Self-Regulation at Work

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Key Words

motivation, negative feedback loops, goal-performance discrepancies, multilevel processes

Abstract

Self-regulation at work is conceived in terms of within-person processes that occur over time. These processes are proposed to occur within a hierarchical framework of negative feedback systems that operate at different levels of abstraction and with different time cycles. Negative feedback systems respond to discrepancies in a manner that reduces deviations from standards (i.e., goals). This is in contrast to positive feedback systems in which discrepancies are created, which can lead to instability. We organize our discussion around four hierarchical levels—self, achievement task, lower-level task action, and knowledge/working memory. We theorize that these levels are loosely connected by multiple constraints and that both automatic and more conscious processes are essential to self-regulation. Within- and cross-level affective and cognitive processes interact within this system to motivate goal-related behaviors while also accessing needed knowledge and protecting current intentions from interference. Complications common in the work setting (as well as other complex, real-life settings) such as the simultaneous pursuit of multiple goals, the importance of knowledge access and expertise, and team and multiperson processes are also discussed. Finally, we highlight the usefulness of newer research methodologies and data-analytic techniques for examining such hierarchical, dynamic, within-person processes.

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INTRODUCTION

Our understanding of motivated behavior in the workplace increasingly relies on a dynamic self-regulatory framework to understand how individuals allocate volitional, cognitive, and affective resources across multiple tasks (Kanfer et al. 2008; Vancouver 2005, 2008). Work motivation has traditionally been approached from a between-person perspective that typically uses cross-sectional methods and emphasizes individual differences (Latham & Pinder 2005). In contrast, recent trends emphasize longitudinal and within-person approaches. We view this as a challenging but positive change. This emphasis has required applied researchers to (*a*) rethink theory, (*b*) adopt new methodologies and analytic techniques, (*c*) carefully consider how the phenomena of interest unfold over time and in the context of competing work tasks and social demands, and (*d*) incorporate knowledge from research on basic cognitive and affective processes, as well as advances in neuroscience that have implications for dynamic models. Ultimately, we believe a focus on understanding dynamic self-regulatory processes has the potential to address previous calls to integrate the wide variety of motivation theories (Locke & Latham 2004).

Why is this shift to more dynamic theories and models occurring? One reason is the increased recognition that although cross-sectional research contributes to our understanding of performance based on observations of stable differences between persons, many of our theories, as well as our subjective experiences, tell us that self-regulatory processes vary within individuals. Moreover, many of the practical motivational issues that managers wish to better understand are at least implicitly within-person in nature (e.g., "how do I *keep* my current employees motivated?"). Dalal & Hulin's (2008) review finds many variables traditionally studied by motivational researchers exhibit a great deal of within-person variability, e.g., 29% to 78% of variance in performance was within persons, and proximal motivational predictors such as affect (47% to 78%) and goal level (31% to 38%) also showed substantial variability. We believe a large proportion of this within-person variability reflects internal self-regulatory processes engaged to adapt to changing situational and environmental features.

Importantly, generalizing from between-person research findings to within-person motivational theories can be misleading, even when the same set of variables is considered. For example, cross-sectional, between-person research consistently shows positive associations between self-efficacy and performance (Stajkovic & Luthans 1998). Yet within-person research finds self-efficacy can be negatively associated with subsequent performance

(Vancouver et al. 2001, 2002) when high self-efficacy leads one to coast, but low self-efficacy motivates greater effort expenditure. This example serves as a general warning that cross-sectional studies may do little to inform our understanding of within-person self-regulatory processes; studies of within-person processes will require fresh expectations about critical constructs and the nature of relationships among them.

The work context has several aspects that may make it of special interest to researchers focused on self-regulation. First, because workers are expected to self-manage much of their behavior, mechanisms that allow for internalization and tying of goals to the self are especially critical. Second, work goals are often pursued under time pressures and deadlines that may modify the nature of self-regulatory processes. Third, many work situations require juggling the simultaneous pursuit of multiple goals (Schmidt & DeShon 2007). Fourth, employees often have relevant formal education, job training, and prior job experience, thus function as expert information processors. Because effective performance draws on this expertise as well as conscious processing (Newell 1990), self-regulation includes the management of knowledge access as well as the management of selective attention, emotions, and behavioral processes. Finally, success at work often requires regulation of interpersonal behaviors directed toward supervisors, coworkers, customers, etc., while simultaneously meeting task demands. Although each of these features can be present in nonwork contexts, they may be more prominent when individuals pursue goals at work.

Our review begins with a description of basic self-regulatory processes, building on research that explicitly addresses self-regulation across time. Initially, we focus on single tasks and a unitary criterion, and then extend this model to include multiple tasks and criteria. This description is informed by relevant works from cognitive, affective, personality, and social areas of psychology, which provide a foundation for understanding the nature of dynamic self-regulatory systems and their emergence from more fundamental intrapersonal processes. By extending this model, we hope to advance research on work motivation by incorporating ideas from research on dynamic processes, affect, goal content, and multiple goals. Importantly, we argue that self-regulation at work is shaped by multiple external constraints, including social and organizational factors, in addition to those constraints originating from internal sources.

Constraints: connections between units in a system that transfer activation or inhibition, helping to activate or inhibit the receiving unit

Negative feedback loops: compare sensed inputs to internal standards and respond to detected discrepancies from those standards with self-corrective actions

SELF-REGULATION

Self-Regulation: A General Model

Self-regulation includes "processes involved in attaining and maintaining (i.e., keeping regular) goals, where goals are internally represented (i.e., within the self) desired states" (Vancouver & Day 2005, p. 158). Thus, at the center of most theories of self-regulation are the ideas that individuals set goals, compare their progress against the goals, and make modifications to their behaviors or cognitions if there is a discrepancy between a goal and the current state (Karoly 1993). These variables and their interrelationships comprise the negative feedback loop (see **Figure 1**), which consists of an input function, a reference value, a comparator, and an output function (Carver & Scheier 1998). The input function senses how one is currently performing. The reference value is an image of a desired state such as a task goal that is actively maintained by the system. The comparator matches the input with a standard or goal to determine if there is a discrepancy between them. If a difference is detected, the output function is engaged to bring the subsequent input in line with the goal. This output may include behavioral changes aimed at increasing or decreasing effort, as well cognitive changes aimed at altering one's interpretation of the standard, input, or discrepancy. (Negative feedback loops can be contrasted with positive feedback loops, which have all of the same components but consist of individuals setting standards higher than current performance so as

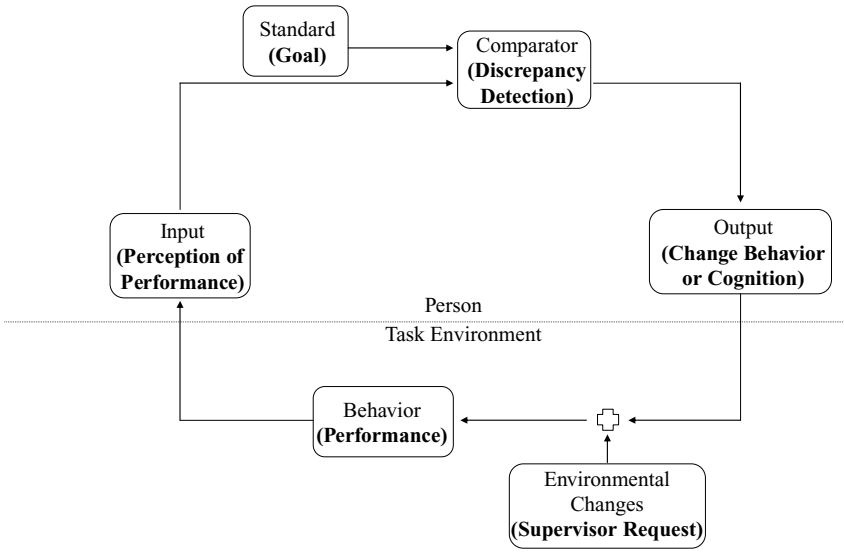

Figure 1

Negative feedback loop.

to create a discrepancy or enlarge an existing discrepancy.)

This general approach also assumes a hierarchical structure in which short-term, concrete goals are low in the hierarchy, and long-term, abstract goals are high in the hierarchy. Lower-level goals can be conceptualized as the means by which higher-level goals are attained (Lord & Levy 1994). This is considered a structural model of self-regulation, describing variables and their interrelationships but not the content or form of any particular goal or behavior (Diefendorff & Lord 2008).

Accounting for Different Levels of Consciousness and the Role of Affect

Any viable model of self-regulation at work must address two fundamental issues. First, both conscious and unconscious processes influence behavior. Although we intentionally and consciously focus on the external task environment and on task-related memories and knowledge, regulation of environmental inputs and other task-relevant information may be largely determined by more automatic processes (Johnson et al. 2006). In addition, goals are often automatically activated by environmental primes or cues arising from social sources (e.g., significant others) or from the recognition of means (i.e., subgoals) that can be used to achieve goals (Shah & Kruglanski 2003). For example, when experimental participants were subliminally primed with father-related words (e.g., "dad"), their father's approach to working on tasks affected participants' approaches to working on an experimental task and the emotions that task feedback produced (Shah 2003, Study 3). The unconscious, automatic nature of many self-regulatory processes has been sadly underemphasized and understudied in contemporary research on work motivation (Locke & Latham 2004).

The second issue is that affective and cognitive systems must operate concurrently and with multiple points of connection to shape self-regulation. Cognition and affect are integrated at fundamental levels and influence each other over time (Allen et al. 2008, LeDoux 1995). Effective self-regulation must allow both for focused attention on current goal-related activities and for rapid reorientation toward new, important information. The affective system plays an important role in achieving this balance; it

Hierarchical structure: the embedding of more concrete, narrow feedback loops within more encompassing, abstract loops

is fast, automatic, and can interrupt and reorient conscious processing (LeDoux 1995, Simon 1967). Dopamine, an affect-related neurotransmitter, also modulates the maintenance of goals in the prefrontal cortex (and indirectly goal-related information) (Diefendorff & Lord 2008, O'Reilly et al. 1999). Thus, affect can quickly clear the conscious workspace when reorientation is required.

These gating and biasing functions of affect are important micro-level regulators of cognition and behavior. They can operate in such a manner because perceptual systems have direct routes to affective centers such as the amygdala (LeDoux 1995), which, in turn, are connected to the prefrontal cortex (Allen et al. 2008). Affect can also have other important functions such as helping to elicit appropriate coping responses, helping to manage goal conflict, or guiding current and future regulatory processes. A general model of self-regulation must account for dynamic interrelations between affect and cognition at multiple levels of consciousness.

Level of Abstraction, Cycle Time, and Self-Regulation

Level of abstraction and cycle time. Self-regulation is future-oriented and takes place within the onward flow of time. It occurs at various levels of abstraction. We discuss four broad levels of abstraction, which we term micro, low, intermediate, and high. Each level is associated with different types of self-regulatory loops—i.e., negative feedback loops that compare desired states to actual states with the objective of detecting and reducing discrepancies.

Importantly, the level of abstraction inversely relates to the cycle times of feedback loops associated with that level. Cycle time is the time required for information to cycle through the entire loop. Longer cycle times tend to be associated with higher-level, more abstract constructs (Johnson et al. 2006, Lord & Levy 1994). For example, self-regulation in terms of possible selves may have a cycle time measured in years as individuals try out and modify various provisional selves as they adjust to new roles (Ibarra 1999). At the intermediate level of abstraction, self-regulation around achievement tasks may have a cycle time of only a few minutes, hours, or perhaps days, as a goal is attempted and feedback received. At lower levels of abstraction, specific actions such as typing a word while writing may take only a few seconds, with feedback and correction operating on a similar scale. Finally, still lower levels involving the regulation of muscle movement, knowledge access, or experienced affect may have cycle times of a fraction of a second, with part or all of the components in a self-regulatory cycle operating unconsciously. Importantly, these differing cycle times imply that the nature and content of self-regulatory processes also may differ radically at different levels, as we suggest in **Table 1**.

Scripts: knowledge structures containing organized sequences of actions that are needed to accomplish higher-level goals

Cross-level linkages and emergence. **Table 1** contains many terms and constructs that are not yet defined. It serves as a rough roadmap for this review as we discuss each of the four cycle levels. Some of our coverage is guided primarily by existing research on self-regulation at work, but other discussion is based on inferences from theory and research on cognition, affect, and neurocognition.

One topic implied by **Table 1**—how the various levels are linked—warrants initial discussion. A common approach to explaining links across levels is to posit a hierarchical arrangement in which higher-level processes exert supervisory control over lower-level processes. That is, in the Focus row of **Table 1**, referents to the left specify the selection of constructs to their right, e.g., possible selves influence one's choice of achievement tasks. Research on metacognitive processes and on control theory (e.g., Carver & Scheier 1998, Powers 1973) fits this hierarchical perspective. Supervisory or hierarchical control operates best when adjacent levels use similar processes (e.g., conscious deliberation) so the output of one level can feed directly into an adjacent level (e.g., intermediate-level goals access lower-level scripts). Such models imply hierarchical, top-down control of actions,

Table 1 Aspects of self-regulatory and motivational theories by cycle level

	CYCLE LEVEL			
	High	***Intermediate***	***Low***	***Micro***
Focus	Possible selves	Achievement task	Integrated task behaviors	Behavioral components
Time	Months/years	Minutes/hours/days	Several seconds	Tens of milliseconds
	Major components of dynamic self-regulatory processes			
Referent establishment	Culture, social, value constraints	Conscious choice or automatic priming	Conscious choice, habit, unconscious goal emergence	Spreading activation from goals, working memory, and environment
Planning, goal maintenance	Provisional self is developed	Goal commitment	Goal shielding	Priming and inhibition-gated neurotransmitters
Action	Working self-concept is activated	New actions composed and executed	Driven by appropriate scripts or schemas	
Evaluation and feedback	Interpreted relevant to self	Interpreted relevant to task	Learning in neural networks updates expectancies	Neurotransmitter release and uptake

but as we illustrate, bottom-up control or sequential linkages among goals at the same level are also common.

When cycle times at two levels differ vastly, or when they emphasize very different types of processes, direct hierarchical supervision falters as a linking mechanism. For example, conscious deliberative processing operates too slowly to control switching from one behavior to another in complex scripts (e.g., well-learned dance steps) or to control the access of knowledge from working memory. Structured knowledge may create links, as when one activity automatically primes subsequent activities and when this procedure operates within knowledge structures cued by higher levels. For example, setting forks on the table may automatically prime getting napkins and may be cued by higher level goals related to getting ready for dinner. But in other circumstances, there may be no direct links between adjacent hierarchical levels. Instead, higher levels may merely create constraints on processes that run fairly autonomously at lower levels. For example, having an "effective worker" identity may not directly specify how one's job should be performed, but rather will impose more general constraints on task activities.

Constraints are connections between units in a system that transfer activation or inhibition from one unit to another, making it more or less likely that the receiving unit will become sufficiently active to affect behavior. Often, multiple constraints must operate in concert to create sufficient input to activate a lower-level process. When higher levels create constraints, lower-level processes may be guided by structures that emerge spontaneously as a result of these internal constraints combined with any relevant external constraints from task environments (Carver & Scheier 2002, Johnson et al. 2006). For example, an active collective identity may promote cooperation (i.e., an internal constraint from a higher level), but cooperative achievement task goals may emerge only when one encounters coworkers who are liked and need help (i.e., an external constraint originating in the task environment). DeShon & Gillespie (2005) successfully use the idea of cross-level constraints to articulate how particular goal orientations emerge from higher-level personality and goal structures.

Cross-level constraints can also operate in a bottom-up fashion, as when readily available means or task strategies prime higher-level

goals. For example, in four experimental studies Shah & Kruglanski (2003) found that means like studying and exercising made goals related to education and fitness more accessible and also that priming means associated with a task increased persistence and performance, but priming means related to an alternative goal reduced task performance and persistence. Cross-level links can also conflict (Sherman et al. 2008), as when lower-level environmental cues prime behaviors inconsistent with higher-level goals (e.g., one eats desserts that look appealing but are inconsistent with higher-level self-relevant health goals).

Dynamics of Self-Regulation

Idealized, conscious flow, and phase models. Most dynamic models are represented by flow diagrams such as that shown in **Figure 1**, by a sequence of phases, or by a combination of these approaches. Models such as the one depicted in **Figure 1** show how simple regulation occurs based on sensed feedback, but they do not show how such systems are created in the first place. Phase theories help explain how self-regulatory systems may be created. For example, Gollwitzer (1990) identified four self-regulatory phases, which have associated mindsets. These mindsets prepare the person to act, and they appropriately tune information processing to facilitate the operations required in each phase. Typically, goals are established (deliberative mindset), planning occurs (implemental mindset), goal striving takes place (actional mindset), and goal evaluation/revision concludes this process (evaluative mindset). Often the phases are followed in this order, but individuals can also move back and forth among phases. Gollwitzer's model guided our organization of the components of dynamic processes in the bottom portion of **Table 1** (but note at the micro level it is not helpful to distinguish between planning and action phases).

Nature and control of processing and the importance of knowledge. Because most existing motivational theory applied to work situations has focused on achievement tasks, conscious processing has been emphasized. Yet many important dynamic aspects of self-regulatory processing, such as accessing relevant knowledge or learning from feedback, may operate automatically and very quickly. Knowledge management is particularly important because individuals often have considerable experience in their jobs. As experience accumulates, performance becomes increasingly determined by knowledge that is automatically accessed from long-term memory and is less dependent on attention-demanding processes that create needed knowledge on the spot (Anderson 1987, Kanfer & Ackerman 1989, Newell 1990).

Goal-relevant information has easier access to working memory than does information related to competing goals (Diefendorff et al. 1998, Johnson et al. 2006, Shah et al. 2002). How well individuals maintain goals then also influences how well they can access relevant knowledge. Interestingly, automatic management of knowledge access works better for important goals than for unimportant goals (Diefendorff et al. 1998, Shah et al. 2002). Managing working memory is also a critical aspect of effective supervisory control by a higher hierarchical level because activation of other processes spreads from constructs held in working memory in a manner that is biased by goals (Anderson 1987, Lord & Levy 1994, O'Reilly et al. 1999).

Knowledge management: the automatic process by which one accesses and maintains goal-relevant knowledge while it is needed for goal pursuit

Time and deadlines. Importantly, self-regulatory processes may differ as a function of the time remaining for goal pursuit. Deadlines are often an integral aspect of goal assignments (Locke & Latham 1990). Shorter deadlines increase the difficulty of reaching a given level of performance and thus often increase motivation (Steel & König 2006). The pace of work often increases as deadlines draw tighter and time pressure mounts. However, overly imposing or impossible deadlines can result in performance decrements (Andrews & Farris 1972). Additionally, creativity may be impaired by time pressure (Amabile et al.

2002), likely due to the narrowed attentional focus and systematic processing often invoked by anxiety. Steel & König's (2006) temporal motivation theory models the motivating power of approaching deadlines, arguing that the perceived utility of a given activity increases exponentially as the deadline nears. These and similar ideas have been applied to the pervasive phenomenon of procrastination: They imply that immediately rewarding background temptations (e.g., Internet and email) may possess greater utility than do organizationally important activities until their deadlines draw near.

Summary of the General Model of Self-Regulation

In short, self-regulatory processes are controlled and integrated not only by a conscious executive system that uses information deliberately, but also by goal structures maintained in the frontal lobes and affective systems in the midbrain that collaborate to automatically manage goal maintenance, knowledge access, and attention regulation. Active identities and affective states also exert strategic control on several aspects of information processing. Although we can analyze self-regulation in terms of separate levels, and most theories of motivation we review pertain to just one of the levels in **Table 1**, self-regulation in real-world settings requires the collaboration of multiple systems that operate on different time scales and are found in different neural locations. Furthermore, self-regulation may be indirectly or directly influenced by stable attributes of the person and situation, although additional work on these cross-level influences on goal-directed behavior is needed. With this initial understanding of the dynamic, multilevel nature of self-regulation as an underlying framework, we discuss the literature on self-regulation at work for each of the levels represented by the four columns in **Table 1**, noting that it is becoming increasingly clear that the basic processes of self-regulation operate differently at different levels of the hierarchy.

SELF-REGULATION AT ALTERNATIVE HIERARCHICAL LEVELS

High-Level Regulation of the Self

The self is a richly connected, developing knowledge structure widely viewed as important for self-regulation (Markus & Wurf 1987). Indeed, the brain appears to have a specific network of structures that supports introspection and creates autobiographical memories by integrating internal and external information (Raichle et al. 2001). (Interestingly, this network is suppressed below baseline activation when one focuses on task goals, allowing pursuit of task activities without self-relevant distractions.) Autobiographical memories allow a sense of the self to continue through time (Kihlstrom et al. 2003). One's time perspective can influence how the self is construed. Distant self-construals (e.g., "me next year") are more abstract, less complex, and more coherent than construals of the self in the near future (Wakslak et al. 2008). Distant self-construals are also less tied to context than are near selves and are thought to be more closely tied to a stable set of personality traits than are near selves.

Work settings both build on existing selves (in the form of identities) and shape new identities. For example, the sense of self as a leader may develop over a surprisingly long time (Day et al. 2009), with roots in activities going as far back as grade school (Komives et al. 2005). A leader identity in turn may influence many motivated choices and self-regulatory activities in the workplace, ranging from proactive creation of opportunities for one's own self to actions that empower others to demonstrate initiative and exhibit self-leadership.

Work settings shape identities through many mechanisms. The overarching culture and values of a work setting can create powerful sets of constraints on the self, which in turn result in a sense of the self as an organizational member with specific roles and relations to others. There are important dynamic trends within work contexts, particularly when roles change as a result of promotion, developmental

assignments, restructuring, and other new demands. For example, Ibarra (1999) posits that managers develop provisional selves when trying out new roles. Provisional selves operate like the standard in any control system, but they may be quickly modified or discarded based on social feedback or fit with one's active ideal selves. Research by Lockwood & Kunda (1997) in an academic setting found that beginning and advanced students had very different reactions to other high-performing social referents. This effect may be interpreted in terms of provisional possible selves: For beginning students, the performance level of the referent was likely compared to a far self-construal, perceived as attainable, and thus motivating; for advanced students, the comparison was likely to a near self-construal, with the high-performing referent being perceived as an unattainable comparison standard.

Considerable research shows possible selves are influenced by significant others (Andersen & Chen 2002), with unique selves being developed and activated in different social relations. Organizational leaders may play a particularly important role in this process (Lord and Brown 2004, Shamir et al. 1993), and self-identities developed with one supervisor can generalize to other similar supervisors (Ritter & Lord 2007). Groups are also important in refining organizational identities (van Knippenberg et al. 2004), with social justice binding individual identities to groups and social injustice isolating individuals from groups (Lind 2001). Leary & Baumeister (2000) argued that the need to belong is so powerful and adaptive that one function of the self is to continually update where we stand in the opinions of others, and the resulting self-esteem provides an internal meter of the soundness of our interpersonal connections and likely access to socially mediated resources. In short, a variety of individual and collective social processes influence the development and maintenance of one's organizational self, and this development may occur throughout one's organizational life, although changes are most intense for newcomers and individuals who are changing organizational roles.

One's organizational self-identity also creates cognitive, motivational, and affective constraints that guide more achievement-focused activities. At any one moment, only a portion of the self is active and directing achievement-related activities. Markus & Wurf (1987) labeled this momentarily active self the working self-concept (WSC), arguing that it has a direct role in regulating behavior. Various examples can be given of the nature of these dynamics. For instance, De Cremer & van Knippenberg (2002) found that self-sacrificing supervisors elicit corresponding collective selves in subordinates, fostering cooperative work behavior. Self-benefiting supervisors activate individual-level self-identities, with resulting higher levels of subordinate competitive behaviors. In addition, the self has important associations with motivational orientations: Selves defined in terms of "ideals" elicit different regulatory orientations than selves that emphasize "oughts" (Shah & Higgins 2001). Furthermore, appraisal of an organizational event's potential to benefit or harm the self shapes affective reactions to that event. In short, the WSC is influenced by many organizational and social factors, and it has important motivational, affective, and cognitive consequences for self-regulation.

Working self-concept (WSC): the momentarily active portion of the self-concept that regulates motivational processes

Goal shielding: the processes by which active goals and related information are protected from interference from information related to competing goals

Intermediate-Level Self-Regulation

Most research on self-regulation in work settings focuses on regulation at an intermediate level around task or action goals. Regardless of whether the studies have been conducted in the field or laboratory, the goals in question have tended to be of short duration and are often achievement based. Importantly, intermediate-level self-regulation involves both controlled and automatic processes (Carver & Scheier 1998, Lord & Levy 1994, Vancouver 2005). Setting task goals is often viewed as a conscious process, but a comprehensive understanding of self-regulation in work settings must acknowledge the extent to which automatic processes play important roles in the regulation of task goals, as well as sometimes determining which goals are selected for action. For example, goal

shielding, which maintains focus on task activities and prevents derailment by distracting activities (e.g., the planning- and action-phase rows in **Table 1**), is generally thought to be relatively automatic. Task progress is monitored and evaluated, with adjustment to behavior and goals occurring through both conscious and automatic processes.

Another key point is that self-regulation consumes not only regulatory resources, but also attentional resources (Schmeichel & Baumeister 2004, Schmeichel et al. 2008, Vohs et al. 2008). This is particularly true when tasks are novel (Kanfer & Ackerman 1989). In addition, outcomes of self-regulatory processes may have affective consequences that individuals attempt to manage, often without full consciousness and in manners that may detract from the total attentional resources available to devote to the task (Baumeister et al. 2007, Boekaerts & Corno 2005).

Theories of self-regulation that emphasize the functioning of feedback loops (e.g., control theory) have been criticized as being overly mechanical (Bandura & Locke 2003); however, recent findings suggest they are only one component of a more complex human system with cognitive, emotional, and physiological constraints. One challenge for applied research is to understand how these seemingly diverse elements are organized into a coherent, dynamic system. The following sections review current thinking on some of the pieces of that system, which focus on goal setting and selection, goal striving, and feedback processes.

Goal setting and goal selection. Conscious self-regulation begins when an action goal is chosen (Carver & Scheier 1998). Although goals can differ on a large number of attributes (Austin & Vancouver 1996), the dimensions most commonly discussed in organizational research are goal difficulty and specificity. A large body of goal-setting research finds that difficult, specific goals, if accepted, lead to higher performance than do easy or do-your-best goals (Locke & Latham 1990) as long as the goals are attainable and commitment to the goal is maintained (Hollenbeck & Klein 1987). When choosing to pursue a goal (or to commit to an assigned goal), individuals mentally simulate how much effort it would take to reach each potential goal as well as what the potential outcomes of goal pursuit might be (Aspinwall & Taylor 1997). Klein et al. (2008) characterized this goal-selection process as occurring "at multiple levels within goal hierarchies, flowing from broad overarching goals to middle-level 'working goals' and down to lower-level subgoals and behavioral sequences" (p. 110).

Yet even when goals have been consciously adopted, processes that are less conscious may influence goal choice and self-regulation around those goals. For example, affect may indirectly influence goal selection (Hom & Arbuckle 1986), likely through effects on expectancy and valence judgments (Seo et al. 2004). Emerging research suggests that affect also can have direct effects on motivated behavior that do not operate through conscious processes (Bargh 1990). For instance, high activation emotions may lead individuals to exert more energy in the pursuit of desired goals and in the avoidance of undesired goals (Cacioppo et al. 1999). Other research links emotional information to physical movement, such that positive emotions are aligned with approach behaviors such as faster responses for pressing a computer key, and negative emotions are aligned with avoidance behaviors such as faster responses for moving off of a key (Seibt et al. 2008).

As mentioned, although self-regulation is generally thought to be initiated by setting conscious goals (Carver & Scheier 1998), goals in the workplace also may emerge from sets of constraints (Carver & Scheier 2002, DeShon & Gillespie 2005, Johnson et al. 2006), or they may reflect unconscious processes that seem to have effects on behavior that are similar to conscious goals (Chartrand et al. 2008). For example, in a review of 64 independent studies, Ouellette & Wood (1998) found that habit rather than conscious intention was important for frequently performed behaviors (e.g., coffee and alcohol consumption, seat belt use, class

and church attendance, most types of exercise), which occur under stable enabling conditions, but conscious intentions provide a better explanation for infrequent behaviors (e.g., voting, giving blood, obtaining a flu shot), which generally occur under unstable shifting conditions that do not provide constant sets of supportive cues. Wood et al. (2002) used an experience-sampling methodology to examine behavior that reflected both rational cognitions and more intuitive, automatic cognitions. They found that habitual actions that tended to be performed daily (such as getting ready for work) were frequently produced by more intuitive, automatic processes that occurred while individuals were thinking of something else.

The potential role of unconscious processes in goal selection was further elaborated by Lord et al. (2003), who used neural network modeling to show that in stable, familiar situations, neural networks can learn to select alternatives that maximize expected utility (i.e., the product of valance, instrumentalities, and expectancies). They also showed that this automatic selection process is sensitive to shifts in constraints from higher-level goals. Such research is consistent with Vallacher & Wegner's (1985) Action Identification Theory, which maintains that as tasks become more familiar, attention shifts to higher levels in self-regulatory hierarchies, but when difficulties are encountered, attention can again be allocated to lower-level activities. Thus, attention and conscious processing may be flexibly applied to self-regulation, although only to a relatively narrow slice of goal hierarchies (Austin & Vancouver 1996, Lord & Levy 1994).

Goal selection, particularly in work situations, often reflects social processes. Other individuals can prime goals, creating "goal contagion" effects (Aarts et al. 2008, Fitzsimons & Bargh 2003). When this process is repeated, workplaces develop climates that foster particular types of goals (Dragoni 2005). Work supervisors (or other significant figures) may play a particularly important role in such processes by communicating appropriate self-regulatory standards or by activating alternative identities (Lord & Brown 2004, Shamir et al. 1993), which then constrain the goals that emerge. Supervisors can also assign goals directly to subordinates.

Goal striving. Once goals are established, they provide a standard to which feedback is continually compared as a means of regulating behavior and effort. Several factors complicate this dynamic goal-striving process. First, although effort is mobilized to address goal-performance discrepancy (GPD; typically defined as performance minus goal), the relation between GPDs and increases in effort or performance is nonlinear. Large negative GPDs can motivate large increases in performance if self-efficacy is maintained, but they can also reduce effort when they lead to discouragement and task withdrawal (Carver & Scheier 1998). When GPDs direct attention to the self rather than the task, they can also negatively influence task performance (Kluger & DeNisi 1996, Vancouver & Tischner 2004). Ironically, when GPDs are positive (performance exceeds goals) and self-efficacy is high, individuals may coast, reducing effort and performance and perhaps allocating effort to other tasks (Carver & Scheier 1998, Schmidt & DeShon 2009, Vancouver et al. 2002).

In addition to GPDs, individuals are sensitive to the velocity of discrepancy reduction; that is, the rate at which they move toward or away from desired standards (Carver & Scheier 1990, 1998). Chang et al. (2009, Study 2) manipulated velocity and found it was positively related to goal commitment, which in turn influenced task persistence. Building on the seminal theory of Carver & Scheier (1990), the strongest support has been provided for the positive effects of high velocity on the outcome of task satisfaction (Chang et al. 2009, Elicker et al. 2009, Lawrence et al. 2002). Because velocity incorporates information on the time course of performance, Johnson et al. (2006) argued that it may be particularly relevant to self-evaluation (i.e., "Am I an effective employee?"), which may explain its potential to produce strong affective reactions. As already mentioned, because individuals regulate affect

Goal-performance discrepancy (GPD): the distance from an internal standard; represented by subtracting performance from task goal levels

Velocity: the rate at which one is approaching internal standards or reducing a GPD in a given time period

along with task performance (Baumeister et al. 2007), low velocity and the associated negative affect can lead to task disengagement through processes such as reduced attention or lowered goals (Elicker et al. 2009). However, sometimes disengagement may have positive health benefits associated with stress reduction and may allow faster re-engagement of more adaptive alternative goals (Wrosch et al. 2007).

Understanding successful goal striving also requires a consideration of selective attention, which serves as a mechanism linking the intermediate and the micro levels. Lord & Levy (1994) suggested a key function of self-regulation is to protect working memory and that processes of inhibiting competing schema and of activating goal-relevant information are essential to effective self-regulation and performance. Early support for this idea comes from Diefendorff et al. (1998), who found that students who were better at inhibiting distracting information in a cognitive-reaction time task were better able to achieve important life goals.

Shah et al. (2002) demonstrated that activated goals inhibit information related to competing goals and that individual differences in the strength of this inhibitory process (tenacity, in their terms) affected goal shielding. Johnson et al. (2006) provided the most systematic study of the effects of goals on attention regulation. Their meta-analysis showed instantiating goals increase accessibility of goal-relevant information relative to neutral information (based on 41 effects) and also reduce accessibility of information related to competing goals (based on 27 effects). Interestingly, when goals are completed, they are then suppressed relative to baseline conditions, and goal-relevant information becomes less accessible (based on 22 effects). Such research clearly establishes the important link between one's current motivational intentions and the knowledge that is easily available to guide task activities.

Thus, selective attention processes serve a dual function of shielding motivation and of enhancing performance by facilitating access to relevant knowledge. Performance is generally believed to rely on both motivation and ability; in this context, ability can be thought of as having access to relevant knowledge. There may be many work tasks for which knowledge differences have a greater effect on performance than do motivational differences. If some workers are experts (i.e., have extensive training and work experience), whereas others are novices, performance will primarily be a function of differences in task-specific ability (Newell 1990). An implication of this point is that attempts to increase performance by increasing goal difficulty will have limited success to the extent that performance also relies on access to knowledge that may not be readily available.

Feedback. For many tasks, individuals receive periodic external feedback (performance appraisals, informal social responses, customer reactions) that complements the self-generated feedback they create while doing tasks. External feedback often partitions activities into discrete episodes and momentarily focuses individuals on the re-evaluation of appropriateness of goals and the maintenance of task engagement. The sign and magnitude of GPDs are critical influences on subsequent actions. Many studies show downward revision of goals when large negative GPDs exist and show increases in goals when GPDs are positive (Campion & Lord 1982, Donovan & Hafsteinsson 2006, Ilies & Judge 2005, Kernan & Lord 1990). Several studies qualify the relationship of GPD to goal revision, showing it is stronger late in performance cycles and when internal attributions are made (Donovan & Williams 2003, Williams et al. 2000), or when learning or performance-avoidance goal orientations are salient (Radosevich et al. 2004). In addition, affect also appears to be an important mediator of within-person goal revision (Ilies & Judge 2005).

With a few notable exceptions, most empirical work has focused on the effects of negative GPDs. Donovan & Hafsteinsson (2006) found the effect of positive GPDs on goal levels was moderated by self-efficacy and by performance and learning goal orientations. Specifically, the GPD–goal setting relationship

was stronger when self-efficacy and performance goal orientation were high and learning goal orientation was low. Tolli & Schmidt (2008) examined both positive and negative feedback (GPDs), finding performance feedback and causal attributions interactively influenced self-efficacy, which then influenced goal revision. Elicker et al. (2009) also showed velocity related positively to increases in goal levels when goals were high in importance. But with low goal importance, velocity negatively related to goal revision, perhaps reflecting a coasting response invoked when performance was perceived to be going well. Finally, in an interesting study that probed possible explanations for increasing goals above one's prior performance, Phillips et al. (1996) found that both higher-level achievement needs and one's desire to maintain high performance were associated with setting goals higher than past performance.

In contrast to the complex and often moderated effects of GPD on performance, a more straightforward relationship exists between GPDs and satisfaction. Satisfaction is greater the more performance exceeds prior goals (Elicker et al. 2009, Ilies & Judge 2005, Kernan & Lord 1991, Thomas & Mathieu 1994). These effects are stronger when internal causal attributions are made (Thomas & Mathieu 1994). High velocity also contributes to task satisfaction (Elicker et al. 2009) and job satisfaction (Chang et al. 2009) over and above the effects of discrepancies. The positive affect generated by high velocity may have indirect effects on performance if it spills over into the next self-regulatory cycle.

Summary and extensions for intermediate-level self-regulation. Intermediate levels of self-regulatory processes have received the most attention to date by organizational researchers, with emphasis on the role of goals and goal-performance discrepancies as they function within negative feedback loops. Early studies by organizational scholars who were focused on workplace applications tended to employ goals that were held in consciousness and that often were assigned. More recent work has broadened this focus, but as discussed above, an increasing body of research indicates that substantial work activity appears to be regulated by standards other than conscious, assigned goals, including (*a*) goals whose selection is biased by unconscious affective influences, (*b*) goals emerging from sets of multiple external constraints (e.g., social factors) whose influences are largely unconscious, and (*c*) habit.

Although a basic mechanism associated with GPDs in feedback loops has been established, there are challenges in accurately modeling the resulting performance during goal striving. GPD effects appear to be nonlinear and asymmetric with respect to the effects of negative versus positive discrepancies. Workers are likely sensitive (perhaps even differentially sensitive) not only to the distance from a goal or standard (i.e., GPDs), but also to the rate at which that distance is changing (i.e., velocity). The importance of attentional focus and knowledge access to protecting and facilitating goal striving has recently become clear. We have less knowledge about how to actually apply this understanding to specific work situations in order to increase performance. The capacity of external feedback to influence the parsing of goal striving into episodes raises interesting questions for future applied research about the optimal timing of feedback provision. The ongoing state of the organization's feedback environment may be an important contextual factor for self-regulation around intermediate goals (Steelman et al. 2004).

Lower-Level Self-Regulation

Achievement goals often affect behavior indirectly through their activating or inhibiting effects on shorter-term self-regulatory processes with very simple objectives (e.g., reading a document). We separate this level from that associated with achievement tasks for several reasons. First, activities at this level often require less attention and are more knowledge-dependent. For example, Schank & Ableson (1977) explained that these short-term goals were

often organized into knowledge structures called scripts, and Gioia & Poole (1984) discussed the relevance of scripts to organizational behavior. Scripts often specify the sequence of events needed to accomplish higher-level goals, but they can be flexibly applied in a manner that is sensitive to context. Many familiar work tasks are guided by a script structure (e.g., a staff meeting), and scripts can substitute for conscious goal selection in familiar, stable situations, a phenomenon that also can be understood in terms of habit (Ouellette & Wood 1998). Second, recent neurocognitive research also supports the distinction between these two levels. Neuroimaging studies indicate that there are different control structures in the brain for very short-term task activities compared to higher-level systems that maintain task focus for achievement tasks (Dosenbach et al. 2008).

Self-regulation at lower levels is much faster than at the two levels previously discussed. It is generally more dependent on automatically accessing appropriate behaviors based on cues from higher-level achievement goals or the situation than on conscious search or problem solving. For example, booting up one's computer requires some attention to the task environment, but retrieval of appropriate sequences from memory (e.g., mousing, entering login and password) is much faster and more efficient than is consciously thinking about needed actions. Environmental cueing of actions at this level can be facilitated by the formation of implementation intentions (Gollwitzer & Schaal 1998), which specify the conditions under which one will exert effort toward goal pursuit (Gollwitzer et al. 2008). Implementation intentions are formed by creating if-then statements that tie action to an anticipated environmental circumstance (i.e., when, where). When a cue is encountered, the goal-directed behavior is enacted (e.g., "When I go to lunch, I will drop off my report"). In other words, implementation intentions create a production system that operates automatically to elicit relevant action when the cue ("if" statement) is encountered, but this is a flexible system and the action only occurs as long as the higher-level goal (dropping off a report) is maintained (Gollwitzer et al. 2008). Research has shown that forming implementation intentions leads to better performance (Gollwitzer & Brandstätter 1997), with these effects operating through self-regulatory processes rather than through goal-related cognitions, such as choice or efficacy beliefs (Diefendorff & Lord 2003).

Goal setting creates an implicit bias in the accessibility (O'Reilly et al. 1999) and evaluation of the favorableness (Ferguson 2008) of goal-relevant stimuli so that individuals are cognitively and affectively ready to pursue goal-related activities. However, this effect occurs only when goals are actively pursued (Ferguson 2008, Johnson et al. 2006). Thus, goal activation at an intermediate level creates cross-level effects on the activation and evaluation of actions at lower levels. Implementation intentions may also elicit such effects.

Cross-level effects associated with the nature of achievement goals may also influence regulatory processes at this lower level. For example, having a learning goal may help to focus attention on task factors, thus facilitating learning and acceptance of feedback. Having a performance goal may direct attention toward comparisons to others, making learning less likely and increasing defensiveness. Also, achievement-related anxiety can draw performance away from task activities and orient it toward the self (Vancouver & Tischner 2004), especially when self-rated anxiety is high (Simpson et al. 2001).

Cross-level influences can also operate in the other direction. As task skill develops, many work tasks can be accomplished automatically. This frees attentional resources for focusing on other factors in the work environment, thus facilitating meta-cognitive activities associated with higher levels in hierarchies (Anderson 1987). Because self-regulatory cycles are completed quickly at this lower level, the resulting self-regulatory activities are often tightly integrated with one's task environment as well as with higher-level goals—consider the act of driving a car, which requires rapid and relatively automatic behaviors to be performed, but

with a consideration of driving conditions and an awareness of where one is headed.

Very Fast, Micro-Level Regulation

There is also a still faster micro level in which regulation occurs that is important to understand because it determines information access and working memory content. The content of working memory is particularly important because it determines what knowledge is accessed and maintained, allowing easy reliance on previously learned work behaviors. It is at this level that goal shielding is likely to occur. And, because activation spreads from high activation sources such as goals and working memory contents, the resulting activation of other structures is often regulated indirectly by processes such as goal shielding and working memory protection (Lord & Levy 1994). Thus, various tracks in scripts are likely automatically cued by higher-level goals and working memory contents rather than being consciously selected.

As shown in **Table 1**, activation and inhibition are key self-regulatory processes at this level. We have already discussed how these two processes contribute to the biasing effects of achievement goals, but there is also an important micro-level link between activation/inhibition and affective processes. It is widely known that the prefrontal cortex exerts brain-wide executive control through projections to many parts of the brain (Braver et al. 2002, O'Reilly et al. 1999). It does this by actively maintaining the patterns of activity represented by goals and the means to achieve them, a process mediated by the neurotransmitter dopamine. O'Reilly and colleagues (1999) argue that goals, which are maintained in the prefrontal cortex, must exhibit both a resistance to interference from new information (to maintain focus on necessary tasks until they are completed) and a receptivity to new information (in order to adapt to changing circumstances). These conflicting requirements are managed by dopamine availability in the following manner: When task success is anticipated, dopamine levels are high, positive affect is experienced, and the biasing function of patterns or images in the prefrontal cortex is enhanced; however, when task difficulty is encountered and reward expectations decrease, dopamine levels are reduced, and the gate for new information is opened, enhancing sensitivity to a broader context and alternative goals.

Such processes are important in three respects. First, they help us understand how affect could mediate the effects of performance discrepancies on goal change as reported by Ilies & Judge (2005). An increase in dopamine is experienced as rewarding, and it also triggers approach behavior and goal maintenance. Second, these processes suggest a broad and subtle means of adjusting one's task involvement in a rather automatic fashion. When things are going well and task requirements challenge but do not exceed one's abilities, attentional focus is automatically maintained and a sense of flow and positive affect is experienced (Csikszentmihalyi 1990). Yet when doubts about potential success develop, attention disengages, allowing one to protect the self from more severe disappointment and negative feedback associated with unexpected failure. Such a mechanism may help explain why self-efficacy (Vancouver & Day 2005) or positive expectancies (Carver & Scheier 1998) are associated with task persistence and why negative feedback interpreted at the level of the self (rather than the task) is so damaging (Kluger & DeNisi 1996). Finally, because information access is very fast [Newell (1990) estimates it to occur in about 10 ms], it may be more effective to regulate information access by an emotional gating mechanism than by a relatively slow conscious process. The implications of such processes for applied motivation are discussed more fully by Diefendorff & Lord (2008).

Self-regulation and multiple cycle levels. We have stressed that self-regulation involves the joint functioning of multiple levels of abstraction, which correspond roughly to the cycle times shown in **Table 1**. Thus, one may be performing a work task that is guided by a

conscious achievement goal. However, at the same time, (*a*) this occurs in the context of an active WSC, (*b*) lower-level actions may be automatically cued by scripts activated by the environment, task, and achievement goal structures, (*c*) these processes co-occur with an affective tone associated with success or failure on the achievement task and periodic assessment of goal progress, and (*d*) these factors together activate information in working memory while protecting it from interference. When self-regulation works effectively, processes at various levels and with various feedback cycles complement each other, but because of their different cycle times, are only loosely connected.

COMPLICATIONS IN THE WORKPLACE

Multiple Goals

As jobs become increasingly multifaceted, effectively dividing one's time and energy across multiple tasks has become critical for success. Unfortunately, goals sometimes conflict, with time spent on one goal coming at the expense of others (time spent on research versus time spent on teaching). A growing body of research has begun to identify factors influencing goal prioritization; GPDs appear to play a particularly important role in this process, too (Kernan & Lord 1990, Schmidt & DeShon 2007, Schmidt & Dolis 2009, Schmidt et al. 2009, Vancouver 1997). In laboratory settings where participants are presented with multiple goals, all possessing the same deadline, participants typically divide their regulatory resources by need. That is, they allocate more time toward goals that are furthest from attainment, particularly when the tasks are highly dynamic, with external factors contributing unpredictably to progress toward goal attainment.

Discrepancy-driven allocation allows attention to be flexibly reallocated to address changing circumstances, rather than rigidly maintaining current focus regardless of the situation (Carver & Scheier 1998, DeShon & Gillespie 2005, Lord & Levy 1994). This discrepancy-driven allocation strategy may be less prominent when the task environment is stable (it is clear from the outset what level of performance is necessary to achieve the task goals) and also when individuals perceive little likelihood of achieving both goals (Schmidt & Dolis 2009, Schmidt et al. 2009). Rather, under such conditions, there is a tendency to allocate more resources towards the goal closest to attainment. However, Steel & König's (2006) temporal motivation theory also suggests that differences in deadlines between multiple tasks may exert a heavy influence on goal prioritization. Goals with more immediate deadlines gain greater salience. Research is needed to integrate these varying perspectives on multiple-goal prioritization.

Goal difficulty also plays a role in resource allocation. Erez et al. (1990) found that differences in goal difficulty across two concurrent tasks (e.g., an easy goal for one task and a difficult goal for another) predicted resource allocation and performance. More resources are devoted to the more difficult goal, resulting in higher performance on that task. Yet, as difficulty increases, the resources required for attainment also increase and may eventually exceed the supply (Navon & Gopher 1979). Thus, concurrent assignment of difficult goals for multiple tasks may overburden individuals and necessitate tradeoffs, so that increased performance for one task comes at the expense of another (e.g., Schmidt & Dolis 2009). This finding serves as a caution to managers seeking to increase subordinates' performance on multiple tasks competing for limited resources.

Although it is underexplored, affect may influence multiple-goal processes. Carver & Scheier (1998) propose that positive affect can signal when a goal is well maintained and effort can be reallocated to other concerns, while negative affect can indicate a necessity for greater effort and sustained attention. Beal et al. (2005) argue that regulation of affect may draw cognitive resources from focal concerns, essentially functioning as a competing demand. However, they further argue that affective experiences can

influence response tendencies, such as positive moods increasing the likelihood that prosocial goals will become active. Although empirical studies explicitly linking affect to multiple-goal regulation are relatively rare, one recent exception is Louro et al. (2007), who found that negative emotions can encourage increased effort toward the focal goal when it is close, whereas positive emotions facilitate effort toward distant goals.

Research on multiple goals has primarily focused on alternative tasks that fit within the same overall motivational structure (e.g., two similar tasks may both be assigned by an experimenter). In applied situations, goals related to dual tasking may involve differences at all levels of our hierarchy, including different WSCs, goals, scripts, and motor activities, each with distinct emotions (e.g., one may be text messaging a family member during a meeting or one may be talking on a cell phone while working on a computer task or driving a car). Effectively switching between such tasks may involve more than just working memory capacity, but we know little about how other levels of self-regulation are involved. Future research is needed to clarify this issue.

Knowledge and Expertise

Often, workers perform the same job for many years and possess considerable expertise in their task domains. In contrast, much of the research on self-regulation presents participants with relatively novel situations. Expertise has numerous implications for self-regulation, some of which are mentioned above. Experts can extensively rely on automatic access to structured knowledge such as scripts to generate actions, in contrast to novices for whom performance creates a greater attentional load (Anderson 1987, Kanfer & Ackerman 1989, Newell 1990). Because fewer cognitive resources are required for the execution of basic task functions, experts can devote more resources to other processes, such as more strategic, meta-cognitive considerations.

Using a cognitively complex air-traffic controller task, Kanfer & Ackerman (1989) found that active monitoring of one's performance during task engagement can impair performance by consuming attentional resources that might otherwise be devoted to the task itself, a phenomenon that is particularly debilitating for novices and individuals with low cognitive ability. They explain such effects in terms of the competing attentional demands created by self-regulation and the complex task, but based on our perspective, performance goals assigned early in learning a task may also make the wrong information available because the links between goals and useful information have not yet been refined. Following this logic, experts are likely to experience less goal conflict and greater expectancy when faced with multiple tasks, particularly if they possess expertise on all tasks, both because attentional demands are reduced and because needed information is more efficiently accessed. Through experience, experts may be better able to make decisions that strategically balance competing goals in situations where one goal must be sacrificed for the sake of the other, as well as to better anticipate and prevent such situations from arising.

Multiperson Processes

The increasing prominence of teams in the workplace elevates the importance of understanding motivational processes within workgroups. Researchers have sought to extend basic principles of individual motivation to the group level. For example, studies on team goal setting have found that difficult, specific team goals often foster better team effort, planning, and strategy development, resulting in better team performance in comparison with easy or "do your best" goals (e.g., O'Leary-Kelly et al. 1994). Feedback is also an important factor in team performance (e.g., DeShon et al. 2004). Because feedback can direct attention to particular aspects of a task, it can influence the tradeoffs that team members make between maximizing their individual attainments and

contributing to the team. Provision of individual feedback produces greater emphasis on individual than on team performance and vice versa, whereas provision of both types of feedback encourages tradeoffs between individual and team orientations (DeShon et al. 2004).

Self-efficacy has also been extended to the team level in the form of team efficacy and group potency. Team efficacy refers to a shared belief that the team can effectively perform a specific task (e.g., Lindsley et al. 1995), whereas group potency is a more generalized belief in the team's capabilities across a range of tasks or situations (Guzzo et al. 1993). Similar to the typical finding regarding self-efficacy, team efficacy and potency have been found to be positively related to team performance (e.g., Gully et al. 2002). However, it is worth noting that these studies have typically utilized cross-sectional designs, leaving open the possibility of divergent effects analogous to those observed for the self-efficacy of individuals when examined longitudinally across time (e.g., Vancouver et al. 2001).

An important aspect of self-regulation is the adaptation of effort and strategies to maintain desired states despite changing external demands, ideas that have also been extended to the team domain. Similar to phase models of self-regulation discussed above (e.g., Gollwitzer 1990), Marks et al. (2001) distinguish between action phases, which are characterized by task engagement, and transition phases, which are characterized by task preparation and post-task reflection. Processes in the transition phase—such as careful mission analysis, goal clarification, strategy formulation, and contingency planning—as well as those during the action phase—such as careful monitoring of goal progress, team resources, environmental conditions, communication, and coordination—help promote adaptation to changing circumstances. LePine (2005) found that transition processes promoted adaptation during an unexpected disruption, whereas action processes facilitated adaptation after the disruption had ceased.

METHODOLOGICAL AND ANALYTIC CONSIDERATIONS

As models of motivation and self-regulation become more dynamic and complex, there is a parallel need for changes in research designs and analytic tools. In particular, repeated measures or longitudinal research designs that capture within-person data from multiple assessments are required to model or test propositions regarding cycles of self-regulation as described in previous sections of this review. Experimental designs using laboratory tasks in which multiple performance trials are performed are ideally suited for collecting such information. Additionally, experience-sampling methodology, involving the intensive collection of measures of motivational processes in daily life and natural environments, holds a great deal of promise for testing within-person motivational theories. Fortunately, this need for more sophisticated methodological approaches coincides with the recent development and refinement of a variety of statistical techniques and software designed for longitudinal data (see Collins 2006).

Repeated-measures analysis of variance and multivariate analysis of variance approaches still prove useful for the analysis of data from some research designs, but other procedures such as random coefficients modeling (e.g., hierarchical linear modeling and related techniques) provide very powerful and flexible tools for the specification of multilevel effects and linear or nonlinear patterns of change over time. For example, with such approaches one can model data in which individuals who experience different manipulations or who have different preexisting characteristics are expected to show different patterns of within-person change over time (Singer & Willett 2003). Random coefficient modeling approaches are used increasingly (e.g., DeShon et al. 2004, Ilies & Judge 2005).

Wider application, however, could be made of some other recently developed longitudinal analysis techniques. For example, hazard/survival models (see Singer & Willett 2003) were developed to model the likelihood of

occurrence and timing of events such as graduation from high school, relapse after an alcohol treatment program, or employee turnover (which may alternatively be thought of as length of stay). Perhaps because many of the events that have been traditionally modeled using this approach tend to unfold over relatively long periods of time, it has seen little application in research on self-regulation. However, hazard modeling may prove quite useful for examining phenomena such as persistance at a goal or maintenance of a regulatory focus (i.e., promotion or prevention; Shah & Higgins 2001). In such models, motivational predictors such as self-efficacy, GPDs, commitment, and other time-invariant (e.g., personality) or time-varying (e.g., affect) covariates can be linked to the likelihood of an event (e.g., abandoning a goal) occurring at a particular point in time.

In addition, more use could be made of special applications of structural equation modeling designed to estimate change over time. Particularly interesting are McArdle's (2009) latent change score models, which potentially avoid the classic issue of the unreliability of change scores created from measured variables. Some variations of latent change score models have other advantages such as allowing the decoupling of the time referent of the change score from the specific timing of measurements in the study, allowing for the specification of nonlinear (exponential) growth trajectories and determining the effect of a construct at one point in time on the change in a second construct at a later point in time. These models might be profitably applied to the within-person study of self-regulation in order to investigate issues such as the impact of GPDs experienced early in a performance cycle on potentially nonlinear changes in the allocation of resources later in the performance cycle.

An interesting possibility is to further explore issues of intraperson variability (as opposed to intraperson change) related to the functioning of self-regulatory cycles. Boker & Nesselroade (2002) build on earlier work by Boker to describe the damped linear oscillator model and demonstrate its potential usefulness in studying self-regulatory systems. The damped linear oscillator describes a pattern of change over time that may be compared to the motion of a pendulum swinging back and forth when friction is present. The side-to-side distance covered by the pendulum gradually lessens as friction diminishes the arc that the pendulum traverses. In a similar manner, one's self-regulatory processes may adjust around a trend or baseline, with deviations above or below this baseline lessening (or in some cases, amplifying) over time.

Several potential applications of oscillator systems to the study of self-regulatory processes occur to us. For example, positive and negative variability in effort expenditure may dampen around a finely tuned baseline level as an individual develops increasing experience with a task. Similarly, affect may oscillate more widely directly after a potent event, with variability decreasing around a trend toward neutral affect as the event recedes into the past [see Bisconti et al.'s (2004) study of fluctuations in the emotional well-being of recent widows modeled by an oscillator system]. Finally, variability in self-efficacy beliefs as one pursues a goal may reveal oscillation that dampens as goal completion nears.

Graphic depictions of processes that oscillate look rather different to many researchers because they describe cyclic rather than strictly linear patterns. However, they can be estimated using linear modeling approaches (i.e., within a regression framework). This is accomplished by estimating local approximations to the first derivative (change over time) and second derivative (velocity, or rate of change over time) of the variable being modeled. These approximations are then used as weighted predictors of the third derivative (acceleration). The coefficient for the first derivative estimates a frequency parameter, and the coefficient for the second derivative estimates a damping parameter. Once data points are fit to these models for each individual in the dataset, higher-level models that predict the individual damping and frequency parameters from other situational or individual difference variables can be tested,

much like is done in level-2 analyses in random coefficients modeling. Incorporating individual differences such as personality, attitudes, or values as predictors of damping or frequency parameters might help link between-person approaches to motivation and self-regulation with longitudinal, within-person processes.

Oscillator and related models may aid in more precise estimates of cycle times for specific individuals engaged in specific processes. They may also help in distinguishing data that reflect self-regulatory processes that are homogeneous within a population from those in which observed variability is simply due to normally distributed measurement error. Interestingly, other standard methods for analyzing longitudinal data, even those such as random coefficients models, cannot distinguish between these two types of data if phase length is unknown (Boker & Nesselroade 2002).

One challenge posed by the overarching self-regulatory framework described in this review is the potential that a large number of internal and external factors act as constraints on self-regulatory processes. Simulation techniques may be useful for modeling the effects of many variables that may cumulate or interact in complex manners. For instance, Lord et al. (2003) illustrates the use of simulation to investigate the internal logic of a complex model that recasts what was originally a conscious, symbolic-level approach to valence-instrumentality-expectancy theory into a subconscious neural network processing system. Similarly, Vancouver (2008) uses computational modeling to create mathematical representations of mechanisms involved in acting, thinking, learning, and feeling, which are then compared with results from earlier studies of actual research participant responses (also see Vancouver et al. 2008).

CONCLUSION

Self-regulation is important for success in modern work organizations. The increasing emphasis on personal initiative, empowerment, and self-management places a greater burden on individual workers to control their own goal-directed activities. Yet this increased demand to self-regulate may also yield benefits, including enhanced individual growth and development, greater well-being, and the realization of desired possible selves. We have reviewed recent thought about the operation of within-person self-regulatory processes over time and at different levels of consciousness. Although there will surely be debate about the particulars, we believe a multidimensional and interdisciplinary approach to thinking about self-regulation provides a necessarily complex and nuanced view of how individuals pursue goals. Importantly, workers often pursue multiple goals simultaneously and increasingly do so in socially interdependent contexts. Accompanying this greater complexity in theory is the development of methodological tools that can model self-regulation as a multivariate and longitudinal process. We call on researchers to take advantage of these recent advances to achieve a science of motivation at work that is both accurate in its depiction of self-regulatory processes and useful in its application to daily organizational life.

SUMMARY POINTS

1. Self-regulatory processes occur at different levels of abstraction with accompanying differences in cycle time and relevant variables and processes.
2. A mechanism common across levels is the negative feedback loop, which operates by comparing the current state with a desired standard.
3. Different levels of self-regulation can be linked both through supervisory control of lower-level processes by higher levels and by the imposition of constraints from one level to another (constraints may originate at either higher or lower levels).

4. Self-identities and the working self-concept (which may be influenced by organizational factors such as leadership) create cognitive, affective, and motivational constraints that direct lower-level task-focused activities.
5. Goals and goal-performance discrepancies drive self-regulation at the intermediate level, through both conscious and automatic processes, including biasing effects of affect, and are influenced by selective attention processes.
6. Lower-level self-regulation is often dependent on the relatively automatic application of scripts.
7. Important functions such as goal shielding occur at the very fast micro level of self-regulation, which is more directly dependent on neurological and neurochemical processes than are higher-level cycles of self-regulation.
8. When expertise is high, work performance may depend as much on effective knowledge management, which reflects functions at lower hierarchical levels and thus frees more attentional resources, as it does on effort regulation, which is more dependent on higher-level processes and may require greater allocation of attentional resources.

DISCLOSURE STATEMENT

The authors are not aware of any biases that might be perceived as affecting the objectivity of this review.

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