A Meta-Analysis of Self-Regulated Learning in Work-Related Training and Educational Attainment: What We Know and Where We Need to Go

Traci Sitzmann
University of Colorado Denver

Katherine Ely
Fors Marsh Group

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Abstract

Researchers have been applying their knowledge of goal-oriented behavior to the self-regulated learning domain for more than 30 years. This review examines the current state of research on self-regulated learning and gaps in the field’s understanding of how adults regulate their learning of work-related knowledge and skills. Self-regulation theory was used as a conceptual lens for deriving a heuristic framework of 16 fundamental constructs that constitute self-regulated learning. Meta-analytic findings ($k = 430, N = 90,380$) support theoretical propositions that self-regulation constructs are interrelated—30% of the corrected correlations among constructs were .50 or greater. Goal level, persistence, effort, and self-efficacy were the self-regulation constructs with the strongest effects on learning. Together, these constructs accounted for 17% of the variance in learning, after controlling for cognitive ability and pretraining knowledge. However, four self-regulatory processes—planning, monitoring, help seeking, and emotion control—did not exhibit significant relationships with learning. Thus, a parsimonious framework of the self-regulated learning domain is presented that focuses on a subset of self-regulatory processes that have both limited overlap with other core processes and meaningful effects on learning. Research is needed to advance the field’s understanding of how adults regulate their learning in an increasingly complex and knowledge-centric work environment. Such investigations should capture the dynamic nature of self-regulated learning, address the role of self-regulation in informal learning, and investigate how trainees regulate their transfer of training.

**Keywords**: Self-regulation; Self-regulated learning; Training; Meta-analysis
Self-Regulated Learning

A Meta-Analysis of Self-Regulated Learning in Work-Related Training and Educational Attainment: What We Know and Where We Need to Go

Scholars have been examining goal-oriented behavior for more than 100 years in order to understand how people regulate their behavior across a breadth of situations (Austin & Vancouver, 1996). Self-regulation refers to processes that enable individuals to guide their goal-directed activities over time, including the modulation of affect, cognition, and behavior (Karoly, 1993). Self-regulation is designed to maximize the long-term best interest of an individual, resulting in people controlling their impulses and looking out for their well-being (Hayes, 1989; Kanfer & Karoly, 1972; Mischel, 1996; Muraven & Baumeister, 2000). This literature base can be used to understand how people exert control over an extensive range of behaviors from dieting to religious practices (McCullough & Willoughby, 2009; Muraven & Baumeister, 2000). Furthermore, self-regulation theory can be used to explain why both children and adults are willing to exert considerable mental effort to learn the alphabet, solve a math problem, or understand Newton’s law of motion. For adults, the ability to self-regulate may be their most essential asset (Porath & Bateman, 2006). Self-regulation enables people to function effectively in their personal lives as well as to acquire the knowledge and skills needed to succeed in higher education and the workforce. Researchers have been applying their understanding of goal-oriented behavior to self-regulated learning for the past 30 years, and the field of self-regulation has been instrumental in understanding how adults regulate their learning of work-related training.

Self-regulated learning refers to the modulation of affective, cognitive, and behavioral processes throughout a learning experience in order to reach a desired level of achievement. This definition encompasses the core features of most definitions of self-regulation (e.g., Boekaerts,
Maes, & Karoly, 2005; Karoly, 1993; Pintrich, 2000; Winne, 1995; Zimmerman, 1986): it reflects goal-oriented behavior and includes multiple processes operating in concert. However, this definition is distinct because it focuses on goal striving within a learning context. The self-regulation literature has played a substantial role in shaping our understanding of the processes through which trainees systematically adapt their actions during training in order to achieve their learning goals. However, after more than 30 years of research, it is time to step back and examine the state of self-regulated learning research and identify gaps in our collective understanding of how adults regulate their learning of work-related knowledge and skills.

Understanding the role of self-regulation in a learning context is increasingly important as the nature of training evolves. Over time, work has become progressively more complex and knowledge centric, requiring employees to adapt to changing job demands (Bell & Kozlowski, 2008). Furthermore, employees are often given control over which training courses they participate in and over the content, sequence, and pace of material in the training environment (Kraiger & Jerden, 2007; Maurer & Tarulli, 1994; Sitzmann, Kraiger, Stewart, & Wisher, 2006). Informal learning and peer production of training material (e.g., Youtube, Wikipedia) are also becoming more prevalent, increasing the requirement for employees to evaluate what they need to know and where they can obtain accurate information (Brown & Sitzmann, 2011). All of these changes are escalating the demands placed on employees and higher-education students to self-regulate their learning. As such, researchers need to stop and examine the current state of research on self-regulated learning and how this understanding needs to evolve to accommodate how learning occurs in the modern work and college environments.

The first objective of the current review was to develop a heuristic framework of the self-regulated learning domain. The lack of a comprehensive, yet manageable, list of self-regulation
constructs is one factor that hinders the field’s understanding of how adults regulate their learning activities (Vancouver & Day, 2005). Thus, we examined several of the most frequently cited and influential self-regulation theories in the training and education literatures in order to educate a heuristic framework of the self-regulated learning domain. Our second objective was to use the heuristic framework as a foundation for a meta-analysis examining the interrelationships among the self-regulation constructs and their effects on learning ($k = 430$, $N = 90,380$). The results from the meta-analysis capture the degree of measurement overlap in self-regulation constructs and provide insight as to which constructs have the strongest effects on learning. In addressing these two objectives, this paper provides an overview of the current state of research in the self-regulated learning domain and identifies gaps in the literature that preclude a comprehensive understanding of the domain. We conclude with an examination of how our understanding of self-regulated learning must be adapted to reflect the changing nature of knowledge and skill acquisition in the modern work environment.

*Theoretical Overview and Heuristic Framework of Self-Regulated Learning*

The self-regulated learning domain includes a range of theories that emerged from different disciplines. Some of the most influential theories have emerged from cybernetic engineering (control theory, Carver & Scheier, 1981), clinical psychology (self-efficacy theory, Bandura, 1977), industrial and organizational psychology (goal setting, Locke & Latham, 1990, 2002; action regulation, Frese & Zapf, 1994; Hacker, 1982; resource allocation, Kanfer & Ackerman, 1989) and educational psychology (Pintrich, 2000; Zimmerman, 1990). Despite their divergent backgrounds, the commonalities among these theories are vast, and together they provide a fairly comprehensive understanding of self-regulated learning.
One commonality across all of the theories is that goal setting triggers self-regulation. Locke and Latham (1984, 1990, 2002) are renowned in the goal setting literature for examining the mechanisms through which goals operate and moderators of the effects of goal setting on performance. Their meta-analytic results indicate a positive and linear relationship between goal level and performance with effect sizes (d-effects) ranging from .52 to .82 (Locke & Latham, 1990). Goals operate by directing attention toward goal-related activity, which leads to increases in both effort and persistence and stimulates the discovery and use of task-relevant knowledge and strategies (Locke & Latham, 2002). Research has shown that goal setting is more effective when the goal is specific, and when individuals are committed to reaching the goal, possess task knowledge, and receive feedback on their goal progress. Within a training context, performance goals can have a deleterious effect on the performance of complex tasks, while learning goals lead to higher levels of performance on such tasks (Seijts, & Latham, 2001; Winters & Latham, 1996).

Self-efficacy theory evolved from Bandura’s (1977) work in clinical psychology. The theory focuses on the cognitive processes involved in the acquisition and retention of new behaviors. When trainees judge their self-efficacy for novel tasks, they rely on their past performance in similar situations (Bandura, 1991, 1997; Wood & Bandura, 1989). Self-efficacy then exerts a strong, positive effect on performance through goal setting, effort, and persistence (Bandura, 1977, 1997). Trainees with high self-efficacy engage in positive discrepancy creation by setting goals that are higher than their previous performance levels, exerting more effort, and persisting in stressful situations. The relationship between self-efficacy and performance tends to be stronger when an individual has knowledge of the task to be performed, when measures of
self-efficacy are collected in close temporal proximity to performance measures, and when the self-efficacy items are task specific (Bandura, 1997).

Control theory is based on a machine model derived from cybernetic engineering (Carver & Scheier, 1981, 1990; Powers, 1978). According to control theory, one source of motivation is a negative feedback loop that eliminates goal-performance discrepancies (Powers, 1978). Once a goal is reached, individuals turn their attention toward other goal pursuits. During training, trainees rely on their self-efficacy to determine how much effort to exert to reach their goals (Ilies & Judge, 2005; Thomas & Mathieu, 1994). Higher levels of self-efficacy result in trainees devoting more resources toward their goal. Moreover, trainees’ rate of goal progress influences their affect (Carver & Scheier, 1990). Affect is positive when trainees’ self-evaluation indicates that their progress is quicker than expected and negative when their progress is slower than expected.1

Action regulation theory originated in Germany (Hacker, 1985) and was translated to English by Frese and Zapf (1994). The theory proposes that the psychology of work should be concerned with actions, which are defined as goal-oriented behaviors. The action process begins with developing a goal and deciding between competing goals. Individuals must then decide on their orientation (i.e., collect information relevant to competing goals and develop a prognosis of future events), generate plans, make decisions by selecting a plan from the range of available plans, execute the plan while monitoring progress, and review feedback on progress toward their goals. External feedback is necessary for learning to occur. Errors also play an essential role in action regulation theory because they are a critical component of feedback and influence the efficiency of action. When trainees are given the opportunity to make errors in training, it
stimulates metacognition as trainees reflect on the causes of their errors (Ivancic & Hesketh, 2000; Keith & Frese, 2005).

Kanfer and Ackerman’s (1989) resource allocation theory emerged from the industrial and organizational psychology literature. They proposed that attentional resources are an undifferentiated pool that must be allocated among competing task demands, such that trainees divide their attention between on-task activities, off-task activities, and self-regulation. Proximal and distal motivational processes are used to allocate resources among competing task demands. Distal motivational processes are antecedents to task engagement, referring to the choice of whether to pursue a goal and how much of one’s resources to devote toward goal attainment. Proximal motivational processes comprise self-regulatory activity; they determine the distribution of attention across on-task and off-activities during task engagement.

Additional theories of self-regulated learning have emerged from the educational psychology literature, including theories by Pintrich (2000) and Zimmerman (1990, 2000). These researchers proposed phase models of self-regulation that focus on a broad range of self-regulatory processes. In addition to goal setting, self-efficacy, and the other processes included in the aforementioned theories, these theories include learning strategies, time management, and environmental structuring as part of the repertoire of strategies that trainees employ to succeed in learning situations.

their efforts. Zimmerman (2000) acknowledges that learning conditions are constantly changing, necessitating continuous observation and monitoring of self-oriented feedback loops.

Pintrich (2000) developed a framework that proposes self-regulation occurs in four phases. Phase one involves planning, goal setting, and activation of knowledge and motivational factors relevant to the task. During phase two, trainees monitor various aspects of themselves, the task, and the context, which they subsequently control and regulate in phase three and react and reflect upon in phase four. During the four phases of self-regulation, trainees focus on four areas: cognition, motivation, behavior, and the context. Pintrich then provided a four-by-four grid for classifying all aspects of self-regulation based on the phase and the focus area (e.g., pretraining self-efficacy occurs during phase one and in the motivation focus area).

Taken together, these theories focus on a wide range of self-regulation constructs. By examining their commonalities, it is possible to derive a heuristic framework of the fundamental constructs that constitute self-regulated learning. Our review of self-regulation theories suggests that there are 16 core self-regulated learning constructs. Table 1 lists the self-regulated learning constructs as well as the theories that indicate the construct is included in the self-regulation domain. Each of the constructs can be classified as regulatory agents, regulatory mechanisms, or regulatory appraisals. Trainees’ goal levels serve as regulatory agents; they initiate self-regulated learning on a path toward achieving one’s objectives. Regulatory mechanisms are the processes trainees use to maximize progress toward their goals in an efficient and organized manner. Looking across self-regulation theories, we identified 12 core regulatory mechanisms: planning, monitoring, metacognition, attention, learning strategies, persistence, time management, environmental structuring, help seeking, motivation, emotion control, and effort. Regulatory appraisals are instrumental in evaluating trainees’ progress and determining whether trainees will
either begin or continue striving to make progress toward their goals. The three regulatory appraisals discussed in self-regulation theories are self-evaluation, attributions, and self-efficacy. In the following sections, we provide a broad theoretical overview of each of the regulatory agents, mechanisms, and appraisals and discuss whether the current state of the literature provides an avid understanding of the role of each construct in facilitating learning.

**Regulatory Agents**

Regulatory agents are instrumental for initiating self-regulated learning. Goals are regulatory agents and numerous experiments have examined their effects on training outcomes. Goals reflect the standard for successfully accomplishing a task and self-regulation theories agree that goals provide a criterion for monitoring, evaluating, and guiding self-regulatory activity (Bandura, 1977; Carver & Scheier, 2000; Kanfer & Ackerman, 1989; Locke & Latham, 2002; Pintrich, 2000; Zimmerman, 1986). Goals initiate action (Frese & Zapf, 1994). They direct trainees’ attention, increase effort and persistence, and lead to the use of relevant task strategies (Locke & Latham, 2002).

**Current state of research on regulatory agents.** There is an extensive knowledge base on the effects of goal setting (see Locke & Latham, 2002, for a review). However, in research on self-regulated learning, goals are often experimentally manipulated, as opposed to having trainees report the goals that they are pursuing. Research on goals tends to focus on the effects of qualitatively different goals and how goal content influences self-regulatory processes. For example, researchers have manipulated whether trainees pursue learning or performance goals (e.g., Barron & Harackiewicz, 2001; Kozlowski & Bell, 2006) and whether trainees strive for proximal or distal goals (e.g., Bandura & Schunk, 1981; Kozlowski & Bell, 2006; Kozlowski et al., 2001; Latham & Seijts, 1999). However, manipulating trainees’ goals in experimental
research does not provide insight into the relationships between goals and other self-regulatory processes. When goals are assessed, most self-report measures assess the performance goal level trainees are striving to achieve (Vancouver & Day, 2005). Thus, the construct included in this meta-analytic review is trainees’ self-set goal level for performance in the training environment. For example, Vancouver and Kendall (2006) asked trainees to report what grade they were aiming for on an upcoming test. Many studies have examined the effects of trainees’ self-set goal level on learning, but limited correlational research has examined how trainees’ self-set goal level is related to other self-regulated learning constructs.

*Regulatory Mechanisms*

Regulatory mechanisms are the crux of self-regulated learning because they are largely under the control of trainees and have an instrumental role in determining whether trainees make progress toward their goals in an efficient and organized manner. Furthermore, the majority of these constructs have been subjected to extensive empirical investigations.

*Planning.* When trainees engage in planning activities, they think through what they need to learn and set task-specific goals (Pintrich, 2000; Zimmerman, 2000). When facing a novel task, individuals create plans to determine which strategies they can use to reach their goals (Locke & Latham, 2002). Carver and Scheier (2000) acknowledge that people do not plan too far into the future (Anderson, 1990). Although individuals tend to have a general idea of how to reach their goals, they often only have a few specific steps planned out at a time and the plan evolves as trainees carry out the task (Frese & Zapf, 1994).

*Monitoring.* Monitoring refers to paying attention to one’s performance and understanding of the course material (Kanfer & Ackerman, 1989). Monitoring is a critical component of self-regulation because it provides awareness of one’s knowledge level, which
then leads to changes in one’s affect, cognition, and behavior (Pintrich, 2000). Accurate monitoring enhances the regulation of learning because it reveals what trainees already know and where they need to focus their resources (Dunlowski, Kubat-Silam, & Hertzog, 2003; Zimmerman, 2000).

**Metacognition.** As its name implies, metacognition is a meta-construct that subsumes various components of self-regulation. However, theories differ in the range of constructs that fall in the metacognition domain. Kanfer and Ackerman (1989) use the term extremely broadly, such that metacognition seems to include all aspects of self-regulation. Pintrich (2000) uses the term metacognition to refer to an implicit awareness of various aspects of the self, task, and context. Zimmerman (2000) proposes metacognition encompasses all aspects of cognitive self-regulation. Action regulation theory suggests that metacognition is an aspect of personality (Frese & Zapf, 1994).

**Attention.** Attention refers to the degree to which trainees are able to maintain their cognitive focus and concentrate during training (Zimmerman, 2000). According to resource allocation theory, trainees divide their cognitive resources between on-task, off-task, and self-regulatory activities (Kanfer & Ackerman, 1989). Proximal motivational processes determine the distribution of resources across on-task and off-task activities, and goals direct trainees’ attention toward on-task activities (Kanfer & Ackerman, 1989; Locke & Latham, 2002).

**Learning strategies.** A core cognitive control activity is the selection and use of learning strategies, including elaborating on the training material as well as integrating all of the components of the material with each other and with one’s existing knowledge (Elliot, McGregor, & Gable, 1999; Pintrich, 2000; Pintrich, Smith, Garcia, & McKeachie, 1991). Learning strategies are useful for breaking a task into smaller parts and reorganizing the parts
Self-Regulated Learning (Zimmerman, 2000). They assist trainees in building knowledge structures that are meaningful and coherent so that information can be stored in long-term memory (Winne, 1996; Zimmerman, 2000).

**Persistence.** Persistence enables trainees to devote effort to learning and concentrate on the training material, despite boredom or failure to make progress toward their goals (Elliott et al., 1999). Persistence is a function of trainees’ outcome expectancy for a given task (Carver & Scheier, 2000). Goal setting, self-efficacy, and feedback all have positive effects on persistence (Bandura, 1977; Frese & Zapf, 1994; Locke & Latham, 2002).

**Time management.** Time management involves making study schedules and allocating time for study activities (Pintrich, 2000). Trainees monitor their time and effort levels in order to meet task deadlines. Procrastination is the opposite of time management and involves voluntarily delaying an intended course of action, despite expecting to be worse off for the delay (Steel, 2007). Zimmerman (2000) suggests that procrastination is a defensive self-reaction. Trainees procrastinate in order to avoid future dissatisfaction, but procrastination undermines successful adaptation and limits personal growth (Garcia & Pintrich, 1994; Zimmerman, 2000).

**Environmental structuring.** Environmental structuring involves choosing a study location that is conducive to learning (i.e., quiet and free from distractions; Pintrich, 2000). Monitoring one’s learning environment for distractions and removing the distractions to create an environment that is advantageous for studying are critical components of self-regulated learning (Pintrich, 2000; Zimmerman, 1998). Environmental structuring is imperative in online training, as trainees tend to have control over where and when they review the training material (Lynch & Dembo, 2004). However, environmental structuring is only mentioned in two of the theories included in this review, the educational psychology theories of Pintrich and Zimmerman.
Help seeking. Help seeking refers to the degree to which trainees seek assistance when they have difficulty understanding concepts during training (Pintrich et al., 1991). Good students know when, why, and to whom they should turn when seeking help (Pintrich, 2000; Zimmerman & Martinez-Pons, 1986, 1988). Help seeking plays an essential role in both Pintrich’s and Zimmerman’s (1986) theories and has been included in research on action regulation theory (e.g., Brodbeck, Zapf, Prümper, & Frese, 1993).

Motivation. Motivation reflects trainees’ willingness to engage in learning and desire to learn the course content (Noe, 1986; Noe & Schmitt, 1986, Pintrich et al., 1993). Trainees’ beliefs about the incentives or value of learning have a direct effect on learning because trainees show little interest in activities that they do not value (Schunk & Ertmer, 2000). Specific, difficult, but attainable goals motivate performance as long as trainees are committed to achieving the goal (Locke & Latham, 2002).

Emotion control. Emotion control limits the intrusion of performance anxiety and other negative emotions during task performance (Kanfer et al., 1996). Trainees can engage in relaxation exercises, self-encouragement, and self-talk in order to regulate their emotional states (Kanfer et al., 1996; Pintrich, 2000). Emotion control facilitates performance by keeping off-task concerns from diverting attention away from the current task (Keith & Frese, 2005; Porath & Bateman, 2006).

Effort. Effort reflects the amount of time that trainees devote to learning (Fisher & Ford, 1998; Wilhite, 1990; Zimmerman & Risemberg, 1997). Trainees regulate the amount of effort that they devote to learning by monitoring their behavior and feedback on their performance (Pintrich, 2000). When trainees detect a negative goal-performance discrepancy, they adjust their concentration or effort to reduce the discrepancy (Carver & Scheier, 2000).
**Current state of research on regulatory mechanisms.** Extensive empirical research has examined the associations among multiple regulatory mechanisms (e.g., DiBattista & Gosse, 2006; Garcia, McCann, Turner, & Roska, 1998), their interrelationships with regulatory agents and appraisals (e.g., Orvis, Horn, & Belanich, 2008; Yeo & Neal, 2008), and their effects on learning (e.g., Nisbet, Tindall, & Arroyo, 2005; Quiñones, 1995). However, limited empirical research has focused on four regulatory mechanisms—planning, monitoring, environmental structuring, and emotion control—and these regulatory mechanisms have not been examined in concert with the full range of self-regulation constructs. Only five studies have examined the role of environmental structuring in self-regulated learning (Al-Ansari, 2005; Klomegah, 2007; Kumrow, 2007, who reported correlations from two samples; Pintrich, 1989; Plant, Ericsson, Hill, & Asberg, 2005). Emotion control scales (Keith & Frese, 2005; Warr & Downing, 2000) recently appeared in the literature, and only 11 studies have adopted these scales or developed other measures of emotion control in self-regulation research (e.g., Bourgeois, 2007; Warr, Allen, & Birdi, 1999).

Both planning and monitoring tend to be measured as part of metacognition scales (e.g., Ford, Smith, Weissbein, Gully, & Salas, 1998; Motivated Strategies for Learning Questionnaire—MSLQ, Pintrich et al., 1991), rather than as separate constructs. These metacognition scales assess a combination of planning and monitoring (as well as attention for the MSLQ) but do not include all aspects of self-regulation that are suggested by theory as belonging to the metacognition construct domain. Thus, there is a disconnect between theory and measurement that limits the field’s understanding of the role of metacognition in self-regulated learning.

**Regulatory Appraisals**
Regulatory appraisals are instrumental in assessing goal progress as well as determining whether trainees will either begin or continue striving to make progress toward their goals. A scarcity of empirical evidence exists regarding the role of two regulatory appraisal constructs—self-evaluation and attributions—in self-regulated learning, but extensive research has focused on the third regulatory appraisal: self-efficacy. It is also important to note that self-efficacy judgments can occur before trainees undertake a task as well as during or post task engagement, whereas self-evaluation and attributions typically occur during or post task engagement.

**Self-evaluation.** Self-evaluation refers to assessing goal progress by comparing one’s current level of knowledge or performance with the desired goal state (Kanfer & Ackerman, 1989). Self-evaluation has important implications for affective states. Unfavorable self-evaluations diminish trainees’ self-efficacy, motivation, and self-satisfaction unless the individuals believe that they can adapt their self-regulatory processes by using different strategies, seeking help, or restructuring their environment (Bandura, 1977; Kanfer & Kanfer, 2001; Schunk & Ertmer, 1999, 2000).

**Attributions.** People attempt to understand the causes of outcomes in achievement situations and attribute the outcome to several causal dimensions, including ability versus effort (Dweck, 1986). Trainees’ attribution analysis is one component that influences whether they continue to pursue their goals following self-evaluation (Carver & Scheier, 1982). Trainees react negatively and are unlikely to try and improve when errors are attributed to internal, stable factors, such as low ability (Zimmerman, 2000), but effective self-regulators tend to attribute failure to low effort and poor use of learning strategies (Pintrich, 2000; Zimmerman & Kitsantas, 1997).
**Self-efficacy.** Self-efficacy refers to trainees’ beliefs regarding their capability to succeed in training and perform training-related tasks (Bandura, 1997). Previous performance in similar situations is a powerful predictor of self-efficacy (Bandura, 1986; Carver & Scheier, 1990). Compared to less efficacious trainees, trainees with high self-efficacy set challenging goals, develop useful task strategies, persist, expend effort, and perform at a high level (Bandura, 1977; Carver & Scheier, 2000; Locke & Latham, 2002; Pintrich, 2000; Schunk & Ertmer, 2000; Thomas & Mathieu, 1994; Vancouver & Kendall, 2006; Zimmerman, 2000).

**Current state of research on regulatory appraisals.** Self-efficacy is one of the most extensively studied constructs in self-regulation research (Vancouver & Day, 2005) and is the only regulatory appraisal that has been examined in concert with the majority of self-regulation constructs. Attributions are included in the MSLQ (Pintrich et al., 1991). Thus, attributions have been studied in concert with other MSLQ scales (e.g., learning strategies and persistence), but have not been widely researched outside of educational psychology. As monitoring is an implied precursor to self-evaluation, it is difficult to tease apart trainees’ monitoring of their performance from their evaluation of their performance (Pintrich, Wolters, & Baxter, 2000). As such, we are unaware of any studies that have measured self-evaluation as an independent construct; therefore, self-evaluation could not be included in the meta-analysis. In the following section, we outline the objectives of the meta-analytic investigation.

**Meta-Analytic Objectives**

The first goal of the meta-analysis was to examine the interrelations among the self-regulation constructs. As highlighted by the heuristic framework, theory suggests that self-regulation is a broad domain and encompasses 16 fundamental constructs. Thus, one cannot fully understand the self-regulated learning domain without understanding their associations. Our
meta-analytic review examined the strength of the relations among self-regulation constructs and identified where there are gaps in research regarding how these constructs are related.

Second, we examined the effect of self-regulation on learning. Only 12 of the studies included in the review examined whether self-regulation during training predicted training transfer, which we are defining as the maintenance of trained skills after trainees leave the training environment (Bell & Roberson, 2006; Gardner, Moorcroft, & Metford, 1989; Gist, Stevens, & Bavetta, 1991; Myers, 1997; Nietfeld & Schraw, 2002; Poteet, 1996; Ramirez, 2000; Simmering, 1999; Smith, 1996; Towler & Dipboye, 2001; Warr & Bunce, 1995; Yi & Davis, 2003). Furthermore, these studies focused on different self-regulation constructs, such that only three constructs (i.e., metacognition, motivation, and self-efficacy) have been examined in concert with training transfer in more than two studies, attention has been examined in concert with training transfer in one study, and the remaining 12 constructs have never been examined in concert with training transfer. Thus, we focused our meta-analytic investigation on post-training assessments of learning but not transfer.

Third, one of the advantages of meta-analysis is it allows for a comparison of studies that differ in experimental rigor and other methodological factors (Lipsey, 2003). The current meta-analysis examined whether five moderators influenced the associations between self-regulatory processes and learning: study population (college students or employees), length of the training course, publication status (published or unpublished), research design (experimental or correlational), and year of the publication, dissertation, or presentation. This set of analyses permitted an examination of whether the relations between self-regulation constructs and learning generalize across courses that differ in length, reports that differ in the population sampled and experimental rigor, and recent versus older research reports.
Taken together, the heuristic framework and meta-analysis clarify the constructs that comprise the self-regulated learning domain, how these constructs are interrelated, their effects on learning, and gaps in the field’s understanding of the self-regulated learning domain. A meta-analysis of the self-regulated learning domain is also valuable for determining whether the theoretical definitions of constructs correspond with how these constructs are measured in the literature. Next, we review discrepancies between construct definitions and measurement followed by the meta-analytic methods and results.

One of the challenges in the self-regulated learning domain is developing reliable and valid measures that tap only the target construct. Several measures have been validated and employed in a breadth of studies for the majority of self-regulation constructs. However, some of the measures do not tap the full range of learning activities that theoretically fall in the construct domain, and a few of the scales include items that tap multiple self-regulation constructs. Our understanding of a domain is limited by the quality of the measures employed, so we begin the results section with a discussion of the construct validity of popular self-regulated learning measures, including criterion deficiency and contamination regarding some frequently used measures.

Theoretically, metacognition is an umbrella construct that subsumes multiple self-regulatory processes (Kanfer & Ackerman, 1989; Pintrich, 2000; Zimmerman, 1990). The metacognition scales of Ford et al. (1998) and Schmidt and Ford (2003) assess a combination of planning and monitoring, whereas Pintrich et al.’s (1991) scale also assesses attention. Thus, we expect to see strong intercorrelations with these constructs due to common item content.

Several measures of different constructs are also intricately related. Popular attention scales (e.g., Kanfer & Ackerman, 1989; Weinstein, Schulte, & Palmer, 1987) ask trainees
whether they focused their cognitive resources on the training material, whereas motivation scales (e.g., Noe & Schmitt, 1986; Pintrich et al., 1991; Yeo & Neal, 2004) assess trainees’ willingness to engage in learning and desire to learn the training material. Measures of persistence (e.g., Elliot et al., 1999; Pintrich et al., 1991; Warr & Downing, 2000) overlap substantially with these scales, except that they target trainees’ ability to concentrate and remain motivated specifically when they are bored or dissatisfied with the training material.

Expectancy (Vroom, 1964), motivation to learn (Noe, 1986; Noe & Schmitt, 1986), and task value (Pintrich & DeGroot, 1990; Pintrich, Smith, Garcia, & McKeachie, 1993) theories have all influenced the measurement and naming of motivation scales. However, a recent meta-analysis demonstrated that the various types of motivation—including task value and motivation to learn—have similar nomological networks (Bauer, Orvis, Ely, & Sitzmann, 2010). Thus, it is appropriate to average across these aspects of motivation when examining the role of motivation in self-regulated learning.

Emotion control is an important construct in Kanfer and Ackerman’s (1996) and Pintrich’s (2000) theoretical paradigms, but few measures have been developed to assess it. Keith and Frese (2005) developed an eight-item measure of emotion control, but several of the items tap attention (e.g., *When difficulties arose, I was able to focus all of my attention on the task*) and persistence (e.g., *When difficulties arose, I was able to motivate myself to continue*) when difficulties arose during training, as well as the degree to which trainees tried to combat feelings of anxiety and worry (e.g., *When difficulties arose, I did not allow myself to lose my composure*). This “contamination” may explain why two studies have found that Keith and Frese’s measure correlated .77 with attention (Sitzmann, Bauer, & Ely, 2008), .69 with a cognitive regulation scale, and .39 with an affective regulation scale (Frederiks & Yeo, 2009).
Thus, the scale may be capturing cognitive regulation to a greater extent than affective regulation.

Measures of learning strategies ask trainees if they used strategies such as elaboration and deep processing to help them learn the material (e.g., Pintrich et al., 1991). However, certain learning strategies may be more or less beneficial depending on situational factors, such as the nature of the training content and trainees’ preexisting knowledge of the course topic. Thus, the way in which learning strategies are measured does not account for the utility of different strategies across trainees and training contexts.

Finally, the four items in Pintrich et al.’s (1991) attribution scale assess both whether trainees’ believe that they can learn the course material—similar to self-efficacy scales—and the reasons why they are able to understand the material. A sample item is *If I try hard enough, then I will understand the course material.* Thus, the most popular attribution scale includes several double barreled questions that assess both trainees’ confidence in their ability and whether their success is determine by factors within or outside of their control.

In short, our review of self-regulation measurement suggests that there is evidence of criterion overlap in several of the most popular measures used to assess self-regulation constructs. Our collective understanding of the self-regulated learning domain is limited by the quality of the measures employed and the meta-analytic findings must be interpreted in light of these validity issues. However, a meta-analysis of the domain is needed for diagnosing measurement problems and providing the empirical support needed to identify where further validation research is warranted.

Method

*Literature Search and Meta-Analytic Sample*
Computer-based literature searches of PsycInfo, ERIC, ProQuest, and Digital Dissertations were used to locate studies in the training and education literatures. To be included in the initial review, abstracts had to contain terms relevant to self-regulation or one of the self-regulation constructs and training or education. Initial searches resulted in 26,767 possible studies. Next, we manually searched reference lists from meta-analyses in the training domain (e.g., Colquitt, LePine, & Noe, 2000; Payne, Youngcourt, & Beaubien, 2007; Sitzmann, Brown, Casper, Ely, & Zimmerman, 2008; Sitzmann, Ely, Brown, & Bauer, 2010). An extensive search for unpublished studies was also conducted. First, several conference programs (e.g., the Society for Industrial and Organizational Psychology) were manually searched. Second, practitioners and researchers with expertise in training were asked to provide leads on unpublished work. In all, we contacted 156 individuals.

Studies were included in the meta-analysis if (a) participants were non-disabled adults ages 18 or older, (b) training facilitated potentially job-relevant or education-relevant knowledge or skills (i.e., not coping with physical or mental health challenges), and (c) relevant between-subjects correlations were reported or could be calculated given the reported data. The first two criteria support generalization to adults participating in workplace training or college education. The vast majority of studies that were not included in the meta-analysis were eliminated for the following reasons: participants were children; self-regulatory processes were discussed in the manuscript, but were not measured; or the authors did not report correlations either among the self-regulatory processes or between self-regulation and learning.

The 369 research reports contributing data to the meta-analysis included 210 published studies, 135 dissertations, and 24 unpublished studies. These studies included 430 independent samples with data gathered from 90,380 trainees. Trainees were university students in 82% of
studies, employees in 16% of studies, and military personnel in 2% of studies. Across all studies providing demographic data, the average age of trainees was 23 years and 43% of participants were male.

**Coding and Interrater Agreement**

Table 2 presents definitions of the self-regulation constructs and examples of scales used to assess the constructs. All of the constructs in the heuristic framework were included in the meta-analysis, except for self-evaluation, for which correlational data were not available. Furthermore, learning was coded based on Kraiger, Ford, and Salas’ (1993) multidimensional framework and included assessments designed to measure if trainees remembered concepts presented in training or their ability to perform the skills taught in training. Learning was assessed post-training with a written test (e.g., Vancouver & Kendall, 2006) or through participation in a post-training performance-based activity, such as a simulation (e.g., Yeo & Neal, 2004). Finally, five moderators were coded: population (college students vs. employees), length of the course (hours spent in training), publication status (published vs. unpublished), research design (experimental or quasi-experimental vs. correlational), and year of the publication, dissertation, or presentation.

*Interrater agreement.* Two raters independently categorized the self-regulation measures, and recorded the moderators, correlations, sample sizes, and reliabilities for the self-regulation and learning measures. The absolute agreement across raters was 99% for categorizing the study measures and 97% for moderators. Coders then discussed discrepancies and reached a consensus.

**Meta-Analytic Methods**

The corrected mean and variance in validity coefficients across studies were calculated using formulas for a random-effects model from Hunter and Schmidt (2004). The mean and
variance of the correlations across studies were corrected for sampling error and unreliability in the predictor and criterion. Artifact distributions of the reliability coefficients were created for each construct based on formulas from Hunter and Schmidt. Reliabilities for self-regulation constructs and learning measures from all coded studies were included in the distributions. Range restriction estimates were unavailable so no attempt was made to correct for this bias.

Prior to finalizing the analyses, a search for outliers was conducted using a modified Huffcutt and Arthur (1995) sample-adjusted meta-analytic deviancy (SAMD) statistic with the variance of the mean correlation calculated according to the formula specified by Beal, Corey, and Dunlap (2002). Based on the results of these analyses and inspection of the studies, no studies warranted exclusion.

Some of the studies included in the meta-analysis reported correlations with multiple learning measures (e.g., Kozlowski & Bell, 2006). However, single studies contributing multiple correlations to a single analysis can result in biased sampling error estimates. Thus, when multiple learning measures were present in a sample, the Hunter and Schmidt (2004) formula was used to calculate a single estimate that took into account the correlations among the measures. Studies that included multiple independent samples were coded separately and treated as independent.

There are a variety of techniques for detecting moderators in meta-analytic research. Steel and Kammeyer-Mueller (2002) demonstrated that weighted least squares (WLS) regression provides the most accurate results. Thus, we used WLS regression to examine the joint effect of the moderators on the self-regulation-learning relationships. Correlations were weighted by the study sample sizes and categorical variables were dummy coded. Population was dummy coded such that college students (coded 1) were compared to employees (coded 0). Publication status
was dummy coded such that 0 indicates that the document was unpublished and 1 indicates that the document was published. Research design was dummy coded such that 0 indicates that the design was correlational and 1 indicates that the design was experimental or quasi-experimental.

**Meta-Analytic Results and Discussion**

*Relationships among the Self-Regulatory Processes*

Table 3 presents the corrected correlations among the self-regulatory processes. The corrected correlations ranged from -.30 to .83. One of the strongest correlations was between metacognition and learning strategies (\(\rho = .83, k = 39, N = 9,529\)). These two constructs also had similar patterns of association with other self-regulatory processes, and self-regulation theories suggest that they are distinct but intricately related constructs (Pintrich, 2000; Zimmerman, 2000). For example, Zimmerman (2000) proposed metacognition is a broad construct that encompasses all aspects of trainees’ cognitive self-regulation. Learning strategies are one aspect of cognitive self-regulation; they enhance learning by breaking a task down into its essential components and meaningfully reorganizing the parts. Pintrich’s (2000) theory proposes that metacognitive monitoring of one’s knowledge is closely related to the use of learning strategies for increasing one’s knowledge levels. Thus, learning strategies are theoretically one component of the multidimensional construct of metacognition (Butler & Winne, 1995; Nelson & Narens, 1990; Zimmerman, 1989, 1994). In empirical research, both metacognition and learning strategies are captured with self-report measures, and meta-analytic evidence suggests that trainees may not distinguish between these processes. Thus, researchers should be aware that there is unlikely to be incremental validity in measuring both metacognition and learning strategies. Similar results are likely regardless of whether a metacognition or learning strategies scale is employed.
The attention-time management meta-analytic corrected correlation was .78, based on data from 29 effect sizes and 10,143 trainees. However, these constructs exhibited different patterns of relations with other self-regulatory processes, suggesting that there may be some (albeit minimal) incremental validity in assessing both of these constructs in self-regulation research.

Six other correlations were .70 or greater (i.e., monitoring with persistence, planning with time management, monitoring with help seeking, metacognition with emotion control, persistence with time management, and motivation with emotion control), and 35 of the 116 (30%) correlations on Table 3 were .50 or greater. However, five of the correlations that were greater than .70 were based on a single study and one of the correlations was based on data from three studies. Basing a meta-analytic effect size on data from few studies is less likely to affect estimates of mean corrected correlations than to affect estimates of the variance of the correlations (Hunter & Schmidt, 1990). This pattern suggests that we can be confident that the effect sizes reported on Table 3 are close approximations of the actual population values.

It is interesting to note that all of the correlations that are .70 or greater are between pairs of regulatory mechanisms. It is likely that trainees are not able to mentally distinguish among all 12 regulatory mechanisms in the heuristic framework. Also, it may not be possible to engage in some of these self-regulatory processes without influencing other interrelated processes. For example, trainees who are managing their time during training should naturally focus their attention on the training material. Thus, there may only be limited incremental validity for measuring both time management and attention as well as other strongly related constructs in self-regulated learning research.
There was also evidence that some of the self-regulation constructs were only weakly related. Twenty-two (19%) of the correlations reported on Table 3 were less than .20. However, several of these correlations were based on a limited number of studies. When we focused exclusively on meta-analytic correlations calculated from a minimum of three effect sizes, 10 correlations among the constructs were less than .20 and the majority of the weak correlations occurred with help seeking, effort, and pretraining self-efficacy. Effort is the only construct in the heuristic framework that is often collected with objective rather than self-report measures. This construct was weakly related to 6 of the 16 other constructs in Table 3 and only strongly related to two constructs (i.e., goal level and time management). Relying on objective assessments of self-regulatory processes may reduce common method variance and, thus, the intercorrelations among the measures.

There was great variability in the sample sizes for the relationships between self-regulatory processes. Specifically, the corrected correlations among 25% (29 out of 116) of the constructs were based on data from 15 or more studies. Conversely, only 5 studies reported correlations with environmental structuring, 11 studies with emotion control, and self-evaluation could not be included in the meta-analysis due to the lack of correlational research on this construct. Moreover, 17% (20 out of 116) of the correlations on Table 3 could not be calculated due to missing data and 42% (49 out of 116) of the correlations were based on only one or two studies. Future research on self-regulation should examine these under-researched constructs to better understand the relationships among self-regulatory processes.

The absence of empirical research on the interrelationships among the full range of self-regulation constructs precluded an empirical test of the optimal conceptualization of the self-regulated learning domain. For example, some researchers have focused on understanding self-
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regulation by grouping the constructs into different regulatory pathways (e.g., affective, cognitive, and behavioral), whereas others have utilized phase models of self-regulation—grouping constructs together based on when they occur during goal pursuit (Diefendorff & Lord, 2008). Understanding the correct specification of domains with multiple dimensions is necessary for demonstrating construct validity and for making correct inferences from empirical tests (Edwards, 2001; Law, Wong, & Mobley, 1998; LePine, Piccolo, Jackson, Mathieu, & Saul, 2008). As such, researchers need to examine the pattern of correlations among all 16 self-regulation constructs to inform theory as to which conceptualization is a more accurate representation of the domain.

Predicting Learning

Table 4 presents the meta-analytic correlations between each of the self-regulatory processes and learning. Based on the heuristic framework, regulatory agents (i.e., goal level) had the largest effect on learning with a moderate to strong effect size. Both regulatory mechanisms and appraisals had effect sizes ranging from weak to moderate (.08 to .28 and .18 to .35, respectively).

The self-regulation constructs with the strongest corrected correlations with learning were goal level ($\rho = .44, k = 24, N = 3,565$), self-efficacy ($\rho = .35, k = 160, N = 25,798$), effort ($\rho = .28, k = 61, N = 8,569$), and persistence ($\rho = .27, k = 30, N = 6,979$). Each of the theories included in this review acknowledges the essential role of these four constructs in the self-regulated learning domain (the one exception is that self-efficacy is not mentioned as part of action regulation theory, Frese & Zapf, 1994). Goals initiate action (Frese & Zapf, 1994), whereas high self-efficacy leads to setting more difficult goals, developing useful task strategies, persisting, and expending effort to reach one’s goals (Bandura, 1977; Carver & Scheier, 2000;...
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Locke & Latham, 2002; Pintrich, 2000; Schunk & Ertmer, 2000; Thomas & Mathieu, 1994; Zimmerman, 2000). Learning requires considerable time; thus, trainees who exert substantial effort also learn more from training (Brown & Sitzmann, 2011). Finally, persistence enables trainees to continuously devote effort to learning and concentrate on the training material, despite boredom or dissatisfaction with their current performance (Kanfer, Ackerman, & Heggestad, 1996).

Meta-analytic true score regression analysis with maximum likelihood estimates was used to examine the joint effect of these four self-regulatory processes on learning. In this analysis, we controlled for cognitive ability—the strongest predictor of learning (Ree & Earles, 1991)—and pretraining knowledge in order to account for potential reciprocal effects between trainees’ knowledge levels and self-regulatory processes. Together, cognitive ability and pretraining knowledge accounted for 32% of the variance in post-training knowledge ($\beta = .24, .43$, respectively, $p < .05$). Goal level, persistence, effort, and self-efficacy accounted for an additional 17% of the variance in learning ($\beta = -.29, .37, .28, .07$, respectively, $p < .05$; total $R^2 = .49$; harmonic mean = 796). Thus, collectively the most influential regulatory agent, mechanism, and appraisal constructs captured 17% of the variance in learning, after controlling for cognitive ability and pretraining knowledge. This finding confirms that self-regulatory processes play an independent and instrumental role in the learning process. It is also worth noting that the effect of goals on learning was positive when examined in concert with cognitive ability, persistence, effort, and self-efficacy ($\beta = .17$). However, setting more challenging goals resulted in trainees learning less when pretraining knowledge was also included as covariate in the model. Trainees with high pretraining knowledge are likely to set more challenging goals but also have less room for improvement.
The self-regulation constructs with the weakest correlations with learning were help seeking (ρ = .08, k = 24, N = 4,827), emotion control (ρ = .08, k = 9, N = 13,051), and pretraining motivation (ρ = .10, k = 52, N = 18,402). In addition, 76% (13 out of 17) of the confidence intervals did not include zero, indicating that the corrected correlations are statistically significant. Planning, monitoring, help seeking, and emotion control had confidence intervals that included zero, suggesting that they are not significant predictors of learning, which is inconsistent with theories that support their role in self-regulation (e.g., Kanfer & Ackerman, 1989; Pintrich, 2000). For example, both Pintrich (2000) and Zimmerman (2000) propose that planning occurs along with goal setting during the forethought phase of self-regulation and influences subsequent self-regulatory activity and, thus, learning. However, there may be mediators of the effects of these self-regulatory processes on learning. For example, the quality of trainees’ plans and whether they follow through on their plans may partially explain any effects of planning on learning. Examining whether the effects of these nonsignificant self-regulatory processes (as well as other processes) on learning are indirect via the quality of self-regulatory activity is an essential avenue for future research.

**Moderator Results**

Next, we examined whether the relationships between self-regulatory processes and learning were influenced by five potential moderators: study population (college students or employees), length of the training course, publication status (published or unpublished), research design (experimental or correlational), and year of the publication, dissertation, or presentation. Together the five moderators accounted for between 4% and 49% of the variance in the relationships between self-regulatory processes and learning (see Table 5). However, the impact of four of the moderators—study population, length of course, research design, and year—were
minimal. The population and research design moderator results were never statistically significant. The length of course analysis was only significant for goal level, such that trainees’ goal level had a stronger effect on learning in shorter than longer courses ($\beta = .49, p < .05$). The year of publication moderator was significant only for self-efficacy: self-efficacy had a stronger effect on learning in recent than older publications ($\beta = .21, p < .05$). Thus, the effects of self-regulatory processes on learning tend to generalize across trainee populations, shorter and longer courses, experimental and correlational designs, and recent and older publications. In contrast, there was some evidence of publication bias in self-regulated learning research. Publication bias is often referred to as the “file drawer problem” and occurs when the probability that a study is published is dependent on the magnitude, direction, or significance of a study’s results (Begg, 1994). Three of the constructs—pretraining motivation, pretraining self-efficacy, and post-training self-efficacy—tended to have stronger relationships with learning in published than unpublished research ($\beta = .40, .47, .47$, respectively). Thus, there is some evidence that weaker results are less likely to be published than stronger results.

Meta-Analytic Conclusions

Self-regulation theories tend to be extremely broad and together seven of the most influential theories suggest there are 16 core constructs that account for the extent to which trainees learn from adult work-related training. Moreover, in examining which constructs were included in each theory, we found that the number of theories that discussed a given construct was significantly related to the strength of the self-regulation-learning relationship ($r = .48$). That is, the constructs included in more theories are also the ones that have stronger effects on learning. This provides initial evidence that by examining communalities across theories, a concise list of core self-regulation constructs might be derived.
Ideally, a heuristic framework of self-regulated learning should be comprehensive, parsimonious, and internally consistent (Austin & Vancouver, 1996). However, the meta-analytic results provide evidence that trainees may not mentally distinguish among all of the processes when regulating their learning activity, as suggested by the strong intercorrelations among the constructs. Thus, we propose a parsimonious framework, which focuses on nine self-regulatory processes (see Figure 1). To develop the framework, we started by identifying the constructs that had significant effects on learning. We then combined constructs if they met three criteria: strong intercorrelations with one another, similar patterns of correlations with the other self-regulation constructs and learning, and self-regulation theories suggest that the constructs are strongly related.

The outer ring of Figure 1 includes goal level and self-efficacy, which each have moderate to strong effects on learning and are not redundant with other self-regulatory processes. Effort is included in the center ring of the framework due to its moderate effect on learning. As noted earlier, metacognition measures routinely assess a combination of both planning and monitoring. Also, metacognition and learning strategies are strongly interrelated, have similar patterns of correlations with other constructs, and are linked theoretically (Pintrich, 2000; Zimmerman, 2000). Thus, we propose metacognition (and its narrower components of planning and monitoring) should be combined with learning strategies into a broader construct, which we label metacognitive strategies. Attention and time management are also strongly related and have similar relationships with learning, but their pattern of correlations with other self-regulatory processes differs so these constructs are included separately in the center ring of the framework. Although persistence is among the constructs with the strongest effects on learning, it also has strong correlations with nine self-regulatory processes—goal level, planning, monitoring,
Self-regulated learning involves metacognition, attention, learning strategies, time management, motivation, and self-efficacy. Persistence and metacognition have the greatest evidence of criterion overlap with the other self-regulatory processes, but persistence does not have a similar pattern of relationships with any other construct, suggesting that persistence should not be combined with other constructs. Thus, persistence is excluded from the parsimonious framework to reduce criterion overlap across constructs. Finally, the remaining constructs in the framework with weak to moderate effects on learning are environmental structuring, motivation, and attributions.

Two self-regulated learning constructs—help seeking and emotion control—had nonsignificant effects on learning and were therefore not included in the parsimonious framework of adult self-regulated learning. Help seeking may influence learning only if trainees are able to find the correct answers to their questions. Thus, future research on help seeking should examine the mechanisms that mediate and moderate the effect of seeking help on learning. Emotion control may only be beneficial in learning situations if trainees are able to control their emotions without pulling significant attentional resources away from task engagement while gaining control over their emotional responses. Finally, given the strong theoretical link between monitoring and self-evaluation and the weak effect of monitoring on learning, self-evaluation is not included in the framework.

This reduced list of nine self-regulatory processes allows for a more parsimonious explanation of how trainees regulate their learning activity. Furthermore, it may help to guide self-regulation research by providing a manageable list of the processes that explain meaningful components of the learning process. Future research should elucidate how trainees self-direct their learning activities outside training environments and how these core processes interact over time as adults strive to acquire work-related knowledge and skills.
Integrating Meta-Analytic Findings

Several previous training meta-analyses have examined predictors of learning. Comparing our results with the results of previous meta-analyses provides a comprehensive understanding of the predictors of learning and how self-regulation constructs compare to other predictors.

Colquitt and colleagues (2000) used meta-analytic techniques to test a model of motivation to learn. They found moderate relationships between pretraining self-efficacy and both declarative knowledge ($\rho = .30, k = 16, N = 2,806$) and skill acquisition ($\rho = .32, k = 20, N = 2,745$) and between motivation and both declarative knowledge ($\rho = .27, k = 11, N = 1,509$) and skill acquisition ($\rho = .16, k = 9, N = 1,615$). Although we found slightly weaker relationships ($\rho = .22, k = 86, N = 22,857$ for pretraining self-efficacy and $\rho = .18, k = 67, N = 11,612$ for motivation with learning), our results are based on data from about four times as many trainees, adding confidence in our results.

Compared to goal orientations and trainee reactions, the majority of self-regulation constructs are stronger predictors of learning. Payne et al. (2007) examined the effects of goal orientations on learning and found small meta-analytic relationships (mastery goal orientation, $\rho = .12, k = 43, N = 8,676$; performance-prove goal orientation, $\rho = -.01, k = 38, N = 7,598$; performance-avoid goal orientation, $\rho = -.13, k = 13, N = 2,856$). Thus, the relationships between the goal orientation dimensions and learning tend to be weaker than the relationships between self-regulatory processes and learning. However, Payne et al. noted that learning is a distal outcome of trainees’ goal orientations and suggested that the effects of goal orientations on learning are likely mediated by self-regulatory processes, such as goals, learning strategies, and self-efficacy. Sitzmann, Brown et al. (2008) found small meta-analytic relationships between
trainee reactions and both declarative ($\rho = .12, k = 78, N = 11,005$) and procedural ($\rho = .15, k = 43, N = 4,688$) knowledge. This pattern suggests that the majority of self-regulation constructs have stronger relationships than trainee reactions with learning. Together these findings indicate that self-regulation has a substantial role in predicting learning and may mediate the effects of trainees’ goal orientations on learning. Furthermore, self-regulatory processes collectively account for more variability in learning than the strongest independent predictor—cognitive ability (Ree & Earles, 1991).

In addition to previous training meta-analyses, a meta-analysis was conducted in the performance domain to examine the effect of regulatory agents. Specifically, Wood, Mento, and Locke (1987) found evidence of a moderate positive effect of goal level on performance ($d = .58, k = 72, N = 7,548$). Converting the $d$ to an $r$ to aid comparison with our findings yields a corrected correlation of .28. Although our study is not directly comparable to Wood et al. in that we examined the effect of self-set goal levels on learning (whereas they focused on the effect of assigned goal levels on performance), our results are generally consistent with these findings and support the benefits of goals in enhancing learning. Overall, the current findings and previous research point out the instrumental role of self-regulation in predicting learning and suggest that trainees who engage in self-regulatory activity tend to learn more than those who fail to self-regulate.

Goals are a central construct in all self-regulation theories (e.g., Locke & Latham, 2002; Pintrich, 2000; Zimmerman, 2000), yet a paucity of research has examined the interrelationships between trainees’ self-set goal levels and the majority of self-regulation constructs. In most self-regulation studies, trainees’ goals are implied (e.g., to learn the course material) rather than being explicitly measured. However, trainees may be striving for different goals. Some may be trying
to outperform other trainees, while others may be striving for an “A” in the course or want to improve their knowledge of the training material. As demonstrated by Payne and colleagues (2007), these goals have different relations with self-regulation constructs and learning. It is also likely that the interrelationships among self-regulation constructs differ based on the goals trainees are pursuing. Thus, future research should explicate the goals trainees are striving for by measuring trainees’ goals (including both the level that they are striving for and the content of their goals) and examine the relationships between goal level and content with self-regulatory processes.

Study Limitations

As with any research, there are limitations to the current study. First, although we identified 16 core constructs in the heuristic framework, gaps in existing primary research resulted in missing correlations among self-regulatory processes. This limitation can only be addressed when more primary studies are conducted that assess these understudied constructs and measure them in concert with other self-regulatory processes. Second, correlations between some of the self-regulation constructs are likely inflated by common method bias as many of the measures are self-reported and completed at the end of training. To reduce this bias in the future, researchers should examine which processes can be assessed with non-self-report measures. Third, based on self-regulation theory, self-regulation is a dynamic and cyclical process (Carver & Scheier, 2000; Kanfer & Ackerman, 1989; Pintrich, 2000; Zimmerman, 2000). However, our meta-analytic results cannot provide evidence of causal or reciprocal relationships. Longitudinal research is needed to further examine the relationships among the self-regulatory processes and how these relationships change over time. We return to this point in the next section.

Directions for Future Research
After reviewing theoretical models of self-regulation and conducting a meta-analysis of the self-regulated learning domain, we believe that the field is on the verge of a paradigm shift in the topics examined and methods used to collect data. Specifically, we believe that the future of self-regulation research involves examining the optimal timing of measurement and utilizing longitudinal designs to capture the dynamic nature of self-regulated learning. Our review also suggests that as organizational training shifts away from instructor-driven classroom learning, theory and research need to adapt to address the role of self-regulation in informal learning. Finally, we must begin to examine how self-regulation after trainees leave the training environment influences training transfer. The following sections review some of the questions that need to be answered in the next generation of self-regulation research.

*Dynamic nature of self-regulated learning.* The majority of research included in the current review assessed self-regulation constructs pre-, mid-, or post-training. However, research is needed to better understand the progression of self-regulation over time and to determine the right episodic unit of analysis in different learning situations. For example, in academic learning, where a typical undergraduate course might include two or three tests spread across the semester, self-regulatory processes are likely to look different across the semester. Gersick’s (1988) punctuated equilibrium model proposes groups undergo periods of stagnation punctuated by concentrated periods of activity. Self-regulation may also entail long periods of inactivity followed by spurts of intense activity. For example, college students may go several weeks without engaging in self-regulated learning only to fervently begin to regulate as a key milestone approaches—such as in the weeks (or days) before a test—and then return to a period of decreased regulation immediately following the test. In contrast, during organizational training, trainees may be motivated to continually regulate to ensure that they are learning the knowledge
and skills that are necessary for their jobs. These examples highlight the need for qualitative research to better understand how self-regulation plays out over time in different environments. Research in this area could provide insight as to when self-regulatory processes should be measured as well as the optimal timing for implementing training interventions designed to induce self-regulation. Furthermore, quantitative research needs to collect more data at the point in training when changes in self-regulatory processes are likely to occur, rather than equally spacing the waves of data (Singer & Willett, 2003).

Additionally, limited research has examined differences in the effects of self-regulatory processes at the within- and between-subjects levels of analysis. Theoretically, self-regulation is a cyclical process by which trainees establish training goals, develop metacognitive strategies, channel their attention toward learning, and subsequently modify their self-regulatory processes over time (Carver & Scheier, 2000; Kanfer & Ackerman, 1989; Pintrich, 2000; Zimmerman, 2000). Thus, it is a within-person process that evolves over time. Switching from the between to within-subjects level of analysis requires researchers to rethink self-regulated learning theory, adopt new research methodologies and analytic techniques, and contemplate how self-regulatory processes evolve over time and in the context of work and family demands that may compete for trainees time (Lord, Diefendorff, Schmidt, & Hall, 2010). Some progress has been made in this area. Sitzmann and Ely (2010) found trainees’ learning performance had a positive effect on self-regulatory activity in the subsequent module. Both Vancouver and Kendall (2006) and Yeo and Neal (2006) found self-efficacy was negatively related to performance at the within-subject level, but positively related to performance at the between-subjects level. Moreover, Vancouver and Kendall found a cyclical relationship between self-efficacy and test performance: past performance was a positive predictor of subsequent self-efficacy magnitude, but self-efficacy
was negatively related to future performance. Furthermore, Sitzmann and Johnson (2011) found a cyclical relationship between the amount of time that trainees planned to devote to studying, effort, and learning performance. Planned time on task had a positive effect on effort, which led to higher learning performance. However, performing well resulted in trainees planning to allocate less time to the subsequent module, relative to when they performed poorly on the learning assessment. Future research should continue in this direction, employing longitudinal designs to examine changes in self-regulatory processes as well as the dynamic interplay between learning and self-regulatory processes over time.

*Informal learning.* All of the studies in the meta-analysis focused on formal learning: that is, a planned and systematic effort to teach knowledge and skills. However, the majority of learning in the workplace is informal, via looking up information online, experimentation (i.e., trial and error), and discussions with colleagues (Brown & Sitzmann, 2011). It is likely that self-regulation has a stronger effect on learning in informal than formal settings. Although learning opportunities are explicitly defined in formal settings, in informal settings employees must engage in self-regulation to identify or create learning opportunities (Enos, Kehrhahn, & Bell, 2003). Additionally, the self-regulatory processes with the strongest effects on learning may differ across these contexts (Boekaerts & Minnaert, 1999). For example, trainees may receive less externally-generated feedback when engaged in informal than formal learning where feedback on exams and assignments is built into the curriculum. Thus, in informal learning environments, monitoring may be the sole source of feedback on trainees’ knowledge, suggesting that the accuracy of monitoring has an essential role in determining the effectiveness of informal learning. Moreover, in informal settings employees must independently identify knowledge gaps, determine where they can access relevant and accurate information, monitor the
accuracy of information obtained, and control their emotions if relevant information is difficult to obtain.

Given the prevalence of informal learning in the modern work environment, researchers should begin to examine the effect of self-regulation in this context. New measures need to be developed or existing measures adapted to capture the nuances of informal learning. For example, measures should capture the psychological process by which trainees self-assess their training needs and the types of planning activities that they engage in to locate accurate and relevant information. Research should also examine the effects of self-regulation failure in informal learning. What are the negative effects of trainees acquiring inaccurate information and applying them on the job? Additionally, are there environmental factors, such as strong mentor relationships, that may minimize the effect of self-regulated learning failure on job performance?

_Self-regulation of transfer._ Only 12 of the studies included in the review examined the effect of self-regulation during training on the maintenance of trained skills post-training. Furthermore, none of the studies examined the effect of self-regulation after trainees left the training environment on training transfer. This is a critical gap in our understanding of the self-regulation process because an implicit assumption underlying training is that learning will transfer to the work environment (Brown & Sitzmann, 2011). However, some researchers have offered dismal assessments of training transfer, specifically that only 10% of training transfers (e.g., Baldwin & Ford, 1988). Examining how trainees regulate their transfer of material from training to the job may explain essential variance in the transfer process.

Action regulation theory is the only self-regulation theory in our review that discusses training transfer (Frese & Zapf, 1994; Hacker, 1982). This theory focuses on job design and changing employees’ mentality during training in order to enhance training transfer. However,
we are not aware of any theories that address how engaging in self-regulation after returning to the job enhances training transfer. That is, what is the role of self-regulation after leaving the training environment in determining whether trainees transfer knowledge and skills learned in training to the job?

We propose that self-regulation of transfer after trainees return to the job is essential for ensuring meaningful change in work-related knowledge and skills. Self-regulation of transfer refers to striving to apply knowledge and skills learned in training to the job via control over affective, cognitive, and behavioral processes. Motivational outcomes of training may be key factors for initiating self-regulation of transfer. During training, motivation and self-efficacy are essential for initiating a wide range of self-regulatory activities (Pintrich, 2000; Zimmerman, 2000). This should also hold true for self-regulation of transfer: employees will not set transfer goals if their motivation and self-efficacy are low. Just as goals catalyze self-regulation in training, when returning to the work environment, employees must set specific transfer goals and devise plans for how to achieve them. Specifically, trainees must develop plans to unlearn their old work routines and replace them with the routines taught in training (Frese & Zapf, 1994).

This argument suggests that the majority of self-regulation of transfer processes have analogous self-regulated learning components. Research examining self-regulation of transfer would aid our understanding of the role of self-regulation in the modern work environment and help us design interventions to increase the transfer of trained knowledge and skills back to the job.

**Conclusions**

The past 30 years of research on self-regulated learning have been extremely fruitful. Self-regulation theories provide a tremendous knowledge base for understanding how adults regulate their acquisition of new information. They clarify the fundamental constructs that
constitute self-regulated learning, how these constructs are interrelated, and how they work in concert to predict knowledge acquisition. Our review of self-regulation theories identified 16 core self-regulated learning constructs. These constructs can be classified as regulatory agents, mechanisms, and appraisals based on whether they are instrumental in initiating self-regulated learning, ensuring goal progress proceeds in an efficient and organized manner, or determining whether trainees sustain their goal striving behavior.

Together the meta-analytic findings and heuristic framework of the self-regulated learning domain provide insight as to the current state of the literature. Meta-analytic findings revealed that the majority of self-regulatory processes have moderate to strong relationships with each other, suggesting that the processes are highly interrelated. Additionally, examining the intercorrelations between self-regulation constructs suggests that there is measurement overlap in the assessment of some constructs (e.g., metacognition and learning strategies). Furthermore, most of the self-regulatory processes exhibited positive relationships with learning: goal level, persistence, effort, and self-efficacy having the strongest effects. Together, these four constructs accounted for 17% of the variance in learning after controlling for cognitive ability and pretraining knowledge. However, counter to self-regulation theory, several key regulatory mechanisms—planning, monitoring, help seeking, and emotion control—did not have significant effects on learning. Thus, we presented a more parsimonious framework of the self-regulated learning domain, focusing on a subset of self-regulatory processes that have both limited overlap with other core processes and meaningful effects on learning.

We are hopeful that self-regulation research will continue to progress over the next 30 years. In order to make this goal a reality, researchers must collectively regulate their efforts
toward advancing a parsimonious theory of self-regulated learning and adjust their focus to accommodate how learning occurs in the modern work and higher-education environments.
Author Note

Correspondence concerning this article should be addressed to Traci Sitzmann, The Business School University of Colorado Denver, PO Box 173364, Denver, CO 80217. E-mail: traci.sitzmann@ucdenver.edu.

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References

References marked with an asterisk indicate studies included in the meta-analysis.


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presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.


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doi:10.1037/0021-9010.76.6.759


doi:10.1177/014920639301900109

doi:10.1177/014920639502100409


doi:10.1177/0273475304273346


Table 1

A Heuristic Framework of the Self-Regulated Learning Domain

<table>
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<th>Regulatory Agents</th>
<th>Bandura</th>
<th>Carver &amp; Scheier</th>
<th>Frese &amp; Zapf; Hacker</th>
<th>Kanfer &amp; Ackerman</th>
<th>Locke &amp; Latham</th>
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Notes: An X denotes the theory suggests that the construct is a component of self-regulation.
Frese and Zapf (1994), Hacker (1985)
Kanfer and Ackerman (1989)
Pintrich (2000)
Table 2

Definitions of Self-Regulation Constructs, Representative Scales, and Sample Scale Items

<table>
<thead>
<tr>
<th>Constructs and Definitions</th>
<th>Scales that Assess the Constructs and Sample Items</th>
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<tbody>
<tr>
<td><strong>Regulatory Agents</strong></td>
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</table>
| Goal level: Standards trainees aim to achieve during training | • Self-set goal level (1 item, Yeo & Neal, 2008). I aim to achieve an error penalty of less than ______ on the next trial.  
• Goal level (1 item, Vancouver & Kendall, 2006). What grade are you really aiming for on the upcoming test? |
| **Regulatory Mechanisms**  |                                                  |
| Planning: Thinking through what one needs to learn, setting task-specific goals, and deciding which strategies to employ to achieve the goals | • Planning (7 items, Schraw & Dennison, 1994). I think about what I really need to learn before I begin a task; I set specific goals before I begin a task; I think of several ways to solve a problem and choose the best one.  
• Planning (2 items, Young, 2005). I skim through the chapter to see how it is organized before I read it thoroughly; I set goals for myself in order to direct my study activities. |
| Monitoring: Paying attention to one’s performance and understanding of the course material | • Monitoring (3 items, Miller, Behrens, Greene, & Newman, 1993). As I read the text, I seldom checked my understanding by trying to solve practice problems. (reverse)  
• Comprehension monitoring (7 items, Schraw & Dennison, 1994). I ask myself questions about how well I am doing while learning.  
• Comprehension monitoring (5 items, Warr & Downing, 2000). I made a special effort to check how well I understood what was being taught. |
| Metacognition: Planning and monitoring goal-directed behavior and devoting attention toward the course material | • Metacognitive self-regulation (12 items, Pintrich et al., 1991). When I study for this class, I set goals for myself in order to direct my activities in each study period (planning); I ask myself questions to make sure I understand the material I have been studying in this class (monitoring); During class time I often miss important points because I am thinking of other things (attention; reverse).  
• Metacognitive activity (12 items, Ford et al., 1998). I thought ahead to what I would do next to improve my performance (planning); I tried to monitor closely the areas where I needed the most study and practice (monitoring).  
• Metacognitive activity (15 items, Schmidt & Ford, 2003). During this training program, I tried to think through each topic and decide what I was supposed to learn from it, rather than just jumping in without thinking (planning); During this training program, I asked myself questions to make sure I understood the things I have been trying to learn (monitoring). |
| Attention: Concentrating and maintaining one’s mental focus during training | • Concentration (8 items, Weinstein, Schulte, & Palmer, 1987). I concentrate fully when studying.  
• Off-task attention (2 items, Kanfer & Ackerman, 1989). I daydreamed while doing the task. (reverse) |
| Learning strategies: Techniques employed to elaborate on the training material as well as integrate all of the components of the material with each | • Deep processing (5 items, Elliot et al., 1999). When a theoretical point or conclusion is presented in lecture or in the text, I try to decide if there is good supporting evidence.  
• Elaboration (6 items, Pintrich et al., 1991). When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions. |
**Self-Regulated Learning**

- **Information processing** (8 items, Weinstein et al., 1987). I try to find relationships between what I am learning and what I already know.

**Persistence**: Continuing to allocate effort and attention toward the training material, despite boredom or failure to make progress toward one’s goals
- **Persistence** (4 items, Elliot et al., 1999). Regardless of whether or not I like the material, I work my hardest to learn it.
- **Effort regulation** (4 items, Pintrich et al., 1991). Even when course materials are dull and uninteresting, I manage to keep working until I finish.
- **Motivation control** (5 items, Warr & Downing, 2000). Whenever I was feeling bored, I forced myself to pay attention.

**Time management**: Making study schedules and allocating time for study activities
- **Time management** (8 items, Weinstein et al., 1987). When I decide to study, I set aside a specific length of time and stick to it.
- **Procrastination** (3 items, McGregor & Elliot, 2002). I procrastinated in my studying for the exam. (reverse)

**Environmental structuring**: Choosing a study location that is conducive to learning (i.e., quiet and free from distractions)
- **Study environment** (2 items, Plant et al., 2005). Percentage of time trainees reported studying at the library versus at home.
- **Environmental restructuring** (3 items, Gredler & Garavalia, 2000). I turn off the TV/radio so I can concentrate on what I am doing.

**Help seeking**: Seeking assistance when one has difficulty understanding concepts during training
- **Help seeking** (4 items, Pintrich et al., 1991). I ask the instructor to clarify concepts I don’t understand well.

**Motivation**: Willingness to engage in learning and desire to learn the course content
- **Motivation to learn** (8 items, Noe & Schmitt, 1986). I am motivated to learn the skills emphasized in the training program.
- **Task value** (6 items, Pintrich et al., 1991). It is important for me to learn the course material in this class.
- **Expectancy** (7 items, Noe & Schmitt, 1986). I am willing to exert considerable effort in the training program in order to improve my skills.

**Emotion control**: Keeping negative emotions (e.g., anxiety and worry) at bay while learning
- **Emotion control** (5 items, Warr & Downing, 2000). I told myself not to worry when things were difficult.
- **Emotion control** (8 items, Keith & Frese, 2005). When difficulties arose, I calmly considered how I could continue the task.

**Effort**: The amount of time that trainees devote to learning
- **Time on task** (1 item, Brown, 2001). Total time spent in self-paced training.
- **Study time** (1 item, Wilhite, 1990). Trainees’ estimates of weekly study time.

**Regulatory Appraisals**

**Attributions**: Trainees’ beliefs about the causes of outcomes in achievement situations
- **Control of learning beliefs** (4 items, Pintrich et al., 1991). If I try hard enough, then I will understand the course material.

**Self-efficacy**: Trainees’ beliefs regarding their capability to succeed in training and perform training-related tasks
- **Self-efficacy for learning and performance** (8 items, Pintrich et al., 1991). I’m certain I can understand the basic concepts in this course.
- **Performance expectations** (3 items, Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000). Considering the difficulty of this course and my skills, I think I will do well in this class.
- **Confidence expectancy** (2 items, Elliot & Church, 1997). I expect to do well in this class.
Note: One sample item is provided when all of the scale items are fairly similar and the exemplar is representative of all scale items; several sample items are provided for multidimensional scales. Self-evaluation was not included on the table because there are no existing measures of this construct.
Table 3

Meta-Analytic Correlations among the Self-Regulation Constructs

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<tr>
<th></th>
<th>Goal Level</th>
<th>Planning</th>
<th>Monitoring</th>
<th>Metacognition</th>
<th>Attention</th>
<th>Learning Strategies</th>
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<td>$k$ ($N$)</td>
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<td>$k$ ($N$)</td>
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<td>5 (752)</td>
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### Self-Regulated Learning

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### Note

Env. structuring = Environmental structuring; Pre. = Pretraining; $k$ = the number of effect sizes included in the analysis; $N$ = sum of the sample sizes of the studies included in the analysis; $\rho$ = mean correlation corrected for measurement error based on predictor and criterion reliabilities. Self-evaluation was not included in the table as correlations were not available from any of the studies included in the meta-analysis.
Table 4

Meta-Analytic Correlations for Self-Regulation Constructs with Learning

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<th>N Weighted Mean r</th>
<th>ρ</th>
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<th>Pop. Var</th>
<th>% Var due to Artifacts</th>
<th>95% Confidence Interval Lower</th>
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<th>80% Credibility Interval Lower</th>
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Note. k = the number of effect sizes included in the analysis; Total N = sum of the sample sizes of studies included in the analysis; N Weighted Mean r = sample size weighted mean correlation; ρ = mean correlation corrected for measurement error based on predictor and criterion reliabilities; Var (e) + Var (a) = sampling error variance + variance due to unreliability in the predictor and criterion; Pop. Var = variance of the corrected correlations; % Var due to Artifacts = percent of variance in the observed correlations due to statistical artifacts. Self-evaluation was not included in the table as correlations were not available from any of the studies included in the meta-analysis.
Table 5

Weighted Least Squares Regression Results for Moderators of the Relationships between Self-Regulation Constructs and Learning

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<thead>
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<th>Metacognition</th>
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<td>.34</td>
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<td>.30*</td>
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</tbody>
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Note. The numbers in the table are standardized regression coefficients. A dash (–) indicates that the effect of the moderator could not be examined due to limited variability in the moderator variable. Population was dummy coded such that college students (coded 1) were compared to employees (coded 0). Publication status was dummy coded such that 0 indicates that the document was unpublished and 1 indicates that the document was published. Research design was dummy coded such that 0 indicates that the design was correlational and 1 indicates that the design was experimental or quasi-experimental.

* p < .05.
Figure 1. A parsimonious framework of adult self-regulated learning.

1 Metacognitive strategies encompasses metacognition (including planning and monitoring) and learning strategies.
There has been extensive debate regarding Bandura’s and Carver and Scheier’s perspectives on positive discrepancy creation (see Bandura & Locke, 2003, and Phillips, Hollenbeck, & Ilgen, 1996, for more information). Rather than restating the differences between these theories, the current review focuses on commonalities across theories in order to derive a heuristic framework that specifies the core constructs in the self-regulated learning domain.

To develop the heuristic framework, we identified the most frequently cited and influential theories in the adult self-regulated learning domain. First, we identified 15 self-regulation theories that were included in previous self-regulation review articles (e.g., Diefendorff & Lord, 2008; Kanfer, 1990; Puustinen & Pulkkinen, 2001; Vancouver, 2000). From this list, we eliminated content theories, which do not focus on the components of self-regulation (i.e., Deci & Ryan, 2000; Dweck, 1986; Higgins, 1997). Then, the seven aforementioned theories as well as Boekaerts and Niemivirta (2000), Borkowski (1996), Corno (1993), Kuhl (1992), and Winne and Hadwin (1998) were compared in terms of their number of citations in Web of Science and Google Scholar. There was a clear cutoff in the number of hits per theory such that those included in our review received more than 100 citations in Web of Science and more than 200 citations in Google Scholar and those not included in the review fell below both of these criteria. After choosing the theories, each theory was reviewed by two independent raters to establish which constructs constitute the self-regulated learning domain. The raters independently developed a list of the core constructs in each of the theories (interrater agreement was .89) and then reached a consensus on the construct lists. There are a range of constructs included in self-regulation theories and many theories include constructs that do not have analogous components in other theories (e.g., orientation in Frese & Zapf, 1994, and context evaluation in Pintrich, 2000). Thus, each of the constructs included in the heuristic framework were a component of at least two of the reviewed theories. The next step in the rating process involved classifying the constructs as regulatory agents, mechanisms, and appraisals. Interrater agreement was .93 and once again a consensus was reached regarding all coding discrepancies.

It is imperative that a meta-analysis of the self-regulated learning domain utilizes only scales that assess a single self-regulated learning construct. Thus, we excluded scales that assessed a combination of multiple constructs, with the exception of metacognition, which by definition is multidimensional. For example, the LASSI motivation scale (Weinstein et al., 1987) assesses a combination of planning (e.g., I set goals for the grades I want to get in my
classes) and persistence (e.g., *When work is difficult, I give up or only study the easy parts*). Although Weinstein et al. labeled the scale *motivation*, we did not include it with the other motivation measures in the meta-analysis because the scale label does not match the construct assessed by other motivation scales. This scale, along with many others, was excluded from the meta-analysis because the only way to clarify this domain is to focus on clean measures of self-regulated learning constructs.

4 Many trainees contributed data to multiple analyses (e.g., both pretraining and post-training self-efficacy with learning). Thus, although a total of 90,380 trainees contributed data to the meta-analysis, the Ns on Table 3 sum to 175,389.

5 The MSLQ metacognition scale (Pintrich et al., 1991) also includes items assessing attention. In order to reduce criterion overlap with attention, metacognition scales should eliminate items that tap attention and focus more narrowly on planning and monitoring.

6 Recent research suggests that performance ambiguity moderates this relationship—with self-efficacy having a negative effect on performance when ambiguity is high and a positive effect when ambiguity is low (Schmidt & DeShon, 2010).