Self Control in Society, Mind, and Brain

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CHAPTER 23

From Stimulus Control to Self-Control: Toward an Integrative Understanding of the Processes Underlying Willpower

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ABSTRACT

Self-control is fundamental to human survival and success in the modern world. Consequently, a critical challenge is to understand the processes that underlie it. The main goal of this chapter is to address this issue to demystify the self-control construct. The chapter begins with the assumption that to make sense of the psychological processes that enable self-control it is first necessary to understand how they operate within the larger cognitive affective processing system guiding people's thoughts, feelings, and behaviors (Mischel & Shoda, 1995, 1998; Shoda & Mischel, 1998). We begin by briefly describing this system and discussing its value for conceptualizing self-control dynamics. Drawing primarily from research on delay of gratification in children (Mischel, Shoda, & Rodriguez, 1989) and recent work that has begun to link this research with findings at the cognitive and neural levels of analysis the chapter then describes the psychological processes that enable people to effectively exert self-control. The second half of the chapter transitions from reviewing prior research on delay of gratification to current work examining how findings revealed from this paradigm generalize to different kinds of situations that require self-control. The chapter concludes by discussing how future research on self-control may benefit from work that bridges different levels of analysis.

Keywords: Self-control, dual processes, reconstrual, personality, psychological distance

INTRODUCTION

A key feature that distinguishes human beings from all other animal species is their capacity for "willpower"—the ability to deliberately exert control over one's thoughts, feelings, and actions. Like so many of the remarkable capacities people possess, however, they often fail to be actualized when they are most needed. Consider, for example, the dilemma of the desperate alcoholic who is trying to quit but is tempted to enter the bar, or the starving dieter faced with the decadent crème brûlée, or the test-anxious student before an important examination. These kinds of "hot," emotionally arousing situations rapidly generate intense feelings, bypassing self-regulatory controls when they are most needed and making the person the victim of what Skinner and others called "stimulus control." Without the essential "preliminaries" that enable self-control—as William James (1890) named them over a century ago—willpower becomes a myth rather than a protective factor. The main goal in
this chapter is to identify these preliminaries to demystify the willpower construct. The chapter begins with the assumption that to make sense of the psychological processes that enable self-control, it is first necessary to understand how they operate within the larger cognitive-affective processing system guiding people’s thoughts, feelings, and behaviors (Mischel & Shoda, 1995, 1998; Shoda & Mischel, 1998). We thus begin by briefly describing this system and discussing its value for conceptualizing willpower dynamics. Drawing primarily from research on delay of gratification in children (Mischel, Shoda, & Rodriguez, 1989) as well as recent work that has begun to link this research with findings at the cognitive and neural levels of analysis, the chapter then addresses the main question motivating this review: What psychological processes enable people to transition from stimulus-control to self-control? The second half of the chapter transitions from reviewing prior research on delay of gratification to current work examining how basic findings revealed from this paradigm generalize to diverse situations and domains that require self-regulation—for example, situations in which adolescents and adults experience strong negative emotions that require regulation. The chapter concludes by discussing how current and future research on self-control may benefit from interdisciplinary work that bridges different levels of analysis.

**Keywords:** Stimulus control, self-control, emotion regulation, Cognitive-Affective Processing System.

### A Framework for Understanding Willpower Dynamics: A Self-Regulatory Processing System

The model guiding our conceptualization of willpower is the Cognitive-Affective Processing System (CAPS), a connectionist framework that was designed for analyzing individual differences and basic psychological processes, such as self-control (Mischel & Shoda, 1995, 1998; Shoda & Mischel, 1998). The CAPS model conceptualizes the human mind as a network of mental representations whose distinctive pattern of activation determines the thoughts and feelings they experience and the behaviors they display (e.g., Higgins, 1990; see also Shoda & Smith, 2004). The mental representations that are most relevant to situations that require willpower are captured by a set of cognitive affective units (CAUs) that encompass how people appraise and interpret situations, the feeling states they generate, their goals and values, expectancies and beliefs, and their self-regulatory competencies (for description of CAUs, see Table 23–1). Although each of these CAUs are themselves comprised of lower level processes (a point we return to later), we cast our discussion here at this relatively molar level of analysis because much of the work we review in this chapter has been performed at this level.

Within this model, different CAUs are interconnected within a stable associative network: this organization guides and constrains their activation with pathways of activation and deactivation. The relatively stable patterns of activation constitute the processing dynamics of the self-regulatory system. Situational features,
which may be events that are either encountered in the external world or created internally (i.e., through daydreaming, fantasies, rumination, etc.), are encoded by CAUs, which then activate additional CAUs through the activation network. In turn, the unique patterns of CAUs that become activated elicit a behavioral response pattern.

This kind of model offers a framework for understanding how different psychological processes interact to influence self-regulatory behavior. It thus allows researchers to move beyond broad trait level descriptions of self-control and focus instead on the interacting set of processes that underlie individual differences in self-control patterns. The next section discusses some of these processes, using the CAPS model as a framework to understand their operation.

**Processes in Self-Control**

When considering the processes that underlie self-control, it is important to distinguish between the individual's motivation to exert control and his or her ability to do so effectively (e.g., Mischel, 1974; 2004). This section describes the psychological mechanisms underlying each of these components of self-control, drawing primarily from research on children's delay of gratification ability (Mischel, 1974; Mischel, Shoda, & Rodriguez, 1989). The early phases of this research, which we focus on next, examined differences among children in their willingness to choose more valuable but delayed rewards rather than less valuable but immediately available ones. The emphasis was thus on the *motivational* factors influencing people's initial choice to delay gratification.
Processes Involved in the Decision to Delay Gratification

According to a CAPS analysis, whether people initially choose to exercise self-control in a given situation begins with their encodings. Do they judge a situation to be personally relevant? Is it meaningful and does it warrant further attention? To the extent that the answers to these questions are affirmative, additional CAUs become activated that directly influence goal commitment. Starting in the late 1950s, Mischel and colleagues began to investigate the specific patterns of CAU activation that impact people's decision to exert self-control by examining differences in their preferences for valuable but delayed rewards versus less valuable but immediately available ones. For example, a person's decision to take $1 today rather than get $1.50 tomorrow.

In one early set of studies conducted with children on the island of Trinidad, large differences were first observed in choice behavior between East Indian and Black participants, with the former group often preferring the delayed reward and the latter group the immediately available reward (Mischel, 1961). These differences disappeared, however, when the effect of father absence was statistically controlled. Those children who came from homes with absent fathers were likely to have fewer experiences with male social agents who kept their promises. Consequently, the same children showed less trust (an "expectancy" in CAPS language) that the male experimenter would provide the promised delayed rewards. These findings highlight the role that outcome expectancies and beliefs play in goal commitment. To the extent that participants encoded a situation as requiring self-control, they were likely to attempt to exercise it only if they trusted that the rewards would materialize (and were also valued to them, a point addressed below; Mischel, 1974).

Subsequent studies have indicated that an additional type of expectancy influencing people's motivation to delay gratification are their self-efficacy beliefs—whether they believe they can successfully exert self-control (Bandura, 1986; Mischel, Cantor, & Feldman, 1996). For example, in one experiment, participants were given bogus success or failure feedback for their performance on a series of verbal reasoning problems (Mischel & Staub, 1965). They then had to make a choice between a highly valued reward, the receipt of which depended on their successful performance on a similar reasoning task, and a less preferred but noncontingent reward. Participants who were given false-positive feedback chose to work for the more preferred delayed reward significantly more often than individuals who were given false-negative feedback. Moreover, in a control group in which participants were given no feedback, pre-experimental success expectancies were a significant determinant of people's choices to work for contingent rewards. Thus, how well the participants felt that they could perform the task determined whether or not they chose to try for the more difficult but preferred reward. These findings are consistent with research indicating that individuals who perceive themselves as having little control over the situations they find themselves in often feel powerless and choose to not engage in self-regulation (Dweck, 1986; Seligman, 1975).

Of course, goal commitment does not depend solely on peoples' trust and self-efficacy expectations. It is also influenced by the subjective value of the rewards in the situation. Through temporal discounting mechanisms, rewards that are delayed have less value than equivalent rewards that are immediately available (Ainslie, 2001; Loewenstein, Reid, & Baumeister, 2002; Rachlin, 2000). Therefore, the longer the future rewards are delayed, the less likely it is that children will choose to wait for them (Mischel & Metzner, 1962). Thus goal commitment in delay of gratification is enhanced with the relative magnitude of the delayed reward and decreases as the required time it takes to attain the reward increases (Mischel, 1966, 1974).

Summary

The findings reviewed in this section highlight a specific pattern of CAU activation that influence people's decisions to commit to attempting to exert self-control. Specifically, consistent with utility theories, they indicate that the choice to wait for a larger but delayed reward...
is determined largely by an expectancy-value mechanism (Mischel & Ayduk, 2004). In short, a person must value the delayed reward enough to commit to pursuing it, must believe that they possess the ability to successfully exert self-control should they choose to do so, and must trust that they will receive the valued reward upon successfully fulfilling their goal.

Processes Involved in the Ability to Delay Gratification

Whereas early research on delay of gratification focused on determinants underlying the decision to exert self-control, later research focused on the psychological processes that enable children to successfully delay their immediate gratification once they have committed to the goal of doing so. This section discusses the attentional and cognitive mechanisms that underlie this ability, using findings from the classic preschool delay of gratification paradigm (Mischel et al., 1989).

The delay of gratification task is an experimental method that has become a prototype for studying issues related to self-regulatory competency in the laboratory. In this method, a young child is presented with a desired treat—for example, tiny pretzel sticks, or little marshmallows, or shiny poker chips. A dilemma is then posed: the child can wait until the experimenter returns and get two of the desired treats, or ring a bell and the experimenter returns immediately but the child gets only one treat. The child prefers the larger outcome and commits herself to wait for it. As waiting for the chosen goal drags on, the child becomes increasingly tempted to ring the bell and take the immediately available treat.

A choice conflict between waiting for two treats or settling for one immediately may seem far removed from the choices adults confront in their worlds, but for the young child this type of problem creates a genuine and powerful conflict. Empirically, performance on this task has been shown to predict a number of consequential life outcomes, such as self-control and self-regulation in goal pursuit decades later, suggesting that this paradigm is capable of tapping into the processes that are needed to exert self-control in a variety of domains. For example, the number of seconds children can wait in certain diagnostic situations (i.e., when no regulatory strategies are provided by the experimenter and children have to access their own competencies) predicts higher SAT scores, better personal and interpersonal competencies years later and higher cognitive control ability (e.g., Ayduk et al., 2000; Eisinger et al., 2006; Mischel, Shoda, & Peake, 1988; Shoda, Mischel, & Peake, 1990). Further, it seems to be a protective buffer against the negative consequences of such dispositional vulnerabilities as anxious rejection sensitivity (e.g., Ayduk et al., 2000; Ayduk et al., 2007). The delay task thus provides a method of studying the psychological processes underlying willpower systematically, a methodology that taps the types of self-regulatory skills that enable people to effectively control hot impulsive reactions, which are necessary for successful pursuit of life goals.

Attentional Processes

Early work using the delay of gratification paradigm tested alternative predictions concerning the role that attention plays in people’s ability to delay immediate gratification. On the one hand, Freud (1911) argued that the transition from infantile id-driven impulsivity to ego control and delay of gratification begins when the young child creates a “hallucinatory wish-fulfilling” image of the delayed object. The assumption is that by imagining the desired object and “binding time,” delaying immediate gratification becomes possible. Behaviorists of the time made similar predictions, but for very different reasons (see Mischel, 1974). Their research suggested that when animals learn, behavior toward a goal is maintained by “fractional anticipatory goal responses” that cognitively represent the desired rewards and sustain goal pursuit—for example, as the animal tries to find its way back to the food at the end of a maze in a learning task (Hull, 1931). Again, the prediction was that focusing attention on the delayed rewards—thinking about them—should reinforce one’s ability to sustain delay gratification to fulfill goal pursuit.

To examine the role that attention on rewards plays in self-control, Mischel and Ebbesen (1970)
conducted a series of experimental studies in which they varied whether reward items were available for attention while children were waiting in the delay of gratification paradigm. In one condition, children waited with both the immediately available and the delayed reward exposed in full view. In a second condition, both options faced the child but were concealed from attention by an opaque cover positioned over them. In two other conditions, either the delayed reward alone or the immediately available reward alone was exposed during the delay period. On average, children waited more than 11 minutes when none of the rewards were exposed but waited only a few minutes when any of the rewards—either both rewards, just the delayed reward, or just the immediately available reward—were available to attention. Directly contradicting the predictions coming from both the psychodynamic and animal learning traditions, the results showed that focusing attention on a desired stimulus decreased the ability to delay gratification.

If attention is what matters, Mischel and colleagues next reasoned then distracting children from focusing on the rewards should have the same effect as removing the rewards from attention. This is precisely what has been found. In one experiment, for example, children were provided with a distracting toy (e.g., a Slinky toy) while the rewards were exposed on the table in front of them (Mischel, Ebbesen, & Zeiss, 1972). In this condition, more than half of the children waited the full amount of time until the experimenter returned, indicating that the experiment was over (15 minutes). In contrast, none of the children who were left waiting for the exposed rewards without the distractor toy were able to do so. In another experiment, the same effect of distraction on delay times was found when children were instructed to think about fun thoughts while they waited by receiving the following instruction: “While you’re waiting, if you want to, you can think of mommy pushing you on a swing at a birthday party.” Similar to the Slinky condition, more than half of the children who were cued to distract themselves with fun thoughts waited until the experimenter returned and indicated that the experiment was over (Mischel et al., 1972).

Collectively, these findings indicate that diverting attention away from the appetitive features of a stimulus helps children delay gratification. Note, however, that not all distracters were equally effective. Unsurprisingly, when the distracting object was not appealing (e.g., instructing individuals to think about sad thoughts), then attention was diverted back to the stimulus and delay of gratification was undermined. To be effective in keeping attention away from the temptations in the situation, attention to the distracter must itself be reinforcing.

Reconstrual Processes

Although strategically focusing attention away from a desired stimulus is an effective way of facilitating self-control in the face of temptation, that option often is not available or not sustainable. Consider, for example, the dieting pastry chef who has sworn off eating chocolate yet has to make delectable flourless chocolate cakes for dessert each night (creating one potential temptation after another) and still attend carefully to each or risk his reputation. However, as the cognitive revolution more than 40 years ago has made clear, even when the realities of life prevent sustained distraction, stimulus control does not necessarily have to trump self-control.

As one early step in that revolution, in the late 1960s, Mischel and colleagues began to investigate the role that cognition—specifically the mental representation of a stimulus—plays in self-control, examining how alternative ways of mentally representing the stimulus affect its emotional and behavioral impact. They drew on a distinction that had been made in the research literature between two different aspects of a stimulus: its motivational, consummatory, arousing, action-oriented, or motivating “go” features and its informational, cognitive cue, or discriminative stimulus functions (Berlyne, 1960; Estes, 1972). Given this distinction, Mischel and Moore (1973) reasoned that when a child thinks about the rewards in front of them as “real,” attention is placed on their hot, arousing, consummatory features, which should, in turn, elicit the motivating effects of the stimulus, making delay of gratification more difficult, and leading quickly to the “go” response (e.g., ring
the bell, get the treat now). In contrast, they predicted that thinking about the rewards in terms of their cooler, more abstract features should allow the child to focus on the reward without activating consummatory trigger reactions. For example, mentally representing the rewards as pictures emphasizes their cognitive, informational features rather than their consummatory features. Therefore, Mischel and Moore speculated that this kind of “cool” mental transformation would reduce the conflict between wanting to wait and wanting to ring the bell by shifting attention away from the arousing features of the stimulus and onto their informative meaning (see also Trope & Liberman, 2003).

To test this prediction, Mischel and Moore (1973) presented one group of children in the delay of gratification task with slide-presented life-size pictures of the rewards, formally called “iconic representations.” The hypothesis was that the pictures of the rewards would be relatively more abstract than the actual rewards, and thus the temptation to reach for them should be attenuated. These iconic representations were pitted against the presence of the real rewards themselves during the delay period. As predicted, exposure to the pictures of the images of the rewards significantly increased children’s waiting time, whereas exposure to the actual rewards decreased delay time.

As with distraction, however, individuals need not rely exclusively on changing the external world in efforts at self-control. Moore, Mischel, and Zeiss (1976) faced children with actual rewards, but this time the participants were cued in advance by the experimenters to pretend that they were pictures by “putting a frame around them in your head” (Moore, Mischel, & Zeiss, 1976). In a second condition, the children were shown pictures of the rewards (no “real” rewards were present) but this time asked to think about them as if they were real. The findings indicated that children were able to delay almost 18 minutes when they pretended that the rewards facing them were pictures. In contrast, they were able to wait less than 6 minutes if they pretended that pictures in front of them were real rewards. As one child put in the postexperimental inquiry when asked how she was able to wait so long: “You can’t eat a picture.”

The role that cognitive reconstrual processes play in facilitating delay of gratification was further demonstrated clearly in an early study by Mischel and Baker (1975) using a different type of cognitive manipulation to transform the mental appraisal or representation of the rewards. In this study, children were cued to represent the rewards available in front of them in either cool, informational or hot, consummatory features. For example, children in the cool focus condition who were waiting for marshmallows were cued (or “primed” in current terminology) to think of them as “white, puffy clouds.” Those waiting for pretzels were cued to think of them as “little, brown logs.” In the hot ideation condition, the instructions cued children to think about the marshmallows as “yummy and chewy” and the pretzels as “salty and crunchy.” As expected, when children thought about the rewards in hot terms, they were able to wait only 5 minutes, whereas when they thought about them in cool terms, delay time increased to 13 minutes.

**Summary**

Collectively, the findings reviewed in this section highlight the critical role that mental representations play in determining the outcomes of self-regulatory efforts. Specifically, although different types of cognitive and attentional deployment strategies were used to facilitate self-control in the delay of gratification research, they shared a key characteristic. Namely, they replaced mental representations of rewards that were emotionally “hot” and difficult to resist with alternative representations that were “cool” and did not elicit impulsive trigger reactions, thus enabling persistence for delayed but larger outcomes.

**Hot/Cool Systems Within Cognitive–Affective Processing System**

To integrate findings from the delay of gratification research with recent advances in cognitive psychology and neuroscience, two closely interacting systems—a cognitive “cool” system and an emotional “hot” system—have been proposed as components of the broader CAPS framework.
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(Mischel & Ayduk, 2004; Metcalfe & Mischel, 1999). The interactions between these systems underlie people’s ability—or inability—to exert self-control in general and sustain effortful control in pursuit of delayed goals in particular.

In the hot/cool framework, the cool system is a “know” system. Attuned to the informational, cognitive, and spatial aspects of stimuli, the cool system consists of a network of informational, cool nodes that are elaborately interconnected to each other and generate rational, reflective, and strategic behavior. The cool system is the basis of self-regulation and self-control. In contrast, the hot system is conceptualized as a “go” system: emotional, simple, reflexive, and fast. It is tuned biologically to be responsive to innate releasing stimuli—both negative and positive—that elicit automatic, aversive, fear-and-flight reactions or appetitive and sexual approach reactions. It consists of relatively few representations of hot spots, which, when activated by trigger stimuli, elicit virtually reflexive avoidance and approach reactions. Impulsive and automatic, the hot system is the basis of emotionality. It undermines rational attempts at self-control. The two systems continuously interact, such that as one becomes accentuated, the other becomes attenuated.

Given the relative paucity of research available on the neural correlates of self-control at the time that the hot/cool model was first suggested, Metcalfe and Mischel (1999) deliberately eschewed making strong claims about the differences in brain structures underlying the operation of each system. Since then there has been an explosion of research in this area (for review, see Kross & Ochsner, this handbook; see also Lieberman, 2007; Ochsner & Gross, 2007). Although it is outside the scope of this paper to review this emerging field, collectively the findings suggest that the amygdala—a small, almond-shaped region in the forebrain thought to enable fight or flight responses—is critically involved in hot system processing (Gray, 1982, 1987; LeDoux, 1996; Metcalfe & Jacobs, 1996, 1998). This brain structure reacts almost instantly to stimuli that individuals perceive as arousing (Adolphs et al., 1999; LeDoux, 1996, 2000; Phelps et al., 2001; Winston et al., 2002), immediately cueing behavioral, physiological (autonomic), and endocrine responses. It mobilizes the body for action, readying it to fight or flight in response to a perceived threat. The cool system, in contrast, seems to be associated with prefrontal and cingulate systems involved in cognitive control and executive function (e.g., Jackson et al., 2003; Ochsner & Gross, 2007).

Interactions between Systems

According to the hot/cool model, cognition and affect operate in continuous interaction with one another in producing phenomenological experiences and behavioral responses (for closely related opponent process models see Epstein, 1994; Lieberman, Gaunt, Gilbert, & Trope, 2002). In this model, hot spots and cool nodes that have the same external referent are directly connected to one another, and thus link the two systems (Metcalfe & Mischel, 1999; see also Metcalfe & Jacobs, 1996, 1998). Hot spots can be evoked by activation of corresponding cool nodes; alternatively, hot representations can be cooled through intersystem connections to the corresponding cool nodes. For example, instructing a child to think vividly about the taste of a marshmallow can heighten a craving response. Alternatively, hot representations can be cooled through cool system cognitive processes (e.g., attention switching, reconstrual). Thus children can also attenuate their craving response as they look at an appetizing cookie by focusing their attention on its shape, rather than its appetitive features, or by reconstruing it in ways that lead it to be less appealing—for example, imagining that the chocolate chips aren’t chocolate but, rather, specks of dirt. Willpower becomes possible to the extent that cooling strategies generated by the cognitive cool system circumvent hot system activation.

Evidence supporting the idea that the two systems directly interact with each other in the manner proposed by Metcalfe and Mischel (1999) has come from a recent neuro-imaging study that used functional magnetic resonance imaging (fMRI) to examine the regions of neural activity that become active when people consciously regulate their emotional responses to viewing aversive images (e.g., a picture of a bloody corpse). In this study, Ochsner and
colleagues (2004) found that when participants were instructed to cognitively re-appraise potent negative stimuli in ways that decreased their negative response (i.e., imagine that the image is fake), activity in the prefrontal and prefrontal systems (regions thought to be involved in cool system cognitive processing) increased, whereas activity in the amygdala (a hot system structure according to the current analysis) decreased. In contrast, when participants were told to reinterpret the aversive images in ways that made them feel worse, activity in both the amygdala and prefrontal systems increased, suggesting that individuals were using cognitive reappraisal processes to enhance their negative feelings.

Factors Influencing the Balance of Hot/Cool System Activation

Several factors influence the balance of hot/cool system processing, the first of which is the developmental level of the individual. The hot system develops and dominates early in life, whereas the cool system develops later (by age 4) and becomes increasingly dominant over the course of development. These developmental differences are consistent with evidence on the differential rates of development of the relevant brain areas for these two systems (for reviews, see Eisenberger et al., 2004; Rothbart, Ellis, & Posner, 2004). Consequently, early in development, young children are primarily under stimulus control, as they have not yet developed the cool system structures needed to regulate hot system processing. As the cool system develops over time, it becomes increasingly possible for children to generate cooling strategies to regulate impulses (Mischel et al., 1989). Empirical evidence from the delay of gratification research is consistent with these expectations. For example, whereas delay of gratification is virtually impossible for children younger than age 4 years (Mischel, 1974), by age 12 years almost 60% of children in some studies were able to wait the duration of the period to receive the awaited reward (25 minutes maximum; Ayduk et al., 2000, Study 2).

In the context of the impulsive responses and emotional reactions that fully developed adults commonly face, perhaps the most important determinant of hot/cool system balance is stress. At high levels, stress deactivates the cool system and creates hot-system dominance. At lower levels of stress, complex thinking, planning, and remembering are possible. When stress levels jump from low to very high, responding tends to be reflexive and automatic. Under conditions in which an animal's life is threatened, quick responses driven by inately determined stimuli may be essential. At the same time, such automatic reactions undo rational efforts at constructive self-regulation. Of course, whether a situation elicits stress in the first place depends critically on the individual's encodings. For example, the aspiring graduate student may interpret a rejection letter of her most recent submitted manuscript as a highly stressful event, whereas her tenured advisor may remain calm when exposed to the same rejection feedback. Therefore, to recognize when stress is likely to elicit hot system dominance and problematic responses, it is necessary to identify the specific types of psychological situations that individuals encode as stressful. As numerous recent studies have demonstrated, individuals are likely to differ both predictably and meaningfully in the way they encode such situations (Mischel & Shoda, 1995).

Chronic stress may serve not only to bias processing in terms of hot system functioning but also lead to physical changes that have direct implications for self-control ability. For example, recent studies have indicated that rats exposed to repeated stress demonstrate dendritic spine loss in medial prefrontal cortex (Brown, Henning, & Wellman, 2005; Radley et al., 2006, 2005)—a cellular feature of stress-related psychiatric disorders in which the prefrontal cortex is impaired—and dendritic spine growth in the amygdala (Mitra et al., 2005; Vyas, Bernal, & Chattarji, 2003)—a neuronal event that is thought to facilitate increased emotionality. In humans, severe and chronic stress (as in war and terror conditions) may result in dominant activation of the hot system as opposed to the cool system in ways that become relatively stable and difficult to reverse.
Hot/Cool System Interactions in Everyday Life

When considering how people can be helped to self-regulate adaptively in everyday life, there is an important caveat. In the real world, situations that require individuals to exert self-control often involve both strategic cooling processes that enable people to remain calm and reflective in the face of impulsive responses. But they also need strategic heating processes to maintain the motivation and commitment for pursuing goals rather than quitting. To illustrate, a study by Peake and colleagues (2002) examined the role of attention while delaying gratification when children were required to work to complete a task (rather than passively wait) to get the larger, delayed reward. They found that when the task was interesting (i.e., feeding a toy bird with marbles), deploying attention to the rewards was detrimental. Under such conditions, focusing attention on rewards disrupted a fun and engaging distracter, thus undermining delay of gratification ability. However, when the task was not engaging (i.e., sorting marbles into cups according to color), flexibly focusing attention on the rewards by glancing back and forth at them facilitated delay of gratification. Such flexible strategic attention deployment presumably served to remind children of why they were engaging in the nonengaging task (to get the desired treats), thus motivating instrumental work. Such flexibility in attention deployment is consistent with the idea that the balance interactions between the hot and cool systems that sustain delay of gratification, as they exert their motivating and cooling effects in tandem (see also Mischel et al., 1989).

The critical importance of achieving a balance between hot/cold system processing in everyday life was further supported in a study by Bonanno and colleagues (2004) that examined how individual differences in the ability to flexibly suppress and enhance emotional expression were prospectively linked to adjustment across the first 2 years of college. In this study, people who possessed both of these abilities, and were thus able to both heat up and cool down their emotions, as the situations they found themselves in demanded it, demonstrated the best long-term adjustment (lower levels of distress 2 years after the 9/11 attack). In contrast, participants who were low in both abilities displayed the poorest long-term adjustment.

Hot/Cool Processes in Negative Emotion Regulation

Although the hot/cold framework is based largely on findings from research using the delay of gratification paradigm, new research is extending the predictions that derive from it to a wide variety of contexts in which people must cope with automatically triggered negative emotional reactions (for reviews, see Kross, 2009; Mischel, DeSteno, & Kross, 2006). For example, situations in which a person experiences a transgressor and quickly responds with anger and aggression or situations in which people become anxious and respond with fear related avoidance responses. This research was driven by the assumption that the dilemma activated in the delay of gratification studies, in which a child was required to wait for a delayed treat while facing an immediate temptation, had a basic similarity to many of the situations people regularly experience when trying to go from good intentions to actual self-control efforts in everyday life. Consider, for example, the resolution to maintain relationship harmony that becomes easily sabotaged by the explosion of anger, hostility, and jealousy that erupts virtually automatically. It is in the heat of the moment that the need to inhibit hot, automatic but potentially destructive reactions becomes both most important and most difficult.

Hot/Cool Processes Involved in Coping with Interpersonal Conflict

Preliminary evidence suggesting that the processes involved in delaying gratification also help people regulate automatically triggered defensive emotional reactions comes from work examining the role of delay ability in the context of rejection sensitivity (RS; Downey & Feldman, 1996). Rejection sensitivity is a chronic processing disposition characterized by anxious expectations of rejection. These
expectations stem from prior rejection experiences and get activated when people encounter interpersonal situations in which rejection is possible. In such situations, people who are high in RS (HRS) feel threatened, leading to the activation of their defensive, flight-or-flight systems (Downey et al., 2004; Kross et al., 2007). Attention narrows on detection of threat-related cues, which in turn makes the HRS person ready to see the actualization of the threatening outcome. Anticipation of threat also creates action readiness so that people high in RS are likely to react automatically, defensively, and intensely when the threat is experienced. Unsurprisingly, when HRS people perceive rejection, they respond to it with hostility and aggression as well as depression and withdrawal symptoms (Ayduk et al., 1999; Ayduk, Downey, & Kim, 2001; Downey et al., 1998). These negative behaviors, in turn, elicit actual rejection from their partners, leading to a self-fulfilling prophecy, and their romantic relationships are likely to end sooner than people who are low in RS (Downey et al., 1998).

According to the hot/cold model, effective coping in threatening interpersonal contexts among HRS individuals should involve cooling the “hot,” emotional features associated with the situation (Arriaga & Ruschult, 1998; Mischel et al., 1989). One study exploring these links was an adult follow-up of the participants who had participated in one of the original Bing delay of gratification studies (Ayduk et al., 2000). This study showed that among HRS individuals, the number of seconds that participants were able to wait as preschoolers in the delay situation predicted their adult resiliency against the potentially destructive effects of RS. That is, HRS adults who had high delay ability in preschool had more positive functioning (high self-esteem, self-worth, and coping ability) compared to similarly high RS adults who were not able to delay in preschool. High RS participants showed higher levels of cocaine/crack use and lower levels of education than those low in RS unless they were good delayers in preschool. In contrast, high RS people who had high delay ability in preschool had relatively lower levels of drug use and higher educational levels and in these respects were similar to low RS participants (see also Ayduk et al., 2007).

A similar pattern of results was found in a second study with middle school children. Specifically, whereas high RS children with low delay ability were more aggressive toward their peers and thus had less positive peer relationships than children low in RS, high RS children who were able to delay longer were even less aggressive and more liked than low RS children. Similarly, a cross-sectional study of pre-adolescent boys with behavioral problems characterized by heightened hostile reactivity to potential interpersonal threats showed that the spontaneous use of cooling strategies in the delay task (i.e., looking away from the rewards and self-distraction) predicted reduced verbal and physical aggression (Rodriguez et al., 1989).

**Hot/Cool Process Involved in Coping with Intrapersonal Conflict**

Many of the most troubling self-regulatory challenges do not involve struggling to get along with other people but, rather, battling to resolve intrapsychic conflicts occurring in one's own mind. The rejected lover in a romantic relationship may desperately want to “work through” his feelings to move on but instead finds himself continually brooding and ruminating. The mere thought of the recalled experience easily triggers a cascade of negative responses that make it difficult to think calmly without losing control (Nolen-Hoeksema, 1991). The question here is: How can a person focus on a painful experience in a cool way, so that it can be worked through without becoming overwhelmed with hot system activation and negative feelings?

To address this question, guided by the Hot/Cool framework, Kross, Ayduk, and Mischel (2005) proposed that a critical factor determining whether people's attempts to adaptively work through negative experiences succeed or fail is the type of self-perspective they adopt. Prior research indicates that when people focus on negative past experiences, they typically do so from a self-immersed perspective in which self-relevant events and emotions are experienced in the first-person, through one's own eyes (Nigro & Neisser, 1983). Drawing from this literature,
Kross et al. (2005) hypothesized that when individuals focus on negative feelings from a self-immersed perspective, episodic information concerning the specific chain of events (i.e., what happened?) and emotions experienced (i.e., what did I feel?) would become accessible (cf., McIsaac & Eich, 2004), serving to increase negative affect.

Focusing on negative experiences from a self-immersed perspective is not, however, the only vantage point people can adopt while thinking about past events. As James (1890) suggested long ago, and many others have since examined (e.g., Leary, 2002; Libby & Eibach, 2002; McIsaac & Eich, 2004; Nigro & Neisser, 1983; Prinpin & Ross, 2006; Robinson & Swanson, 1993), experiences can also be focused on from a self-distanced perspective, in which the individual becomes an observer of the self. Kross et al. (2005) predicted that adopting a self-distanced perspective to analyze negative feelings would reduce people’s tendency to reflexively recount what happened to them and instead allow them to reconstruct their experience in cool ways that reduce its aversiveness (Metcalfe & Mischel, 1999; Mischel, 1974; see also Gross, 2001, and Lazarus, 1991).

These hypotheses were supported in a set of studies that manipulated the type of self-perspective (self-immersed vs. self-distanced) participants adopted while focusing on the reasons underlying feelings associated with anger-related interpersonal experiences (Kross et al., 2005). Specifically, when participants analyzed their feelings from a self-immersed perspective (immersed-analysis from hereon), episodic information concerning the specific chain of events (e.g., “He told me to back off,” “I remember watching her cheat on me . . .”) and emotions experienced (e.g., “I was so angry . . .”) became more accessible. In contrast, participants who analyzed their feelings from a self-distanced perspective (distanced-analysis from hereon) focused relatively less on what happened to them (i.e., recounting) and relatively more on reconstruing the event (e.g., “I understand why the fight happened;” “It might have been irrational but I understand his motivation now.”). Moreover, this shift in the content of people’s thoughts about their past experiences (less recounting, more reconstruing) mediated the effect of the perspective manipulations on negative affect (see also Strack, Schwarz, & Gschneidinger, 1985). Thus, the more reconstruing and less recounting participants engaged in, the less negative affect they displayed.

These findings provided initial clues about the processes that enable people to analyze negative experiences without becoming overwhelmed but also raised a number of additional questions. For example, do these different ways of analyzing negative experiences impact people on the physiological level? To the extent that distanced-analysis reduces emotional reactivity, we predicted that these manipulations would influence autonomic nervous system reactivity. To test this prediction, Ayduk and Kross (2008) randomly assigned participants to analyze a recent anger experience from either a self-immersed or self-distanced perspective while their blood pressure levels were continuously monitored. Consistent with predictions, participants in the distanced-analysis group displayed significantly lower levels of blood pressure reactivity (relative to baseline). This was found both during the experiment, when they were explicitly instructed to analyze their feelings, and 20 minutes after the experiment was over, during a recovery period (Ayduk & Kross, 2008; also see Ayduk & Kross, in press).

Another question raised by our initial studies concerned the incremental utility of distanced-analysis compared to distraction. Distracting individuals from thinking about negative feelings is an extremely effective means of cooling negative affect in the short-term (e.g., Nolen-Hoeksema 1991). It therefore provides a “gold standard” to compare distanced-analysis against. Motivated by the delay of gratification findings, which indicated that cognitive reconstrual strategies are at least as effective as distraction in facilitating impulse control (Mischel, Shoda, & Rodriguez, 1989; Mischel & Rodriguez, 1993), Kross and Ayduk (2008) hypothesized that distanced-analysis would be as effective in reducing negative affect as distraction. Findings were consistent with this prediction. Whereas both distraction and distanced-analysis led to
significantly lower levels of negative affect relative to immersed-analysis, distraction and distanced-analysis participants displayed the same relatively low levels of negative affect (Kross & Ayduk, 2008).

Work in our lab also has begun to address the long-term effects of these perspective-taking manipulations. To the extent that a person’s memory of a negative experience has been adaptively “processed” as a function of some psychological intervention (i.e., the individual’s memory of a negative experience is altered in ways that reduce its aversiveness), prior research suggests that the individual should display lower levels of emotional reactivity when that memory becomes reactivated in the future (Foa & Kozak, 1986; Rachman, 1980). To examine whether distanced-analysis facilitates such adaptive emotional processing, two short-term longitudinal experiments were conducted (Kross & Ayduk, 2007). During Session 1 of each study, participants recalled a negative experience and were then randomly assigned to an immersed-analysis, distanced-analysis, or distraction condition. Participants were then asked to return to the lab either 24 hours (Study 1) or 7 days (Study 2) later for additional testing. During Session 2, all participants were instructed to recall and think about the same experience they thought about during Session 1 without receiving any additional instructions. They then indicated their current level of negative affect and the amount of time they spent thinking about their past experience between the two sessions. Findings indicated that whereas both distanced-analysis and distraction participants displayed lower levels of negative affect than immersed-analysis participants during Session 1, during Session 2 only distanced-analysis participants were buffered against negative affect and related recurring negative thoughts (Kross & Ayduk, 2008).

Summary

Collectively, the findings reviewed in this section highlight the role that hot/cool processes play in self-control dilemmas. The dilemmas span situations ranging from those dealing with conflict and emotional turmoil in interpersonal situations to the intrapsychic conflicts commonly experienced in everyday life. Therefore, whether it is waiting for bigger cookies or marshmallows, dealing with the news that your partner no longer loves you, or the remembrance of a distressing, enraging event, the basic underlying processes involved in regulating impulses and emotional responses in a wide range of situations may be the same.

Toward an Integrated Understanding of Self-Control

Our primary goal in this chapter has been to help demystify the concept of willpower by describing some of the basic processes underlying the motivation to exert self-control and the ability to do so effectively. This section turns our discussion toward the future, and some of the research directions that, in our view, may be especially important for constructing a cumulative science of self-control. In describing these future directions, our goal is neither to be exhaustive nor preemptive nor prescriptive. Many exciting paths exist, and we simply point to some of the specific ways that our understanding of self-control may be enhanced.

Biological and Environmental Influences on Self-Control Ability

It is now well-known that biological predispositions (e.g., temperament) bias the development of self-regulatory ability in particular directions. However, their influences are constantly modulated by the affordances presented by cultural, social, and interpersonal contexts (Grigorenko, 2002; Mischel & Shoda, 1999). For example, children’s “difficult” temperament is related to increased cortisol levels—a physiological marker of dysregulation—in the face of stress but only in the context of poor and unresponsive adult caring (for review, see Gunnar & Donzella, 2002). As such, as researchers from different disciplines continue to work together, one important issue will be to further unpack the biological and environmental influences that contribute to self-control ability and to specify how these developmental influences interact.

One particularly exciting direction for future work in this area concerns the genetic factors
that play a role in the development of self-regulatory ability. Although gene association studies attempting to link genes to complex phenomena (e.g., self-control) remain in their infancy, there have been a number of recent advances trying to examine such gene–behavior relationships by focusing on subprocesses involved in self-control. Some studies have focused on the dopamine system—a neurotransmitter system that is believed to play an important role in interference resolution, which is an important feature of cognitive control (e.g., Grannon et al., 2000; Mehta et al., 2006; Brozowska et al., 1979)—and have revealed associations between dopamine transporter and receptor genes and several clinical disorders related to self-control, such as attention deficit hyperactivity disorder (Cook et al., 1996; Gill et al., 1997; Swanson et al., 1991; 2000; LaHoste, 1996). The gains from these early gene association studies highlight the importance of interdisciplinary work. Without knowledge of a basic process involved in self-control, it would not have been possible to establish a gene–behavior link. The success of future work in this area thus hinges on the continued interaction of researchers operating at multiple levels.

**Identifying the Cognitive and Neural Substrates of Cooling Strategies**

There now exists much research identifying the different types of cooling strategies that help people regulate automatically triggered impulses and emotions (for reviews, see Gross, 1998; Mischel & Ayduk, 2004). It remains unclear precisely how these strategies compare and contrast in terms of the cognitive processes that underlie them. To illustrate, consider the case of distraction and reconstrual, as operationalized in the delay of gratification paradigm. Similar low-level cognitive processes (e.g., working memory, mental imagery, interference resolution, language) likely underlie the operation of both of these strategies, each of which has been shown to facilitate delay of gratification ability. For example, both strategies involve switching attention away from the appetitive features of a desired stimulus and then keeping that information out of mind. However, these strategies also likely differ in a number of ways. Distraction, for example, which involves redirecting attention away from one stimulus and onto another one, is likely to recruit semantic processes to a lesser degree than reconstrual strategies that require people to actively represent how they think about a stimulus (i.e., imagine a marshmallow as a fluffy white cloud rather than a gooey sweet treat).

Beyond enhancing our understanding of the processes involved in self-control, work examining this issue promises to have important clinical applications. To the extent that research can reliably identify the specific types of cognitive processes that underlie different types of cooling strategies and CAUs, it may be possible to improve the way individuals who experience self-control difficulties are treated and assessed. For example, self-control interventions could be tailored around assessing what specific types of executive functions people experience difficulty engaging in during situations that require self-control. Treatment then can focus on helping people to improve their ability to engage in those processes when they are needed. In this vein, fMRI and related brain-imaging techniques promise to play a valuable role. A good deal of research already links activity in specific networks of brain regions to cognitive and emotional processes involved in self-control (for reviews, see Lieberman, 2007; Ochsner & Gross, 2007). These techniques could provide researchers with tools for assessing specific deficits in self-control ability and monitoring the effectiveness of training interventions designed to improve people’s skills.

**From Basic to Applied: Self-Regulatory Training Interventions**

The research reviewed in this chapter leaves us with large questions: Can young children be taught effectively and enduringly the skills needed to delay gratification? Could such interventions, particularly early in life, lead to the kinds of adaptive and protective longitudinal outcomes that have been associated with delay of gratification ability when it is assessed spontaneously? We already know that cooling strategies are experimentally modifiable both in children and adults (Ayduk et al., 2001; Kross
et al., 2005; Mischel et al., 1989). Also, modeling effective control strategies can have positive consequences, generalizing to behavior outside of the lab in the short run for at least a month (Bandura & Mischel, 1965). We do not know whether and how socialization, education, and therapy can effectively be utilized to help individuals gain the necessary cooling competencies to make willpower more accessible over the life course. Given the dramatic long-term correlates of delay of gratification assessed in early childhood in the classic paradigm, the need for such research seems self-evident.

Relevant examples already exist for such intervention work, for example, by using implementation strategies and techniques (Gollwitzer, 1996; Mischel & Patterson, 1976). Implementation strategies connect general goals (“Don’t eat the cookie”) to a specific implementation intention (“If mommy says dinner is about to be served, don’t eat any sweets”). In this way, a specific contingency (IF__________) is established that becomes connected to a specific planned response (THEN__________). Gollwitzer and colleagues (1996) have shown that creating implementation intentions helps ensure implementation of the plan by tying a hot trigger event to the intended response rather than the habitual response. Designing interventions of this sort can help automatize the way an individual responds to an impulsive response, altering the unique set of CAUs that become activated when people find themselves in situations requiring self-control, thus enabling them to quickly engage in the appropriate behavior. They also allow interventions to be focused around the specific types of psychological situations in which individuals experience difficulty in self-control, offering a more contextual approach to the treatment of self-regulatory deficits (Mischel & Shoda, 1995). With regard to delay of gratification, effective interventions are likely to require going much beyond teaching a child how to delay gratification in a few particular tasks. Rather, such programs would entail extensive rehearsal, planning, and generalization strategies for implementing the necessary self-regulatory action when it is needed in a variety of everyday life contexts.

**Conclusion**

In the opening of his chapter on the will over 100 years ago, William James (1890/1981) distinguished between wishing and willing thought into action. According to James, “ Desire, wish, will, are states of mind which everyone knows and which no definition can make plainer... If with the desire there goes a sense that attainment is not possible we simply wish; but if we believe the end is in our power, we will that desired feeling, having, or doing shall be real... and real it presently becomes, either immediately upon the willing or after certain preliminaries have been fulfilled (p. 486). As James noted, to transition from wishing to willing, certain preliminary conditions must be met. This chapter described some of these preliminary conditions. It focused on a set of cognitive and attentional processes that substantially enhance the ability to achieve self-control and showed the impressive long-term correlates of this ability. The chapter also outlined the broader CAPS framework in which these processes have been conceptualized, specifying some of the conditions under which the necessary psychological operations may be effectively implemented.

The demystification of “willpower” and human agency, and the development of an increasingly powerful analysis of the processes that underlie and undermine the human capacity to exert self-control, will long remain one of the great challenges within psychology and related disciplines. We hope this chapter has shown it is a challenge worth pursuing, with useful methods and models already in reach and with results that suggest some of the demystification is at least on the way.

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