can indeed influence future performance, but that the effect is fully mediated by their influences on beliefs of self-efficacy. For instance, attributions of past success to one’s ability heighten beliefs of personal efficacy, which in turn influence future attainments.

SCT, however, presents a more comprehensive picture of the mechanisms by which past performance influences self-efficacy than does attribution theory, which is generally limited to considerations of effort, ability, task difficulty, and chance. People also consider the situation under which they performed, the amount of assistance received, and the rate and pattern of past successes as valuable information that is integrated into judgments of capability. In addition, efficacy beliefs can also bias causal attributions. Thus, efficacious individuals are more likely to attribute failures to insufficient effort or environmental impediments, whereas those with a low sense of efficacy attribute them as arising from a lack of ability. Performance feedback that is inconsistent with perceived self-efficacy is dismissed as less accurate and more likely to be attributed to extraneous factors.

Individuals also motivate themselves by considering the outcomes they expect to accrue from following a given course of behavior. Expectancy-value theory essentially predicts that motivation to perform an activity is the result of expecting that doing so would secure specific outcomes and that those outcomes are highly valued by the person considering the performance. Bandura (1997) notes, however, that people are less systematic in their consideration of potential courses of action and in their appraisal of likely outcomes than expectancy-value models would suggest and argues that individuals act on their beliefs about what they can do as well as on their beliefs about the likely effects of their actions. A diminished sense of efficacy can then eliminate the potential allure of certain outcomes if individuals believe that they cannot successfully perform the actions that would lead to them. In activities where outcomes depend on the quality of the performance, efficacy beliefs thus determine which outcomes will be foreseen, and expected outcomes contribute little to future performance when efficacy beliefs are statistically controlled for in research models.

Lastly, behavior is also motivated and directed by goals that result from forethought and self-regulatory mechanisms. Cognitive motivation, based on the pursuit of goals or standards, is further mediated by different types of self-influences—affective reactions to performance. Such self-influences include anticipated satisfaction from fulfilling valued standards or self-dissatisfaction with poor performance, perceived self-efficacy for goal attainment (which influences which challenges to undertake), how much effort to spend in the endeavor and how long to persevere in the face of difficulties, and adjustment of standards in light of past attainments (which depend on the construal of the pattern and level of progress being made).

39.2.5 Affective Processes

Efficacy beliefs also play a pivotal role in the regulation of affective states, impacting the nature and intensity of emotional experiences through the exercise of personal control on thought, action,
and affect. In the first case, efficacy beliefs create attention biases and influence whether and how events are construed, represented, and retrieved in ways that are emotionally benign or perturbing. Also perceived cognitive abilities influence the control of negative trains of thought that intrude in the flow of consciousness and distract attention from the task and situation at hand. In the action-oriented mode of influence, efficacy beliefs support courses of action that transform the environment in ways that improve its emotional potential. The affective mode influences self-efficacy to negatively affect aversive emotional states once they have been aroused.

### 39.3 General versus Specific Computer Self-Efficacy

Consistent with the root theory, SCT, upon which the CSE construct is based, we recognize that CSE is a multilevel construct. CSE can be, and has been, operationalized at both the general computing behavior level and at the specific computer application level. Thus, GCSE refers to an individual’s judgment of computing capability across multiple computer application domains whereas CSE refers to an individual’s perception of efficacy in performing specific computer-related tasks within the domain of general computing. Research has shown that these two constructs are correlated but distinct (Johnson and Marakas, 2000).

Figure 39.2 presents a theoretical model describing the relationship between GCSE and CSE as well as how the two constructs uniquely affect both task-specific and overall computing performance. Each CSE perception is the major determinant of its associated task performance, and GCSE is the major predictor of general computer performance. Each computer user can have a different set of CSE perceptions related to multiple domain-related experiences that affect the formation of GCSE and can apply different weights to each of them in forming their GCSE perception.

The level of CSE formed at one time further influences the level of subsequent CSE perceptions. Thus, the model explains why two individuals can have the same level of GCSE when their CSEs are different in an application-specific computer domain. It also explains why two individuals can have different levels of GCSE while having similar levels of CSE at the task level. From this, we expect an increase in GCSE as an individual gains experience with different computer applications and computer-related tasks and experiences. We also expect an increasing initial level of CSE for future application-specific tasks over time. Furthermore, the model suggests that particularized measures of CSE will surpass general measures of GCSE in explanatory and predictive power for specific performance as suggested
by Bandura (1986a) and Gist (1987) but not for general computing performance. This implies that CSE is a more cost-effective and powerful mechanism to make an impact on user’s specific computer performance whereas GCSE is a less malleable but more enduring mechanism over time. This has significant implications for organizational training programs that use CSE formations to assist in performance enhancement within the computing domain.

From an academic perspective, it is important to note that out of the 59 IS papers that used self-efficacy published in the top 4 IS journals from 1985 to 2011, 40 articles chose to employ the GCSE construct while only 19 articles used the CSE construct. This suggests the original premise advanced by Marakas et al. (1998) regarding the need for specific task-related measures of CSE versus simply measuring GCSE has yet to be adopted by the IS research community at large. Additional research is needed to establish the true boundaries of GCSE perception formation such that a generalizable, and reliable, measure of the GCSE construct can be developed.

39.3.1 CSE and Task-Specific Self-Efficacy

Although Bandura (1997) convincingly argued that multiple types of self-efficacy are relevant to performance in any given domain, few studies have examined the joint effects of more than one type on performance (Tierney and Farmer, 2002). Complex organizational tasks generally involve the use of particular means in order to achieve the desired level of performance. However, a mismatch between self-efficacy and performance occurs when only judgments of capability for performing the prescribed means are involved as predictors of performance, since the latter depends also on the particular influence of the selected means and how they relate to task accomplishment (Stajkovic and Luthans, 1998). In particular, Bandura (1997) stated:

> When personal efficacy to perform the prescribed means is used as a predictor in the hypothesized causal model, one is testing not only the predictive power of efficacy beliefs but also the validity of the posited influence of the prescribed means on attainments in the causal model... When the means that produce certain behavioral attainments are only partially understood or have not been adequately verified, efficacy beliefs should be measured at two levels of specificity: efficacy to execute the prescribed means successfully and efficacy to achieve different levels of performance attainments by whatever means people choose to do so (p. 63).

It seems reasonable, given the earlier text, to consider the appropriate positioning of CSE, which is argued to represent the prescribed means of attainment (e.g., performing a certain task with the use of computer technologies), in relationship to task self-efficacy (TSE), which represents the more general level of specificity. In line with these arguments, Marakas et al. (2007) noted the need to develop complex models of performance that incorporate efficacy estimations of both domain and technical skills, involving the use of multiple instruments. However, there is essentially little existing research (with the singular exception of the work of Looney et al. 2006) that sheds light on the form of the relationship between domain and computing skills and its effects on task performance. In other words, when considering CSE as it relates to a computer-related task, we must not only consider a person’s perception of their ability to use a computer to perform the task, but we also simultaneously consider the person’s perception of their ability to perform the task. People do not simply use a computer—rather, they use a computer to do something specific. If a person is faced with using an Excel spreadsheet to construct a budget, we must consider their perceived ability to use Excel (CSE) simultaneous with their perceived ability to construct a budget (TSE).

Given this, it is argued that the more specific perception of self-efficacy, one that captures the use of technologies to perform the task, will be most closely related to performance. The next step, then, is to theorize how CSE is related to this intervening construct. Aguirre-Urreta (2008) positions CSE as moderating the effects of TSE on computer-specific task self-efficacy (CSTSE), “an individual’s perception of...
efficacy in performing a particular task with the support of computer technology” (pp. 84–85). While judgments of capability in both realms are jointly needed to influence CSTSE, TSE is positioned as the main driver of the relationship. Paralleling creativity self-efficacy research, it is argued here that, even in the presence of strong CSE, it would be difficult for an individual to feel efficacious in performing a task when devoid of perceived functional capacity (Tierney and Farmer, 2002). On the other hand, weak computer skills are likely to erode the positive effects that TSE brings to performance.

It is expected, then, that feelings of efficacy to perform a task with the support of technology would be stronger when feelings of adequacy for both functional and technology skills are present. Conversely, when both TSE and CSE are low, it is expected that CSTSE would be low too. As theorized by Aguirre-Urreta (2008), the depiction of TSE as the main driver and CSE as the moderating influence would lead one to expect that in situations where TSE is high and CSE is low, CSTSE would be higher than that in those occurrences when the opposite occurs. Finally, when multiple self-efficacies come into play in predicting performance, it is expected that the more specific and proximal type would account for the direct effects on the dependent variable (Bandura, 1997). This positioning of the CSE construct as a moderating variable is a significant departure from previous research, which commonly positioned the CSE construct as an independent or mediating variable.

39.4 CSE and Performance

Of the myriad of antecedent and consequent relationships that have been empirically employed using the CSE construct, there is extensive support for the relationship between CSE and computer performance, in different contexts and for a variety of software applications (Compeau and Higgins, 1995a; Johnson, 2005; Johnson and Marakas, 2000; Marakas et al., 2007; Yi and Davis, 2003; Yi and Im, 2004). Given the objective of these efforts on isolating the performance effects of this central construct, dependent measures have focused exclusively on syntactic- and feature-based uses of the different software packages involved, most notably productivity suites. As such, these outcomes represent knowledge situated in the first three levels of the hierarchy developed by Sein et al. (1998): syntax (actual language through which a user interacts with the application), semantic (meaning of those commands), and functional (e.g., grouping commands into a task such as creating a document).

On the broader level, decades of research involving the self-efficacy construct and work-related behaviors have generated a rich and extensive literature that would be impossible to review in any comprehensive manner but that is, nonetheless, applicable to the more narrowly focused CSE construct.* Empirical findings have demonstrated the relationship with work performance in a wide variety of settings, such as idea generation (Gist, 1989), newcomer adjustment (Saks, 1995), coping with career events (Stumpf et al., 1987), creativity in the workplace (Tierney and Farmer, 2002), skill acquisition (Mitchell et al., 1994), and even seasickness (Eden and Zuk, 1995), along with the ever-present research regarding computer-related behaviors (Compeau and Higgins, 1995a; Gist et al., 1989; Johnson, 2005; Johnson and Marakas, 2000; Marakas et al., 2007; Martocchio, 1994; Martocchio and Judge, 1997; Yi and Davis, 2003; Yi and Im, 2004).

Continuing with the focal area of interest, some of the early work on CSE was conducted by Hill et al. (1987) and by Gist et al. (1989). In the first case, the authors postulated that efficacy beliefs with respect to computers would be important determinants of the decision to use computers in the future and thus a possible avenue through which adoption could be fostered. In particular, they investigated

* The reader is referred to the large-scale meta-analysis conducted by Stajkovic and Luthans (1998). Reviewing in excess of 100 different studies, the authors examined both the general performance effects of self-efficacy and the significant within-group heterogeneity of individual correlations. Overall results from the meta-analysis, exclusive of moderator considerations, indicated a positive and significant correlation of self-efficacy and performance of 0.38 (p < 0.01). Further analyses indicated the presence of an interaction between moderators, such that average correlations between self-efficacy and performance were strongest for low-complexity tasks performed in laboratory settings (0.50, p < 0.01), and weakest, but always significant, for highly complex tasks assessed in field settings (0.20, p < 0.01).
the importance of efficacy beliefs over and above beliefs about the instrumental value of using computers. The underlying rationale for their Study 1 was that perceptions of controllability would have an important impact on whether individuals decided to use computers, separately from whether they believed their use implied any particular positive or negative consequences. It has been noted that, in this regard, self-efficacy beliefs may not be altogether different from perceived behavioral control, as incorporated into Ajzen’s Theory of Planned Behavior (see Ajzen, 2002; Terry and O’Leary, 1995). Their results showed that, for both men and women, behavioral intentions to use computers were significantly predicted by both instrumentality and efficacy beliefs, and that behavior, measured as enrollment in classes requiring the use of computers, was significantly predicted by behavioral intentions.

In a second study, Hill et al. (1987) predicted that the same relationships would hold, but after adding previous experience with computers as a covariate with both efficacy and instrumentality beliefs. In addition, the behavior of interest was expanded to incorporate the decision to use technological innovations in general. Using a different subject sample, their results confirmed those discussed earlier, even when controlling for previous experience, measured in terms of the number of times a computer had been used in the past, whether the participants had written a computer program, or used a packaged computer system.

Gist et al. (1989) studied the relative effectiveness of alternative training methods designed to foster self-efficacy and the relationship of these perceptions to performance on an objective measure of computer software mastery. The two chosen training approaches were modeling, where participants watched a video of a model illustrating specific steps needed to perform a task, and a tutorial setting, where participants in the study employed an individual training program that presented concepts similar to those shown in the modeling condition. The authors assessed CSE prior to training as a general variable that attempted to capture the confidence subjects brought to the training sessions, and software self-efficacy, post-treatment, as the focal variable of interest.

Results showed support for the hypotheses that trainees in the modeling condition would develop higher software self-efficacy than those in the tutorial condition and that participants initially low in CSE would report higher software self-efficacy in the modeling compared to tutorial training condition. While the relationship between software self-efficacy and performance was not examined, pretest computer efficacy was significantly related to training performance, thus providing additional support for the efficacy–performance relationship in a computer-related context. In addition, this study represents an early example of the separation between more specific and more general types of computer-efficacy perceptions.

Marakas et al. (1998) proposed a model of the relationship between CSE and performance, discussed previously, which included direct and indirect effects of the former on the latter, in some cases also involving moderated relationships.

Yi and Davis (2003) examined the relationship between self-efficacy and performance as part of their efforts to develop an improved training approach based on behavior modeling and observational learning processes such as attention, retention, production, and motivation. This new model was proposed in order to provide a more detailed account of the mechanisms by which modeling-based interventions enhanced training and thus provide a base for both the evaluation and the improvement of training techniques in the future. Software self-efficacy was measured prior to training, as part of the effort to control for pre-training individual differences, and after the training intervention as one of the main outcomes of the proposed approach, declarative knowledge being the other. Task performance was measured immediately after training and a second time with a 10 day delay in between. Results from PLS analysis show that pre-training self-efficacy is significantly related to the post-training construct. The latter had significant effects on both immediate and delayed task performance, even when declarative knowledge was also included in the analysis. This confirms the role of CSE as both one of the primary determinants of performance and one of the primary outcomes of training interventions.

Yi and Im (2004) studied the relationship between CSE, personal goals, and performance, using data from a software training program. Considering beliefs of efficacy and personal goals is important.
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because they provide two different, even if complementary, answers to the question of why some individuals perform better on tasks when they are similar in ability and knowledge to others that do not perform as well on the same tasks. Individuals that display higher levels of self-efficacy believe that they can do more with their capacities than others that possess less confidence in their capability to perform a task. On the other hand, participants that set more challenging and meaningful goals for themselves are more likely to exert additional effort in order to achieve increased performance than those that set less challenging objectives for themselves. In order to account for other pre-training differences, the authors also included prior experience and age as determinants of computer task performance. Results from their structural model showed no significant direct effect of CSE on performance, but did show a significant, if rather small, indirect effect through personal goals. Prior experience had a strong positive effect and age a negative one on performance. Overall, the model proposed by Yi and Im (2004) accounted for almost 40% of the variance in the dependent variable.

Also within a training context, Johnson (2005) proposed two mediators, in addition to a direct effect, of the relationship between application-specific self-efficacy and performance: goal level and goal commitment. These two mechanisms have been shown to be primary determinants of the motivation with which individuals approach tasks and improve performance. Individuals who set challenging goals for themselves exert greater effort and maintain it for longer, and perform better than those who set lower goals. Commitment to these goals, however, is required for them to have any motivational impact on performance; personally, meaningless objectives are unlikely to motivate greater effort expenditure.

Indeed, these motivational processes have been shown to be two of the primary channels by which cognitive appraisals of capability (e.g., efficacy beliefs) operate on behavior and ultimately performance in the series of studies by Bandura and colleagues (Bandura and Jourden, 1991; Bandura and Wood, 1989; Cervone et al., 1991; Wood and Bandura, 1989a). Results from Johnson (2005) confirm these previous findings. Application-specific CSE has significant impacts on performance both directly and through its positive effects on self-set goals and goal commitment, for a combined standardized path coefficient of 0.2933. In addition, it explains 13% and 14% of the variance, respectively, in the two mediating constructs.

Marakas et al. (2007), although specifying CSE as a formative composite, also examined its relationship to performance in the context of analyzing the differential predictive validity of measures developed at different points in the evolution of the computing domain. In order to accomplish this, the authors compared the spreadsheet measure used by Gist et al. (1989) and the one developed by Johnson and Marakas (2000). While both measures significantly predicted spreadsheet performance, the more recent essentially tripled the proportion of variance explained in the dependent variable (it is not clear whether the scale developed by Gist et al., 1989, was also specified as a formative composite).

39.5 CSE and Technology Adoption

In addition to performance, researchers also investigated the role of CSE as a distal predictor of technology adoption behavior and as an antecedent to perceived ease of use (EOU). Although Davis (1989) originally considered self-efficacy as part of the root formulation of perceived EOU, later research positioned CSE in its current role. Venkatesh and Davis (1996) conducted a three-experiment study to test, among other relationships, the hypotheses that GCSE would be a strong predictor of perceived EOU, both before and after hands-on experience with the focal systems. Results from this research revealed significant and large effects of CSE on perceived EOU, both for two different systems and before and after hands-on use. The authors theorized, and empirically supported, that objective usability of the application would only be a factor after participants in their studies had the opportunity to experience the systems by themselves, but that in either case, subjects would still anchor their general perception of EOU on their individual level of self-efficacy.

Building on these results, Venkatesh (2000) used an anchoring and adjustment framework to propose that in forming system-specific EOU, individuals anchor on key individual and situational variables
that relate to control, intrinsic motivation, and emotion. With increasing experience, individuals adjust their system-specific perceived EOU to reflect their interaction with the system. Understanding determinants of EOU, such as CSE and computer anxiety, become important from two standpoints: (1) the construct has a direct effect on intention to adopt and indirectly through perceived usefulness and (2) perceived EOU is argued to be an initial hurdle that users have to overcome for acceptance, adoption, and usage of a system. In the absence of direct hands-on experience with new systems, perceived EOU of systems is not distinct across different new systems, suggesting the existence of “common” set of determinants. In this light, CSE and computer anxiety are conceptualized as anchors of this perception. Through a multisite longitudinal (three measurement points) study, the author showed the consistent and strong effects of both constructs on perceived EOU, which did not significantly change as additional experience with the application was gained.

Agarwal et al. (2000) also examined the relationship between CSE and perceived EOU, but distinguished between general and specific levels of the former. In this research, both perceptions of efficacy and EOU were conceptualized at the level of particular applications: the general Windows environment and a spreadsheet package. In addition, a general measure of CSE, adapted from Compeau and Higgins (1995b), was used. The authors predicted that the specific self-efficacy measure would be a more proximal predictor of perceptions of EOU, given that it was a particularized judgment, as opposed to the more general feeling of confidence represented by the more general measure of computer efficacy. Their results show the specific efficacy measures having significant effects on their respective EOU judgments, and the more general measure having indirect and partially mediated direct effects on perceived EOU for Windows (through the specific Windows self-efficacy measure).

CSE was also included as part of the nomological network of the construct of cognitive absorption, developed and validated by Agarwal and Karahanna (2000). Cognitive absorption, defined by the authors as a “state of deep involvement with the software” (p. 673) was tested in relation to the two main technology acceptance beliefs, perceived usefulness and perceived EOU (Davis, 1989). The inclusion of CSE as an antecedent to these beliefs served to help establish the value of the new construct over and above already known influences. In addition to this purpose, beliefs of efficacy were found to have a significant and positive effect on perceived EOU, once more validating the important role CSE has on forming these perceptions and, by extension, in the overall process of technology adoption.

### 39.6 Impact on Practice

The study of both CSE and GCSE has had a significant impact on both the applied and academic communities. Given its known relationship to performance, the applied community has a powerful tool to effect improvements to computer-related task performance throughout its workforce.

The distinction between internal and external sources of efficacy was first formulated by Eden (2001) based on earlier work on Pygmalion-style leadership (Eden, 1988, 1990, 1992), conceptual distinctions between different sources of efficacy beliefs by Gist and Mitchell (1992), and earlier work on the subjective assessment of the adequacy of tools for job performance (Eden and Aviram, 1993). Though of relatively recent appearance in the management literature, there is a small but growing collection of empirical studies that provides support for the validity of its main propositions across a number of different contexts, such as psychology (Stirin et al., 2011), leadership (Walumbwa et al., 2008), training (Eden and Sulimani, 2002), and, most notably, the introduction of new information technologies to the workplace (Aguirre-Urreta, 2008; Eden et al., 2010).

The vast majority of research related to self-efficacy, however, has been conducted following the seminal work of Bandura (1986b, 1997) with its clear focus on self-efficacy as a subjective judgment of competence for performing specific actions or achieving specific goals. Indeed, Bandura (1997, p. 21) defines self-efficacy as “… a judgment of one’s ability to organize and execute given types of performances.” After more than 30 years of research in this area, there is overwhelming empirical evidence of the effects of self-efficacy on performance, in both the psychology and management literatures, which includes
experimental evidence in both laboratory studies and field experiments (Bandura and Jourden, 1991; Bandura and Wood, 1989), that support the causality of those relationships. There is also ample literature on the determinants of self-efficacy (Bandura, 1997; Gist, 1989; Gist and Mitchell, 1992).

### 39.7 Implications for Future Research into CSE and GCSE

As discussed in the opening comments of this chapter, it may be easy to conclude that the pervasive nature of computing technologies and their associated skills has rendered further investigation in CSE a moot issue. We wish to be clear that we believe nothing could be further from the truth. As computing technologies continue to become a part of our daily lives, any research that advances our understanding with regard to how we mere mortals interact and perceive such technologies must be regarded as relevant. To that end, continued research focusing on the CSE construct at all levels of analysis and all generalizable contexts should be encouraged and welcomed by both the academic and applied communities alike.

Despite the rich empirical literature, across a wide variety of disciplines, into the CSE construct, there exists a significant portion of our body of knowledge in this area yet to be determined and validated. Extant research has largely ignored the temporal development of self-efficacy beliefs and the possibility of different individual patterns underlying their growth. While this is a rather common limitation of this literature, which has largely focused on cross-sectional and between-individual studies, rather than considering intra-individual variation, a wide variety of specific areas of focus and specific research questions remain to be addressed and answered. Future research should study whether the development of the self-efficacy construct occurs at different rates for different individuals. Further, is there a ceiling effect with regard to either the development of CSE perceptions or their effects on performance-related constructs? Such research becomes important as we begin to place greater emphasis on the development of computer literacy at the elementary education levels. Is there an optimal starting point for such skill development as it relates to raising levels of CSE or GCSE? Can we manipulate CSE at early stages of chronological and cognitive development to mitigate the known gender bias observed in much of the CSE research? Can we use the temporal development of CSE in individuals to predict future performance in computer-related domains? The answers to such research questions would serve to inform for the applied and academic communities and would become instrumental in the design and development of more rigorous and complex training programs and mechanisms.

Along these same lines, research should focus on whether these individual temporal patterns of growth and development of CSE beliefs can be reduced to a limited number of archetypes and can be, therefore, identified based on observable features such that targeted development interventions can be derived. This line of research would be of value not only to the information systems domain, but also to the general literature on efficacy beliefs and human development, and falls in line with recent calls to reconsider the importance of individual units of analysis in psychology (Molenaar, 2004).

Another fruitful area of research that has remained largely unexplored is the determination of exactly what the relationship is between the task-specific CSE and the GCSE level. Marakas et al. (1998) theorized a relationship between the two levels similar to that depicted previously in Figure 39.2. Despite this conceptualization rapidly approaching two decades old (along with the popular application of the GCSE construct in numerous research efforts), no known empirical work has been conducted to validate this conceptualization—or any other, for that matter. It seems reasonable to conclude that the level of interest with regard to the use of the two levels of the construct can be advanced only by an empirical investigation into their true relationship to each other. Is GCSE simply a weighted average of the sum of CSE formations as suggested by Marakas et al. (1998) or is there a different mechanism in place? Do all CSE formations contribute to a formation of perception regarding GCSE or is there a point where no further significant change in GCSE levels is observed despite continued exposure to new opportunities to form CSE perceptions at the task-specific level?

More recently, work by Marakas et al. (2007) specified CSE using a formative, as opposed to reflective model. Up to this point, researchers using SCT, and even within the domain of computing, had always...
used the latter form to posit the relationships between latent and manifest variables. The authors argued for this new conceptualization of CSE by noting that indicators currently used to measure the construct did not necessarily follow any particular pattern of correlations, as required by the reflective mode of measurement. In particular, they proposed that a person answering positively to one item might not necessarily answer in a similar manner to a second one, e.g., “It is possible, even likely in many cases, a person responding to the instrument might be capable of installing software, but not capable of accurately describing how a computer works” (p. 21).

The road chosen by Marakas et al. (2007) follows a literature that has so far been mainly concerned with the issue of direction of causality between manifest and latent variables (Bollen and Lennox, 1991; Edwards and Bagozzi, 2000; Jarvis et al., 2003; Mackenzie et al., 2005). As argued by Diamantopoulos and Siguaw (2006), it is not clear why researchers seem to argue that, following a process of measurement construction, the same items should have been selected to comprise either formative or reflective specifications. Pushing the issue a little further, it is also not clear why Diamantopoulos and Siguaw (2006) believe that the issue boils down to selecting different items from the same pool, as opposed to creating separate pools of items altogether. In all this literature, however, there is a more fundamental question that has so far been left unanswered, and from which all other considerations follow directly, namely, why would a researcher choose a reflective or formative specification in the first place? Borsboom et al. (2003) propose that the answer depends on the ontological status of the latent variable being invoked in the research model. In addition, a number of other important issues arise from the choice of specification that extends beyond the mere direction of arrows in the graphical depiction of a causal model, such as the error-free nature of the manifest indicators. Recent research has also questioned the quantitative accuracy of studies implying that misspecification of formative specifications as reflective result in large estimation biases (Aguirre-Urreta and Marakas, 2012), and even others disagree with the choice of model specification by Marakas et al. (2007), as well (Hardin et al., 2008a,b). While the issue of model specification has implications that extend beyond the CSE construct, it has happened that this construct has become the subject matter on which many of these issues are discussed.

This area of focus, along with those previously identified, provides a rich and fertile opportunity for CSE research. Beyond the work conducted by Marakas et al. (2007), no specific focus on advancing our understanding of this debate has been identified. Future research should begin an organized effort to better understand the implications of specifying the construct as formative or reflective. Is it possible that each perspective provides a window into a better understanding of the construct or its direct implications to the applied community that the other does not? Can the two perspectives be reconciled such that the decision as to how to specify the construct lies with the convenience of the researcher? Does the level of analysis at which an investigation is conducted receive any benefit from one perspective over the other? The benefits derived from this area of future research will most assuredly extend beyond the CSE research community and, as such, potentially provide a much larger return, as measured by the breadth and depth of potential beneficiaries, than those discussed earlier. Regardless of the chosen area of focus, however, the need for continued and varietal research into the CSE construct appears to be both clear and unequivocal. Any thought of the sun setting on this stream of research is still far off in the distance, to be sure.

39.8 Summary

The CSE construct, and its related general level, has enjoyed, and continues to enjoy, a rich nomological net developed from a wide variety of disciplines and empirical studies. Further, it stands as one of the few academic foci that can be easily extended into the applied realm to effect material changes and value with regard to the continued development of computer-related skill sets.

Given its strong theoretical foundation, CSE represents a product developed within the academic realm, through the combined efforts of a wide variety of researchers, that has sustainable value in furthering our understanding of human behavior in a society where computing technologies are, and will continue to remain, pervasive.
References


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