A Theoretical Review of Winne and Hadwin’s Model of Self-Regulated Learning: New Perspectives and Directions

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This theoretical review of Winne and Hadwin’s model of self-regulated learning (SRL) seeks to highlight how the model sheds new light on current research as well as suggests interesting new directions for future work. The authors assert that the model’s more complex cognitive architecture, inclusion of monitoring and control within each phase of learning, and separation of task definition and goal setting into separate phases are all important contributions to the SRL literature. New research directions are outlined, including more nuanced interpretations of judgments of learning and the potential to more thoroughly assess the influence of interactions among cognitive and task conditions on all phases of learning.

KEYWORDS: cognition, information-processing theory, metacognition, review, self-regulated learning.

Among the primary goals of educational psychology are to understand the learning process and to help those who struggle with it. Computer metaphors used in information-processing theory (IPT) suggest that difficulty in learning can be attributed to biomechanical processes, such as memory storage and retrieval, or inadequate production rules that guide strategy use (e.g., Anderson & Labiere, 1998; Newell, 1990; Newell & Simon, 1972). Other researchers have suggested that motivation, self-efficacy, and goal orientation are keys to the learning process (Pintrich, 2000). Still others suggest that learning is situated, with contextual factors that do not span domains (Greeno & the Middle School Mathematics Through Application Project Group, 1998). Each of these perspectives on learning contributes to our understanding of the phenomenon.

Self-regulated learning (SRL) theories attempt to model how each of these cognitive, motivational, and contextual factors influences the learning process (Pintrich, 2000; Winne, 2001; Winne & Hadwin, 1998; Zimmerman, 2000). Although there are important differences between various theoretical definitions, self-regulated learners are generally characterized as active, efficiently managing
their own learning through monitoring and strategy use (Boekaerts, Pintrich, & Zeidner, 2000; Butler & Winne, 1995; Paris & Paris, 2001; Pintrich, 2000; Winne, 2001; Winne & Hadwin, 1998; Winne & Perry, 2000; Zimmerman, 2001). Students are self-regulated to the degree that they are metacognitively, motivationally, and behaviorally active participants in their learning (Zimmerman, 1989). SRL has also been described as a constructive process wherein learners set goals on the basis of both their past experiences and their current environments (Pintrich, 2000). These goals become the criteria toward which regulation aims. In essence, SRL mediates the relations between learner characteristics, context, and performance (Pintrich, 2000, 2004).

Pintrich (2000) organized SRL research using a taxonomy focusing on the phases and areas of self-regulation. These phases include task identification and planning, the monitoring and control of learning strategies, and a reaction and reflection phase. The various areas in which self-regulation can occur fall into four broad categories: cognition, motivation, behavior, and context. By crossing phases and areas, Pintrich presented a four-by-four grid wherein various research findings and theoretical constructs can be categorized. For example, judgment of learning (JOL) is a monitoring process within the area of cognition, whereas changing studying venues to one that is less noisy is the enactment of a context-control strategy.

This kind of taxonomy helps researchers organize the many lines of SRL research currently being conducted and gives some general information regarding how they might relate. Different models of SRL focus on specific cells or groups of cells within Pintrich’s (2000) taxonomy. Winne and Hadwin’s (1998) model of SRL, influenced by IPT, complements the work of Pintrich and others by more specifically outlining the cognitive processes that occur during learning, as well as reconceptualizing some of the phases (Winne, 2001). This affords a different perspective on SRL. However, given the number of SRL models currently in existence, the question is how these contributions aid in understanding current literature or in positing new lines of future research.

Winne and Hadwin’s Model of SRL

There are numerous theories of SRL that differ in sometimes subtle and sometimes significant ways (for extensive reviews, see Boekaerts et al., 2000; Zimmerman & Schunk, 2001). Winne and Hadwin (1998) posited that learning occurs in four basic phases: task definition, goal setting and planning, studying tactics, and adaptations to metacognition (see Figure 1). The first notable difference between Winne and Hadwin’s model and that of Pintrich (2000) is that they separated the processes of task definition from those of goal setting and planning.

In addition, Winne and Hadwin’s (1998) SRL model differs from others in that they hypothesized that an IPT-influenced set of processes occurs within each phase. Using the acronym COPES, they described each of the four phases in terms of the interaction of a person’s conditions, operations, products, evaluations, and standards. All of these aspects, except operations, are kinds of information that a person uses or generates during learning. It is within this cognitive architecture, composed of COPES, that the work of each phase is completed. Thus, Winne and Hadwin’s model complements other SRL models by introducing a more complex description of the processes underlying each phase.
Conditions are the resources available to a person and the constraints inherent to a task or environment. These conditions come in two types. Cognitive conditions are akin to memories of past learning experiences and include beliefs, dispositions, and styles; motivation; domain knowledge; knowledge of the current task; and knowledge of study tactics and strategies. Task conditions are external to the person and include resources, instructional cues, time, and the local context. Thus, in Winne and Hadwin’s (1998) model, two foci of Pintrich’s (2000) framework, motivation and context, are subsumed in conditions. Conditions influence both standards as well as the actual operations a person performs.

Standards are multifaceted criteria that a student believes are the optimal end state of whatever phase is currently running, and they include both metrics and
beliefs. For example, in the task definition phase, a student might examine a list of guidelines a teacher provides for exam preparation and develop task standards, including what needs to be learned (metrics), as well as beliefs about the act of studying itself, such as how much depth of understanding is required or how difficult the task will be. In Figure 1, Winne and Hadwin (1998) used a bar graph to illustrate how a student actively determines criteria for “success” in terms of each aspect of the learning task, with each bar representing a different standard with varying qualities or degrees. The overall profile of these Phase 1 standards makes up the person’s goal. These standards or goals are used to determine the success of any operations the person might perform within each phase.

Operations are the actual information manipulation processes that occur in learning, including searching, monitoring, assembling, rehearsing, and translating or, as Winne (2001) referred to them, SMART. These SMART processes are cognitive in nature, not metacognitive; as such, they result only in cognitive products, or information for each phase. For example, the product of Phase 1 is the definition of a task, whereas the product of Phase 3 might be the ability to recall a specific piece of information for a test. These products are then compared with the standards by way of monitoring.

Through monitoring, a person compares products with standards to determine if phase objectives have been met or if further work remains to be done. These comparisons are called cognitive evaluations, and a poor fit between products and standards may lead a person to enact control over the learning operations to refine the product, revise the conditions and standards, or both. This is the object-level focus of monitoring. However, this monitoring also has a metalevel information, or metacognitive, focus. A student may believe that a particular learning task is easy and thus translate this belief into a standard in Phase 2. However, in iterating through Phase 3, perhaps the learning product is consistently evaluated as unacceptable in terms of object-level standards. This may initiate metacognitive monitoring that determines that this metalevel information, in this case regarding the actual difficulty of this task, does not match the previously set standard that the task is easy. At this point, a metacognitive control strategy might be initiated whereby that particular standard is changed (“this task is hard”), which might in turn affect other standards created during Phase 2, goal setting. These changes to goals from Phase 2 may include a review of past material or the learning of a new study strategy. Thus, the model is a “recursive, weakly sequenced system” (Winne & Hadwin, 1998, p. 281) in which the monitoring of products and standards within one phase can lead to updates of products from previous phases. The inclusion of monitoring and control in the cognitive architecture allows these processes to influence each phase of SRL.

Overall, although there is no typical cycle, most learning involves recycling through the cognitive architecture until a clear definition of the task has been created (Phase 1), followed by the production of learning goals and the best plan to meet them (Phase 2), which leads to the enacting of strategies to begin learning (Phase 3). The products of learning, say an understanding of relativity, are compared against standards including the overall accuracy of the product, the learner’s beliefs about what needs to be learned, and other factors, such as efficacy and time restraints. If the product does not adequately fit the standard, further learning operations are initiated, perhaps with changes to conditions, such as setting aside
more time for studying. Finally, after the main process of learning has occurred, students may decide to make more dramatic and long-term alterations to the beliefs, motivation, and strategies that make up SRL (Phase 4). These changes can include the addition or deletion of conditions or operations, as well as minor (tuning) and major (restructuring) changes to the ways conditions cue operations (Winne, 2001). The output, or performance, is the result of recursive processes that cascade back and forth, altering conditions, standards, operations, and products as needed.

The Purpose of This Article

Winne and Hadwin’s (1998) four-phase model describes the specific cognitive processes that entail a learner’s self-regulation through the definition of a task, the setting of goals and plans, the use of tactics to learn, and the metacognitive processes used to adapt learning both within the task and more globally. We believe that their model makes three unique and important contributions to understanding SRL. First, each phase incorporates similar processes that together make up a cognitive system or architecture. This architecture explicitly models how the work of the phase is done and allows for a more detailed look at how various aspects of the COPES architecture interact. Second, with monitoring and control functioning as the hubs of regulation within each phase, Winne and Hadwin’s model can more effectively describe how changes in one phase can lead to changes in other phases over the course of learning. This allows the model to explicitly detail the recursive nature of SRL. Finally, this model separates out task definition and goal setting into separate phases, allowing more nuanced questions to be asked about these phenomena. It is our contention that these three IPT-influenced elaborations on the general SRL model (as outlined by Pintrich, 2000) suggest new ways of conceptualizing and analyzing the learning process. In addition, we believe that these three contributions also point to profitable new directions for future research.

This theoretical review provides evidence to support these claims. First, current research and theory are examined from the perspective afforded by Winne and Hadwin’s (1998) model. We believe that the cognitive architecture and focus on monitoring that differentiate Winne and Hadwin’s model align with much in current research while providing additional explanatory power regarding results that have seemed contradictory or confusing. Likewise, the generative qualities of the model are evaluated: How do the unique contributions of this model suggest novel, interesting, and plausible paths for future research? Given the breadth of the research areas integrated in Winne and Hadwin’s model (cognition, motivation), the initial exploration of these questions depends on literature reviews of each area, followed by the inclusion of specific, relevant empirical articles.

It is important to note that this is a theoretical review of Winne and Hadwin’s (1998) model, not a comprehensive review of empirical literature in any one particular topic area. SRL models, including Winne and Hadwin’s, generally cover a broad array of phenomena, including many well-researched areas, such as goal setting, motivation, personal epistemology, and emotions. It would be a formidable and lengthy task indeed to review the empirical work in each area. Instead, we depend on reviews of research and selected key studies to examine what Winne and Hadwin’s model contributes to current understanding and future work.
Method

Population Characteristics

Given the lack of a comprehensive, integrative review of the many areas covered by SRL, it was determined that this article should be as broad based as possible. Therefore, this review is inclusive of all age groups and cultural backgrounds. Although research based in the United States is predominant, relevant research from other countries was sought out and included when appropriate.

Search Method

We used the EBSCO databases through the University of Maryland’s University Libraries Web site to search for relevant articles. The databases searched included Education Resources Information Center, PsycARTICLES, and PsycLit. These databases were chosen because they were found to be the most reliable and to produce the highest quality review and empirical research. Search terms used included “self-regulat* learn*” (as a generic term used to expose all variants of self-regulation); “metacognition,” “learning,” “academic achievement,” “self-control,” and “goals.” These terms were the ones most often found among relevant articles. Likewise, each included article’s references were examined, and relevant studies were culled from these as well.

For each aspect of Winne and Hadwin’s (1998) model, we attempted to find quality review literature that effectively summarized the current thinking in the field. If such articles were found, we examined other research to see if those articles needed to be supplemented with specific studies. When appropriate review literature was not found, we went directly into the empirical literature and attempted to cull a diverse but concise list of articles that effectively conveyed current directions in the field. Space constraints prevent us from being as thorough as we would like in each area, but we did endeavor to get a representative and informative sample.

The article search was ended when article redundancy was achieved between database searches, reference lists, and reviewed work. The main review was completed in November 2005 and covered the period from that time back to 1980. A supplemental review of new secondary sources was completed in October 2006. The final list of articles, book chapters, and conference presentations included in this review is presented in Table 1 and includes 113 unique articles and book chapters.

Literature Review

Although this review addresses each aspect (COPES; see Figure 1) of Winne and Hadwin’s (1998; Winne, 2001) model in a linear fashion, it is important to remember the recursive nature of the model within individual phases, across phases, and from external feedback. For each aspect, beginning with the determination of task conditions, the relevant research is examined, along with general comments about what the model contributes to research in that area, including possible new directions. However, although we endeavor to provide representative examples from each of the five main areas (COPES), as well as monitoring and control, we do not present comprehensive reviews of research from every subsection of Winne and Hadwin’s model. We present only research that aids in our main goals of illustrating the benefits of viewing SRL research through the lens of
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Winne and Hadwin’s model. Thus, subsections that do not contribute to these goals (such as “knowledge of task” and “knowledge of study tactics and strategies”) are not covered.

Task Conditions

Task conditions are any task-related influence that is external to a learner. The context for learning, time allowed, instructional cues, and resources are all listed as task conditions, but it should be noted that there are most likely other influences, such as teachers (Winne, 2001). Of the various task conditions, we have chosen to focus on context, teacher influences, and time. Instructional cues and resources are certainly important but are not as helpful here in terms of our main goals.
Students are almost certainly influenced by their local contexts when learning (for a review, see Perry, Turner, & Meyer, 2006). SRL behaviors are more likely when tasks are meaningful, when students collaborate, and when they have some level of control over how they are assessed (Perry, 1998; Perry, Phillips, & Dowler, 2004). Eshel and Kohavi (2003) found that students’ perceptions of classroom control were composed of two independent dimensions: level of student control and level of teacher control. Classrooms characterized as having high levels of student control offered numerous opportunities for self-directed learning. Teacher control measured the degree of structure and direction provided by teachers. Higher self-efficacy, here defined as expectations for success (Bandura, 1997), and the more frequent use of cognitive strategies were associated with high levels of student control, regardless of perceptions of teacher control. Students who perceived high levels of control on both dimensions scored the highest on tests of mathematics achievement.

Young (1996) investigated what happened when seventh grade students were given varying degrees of control over a hypermedia learning environment. He found that students who scored as low self-regulated learners on a self-report pretest, when given a high degree of control over what and how they learned, scored more poorly on a posttest than both students who were high self-regulators and those low self-regulators who were given less control over their learning environment. This suggests that for students who lack the skills to self-regulate, providing them with a high degree of responsibility for guiding their learning can be more detrimental than providing a clear guide or scaffold (for a review, see Kirschner, Sweller, & Clark, 2006).

Students’ perceptions of the level of competition inherent in their environment influence their self-regulatory behavior as well. For example, classroom climate can influence a student’s goal orientation. Performance-approach and performance-avoidance goals are two kinds of goal orientations, which are discussed in more detail later. The former is an orientation toward wanting to do well in comparison with others, whereas students with the latter orientation seek to avoid being seen as less able than their peers (Elliott & Harackiewicz, 1996). Bråten, Samuelstuen, and Strømsø (2004) examined whether self-efficacy moderated the influence of performance-approach and performance-avoidance goals on self-regulatory strategy use and hypothesized that this moderating effect would occur only among students with performance-avoidance goal orientations in a competitive learning environment, such as a business administration program. Their findings supported their hypotheses: Students’ use of SRL strategies in a less competitive environment, teacher training, was unaffected by self-efficacy, regardless of the students’ goal orientations. However, in the competitive environment, students with performance-avoidance goal orientations and high self-efficacy actually engaged in fewer SRL strategies than those with lower self-efficacy. Bråten et al. explained this seemingly counterintuitive interaction by positing that when expectations of success are high, students self-handicap to avoid the possibility of failure. When expectations of success are low, students’ fear of poor performance overrides any concerns about trying and failing. This study demonstrates that students’ perceptions of context can moderate the effects of other cognitive conditions, such as goal orientation and self-efficacy.
The influence of context on motivation has been further examined by Linnenbrink and Pintrich (2001). They also stated that objective, contextual influences on a student’s goal orientation may be mediated by the student’s other cognitive conditions. The student’s subjective experience of the context, however, probably carries the most weight in terms of influencing other aspects of the learning process, such as motivation. Linnenbrink and Pintrich noted, however, that empirical research into these contextual and motivational interactions has just begun.

Winne and Hadwin’s (1998) model certainly meshes with the above research, with task conditions influencing both the operations that students enact as well as cognitive conditions and standards. What is not clear is how exactly this occurs. Do aspects of the context directly influence the choice of operations and setting of standards, or are the effects indirect through other cognitive conditions? Likewise, it would be interesting to further explore in what phase(s) these effects occur. Winne and Hadwin’s model, by separating task definitions and goal setting, suggests two possible mechanisms. The first phase in which context may influence operations is during task definition. Perhaps students’ definitions of acceptable performance are shaped by contextual cues. The second way context may influence operations is through goal setting, in which the interaction of self and context influences students’ operations, such as in Bråten et al.’s (2004) work.

Teacher Influences

One way teachers have a great deal of influence on the context and subsequent actions of students is through classroom teaching practices. Perry, VandeKamp, Mercer, and Nordby (2002) and Perry et al. (2004) stated that students are more likely to engage in SRL when they spend prolonged periods of time engaged in complex tasks with multiple goals. In general, students are more engaged when they have teachers who actively encourage motivation, have higher expectations, give appropriate positive and negative feedback, and encourage student collaboration (Bohn, Roehrig, & Pressley, 2004; Dolezal, Mohan Welsh, Pressley, & Vincent, 2003; Paris & Paris, 2001; Perry et al., 2002; Perry et al., 2004).

Rozendaal, Minnaert, and Boekaerts (2005) examined how a specific teaching technique, called the Interactive Learning Group System, influenced self-regulation, specifically students’ investment in and use of surface-versus deep-level processing strategies. This technique involved activating prior knowledge and then allowing students to work on ill-structured problems in groups. The focus was on creating mixed groups of students with different strengths and backgrounds, so that discussion and cognitive conflict could promote learning and mutual responsibility for learning. The teacher provided coaching and feedback to student groups. Rozendaal et al. found that in classrooms in which teachers strongly adhered to the principles of the Interactive Learning Group System, deep-level processing strategy use increased. Investment, as measured by students’ interest and persistence, was not affected by the technique.

Butler (2002) outlined another successful SRL-supportive teaching technique called the strategic content learning (SCL) instructional model. This model has been found to aid performance and self-efficacy among students with learning disabilities. SCL focuses on promoting students’ reflective engagement in three phases of SRL: task analysis, strategy implementation, and self-monitoring.
Winne and Hadwin’s SRL

Teachers using the SCL model do not teach SRL skills; rather, they coconstruct strategies with their students through an individualized, iterative process. Increased self-efficacy comes with successful strategy use. Collaboration and the sociocultural context are emphasized as student discussions are used to promote knowledge abstraction. Research has shown that this technique, when used with students with learning disabilities, has led to increased SRL knowledge, efficacy, strategy use, and transfer of strategies to other contexts (Butler, 1995, 1998).

In terms of more specific strategies and teachers’ instruction of strategies, the literature is vast (for a review of cognitive strategy research, see Pressley & Harris, 2006). For example, Paris and Paris (2001) provided an excellent overview of the ways teachers can promote strategic reading and writing, including assisting students with prereading, inferencing, and self-monitoring. Wade and Trathen (1989) found that explicit, as opposed to vague, task instructions had a significantly positive effect on college students’ recall, but for only those students who were classified as having low ability. In addition, across ability groups, explicit task instructions led to students’ spending less time taking notes on unimportant information. In general, research has shown that explicit SRL strategy training leads to improved performance (Azevedo & Cromley, 2004; Bielacycz, Pirolli, & Brown, 1995; Nietfeld & Schraw, 2002; Perels, Gütler, & Schmitz, 2005).

Winne and Jamieson-Noel’s (2003) work further substantiates task instructions’ impact on what students note. They found that college students who were shown objectives for a learning task involving the science of meteorology studied different things than students who were not shown objectives. However, both groups of students used the same study tactics, such as memorizing or focusing on bolded material in the text. Thus, Winne and Jamieson-Noel found that explicit task objectives influenced what the students studied, but not the actual strategies they used to learn the information. An examination of the architecture of Winne and Hadwin’s (1998) model provides a possible explanation for this: Conditions influence the standards students create in Phases 1 and 2, but to affect the operations of Phase 3, students must perceive a qualitative difference in how different material needs to be studied. Task instructions may provide little information to guide such a decision.

Winne and Hadwin’s (1998) model would suggest that interventions aimed at improving the products of Phases 1 and 2 would have benefits in terms of overall learning, because these products influence the standards against which cognitive evaluations of Phase 3 products are made. Teachers who prompt more effective Phase 1 and 2 processing are more likely to have students with standards that match the task. Research is needed that specifically asks students to state their interpretations of tasks both with and without this type of teacher prompting.

Time

Students must generate goals in Phase 2 that are attainable and that meet the standards set in Phase 1, including the time available for tasks. Indeed, Winne and Jamieson-Noel (2003) found that when studying and self-regulating, students actually exerted less effort for tasks that were cognitively complex and more effort for tasks that were simpler. They hypothesized that students were avoiding aspects of the tasks they felt were too difficult to complete in the time allotted. Winne and Jamieson-Noel’s finding regarding effort dovetails with the work of Thiede and
Dunlosky (1999), who showed that when college students were put under conditions of time pressure, they actually spent less time reviewing more difficult information and instead focused on easier content.

Winne and Hadwin’s (1998) model makes a contribution here, however, in allowing different interpretations of this behavior depending on the phase in which it occurs. If students choose to study easier items based solely on Phase 1 products, they may be selling themselves short in terms of what they believe they can learn in the time allotted. However, if during Phase 3 a student finds a discrepancy while monitoring his or her progress against standards, including the amount of time left, it may be a prudent decision to focus his or her efforts in ways that maximize the amount learned. Overall, it would seem that decisions about how much time to allot to studying would interact with cognitive conditions such as beliefs about what kinds of information are most important to the task: definitions, concepts, or theories, to name but a few. We believe that more research separately targeting student products in Phases 1 through 3 would help elucidate these interactions.

**Cognitive Conditions**

Cognitive conditions are information learners retrieve from long-term memory. Cognitive conditions include motivation, domain knowledge, knowledge of a task, knowledge of strategies, and beliefs, dispositions, and styles. In keeping with our goal of examining how the model sheds new light on current research and provides new directions for future research, we focus on motivation, knowledge of a task, knowledge of strategies, and beliefs, dispositions, and styles.

**Motivation**

Motivation’s influence on self-regulation has been well established (see Pintrich, 2004). Given concerns about nomenclature in motivation research (Murphy & Alexander, 2002), we have attempted to be as comprehensive as possible in reviewing the literature without retracing our steps over similar ground. We include work on goal orientation, self-efficacy, expectancy-value theory, self-determination theory, and interest.

**Goal orientation.** Pintrich (2000) provided an excellent overview relating goal orientation to SRL. Yet there are still numerous debates about the kinds of goal orientations and their terminology (Wigfield, Eccles, Schiefele, Roesner, & Davis-Kean, 2006). Here, we use the same definitions as Pintrich and review research on mastery and performance goals, along with their approach and avoidance forms. Students with an intrinsic interest in a task have mastery orientations. These students pursue learning to broaden and deepen their understanding. Students with performance orientations, on the other hand, have a more extrinsic interest in mind while learning. These students may be focused on learning to appear intelligent to others, or they may be fearful of looking inept or ignorant. These categories are further differentiated into approach and avoidance forms.

In the approach forms, students act with the intent of making something positive happen, whereas in the avoidance forms, they act to prevent negative events from occurring. Therefore, a mastery-approach orientation involves developing understanding for its own value, whereas a mastery-avoidance orientation focuses on ensuring that misunderstanding does not occur. Likewise, performance-avoidant
students are also concerned about avoiding negative outcomes, but with an extrinsic focus, this fear takes the form of being seen as stupid or inferior to others. The performance-approach orientation often manifests as a desire for good grades or other extrinsic markers of success (Elliott & Harackiewicz, 1996).

Most of the research on mastery goal orientations has focused on the approach form and has almost universally found positive associations, including increased monitoring of comprehension, more use of cognitive elaboration and organization strategies, higher levels of other motivational constructs such as self-efficacy and positive attributions, and more frequent help-seeking behavior (Pintrich, 2000; Wigfield et al., 2006). Pintrich and De Groot (1990) found that a mastery orientation was predictive of engagement in academic tasks but that cognitive strategy use and self-regulation mediated the effect of this orientation on academic performance. Unfortunately, little research exists on the mastery-avoidance orientation. Elliott and McGregor (2001) did find an association between this orientation and test anxiety, consistent with the characterization of mastery-avoidant students as perfectionists. In addition, Zusho and Pintrich (2000) found that mastery avoidance goals were positively related to both need for achievement and math performance.

Debates continue regarding whether performance-approach forms of goal orientations can have positive effects on student learning (Wigfield et al., 2006). Some authors argue they can lead to some productive strategy behavior, as well as positive self-concept and academic outcomes (Harackiewicz, Baron, Pintrich, Elliot, & Thrash, 2002), whereas others claim that the effects of this form are still unknown (Midgley, Kaplan, & Middleton, 2001). Research suggests that performance-avoidance orientations are associated with negative outcomes, such as the use of fewer cognitive strategies and decreased self-efficacy and interest (Pintrich, 2000). Pintrich (2000) argued that measures of the approach and avoidance forms of performance goals have not been adequately differentiated, leading to conflicting results.

Winne and Hadwin’s (1998) model can inform this theoretical debate regarding the need for approach and avoidance distinctions within the performance orientation. The focus of the debate has been whether the two forms of performance orientations are associated with different academic outcomes. Winne and Hadwin’s model predicts that if there are two different forms of performance goals, they should influence all four phases of self-regulation, from task definition to adaptations. Students with performance-approach orientations should include success in the classroom in their task definitions, and their goals should include not only learning but also extrinsic recognition of those goals being met. An orientation toward performance avoidance would seemingly be associated with a very different kind of task definition. These students would frame an entire task in terms of avoiding notice or embarrassment, and their goals would be more focused on the views of others than the learning content itself. Likewise, the kinds of adaptations made to task and cognitive conditions should also differ on the basis of students’ goal orientations and the kind of feedback provided: positive, negative, or the lack thereof. Thus, rather than focusing solely on strategy use and academic performance, Winne and Hadwin’s model suggests numerous measurement opportunities to establish discriminate validity between the two disputed forms of performance orientation.
On the other hand, in terms of goal orientation, we do question one aspect of Winne and Hadwin’s (1998) model. As it currently stands, conditions or products do not affect cognitive evaluations. Seemingly, in Winne and Hadwin’s model, cognitive evaluations are immune to the influence of goal orientations. Yet, we wonder whether different kinds of motivation for a topic might lead to differences in cognitive evaluations. For example, would a student with a performance-avoidance goal orientation assess the fit of products and standards with as much vigor as a student with a mastery-approach goal orientation? If not, this would need to be modeled and explored.

Self-efficacy. Research on motivation also includes self-efficacy, or individuals’ beliefs regarding their ability to perform certain goal-oriented tasks. In essence, these beliefs are their expectations for success (Bandura, 1997). Self-efficacy has been primarily investigated as an individual characteristic that varies by domain. Academic performance, persistence, self-regulatory strategy use, and choice of task have all been linked to high academic self-efficacy (Bandura, 1997; Finney & Schraw, 2003; Pintrich & De Groot, 1990; Schunk & Pajares, 2002; Stone, 2000). Robbins et al. (2004) performed a meta-analysis of 109 studies and found that academic self-efficacy was the strongest predictor of cumulative grade point average (GPA) and the second strongest predictor of retention among college students.

Students’ expectations for success are actually composed of two types: efficacy and outcome (Bandura, 1997). Efficacy expectations are formed on the basis of whether an individual feels that he or she has the ability to execute the required behaviors necessary for success. Outcome expectations, on the other hand, concern whether an individual believes that certain actions reliably lead to desired outcomes. Although Bandura (1997) and other researchers have focused on efficacy expectations as the key beliefs associated with academic success, Winne and Hadwin’s (1998) model suggests a possible role for outcome expectations in the maintenance of conditional knowledge, which is knowledge of when and under what circumstances to use certain strategies (Newell & Simon, 1972).

Certainly, efficacy expectations would influence the standards created in Phase 2 and the operations used in Phase 3 of Winne and Hadwin’s (1998) model. Higher self-efficacy would seem to predict the types of goals constructed, and decisions regarding whether to persist in, or even attempt, an academic task. In addition to efficacy expectations, though, it would seem that outcome expectations would influence the types of operations selected in Phase 3 in much the way that conditional knowledge is discussed in terms of strategy use (Alexander & Murphy, 1999). Students are most likely to engage in operations they believe will lead to success. In addition, during Phase 4, adaptations to self-efficacy are most likely influenced by beliefs about outcome expectations. If a student has a high outcome expectancy for a certain operation but has failed in the performance of the task, it would seem that this could lead to an update of the student’s efficacy expectations, a cognitive condition. Students do, however, sometimes engage in behaviors they doubt will lead to success. Failure after using these operations would seem to be much less influential on a student’s efficacy expectations. Winne and Hadwin’s model suggests that the effects of efficacy and outcome expectancies should be studied during both Phase 3, control of tactics, and Phase 4, adaptations on the basis of results.
Another key issue beginning to be examined is the calibration, or accuracy, of individuals’ efficacy expectations (Wigfield et al., 2006). Winne and Hadwin’s (1998) model suggests that those students with poor understanding of their ability to perform necessary goal-related activities may subvert their own learning in multiple phases. For example, do students who overestimate their ability, and thus have unwarranted self-efficacy, create unrealistic goals and plans in Phase 2? Do they enact less effective but easier strategies, expecting that they do not need to exert much effort to do well? Overconfidence in one’s abilities does not necessarily suggest an inability to perform cognitive evaluations of learning products, but consistent overestimation of ability does imply that update information from the mismatch between standards and products is not altering conditions as needed. Future research is needed to investigate these questions, including just how unwarranted self-efficacy beliefs persist in the face of contrary evidence from both within the cognitive architecture, such as cognitive evaluations, and without, such as external evaluations.

Expectancy-value theory. Eccles and colleagues (Eccles & Wigfield, 2002; Wigfield et al., 2006) advanced a model of motivation based on efficacy expectations and task value. This model focuses on individuals’ expectations for success on upcoming tasks, be they in the short- or long-term future. Whereas Bandura’s (1997) efficacy expectations concern only a student’s views of his or her ability to succeed, Eccles and colleagues included in their definition an individual’s comparisons of his or her performance with that of others (Wigfield et al., 2006).

Task value includes four components: attainment value, intrinsic value, utility value, and cost. Tasks that are important to an individual, or tasks that the individual feels directly contribute to his or her self-schema, have a high attainment value. Intrinsic value is related to how interesting or motivating an individual finds a task. Utility value concerns how much a task contributes to current and future goals. Finally, the cost of a task incorporates a number of factors related to the decision to engage in a task, including any other opportunities lost; any negative consequences, such as anxiety or fear of failure; and the amount of effort needed.

Research on expectancy-value theory has shown that even after controlling for prior performance, academic performance can be predicted by expectancies for success, while task values seem to predict academic decisions such as enrollment (for a review, see Wigfield & Eccles, 2002). In addition, there has been some evidence to suggest that as an individual’s competency in an area increases, interest rises as well (Wigfield et al., 1997).

The idea of cost is another contribution of expectancy-value theory, above and beyond that of self-efficacy and interest theories. Yet Wigfield et al. (2006) claimed that cost is just beginning to be investigated. Winne and Hadwin (1998) suggested that determinations of effort are products of Phase 2, goal setting and planning. It may be that individuals engage in some kind of cognitive evaluation of the standards for success in tasks, composed in Phase 1, with the effort required as determined in Phase 2. If the effort necessary exceeds some personal threshold, a student may ignore other standards and decide to forgo a task. This threshold would be fascinating to investigate, particularly to determine whether students are accurate in their assessments of effort required and whether a student’s emotional state raises or lowers that threshold.
The idea of cost from expectancy-value theory also points to a possible critique of Winne and Hadwin’s (1998) model. Cost includes an assessment of what options are eliminated when a student decides to engage in learning. It is not clear where information regarding other nonlearning activities should be placed in Winne and Hadwin’s model, suggesting a need for another facet of task conditions concerning competing demands for time and effort. This would expand the model to include cognitions beyond the current task. It also could be that these competing demands have influences beyond Phase 2. It is possible that within each phase of learning, a student compares products to a set of standards that includes cost. If the products of learning do not meet a certain criteria, perhaps the cost to the student becomes too high, and he or she moves on to other activities.

**Self-determination theory.** Self-determination theory is one area of research that continues to stress psychological needs and the benefits of intrinsic over extrinsic motivation (Deci & Ryan, 1985; Wigfield et al., 2006). Strong volition, what Deci and Ryan (1985) called self-determination, leads to intrinsic motivation for learning and development. Healthy development, and thus a sense of self-determination, occurs when three fundamental human psychological needs are met: competence, autonomy, and relatedness. Competence involves beliefs about one’s ability, such as those found in self-efficacy theory, but the need for autonomy introduces the importance of self-determination or control. The need for autonomy is balanced, however, with the need for relatedness, or connections with others. Ryan and Deci (2000) saw motivation as a continuum, moving from amotivation through various extrinsic motivational states before ending at intrinsic motivation. Again, intrinsic motivation is considered the optimal state in this theory, and Ryan and Deci examined how extrinsic rewards can actually undermine intrinsic motivation and self-regulation.

The issue of rewards has been a focus of these researchers (see Deci, Koestner, & Ryan, 1999), particularly as described in their cognitive evaluation theory (CET). CET suggests that when rewards are seen as controlling, they challenge a person’s need for autonomy. When rewards are perceived to be an indication of a person’s lack of ability, they work against the need for competence. In a meta-analysis of 128 studies, Deci et al. (1999) found support for CET, particularly in the finding that tangible rewards such as money decreased intrinsic motivation, whereas verbal encouragement increased intrinsic motivation. The key issue seems to be how rewards influence a student’s perception of control. Within Winne and Hadwin’s (1998) model, this can be seen as an interaction of a task condition (reward) with a cognitive condition (need for autonomy). Questions remain regarding in what phase this interaction occurs, the kinds of standard it produces, and how it influences operations. Do students’ interpretations of the reward in light of their need for autonomy occur in task definition or during planning? What kinds of products result from this interaction, and does the resulting standard (that the task is controlling) overcome all other standards, or just some, or in just certain people? Thus, Winne and Hadwin’s model certainly can accommodate an interaction of task and cognitive conditions, but it also points to new research directions by positing that the influence of this interaction may be felt at numerous phases and in both products and operations.
**Interest.** Researchers of student interest have split the construct into individual and situational types (Wigfield et al., 2006). Individual interest seems to be related to the use of more advanced cognitive strategies (Schiefele, Krapp, & Winteler, 1992) as well as better academic performance (Alexander, Kulikowich, & Jetton, 1994; Pintrich & Schunk, 2002). Situational interest also seems related to academic performance, particularly recall (Hidi, 2001).

Within Winne and Hadwin’s (1998) model, interest would most likely be a standard created within a Phase 1 product. This product would then influence the types of operations selected for initiation in Phases 2 and 3. As with goal orientations, above, one question that has not been asked in the literature is whether interest influences students’ cognitive evaluations and monitoring. Do disinterested students fail to monitor learning products as accurately, or do they simply create subpar standards? Asking students to think aloud regarding their phase products throughout a learning task may bring these effects to the surface.

**Motivation summary.** As stated above, the literature on motivation is vast, and its influence on SRL is clear (Pintrich, 2000). Winne and Hadwin’s (1998) model contributes to this literature by reorganizing some findings and asking new questions, specifically about how the various constructs under the general motivation umbrella influence each phase of learning, not just strategy use and performance. In addition, Winne and Hadwin’s model may provide a framework within which researchers can examine how these aspects of motivation interact with each other. For example, few have asked whether interest can overwhelm low self-efficacy or if the debilitating effects of external rewards can swamp a mastery goal orientation. The model also highlights the importance of tracking the effects of differing levels of goal orientation and interest throughout all four phases of learning to see if monitoring and cognitive evaluation quality differs.

**Domain Knowledge**

Domain knowledge is one of the key conditions influencing SRL (Winne & Hadwin, 1998). Nietfeld and Schraw (2002) found that higher prior knowledge predicted better performance, but the question remains as to how this occurs. Certainly, expertise research (for a historical review, see Ericsson, 2005) suggests that knowledge of a domain is essential for advanced planning and performance (Ericsson & Charness, 1994). However, this research also points out that true expert performance requires more than just knowledge. Alexander (1997) advanced a multifaceted model that attempts to explain how domain knowledge influences interest and strategy use, leading to better performance.

Alexander’s (1997) model of domain learning states that learners move through three stages of development in pursuing an academic domain. Early on, students are in the acclimation stage, when both their knowledge and interest tend to be low. These students tend to use more surface-level strategies (Alexander, Sperl, Buehl, Fives, & Chiu, 2004), or operations, as Winne and Hadwin (1998) would call them. Surface-level strategies are less cognitively complex and include rereading. As students gain familiarity in an area, they enter the competence stage, with an increase in both knowledge and interest. Students in competence use more deep-level strategies, such as reframing a problem (Murphy & Alexander, 2002). Finally, advanced students enter the proficiency stage, when knowledge, interest, and
Greene & Azevedo
deep-level strategy use are all high. It is important to note that in Alexander et al.’s
(2004) study, some participants in acclimation did use some deep-level strategies,
just as some in proficiency used some surface-level strategies. The model of
domain learning also highlights the domain-specific nature of SRL (Alexander,
1995).

Alexander’s (1997) model focuses on the influence of domain knowledge and
interest on Phase 3 operations, learning strategies. However, Winne and Hadwin’s
(1998) model suggests the possibility that operations in Phases 1 and 2 may also
be affected by domain knowledge. For example, it would be intriguing to examine
how task definitions differ between those in acclimation and those in proficiency.
It may also be that novices’ lack of domain knowledge influences their ability to
create accurate standards regarding goals, leading to the selection of ineffective
strategies. The Winne and Hadwin model’s focus on phases and standards might
also shed light on other models of expertise (Ericcson, 2005) claiming that novices
lack not only knowledge but also the planning skills and schema (operations) nec-
essary for superior performance.

Beliefs, Dispositions, and Styles
The last set of cognitive conditions discussed here, beliefs, dispositions, and
styles, includes many constructs. Here, we focus on two areas we believe demon-
strate the utility of viewing research through the lens of Winne and Hadwin’s
(1998) model. Research in both personal epistemology and emotions illustrate how
the model is flexible enough to accommodate diverse constructs while able to sug-
gest new directions for study.

Personal epistemology. A diverse set of theories tend to be grouped under the head-
ing of personal epistemology, but generally it is defined as the study of how peo-
ple view the nature and source of knowledge (Hofer & Pintrich, 1997). Theories
differ regarding whether the construct is unitary (Baxter Magolda, 1992; King &
Kitchener, 1994) or multidimensional (Hofer & Pintrich, 1997; Schommer, 1990)
as well as whether personal epistemology is domain general or specific (Buehl &
Alexander, 2005; Hofer, 2000). Numerous researchers have shown that more
sophisticated beliefs about knowledge are associated with higher academic per-
formance on a number of metrics, such as reading comprehension (Schommer,
1990), test performance (Schommer, Crouse, & Rhodes, 1992) and overall college
success (King & Kitchener, 1994; Schommer, 1993). Research has recently coa-
lesced around the idea that epistemological beliefs may mediate the relation
between task conditions and cognitive and motivational strategy use during SRL

Within Winne and Hadwin’s (1998) model, beliefs about knowledge would
seem to influence Phase 1 and 2 standards. Students with more adaptive beliefs,
such as those that deny the intractability of intelligence, would seem to be more
likely to create task definition and goal products that allow for greater effort and
persistence in the face of difficulties in Phase 3, enacting strategies. As discussed
with expectancy-value theory, perhaps these students are less likely to foreclose
on learning tasks, because they expect that effort and persistence will lead to suc-
cess in spite of early problems. Students’ beliefs about what qualifies as the ade-
quate justification of knowledge would seemingly influence their task definitions.
Students who believe that the argument from authority is sufficient for justification may enact different strategies and have different expectations about tasks than students who have other standards for justification, such as deductive proof (Murphy, Alexander, Greene, & Edwards, 2004).

It seems plausible to hypothesize that adaptations in Phase 4 would be influenced by a student’s beliefs about innate ability or the nature of knowledge and its acquisition. Students who believe that people are born either “smart” or not would be unlikely to update self-efficacy beliefs even when successful in learning tasks. Likewise, students who believe that knowledge is merely the accumulation of facts would seem to be less likely to update standards for learning, regardless of whether their performance led to desired outcomes such as good grades. What is less obvious, and deserving of study, is how resistant epistemological beliefs are to updates from Phase 4 products. Do beliefs about knowledge change on the basis of individual learning experiences, and if not, how are they influenced? Winne and Hadwin’s (1998) model allows for external evaluations to influence cognitive conditions, but the question remains as to what kinds of evaluations are necessary to influence epistemological beliefs.

**Emotions.** Whether because of more biologically based temperaments or socially and situation influenced moods, the feelings accompanying learning can influence the relations between other conditions and operations (for a review, see Snow, Corno, & Jackson, 1996). For example, recall seems to be enhanced when a student’s emotional state matches the one he or she had at the time of learning. In general, a positive affective state has been shown to facilitate higher order cognitive processes, such as knowledge organization and modification. Likewise, negative affective states seem to be negatively correlated with academic performance.

Carver and Scheier (1990) theorized that when students monitor their performance, they compare current achievement against what they expected to achieve. If students decide that they are meeting their achievement expectations, their emotional response is neutral. However, if they decide that they are not progressing as quickly as expected, this can lead to negative affect and decreased persistence. Achieving more quickly than expected can lead to positive affect. Butler and Winne (1995) pointed out that negative affect can result, even if a student is learning, if that learning is not proceeding at a rate acceptable to the student. This suggests that learning and study strategies that require a high amount of effort may be cast aside, even when successful, if they take too long to enact.

Winne and Hadwin’s (1998) model provides a framework for studying how students’ beliefs about the appropriate rate of learning affect their persistence decisions. It may be the case that in general, students have a less adaptive epistemological belief about learning being “quick” (i.e., easily achieved or not possible at all; see Schommer, 1990) that causes them to create unattainable standards regarding how much time it should take to complete learning tasks. It may also be the case, however, that students are not adept at monitoring how long they have spent on tasks or how far along they are in terms of meeting their goals. Winne and Hadwin’s model suggests that three variables are involved in students’ persistence decisions: their beliefs about how long tasks should take, their beliefs about how long they have spent on tasks, and their evaluations regarding how close they are to completing learning tasks. Researchers could examine each of these
variables in studies of persistence. It is unclear whether the negative affect created differs depending on these variables and what amount of negative affect is necessary to cause a student to modify plans and goals.

**Summary and Critique of Task and Cognitive Conditions**

Winne and Hadwin’s (1998) model shows task and cognitive conditions influencing the types of operations a student performs and the standards created. Motivation seems to influence not only the types of strategies used but also a student’s persistence. We believe that the interactions among motivational constructs may also be seen in Phase 1 and 2 products, and this should be investigated further. Beliefs about the self and learning also seem to both influence standards and operations as well as make cognitive conditions more or less likely to be adapted during Phase 4. A key direction for future research is to focus measurement tools on these two phases separately, to assess how conditions influence each.

Conditions influence learning through two different paths in Winne and Hadwin’s (1998) SRL model (see Figure 1). Conditions directly influence operations and products as well as indirectly affecting the monitoring and control process through standards. The first path to operations is explored next, followed by the second, involving the hubs of metacognition, monitoring, and control.

**Operations and Products**

Conditions influence the kinds of operations a learner performs in each phase of SRL. Operations in Winne and Hadwin’s (1998) model include both primitive IPT activities, such as accessing long-term and working memory, and more sophisticated strategies for learning. Using the acronym SMART, Winne (2001) outlined the processes involved in memory storage and retrieval: searching memory, monitoring new information’s fit with previously learned information, assembling new links to knowledge, rehearsing knowledge to commit it to memory, and translating knowledge in one form, such as verbal, to another, such as pictorial. From operations, products are created within each phase. These products include task definitions in Phase 1, goals and plans in Phase 2, and attempts at learning in Phase 3. These products are then compared with standards through the monitoring process, and the fit between product and standards determines whether any particular phase’s product will suffice and the next phase will begin or whether recycling through the current or previous phases is required to bring the product up to specification.

In terms of IPT and SRL (for a review, see Winne, 2001), memory capacity has a limiting effect on these processes. Cognitive load theory (for a more complete examination of cognitive load architecture, see Sweller, 2006) suggests that working memory is limited to three to five chunks of information (Paas & Kester, 2006). Advanced processing limits this amount to three in many cases. Students do develop automaticity (Logan, 1988) or the ability to recall multiple steps of a strategy in one memory unit, so that they do not exhaust their working memory on procedure. For more advanced strategies, or operations, automaticity may be essential, and the failure to achieve it may set limits on whether more advanced kinds of concepts can be learned effectively. However, just how automaticity and long-term memory limits influence the comparison of standards and products during each phase is not clearly outlined in Winne and Hadwin’s (1998) model. Do cognitive
evaluations require memory space, and if so, how does this competition for resources influence the quality of monitoring? Future research suggested by the cognitive architecture includes an examination of how automaticity relates to the effective use of operations and whether standards degrade over time if they are not stored in long-term memory.

Standards

Standards in Winne and Hadwin’s (1998) model are derived from students’ assessments of task and cognitive conditions. A schema of standards is a goal, and Winne and Hadwin made it clear that the monitoring of products and standards may lead to reevaluations of these goals as well as the means of achieving them. Indeed, Ridley, Schutz, Glanz, and Weinstein (1992) found that goal setting coupled with high metacognitive awareness led to better performance among college students, as did Morgan (1987). Likewise, how learners construct goals seems to be important. Research suggests that specific goals stated as production rules (i.e., if-then statements) are more effective than more general ones (Oettingen, Honig, & Gollwitzer, 2000). This finding is supported by research in organizational psychology that specific, difficult goals are associated with higher levels of effort and performance (Locke & Latham, 2002). Schwartz and Gredler (1998) found that teaching goal setting to graduate students led to better performance.

Researchers may benefit from assessing goals throughout the course of learning, to monitor how they change from phase to phase during the process of learning as described in Winne and Hadwin’s (1998) model. The recursive nature of the model suggests that standards almost certainly change during learning, as students adjust to changing task conditions (“I’m running out of time”), the consistent update of cognitive conditions (“I’m not learning this as quickly as I thought; I must not be good at this”) and the monitoring of strategy use (“Just reading the text is not helping me learn; maybe I need to start quizzing myself”). Thus, researchers should assess goals at multiple points during learning to better understand these changes.

Monitoring and Cognitive Evaluations

Monitoring can be defined generally as “deliberate attention to some aspect of one’s behavior” (Schunk, 1991, p. 267). The process of monitoring can be considered one of SRL’s definitive qualities (Pintrich, 2000; Winne, 2001; Winne & Hadwin, 1998; Zimmerman, 2000, 2001). SRL theories assert that students have the capability to actively and purposefully assess their learning and make adjustments as needed on the basis of these evaluations, even if sometimes they do not do this. Winne and Hadwin (1998) highlighted that there are two different levels of monitoring. Metacognitive monitoring involves evaluations of the processes of SRL, whereas cognitive monitoring includes more specific processes such as calibrations and JOLs.

Metacognitive Monitoring

Given its prominence in every phase of Winne and Hadwin’s model, persistent metacognitive monitoring would seem to be an essential component of successful SRL. Indeed, high self-monitoring ability, defined as the monitoring of the entire SRL process, has been associated with better performance and predictions of
performance among college students (Schraw, 1994) and seventh graders (Pintrich & De Groot, 1990). Lan, Bradley, and Parr (1993) and Lan (1996) compared students engaged in self-monitoring with other students who either monitored the instructor or did no monitoring. In these studies, self-monitoring students outperformed instructor-monitoring students. However, the results were mixed regarding self-monitoring and no-monitoring students, with one study showing no difference and one showing an advantage for self-monitors.

In absolute terms, research suggests that students are not effective at monitoring their learning on their own (Butler & Winne, 1995; Stone, 2000). However, broad characterizations may not be appropriate, because there is evidence that monitoring skill is domain general among college students (Schraw, Horn, Thorndike-Christ, & Bruning, 1995; Schraw & Nietfeld, 1998). The hope that monitoring skill can be taught has received little attention. In one of the few studies on this topic, Delclos and Harrington (1991) showed that fifth graders who received monitoring support, compared with a control group, did better on some types of logic problems but not others.

In general, metacognitive monitoring seems essential to productive learning. Unfortunately, Winne’s (2001) research has found that when a task is clearly beyond a person’s capability, memory and cognitive resources are overtaxed, leading to a decline in self-monitoring behavior. Winne posited that when overtaxed, students prefer cognitive monitoring over metacognitive monitoring. Yet in Winne and Hadwin’s (1998) model, monitoring requires both appropriate standards from other phases (such as task definitions) and products from the current phase. Therefore, a failure to monitor standards from Phase 1 or 2 may be just as problematic as a lack of monitoring of Phase 3 products.

**Cognitive Monitoring**

There is also a great deal of research focusing more on the monitoring of specific learning outcomes. These cognitive, as opposed to metacognitive, evaluations are called calibrations or judgments of learning. They are confidence judgments about future test performance “indicating how aware individuals are of what they do and do not know” (Stone, 2000, p. 437). These judgments can have an influence on both performance and metacognitive monitoring in general (for a thorough review of calibrations and SRL, see Stone, 2000).

These cognitive evaluations are often measured as the correlation of test performance and predicted performance before studying, during studying, after studying, or even after a test itself. Winne and Hadwin’s (1998) model casts light on the question as to whether all cognitive evaluations are the same, particularly when they occur at different times in the learning process. For example, are students’ predictions of test performance before studying based more on interpretations of the task created in Phase 1 and less on the success of the learning strategies used in Phase 3, given that they have not had the chance to enact Phase 3 yet? Are cognitive evaluations during studying based solely on Phase 3 products? What influences cognitive evaluations made after learning? Are they an overall assessment of the success of the entire learning process? Are they influenced by prior judgments or self-schemas enacted during Phases 1 or 2?

A review of some key studies involving cognitive evaluations before, during, and after learning is necessary before these concerns can be explored more
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thoroughly. In this review, cognitive evaluations after learning are presented first, followed by evaluations after performance. Each of the empirical articles addressing prelearning evaluations also involved evaluations at other times as well, so they are presented last.

Cognitive evaluations after learning. In most cases of JOL research, participants are asked after a learning task to make a prediction about how well they would do on a test of the material (Pintrich, 1999). Participants scoring high on JOL measures accurately predict both the questions they will answer correctly as well as the ones they will answer incorrectly. A fundamental question alluded to earlier is whether a confidence judgment made after the learning processes has ended, such as JOL, is the same as a cognitive evaluation made within the process, as described by Winne and Hadwin’s (1998) model.

For example, in a study of word-pair recall, Dunlosky and Nelson (1992) found that college students were more accurate in predicting whether they could successfully recall a word pair in a future test if they made their JOLs after a 10-minute delay. Students who engaged in JOLs immediately after studying the word pair tended to be less accurate in their predictions. In addition, students were more accurate when presented solely with the stimulus word, as opposed to seeing the stimulus and response words together. Following Winne’s (2001) findings regarding memory and SRL, these studies suggest that these cognitive evaluations are based not on long-term memory but rather on working memory, so the delay allows working memory to decay and a long-term memory product to be accurately assessed.

The cognitive architecture of Winne and Hadwin’s (1998) model highlights that for students to accurately assess their learning, they must have both an appropriate learning product from Phase 3 as well as a correct task definition or standard against which to compare that learning product. The task in Dunlosky and Nelson’s (1992) study was very clear: simply being able to recall the responses to a set of word stimuli. It seems unlikely that participants would create a poor standard, or definition of the task, in Phase 1, so in this case, it seems likely that they were evaluating the fit of that product to the standard.

In another study of JOL, Thiede and Anderson (2003) asked college students to read a text passage and then summarize it immediately, after a delay, or not at all. Participants then predicted whether they would be successful on a test of reading comprehension. In this JOL study, the task definition was somewhat more ambiguous, because reading comprehension could be operationalized into any number of standards. Nonetheless, Thiede and Anderson’s findings corroborated Dunlosky and Nelson’s (1992): Participants who delayed before summarizing were more accurate in their JOLs, with the delayed summarization group also doing better on the performance test. Thiede, Anderson, and Therriault (2003) also found that a short delay preceding a keyword generation task helped students better monitor their learning, leading to increased study time and better performance on a posttest. Each of these studies would seem to indicate that JOLs are best performed after a delay and have to do with the comparison of Phase 3 products with previously established standards.

However, Koriat’s (1997) investigation of the cues that college students use to predict word-pair recall sheds a different light on what phase products students use
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in making JOLs. Koriat found that intrinsic factors, such as perceived item difficulty, a Phase 1 product, were the basis of JOLs much more than extrinsic factors, such as the number of repetitions of presentation. This produced the interesting result that as presentation frequency increased, participants’ JOLs got more and more inaccurate. Participants continued to believe that they would not remember the items, when in fact they were more likely to do so because they saw the items more. Instead of relying on judgments of difficulty made in Phase 1, the most accurate JOLs were those that were based on mnemonic-based heuristics, such as previous experience with word pairs, cue familiarity, and the ease with which the pair came to mind. Thus, Koriat’s work seems to imply that participants form initial beliefs about the likelihood of recalling an item in the task definition phase. In terms of Winne and Hadwin’s (1998) model, even though the learning occurs in Phase 3, and repeated presentations improve a person’s chances of successful recall, Koriat’s findings suggest that the person continues to hold the previous belief about recall that was formed in Phase 1, which can lead to an inaccurate JOL. This implies that JOLs may be based on products from multiple phases in Winne and Hadwin’s model, and thus any interventions designed to improve their accuracy must address both cognitive evaluations made in Phase 3, as well as the products of Phase 1 that might be influencing students’ judgments.

Cognitive evaluations after performance. Cognitive evaluations can also be made after a posttest. Pressley, Ghatala, Woloshyn, and Pirie (1990) presented college students with multiple readings from literature and science that were gauged to be at a PSAT level. Participants were told that they would be taking a thematic test after these readings. After answering questions on the readings, participants were asked either whether they wanted to reread the passage to get more information to improve their answers (Experiment 1) or to rate their confidence in their answers (Experiment 2). In both experiments, students were asked to judge whether their answers were correct, and in both experiments, students showed an inability to recognize that they had given the incorrect answer. Students chose to move to the next reading (Experiment 1) or rated their confidence in their answers as high (Experiment 2) more often when their answers were incorrect than when they were correct. Winne and Jamieson-Noel (2002) found in their study of science reading that for the most part, college students were reasonably accurate in their posttest ratings of evaluation, with a correlation of .88 between their evaluations and performance. Interestingly, though, a regression analysis of test achievement found a significant negative β weight for calibration of achievement, suggesting that as calibration skill increases, test achievement goes down. There are numerous possible explanations for these seeming discrepancies, including the possibility that the most accurate students are those who know that they do not know something and that there are systematic group differences that are unexamined in the data. Both Kruger and Dunning (1999) and Sinkavich (1995) have done work investigating this latter possibility.

Kruger and Dunning (1999) gave a grammar and logic problem-solving ability pretest to college students and then asked them to rate their confidence in their answers on a posttest after each individual question. Their data showed that those students who scored the lowest on the ability pretests were most likely to mis evaluate their performance, demonstrating unjustified overconfidence in each case. Sinkavich (1995) obtained similar results, showing that low-achieving college
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students had poorer metamemory, or cognitive posttest evaluations, than high achievers. Even so, the high achievers correctly evaluated their performance only about 60% of the time. Thus, research such as Pressley et al.’s (1990) work suggests that the lowest performers are the poor evaluators, and their gross inability is masking the results of the other students who are better at this skill. That being said, Sinkavich’s work suggests that even high achievers could stand to improve their estimates of performance. These findings stress how important it is to determine what kinds of task definitions and standards students are developing in Phase 1 of Winne and Hadwin’s (1998) model. Is student overconfidence due to poorly created standards, an inability to make good cognitive evaluations due to memory overload, or some other reason altogether? Winne and Hadwin’s focus on phases of learning, with monitoring occurring during both task definition and goal-setting, helps identify multiple areas to investigate regarding poor cognitive evaluations after learning. These findings also suggest that students’ ability levels might be a determining factor and should be included in future work.

Cognitive evaluations at multiple times. Although the focus of their study was more on the role of practice tests’ effect on test prediction accuracy, Maki and Serra (1992) found that college students could reliably rank their relative performance both before and after testing. Maki and Serra’s results on the effect of practice exams on posttest scores were mixed, with a lack of correlation between the practice test and the actual test calling the results into question.

Two studies looked at students’ judgments of learning prior to a learning task, after a learning task, and again after performance on a test. Peverly, Brobst, and Graham (2003) asked college students to predict their performance before and after reading a history text, as well as after they had taken an essay test and a multiple-choice test. Students were not adept at predicting their performance at any of these times. Within groups that were allowed to take notes and had a more in-depth interaction with the material, many students failed to accurately predict their performance, despite the fact that these groups did better on the tests than the groups that were not allowed to take notes.

In an attempt to study prediction accuracy and metacomprehension judgments in a more naturalistic setting, Hacker, Bol, Horgan, and Rakow (2000) followed students over an entire semester in an undergraduate educational psychology course in which self-assessment was emphasized. One week before each of the three exams, students were given a practice test and told to use these tests as a means of determining what they did and did not know. Before each exam, students reported what percentage of the exam questions they expected to answer correctly. After the exam, students recorded how many questions they believed they actually got correct. Finally, after each of the first two exams, students were told how their predictions compared with their actual performance and were encouraged to determine the cause of any discrepancies in preparation for the next exam.

This study involved a setting with high stakes (course grades) and an environment that was extremely focused on understanding and applying cognitive evaluation skills. In results that may clarify findings from other studies, Hacker et al. (2000) found differential effects of cognitive evaluation dependent on students’ performance. High achievers were good at evaluating their performance both before and after the exams. Students with average ability were not good at predicting performance beforehand but were effective at doing so after the exams.
Most significantly, the lowest scoring students in the class were also the worst at evaluating their performance both before and after the exams. In addition, Hacker et al. found that high achievers’ prediction and postdiction evaluation skills improved over the three exams, whereas low achievers’ evaluation skills did not. Finally, throughout the course, the students’ predictions of performance were stronger predictors of future performance than their actual test scores, suggesting that students failed to attend to their actual achievement, instead opting to base their evaluations on their initial perceptions.

These results suggest that, particularly for low-achieving students, there is a failure to incorporate Phase 4 and external evaluation information into future cognitive conditions. Students’ beliefs in their abilities remain impervious to performance feedback, which for low achievers is a dangerous gap in the SRL loop. These data may also suggest a failure to correctly engage in cognitive evaluations in Phase 3 learning. Research needs to be done regarding whether these students are creating faulty standards in Phase 1 or whether they are for some reason unable to effectively evaluate the match between their products and standards in Phase 3. De Bruin, Rikers, and Schmidt (2005) provided support for the latter hypothesis. These authors found that prompting JOLs from students with low prior knowledge actually impeded their learning. It could be that novices must exert so much effort in the basic task of learning that any additional activity, such as JOLs, exerts too high a cognitive load, impairing performance (Winne, 2001).

Summary of Monitoring and Cognitive Evaluations

Thus, viewing research on metacognitive and cognitive monitoring and evaluations through the lens of Winne and Hadwin’s (1998) model suggests that researchers should examine which phase products are influencing these assessments. Students may calibrate and judge their learning on the basis of products from Phase 1, 3, or 4. A challenge for SRL researchers is to find a way to make explicit participants’ weighing of Phase 1 products versus new information regarding the relative success of their learning activities in Phase 3. Think-aloud protocols have been used with some success in making students’ dynamically changing beliefs about learning explicit (Azevedo, Cromley, & Seibert, 2004). Cognitive monitoring also influences metacognitive monitoring (Stone, 2000). If high metacognitive monitoring skills are essential to successful SRL, another question to be explored is whether overconfidence leads to a decline in metacognitive monitoring. Do students who have unwarranted faith in their learning processes therefore fail to exert the effort to metacognitively monitor their other SRL processes? Given that standards created in Phase 1 directly influence the cognitive evaluations made in Phase 3, this could lead to a vicious cycle of poor phase products and the inability to recognize that the manner in which those products have been made requires adaptation or metacognitive control.

Control

The other hub of Winne and Hadwin’s (1998) SRL model is metacognitive control. When cognitive evaluations indicate a discrepancy between products and standards, adjustments should be made. Cognitive evaluations might indicate that task definitions are at fault, in which case adjustments are made to those Phase 1 products accordingly. However, the problem might also lie in Phase 3, suggesting that
the operations used to learn the material were unsuccessful. This would entail metacognitive control over the choice of learning strategies and operations. The ability to change learning behaviors is an indicator of eventual success, as shown by Azevedo and Cromley (2004), who demonstrated that those students who enacted more SRL strategies had larger mental model shifts than those who used fewer SRL strategies. Likewise, Nelson, Dunlosky, Graf, and Narens (1994) demonstrated that although JOLs may be inaccurate (Hacker et al., 2001; Pressley et al., 1990; Sinkavich, 1995), when college students correctly recognize what items require further study and devote time to them, their performance does improve. Nelson et al.’s research also suggests that Thiede and Dunlosky’s (1999) findings, in which students chose to study easier items already learned rather than harder items not yet committed to memory when under time constraints, have additional negative implications, because they might teach students to ignore harder items when in fact studying them would improve performance.

Again, in support of the idea that SRL can be taught, Ghatala, Levin, Pressley, and Lodico (1985) found that teaching second grade students how to monitor strategy use and alter strategies when they prove ineffective led to increased performance compared with control groups both immediately after the intervention and 9 weeks later. Among struggling college students, Ley and Young (1998) found that what differentiated successful students from those who struggled was the consistency of the SRL strategy, rather than any particular strategy in and of itself.

Winne and Hadwin’s (1998) model contributes to the literature through its explicit modeling of control during each phase of learning. When a cognitive evaluation indicates a mismatch between a phase product and standard, Winne and Hadwin suggest that students can enact control functions that can alter current and previous phase products. Although certainly other models of SRL include such dynamic interactions across phases of learning, Winne and Hadwin made these relations much more explicit, as can be seen in Figure 1.

In addition, by separating task definition and planning, Winne and Hadwin (1998) allowed for the possibility that students may be effective in controlling one but not the other. It could be the case that some students show the ability to regulate their learning by changing strategies in the face of poor Phase 3 products but fail to select appropriate alternate strategies because of a poor task definition. In this case, control is being exerted, but it is not leading to success in Phase 3. Measures of SRL strategy use must be able to identify these students. Researchers should take care to examine both the ability of students to change plans as well as task definitions. Students must be able to do both effectively.

**External Evaluations and Performance**

Winne and colleagues (Butler & Winne, 1995; Winne & Hadwin, 1998) have already provided a comprehensive review of how both internal and external evaluations influence performance. In general, when students adapt their learning to external feedback, their performance tends to improve. Feedback can come in many forms, but the most effective seems to be that which provides students with information about domain-specific content and how students can more effectively use tactics and strategies, rather than just simple outcome feedback (Butler & Winne, 1995; Stone, 2000). Students may benefit from both conditional knowledge regarding when and why strategies should be used as well as procedural
instruction on how to monitor more effectively (Stone, 2000). However, feedback’s influence on future performance is mediated by task and cognitive conditions (Winne & Hadwin, 1998). For example, feedback indicating that a student did not meet an external criterion may not influence future behavior if the student’s own goals for the task were met (Butler & Winne, 1995). Therefore, external evaluators such as teachers must also assess whether the source of students’ poor performance lies in their beliefs and, if so, make efforts to tune or restructure those cognitive conditions into more availing ones. In addition, Schunk (1982, 1983) showed that feedback that connects students’ effort to prior achievement has a positive influence on task motivation and self-efficacy, particularly for students with learning disabilities (Schunk & Cox, 1986). Winne and Hadwin’s (1998) model contributes to the literature on feedback by making clear that both content and cognitive feedback are mediated by conditions, and research into which types of feedback are most helpful needs to take into account these factors.

Discussion

This has been a theoretical review of Winne and Hadwin’s (1998) model of SRL. We have attempted to show how current literature can be productively viewed through the lens afforded by this model, and we believe that numerous areas for future research result from this new perspective. Specifically, Winne and Hadwin’s integration of a more complex, iterative cognitive architecture (COPES), with a focus on phases and the inclusion of monitoring and control in every phase of SRL, has shed new light on numerous areas of SRL research, including contextual influences, motivation interactions, and judgments of learning. These contributions, plus the model’s clear separation of task definition and goal-setting processes into distinct phases, have presented new areas for future research mostly involving more targeted measures of task definition, goal setting, and the interaction of conditions both before and during the learning process. However, the model itself is not immune to constructive criticism, and below we outline some challenges as well as limitations.

Challenges for Winne and Hadwin’s Model of SRL

Despite our enthusiasm for Winne and Hadwin’s (1998) model, we do see some areas that need to be addressed. Specifically, we think the model could be improved by clarifying the role of Phase 4 and external evaluations, addressing the regulation of motivation, integrating developmental literature, and clarifying student characteristics.

Phase 4 and External Evaluations

Throughout the learning task, the monitoring of products from each of the first three phases of Winne and Hadwin’s (1998) model can lead to updates to task and cognitive conditions. However, these updates are supposed to be constrained to only that task. Long-term changes to task and cognitive conditions are supposed to come about only as the product of Phase 4. It seems odd to suggest that there might be updates to cognitive conditions that last only for the duration of the learning task. For example, Zimmerman and Kitsantas (2002) described how certain kinds of modeling lead to increases in self-efficacy, among other things. Is this change in self-efficacy localized only to that task at that time? If so, why? If not, is it then
a Phase 4 product? The model certainly needs some way of explaining long-term changes to cognitive conditions and operations, but given that the cognitive architecture is constantly updating throughout each phase, it is unclear to us how Phase 4 differs. It seems that any updates regarding the utility of certain strategies or the influence of successful strategy use on cognitive conditions could occur as a result of Phase 3. In fact, Winne (2001) described Phase 4 as “optional” (p. 168). Under what conditions is this phase optional? Does a student make a conscious choice to update conditions or not?

In addition, the very process by which Phase 4 occurs is also somewhat unclear. Each phase of Winne and Hadwin’s (1998) model is supposed to engage the same COPES mechanisms. If Phase 4 involves “relatively permanent changes” (Winne & Hadwin, 1998, p. 285) to cognitive conditions, it seems the conditions would be the products, an overlap that is not entirely clear. In addition, what would be the standards in this phase? We encourage Winne and Hadwin to provide more information regarding how the COPES mechanisms within Phase 4 work to produce whatever changes to conditions may result.

Finally, the influence of external evaluations, particularly feedback and external regulation, also poses many testable hypotheses. For example, do students who learn with the assistance of peers, teachers, or hypermedia environments integrate what is scaffolded into their future solo learning? Does external feedback transfer to novel situations? What areas or phases of Winne and Hadwin’s (1998) model are most susceptible to external feedback? By systematically varying the type of external feedback in an experimental design, researchers could answer these questions and perhaps tailor future external regulation interventions on the basis of these results, as well as craft hypermedia environments with the appropriate levels and kinds of feedback.

Regulation of Motivation

Just as students are able to assess their learning and adjust their strategies as necessary, they are also able to do so with their motivation. The regulation of motivation occurs when students “purposefully act to initiate, maintain, or supplement their willingness to start, to provide work toward, or to complete a particular activity or goal (i.e., their level of motivation)” (Wolters, 2003, p. 190). These actions can include strategies that influence a student’s choice of task and persistence in doing it. Thus, motivation can be seen as both a product, in terms of the current state of motivation, and a process, in terms of the actions taken to motivate oneself. The regulation of motivation is influenced by many of the same conditions as cognition, including beliefs (such as epistemological beliefs regarding innate ability and effort), context, and knowledge of strategies. Strategies for the regulation of motivation include self-consequating, goal-oriented self-talk, interest strategies, self-handicapping, and emotion regulation.

As Wolters (2003) made clear, however, the regulation of motivation is underemphasized in the literature. In particular, we believe that Winne and Hadwin’s (1998) model can incorporate the regulation of motivation, but its place and function are not as clear as they could be. Winne and Hadwin’s model posits that regulation occurs because of the cognitive evaluations resulting from monitoring the fit of products and standards. The four phases each result in a different product that is monitored. The regulation of motivation would also seem to require the
evaluation of products against standards, but with the content being a student’s
effort, affect, and volition. It is not clear how this would occur in Winne and
Hadwin’s model. Are motivation products created alongside cognitive products?
If so, how do operations create these motivation products? Are motivation prod-
ucts a part of phase products, and if so, do they differ by phase? Is there another,
motivational architecture running in tandem with the cognitive? At this time we
are not clear on how the model would address these questions.

**Development**

Similar to other IPT-influenced models (Anderson et al., 2004; Anderson &
Labiere, 1998; Newell, 1990), nowhere in Winne and Hadwin’s (1998) model is
there a discussion of how SRL phase activities develop over the life span. In gen-
eral, IPT models have traditionally focused on adult cognition and the underlying
cognitive processes supporting learning and performance, with very little or no
attempt to discern developmental differences (cf. Siegler, 1996). In one study that
did look at SRL developmentally, Azevedo, Cromley, Winters, Moos, and Greene
(2005) did find that college students outperformed high school and middle school
students in terms of their acquisition of declarative knowledge, the sophistication
of their mental models, and their use of effective SRL monitoring activities and
strategies.

Yet it would seem doubtful that students come to college, or elementary school
for that matter, fully formed with a complete complement of SRL abilities. Instead,
research into frontal lobe development and the ability to forestall gratification and
manage emotions (Damasio, 1994) suggests biological influences on the ability to
self-regulate. It seems reasonable to ask whether there is some kind of develop-
mental progression within SRL, and research in this area would perhaps not only
allow us to more clearly examine individual phenomena in SRL but also provide
clues as to how good SRL behaviors might be taught (Pintrich & Zusho, 2002). A
developmental trajectory might also give us some clues as to whether there are
intractable differences between novices and experts in SRL, or whether it is a skill
in which most people can attain proficiency (Zimmerman, 2006).

**Student Characteristics**

Finally, we are concerned that so much of SRL seems to vary depending on stu-
dent characteristics. For example, it should be noted that numerous studies have
found differential effects depending on student ability level, such as the finding
that strong students monitor and calibrate their learning effectively, whereas low-
achieving students do not (Garavalia & Ray, 2003; Hacker et al., 2000; Pintrich &
De Groot, 1990; VanZile-Tamsen & Livingston, 1999). In addition, there is some
evidence that the relations between conditions, operations, and products may dif-
fer between students with and without learning disabilities (Ruban, McCoach,
McGuire, & Reis, 2003). Using a self-report measure called the Learning
Strategies and Study Skills survey, Ruban et al. (2003) examined the relations
between college students’ motivation, use of SRL strategies, and academic
achievement. After achieving acceptable fit of their measurement model, the
authors used multiple-groups structural equation modeling to compare the strength
of the relations across students with and without learning disabilities. They found
that the relations between motivation, memorization strategies, and self-reported
GPA did not differ across groups. However, the influence of SRL strategies on GPA, controlling for other factors, was much stronger among students with learning disabilities compared with those who did not have learning disabilities. At the same time, students with learning disabilities perceived these skills to be less important than other students, instead favoring compensation strategies. Thus, it would seem that there are additional student-level characteristics beyond cognitive conditions that mediate the relation between SRL behaviors and performance.

We are not clear as to how Winne and Hadwin’s (1998) model can account for these types of student characteristics. As we understand it, the model posits relatively stable relations between conditions, operations, and products. But the research cited above suggests that these relations may vary depending on numerous student characteristics. The specific inclusion of these characteristics in the model may point to ways of examining how students’ characteristics influence their movement through the four phases.

Conclusion

Despite these challenges, we feel that Winne and Hadwin’s (1998) model has much potential to influence how researchers can understand the phenomenon of learning. We believe that this theoretical review has outlined a number of ways that the model affords a new perspective on current research, as well as suggesting many potentially fruitful directions for new research. However, it is important to remember that Winne and Hadwin’s model is but one of many. None of these models can yet be considered “definitive,” and each makes important contributions to the rather broad area of SRL. It is our hope that this review helps others better understand the unique contributions of this model and prompts researchers to begin exploring the many seemingly fertile paths for future research that the model suggests.

Notes

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Winne and Hadwin called the four processes stages, whereas Winne (2001) described them as phases. We have chosen to use the more recent designation of phases throughout this article.

References


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