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16

The Cybernetic Process Model of Self-Control

Situation- and Person-Specific Considerations

Eran Magen and James J. Gross*

Eddie is hungry. Standing in line at the cafeteria, he tries to decide between the roasted eggplant sandwich and the triple-cheese pizza. Eddie faces this choice daily. Ever since the school cafeteria added the fast food stand, students have been able to make their own decisions about the content of their lunches. Eddie has been making decisions for a while, and has recently started gaining weight at an alarming rate. His parents have talked with him about making responsible food choices, and he himself has noticed that he has less energy to play and to study. Standing in line, Eddie is torn between his wish to improve his situation, and his desire to eat the warm, rich, luxurious pizza. He knows it would be best to pick the healthy but boring sandwich, but the pizza is just so inviting, and the sandwich will always be there tomorrow, right?

Throughout the world, millions of people face dilemmas similar to the one that Eddie faces every day. Many of them know what would be the best thing to do, but still find themselves wanting to do just the opposite. Dilemmas of this nature are not limited to food choices. They span decisions involving sleep, exercise, sex, drug use, work, relationships, retirement savings, and more. We can define temptation in a general way as *the impulse to behave in a way that one fully expects to regret at a later time* (Magen & Gross, 2007). Although people frequently behave in ways that they know they *may* regret, our focus is on behaviors that people *fully* expect to regret, even before they perform them. Note that this definition does not include an element of probability ("maybe I'll regret it, and maybe I won't"); instead, one is certain that acting in accordance with the desired behavior will lead to regret. More specifically, people experience temptations when the goal of experiencing a relatively small short-term

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Table 16.1 Examples of Temptations and Nontemptations

Short-term goal	Long-term goal	Self-control task
Temptations (conflict between	en short-term and long-term goals)	5,2
Earing pizza	Eating healthily	Inhibiting pizza consumption
Not "rocking the boat"	Eradicating workplace racism	Initiating assertive objection
Nontemptations (no conflict	between short-term and long-term g	goals)
Eating pizza	Enjoying lunch	N/A
Not "rocking the boat"	Maintaining good relations	
	with the boss	N/A

Note. In tempting situations, the person realizes that acting in line with the short-term goal will result in failure to attain the long-term goal, and consequently lead to regret.

gain is competing with the goal of experiencing a relatively large long-term gain (see Table 16.1). For example, the short-term goal of enjoying the taste of pizza may compete with the long-term goal of eating more healthily. Generally speaking, despite having a clear long-term goal in mind, one may feel drawn to act in a way that prevents the attainment of this goal, in order to experience a relatively small but more immediate short-term gain.

Dilemmas such as these require self-control in order to overcome the temptation to act in a way that would provide short-term pleasure and long-term suffering. We will use the term "self-control" to denote *the ability to resist temptations*. Self-control may be achieved through deliberate, conscious acts, or through nonconscious acts. Our main focus in this chapter revolves around ways in which people consciously apply self-control, having realized that they are facing a temptation and decided to volitionally resist it. Our focus notwithstanding, we find it important to note that a growing body of research has been exploring ways in which behavioral goals can be activated nonconsciously (e.g., Bargh, Gollwitzer, Lee-Chai, Barndollar, & Troetschel, 2001; Bonson et al., 2002; Fishbach, Friedman, & Kruglanski, 2003; Förster, 2007; Kavanagh, Andrade, & May, 2004; Lowe & Levine, 2005; Mauss, Cook, & Gross, 2007; Wansink, Painter, & Lee, 2006).

The specific technique or method that people employ to achieve self-control can change from one temptation to the next. Referring to the examples we listed in Table 16.1, one might need to inhibit a certain impulse (e.g., avoid ordering pizza despite the urge to do so) or to initiate a behavior despite the impulse to avoid doing so (e.g., voicing disagreement despite the urge to stay quiet). Self-control refers to acting in line with one's long-term goal, despite the allure of a contradictory shortterm goal.

Research has outlined a multitude of techniques for self-control, resulting in an overwhelming array of solutions to specific problems, but without an overarching

framework that would enable researchers and practitioners to classify the various techniques into related groups. Furthermore, specific techniques of self-control are described and studied without consideration to the specific situation in which the temptation arises, or to the traits and personalities of specific individuals, and are thus rarely custom-tailored to the person who will need to apply them in a given situation. What could Eddie do to eat more healthily when he is standing in line at the cafeteria? What about recess, when a well-meaning friend offers him a calorie-rich (but nutrition-poor) treat? What would we advise Eddie to do if he were a 2nd grader? Would that be different if he were a 10th grader? Would we give different advice to Eddie's father, with respect to his own similar dilemmas at work?

Our goal in this chapter is twofold. First, we present an integrative framework that will enable researchers and practitioners to use a shared language when communicating their insights and findings. To this end, we present a model of self-control, which we call the cybernetic process model of self-control. Second, we propose situationand person-specific considerations when developing and choosing specific techniques for self-control. This, in turn, will allow practitioners and researchers to systematically examine the etiology of the difficulty that their client (or research participant) is facing, determine the points that are most amenable to intervention, and then select or develop the interventions that would be most appropriate, given the particular person and the particular situation.

The Cybernetic Process Model of Self-Control

The cybernetic process model of self-control (see Figure 16.1) represents a synthesis of two earlier models: the cybernetic control model (Carver & Scheier, 1982) and the process model of emotion regulation (Gross, 1998; Gross & Thompson, 2007). The cybernetic control model provides a broad conceptual framework that describes ways in which people (and other systems) manipulate their environment in order to achieve desired end states. However, it does not explicitly address the problem at the heart of self-control challenges: the need to override prepotent responses that may undermine important long-term goals. The process model of emotion regulation was developed to organize the literature on the self-regulation of a particular type of prepotent response (i.e., emotions), and to delineate discrete methods that people employ to this end. Combining the two models allowed us to integrate the broad applicability of the cybernetic control model with the explicit focus on self-regulatory processes of the emotion-regulation process model. The resulting cybernetic process model of self-control can be applied to describe and analyze self-control behaviors (both successes and failures) in a wide array of domains.¹

At the heart of the cybernetic process model of self-control is the notion that behavior is motivated by the difference between how things are (one's perceived environment) and how one would like things to be (one's goals). The impulse to behave in



Figure 16.1. The cybernetic process model of self-control, based on cybernetic control theory (inner circle: Carver & Scheier, 1982) and the process model of emotion regulation (outer circle, gray boxes: Gross, 1998; Gross & Thompson, 2007).

a certain way represents an attempt to change the way things are, so that they would become more similar to the way one would like things to be. Each stage of the process receives input from the preceding stage, processes it in some way, and feeds an output to the subsequent stage of the process. Thus the environment is perceived, and this impression of the environment is fed to the comparator. The comparator compares the perceived environment to a goal (or standard), and outputs an impulse, aimed at generating behavior that would influence the environment, so that it would more closely match the goal on the next comparison. This impulse influences behavior, which in turn impacts the environment. The acted-upon environment is perceived again, compared again with the goal, the comparator outputs another impulse, and so on.

The cybernetic process model of self-control allows us to describe in detail the process by which impulses arise, as well as ways in which impulses can be self-regulated. The process by which the individual perceives the world, compares it with a goal, and acts upon it in a goal-oriented manner provides the inner circle of the model (see Figure 16.1). As we describe in greater detail below, the cybernetic process model of self-control proposes that control of behavior may be achieved by applying one of the following methods, or any combination of them: (a) situation selection, (b) situation modification (c) attention deployment, (d) cognitive change, or (e) response modulation (see Table 16.2). Many effective responses to temptations involve using more than one type of method. A common example is engaging in an alternative activity in order to distract oneself (e.g. Feindler, Marriott, & Iwata, 1984; Patterson & Mischel, 1976), which combines elements of both attention deployment and response
 Table 16.2
 Examples of Existing Self-Control Techniques and Their Corresponding Stages

 and Intervention Types in the Cybernetic Process Model of Self-Control

Cybernetic stage	Intervention type	Specific techniques
Environment	Situation selection	Breaking ties with drug-using associates ¹ Reduce stress through mindful scheduling ²
	Situation modification	Hiding tempting object ³ Chemical pleasure blockers ⁴ Community reinforcement ⁵ Precommitment ⁶
Perception	Attention deployment	Engaging in alternative activity ⁷ Goal verbalization ⁸ Cognitive load + self-control cues ⁹ Relaxation, e.g. deep breathing, imagery ¹⁰
Goal/Comparator	Cognitive change	Cognitive reconstrual ¹¹ Modifying internal dialog ¹² Soft commitment ¹³ Acceptance and defusion ¹⁴
Behavior	Response modulation	Behavioral suppression ¹⁵ Engaging in alternative activity ⁷ Relaxation, e.g. deep breathing, imagery ¹⁰

Note. 1 Schroeder et al., 2001; 2 Fristad, Gavazzi, & Soldano, 1998; 3 Metcalfe & Mischel, 1999; Wansink, Painter, & Lee, 2006; 4 Drugs meant to reduce pleasure from alcohol consumption (e.g. Acamprosate/Disulfiram/Naltrexone); Luty, 2006; 5 Sisson & Azrin, 1986; 6 Ariely & Wertenbroch, 2002; 7 Kavanagh, Andrade, & May, 2004; Patterson & Mischel, 1976; 8 Genshaft, 1983; Patterson & Mischel, 1976; 9 Mann & Ward, 2004; Parent, Ward, & Mann, 2007; Westling, Mann, & Ward, 2006; 10 Feindler, Marriott, & Iwata, 1984; Mann & Ward, 2004; 11 Fujita, Trope, Liberman, & Levin-Sagi, 2006; Magen & Gross, 2007; W. Mischel & Moore, 1980; 12 Stern, 1999; 13 Kirby & Guastello, 2001; Khan & Dhar, 2007; 14 Forman et al., 2007; Gifford et al., 2004; Kavanagh et al., 2004; 15 Baumeister, Muraven, & Tice, 2000; Feindler et al., 1984; Muraven & Baumeister, 2000.

modulation. Successful application of any of these interventions will result in behavior that is better aligned with long-term goals (e.g., choosing a healthy lunch), despite competing short-term goals (e.g., eating pizza).

In the remainder of this section, we elaborate on each of the five families of selfcontrol techniques, as delineated by the cybernetic process model of self-control. We explain the general principle behind each method, and provide examples to illustrate when and how each may be used, based on examples from the research literature (see Table 16.2). Although these general techniques can be applied with respect to any self-control challenge, we will demonstrate how each method can be applied in a specific

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case, in order to provide a concrete example. To this end, we will consider a person who is sorely tempted to shoplift, but is trying to overcome this powerful urge. For each of the techniques in our model, we will provide a concrete example, followed by a brief overview of research findings related to that technique of self-control.

Situation Selection

Situation selection is the most forward-looking approach to self-control. This family of self-control techniques includes any attempts to choose situations or environments that make it less likely for temptation to arise. In terms of the cybernetic control model, this technique operates on the *environment* element of the loop.

Robyn has managed to avoid shoplifting for almost a week. She is running low on groceries, and realizes that she needs to replenish her stock. However, the supermarket has always presented her with endless opportunities to steal various products, and she is concerned that she may not be able to resist the temptation of shoplifting if she goes. Robyn decides to order her groceries online and have them delivered to her house. By doing this, Robyn would not have to confront the powerful temptation to shoplift.

In this example, Robyn chose an environment that would not threaten her goal of avoiding shoplifting. In terms of the cybernetic process, if Robyn spends time near certain stimuli (*environment*), she is likely to notice them (*perception*). This may generate a temptation to steal (a *goal*), which may lead to shoplifting (*behavior*). Conversely, if Robyn avoids such stimuli, she is less likely to perceive them, temptations are less likely to be activated, and shoplifting is less likely to be initiated.

In social psychology, classic research demonstrates the powerful effects of channel factors (Leventhal, Singer, & Jones, 1965), and how the accessibility of environmental facilitators and hindrances impacts behavior. More recently, researchers studying addiction have presented overwhelming evidence that points to the power of environmental stimuli to generate drug craving, if these stimuli were previously associated with drug consumption (Bonson et al., 2002; Weiss, 2005). In Robyn's case, choosing to stay out of the supermarket will make her more less to perceive the easy-tosteal products, shoplifting goals would be less likely to become activated, and she would be less likely to steal, thereby realizing her long-term goal of not shoplifting. For other examples of situation selection techniques, see Table 16.2.

Situation Modification

Even if a problematic situation cannot be entirely avoided, key elements of the environment may still be subject to deliberate beneficial change. *Situation modification* refers to the family of self-control techniques by which people strategically change the environment in order to alter the impulses and subsequent behaviors that will result from it. Situation modification and situation selection are not easily separable, since modifying a situation beyond a certain extent can be said to produce a new situation, and we will occasionally refer to the two sets of techniques as "situation selection / modification." In terms of the cybernetic control model, situation modification operates on the *situation* element of the loop.

Robyn, who has recently decided to stop shoplifting, is driving with a friend to a potluck dinner party. Shortly before arriving at the host's house, Robyn realizes that she forgot to bring the dish that she prepared. She decides to stop at a local grocery store and pick up some ice cream. As she pulls into the parking lot, Robyn becomes worried that she may be caught by the urge to shoplift once she is inside. She prefers not to avoid the store altogether (doing that would qualify as an application of the situation selection technique, and would also leave her empty-handed at the potluck). Instead, Robyn asks her friend to accompany her into the store, briefly explaining that she sometimes experiences a strong urge to shoplift, and that having somebody to watch her would be of great help.

In this example, Robyn altered the situation she was in, in order to prevent the elicitation of undesirable impulses, or facilitate the elicitation of desirable impulses. In this way, even without avoiding the situation or choosing a new environment, Robyn successfully negotiated a temptation she wished to resist. Even small changes to tempting situations, such as placing candy bowls a short distance away from an easy-to-reach location (Wansink, Painter, & Lee, 2006) or hiding treats behind a screen (W. Mischel & Ebbesen, 1970) can significantly impact the pull that these temptations hold over children as well as adults. For other examples of situation modification techniques, see Table 16.2.

Attention Deployment

Even without changing the external situation, it is possible to selectively attend to certain aspects of the situation, in order to alter the flow of information processing and subsequent reactions to this information. Situations have many aspects, and *attention deployment* refers to the family of techniques by which individuals direct their attention within a given situation in order to influence their reactions to it. This method of self-control can be thought of as an internal version of situation selection, as it changes the *internal* situation that is experienced (as opposed to situation selection/ modification, which seeks to change the external environment). In terms of the cybernetic control model, this technique operates on the *perception* element of the loop.

The checkout line at the video rental store is unusually slow, and Robyn can feel the rising temptation to steal some of the snacks that are displayed so prominently

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for those waiting in line. She knows that continuing to pay attention to these products is likely to result in even stronger temptation, which may prove to be too great a challenge. Robyn was looking forward to watching the movie she is about to rent, and prefers not to simply walk out of the store without the movie. But the temptation to steal a small pack of candy is growing. Shaking her head, Robyn examines the faces of the people who are in front of her in the line. She decides to play a detective game with herself: trying to guess which movies they came to rent, and then verifying her guesses by seeing which movies they hold – without being seen by any of them. This game amuses her and keeps her mind off the products that are around her, until it is her turn to pay for her movie rental and leave the store.

In this example, Robyn selectively turned her attention towards certain aspects of the situation that she was in, and away from others. By doing this, she prevented the generation of undesirable impulses and behaviors while promoting desirable ones, even without changing the external situation that she was in. By strategically directing her attention, Robyn weakened the link between attending to the temptation-eliciting stimuli and the undesirable goal that it usually activates. In order to control their attention, people may make internal changes (e.g., through distraction or concentration) or external changes (e.g., by covering the eyes or ears). This method of self-control is one of the earliest self-regulatory abilities that appears in the course of lifespan development (Rothbart, Ziaie, & O'Boyle, 1992), and commonly continues to be used from infancy through adulthood, particularly when it is not possible to select or modify one's situation. For other examples of attention deployment techniques, see Table 16.2.

Cognitive Change

At times, people discover that they must attend to (or are unable to turn their attention away from) problematic situations or objects, which may give rise to counterproductive impulses and behaviors. Nevertheless, even in such difficult situations, it is possible to change the way in which one thinks about the situation, in order to alter the impulses that are generated in response to perceiving it. *Cognitive change* refers to the family of self-control techniques by which people can either strategically transform the relevance of a stimulus to their goal, or change the goal against which they compare the stimulus. In terms of the cybernetic control model, this technique operates on the *goal/comparator* elements of the cybernetic loop.

Robyn, whose efforts to avoid shoplifting have been successful for a few weeks, is accompanying a friend to the farmer's market. The sun is shining, a light breeze is blowing, a local music band is playing on a small stage, and the produce in the stands is practically glowing with wholesomeness. Robyn, thoroughly enjoying herself, catches herself considering the best time to snatch a few fruits without the stall owner's attention. Dismayed, she seeks a way to curb the temptation. Robyn studies the stall owner's face, imagining the work he must have put into growing the fruit, and then packing and driving the fruit to the market. She imagines how upset she would be if she knew that something she has spent months growing was stolen from her. The thought of stealing fruits becomes less exciting, less appealing. Instead of being adventurous and exhilarating, the thought of successfully stealing the fruits makes Robyn feel almost sad. Robyn watches the stall owner for a short while, and walks away feeling good about herself—having given him the gift of not stealing from him.

In this example, Robyn strategically changed how she thought about her situation in order to elicit more desirable reactions and less undesirable reactions, even without changing the situation or shifting her attention away from it. Specifically, Robyn *reconstrued* her experience and changed the meaning of her choice. By considering how the "successful" carrying out of her impulse would impact another person, Robyn changed the relative appeal of the behaviors she was choosing between (to steal or not to steal). In an empirical test of this method, undergraduate students who were performing a math task were distracted by comedy video clips. Half of the students were encouraged to think about the situation differently, in order to change its meaning for them. Students who were instructed to think of the distracting comedy clips as a test of willpower were less distracted by them, and showed less enjoyment when they did attend to them—possibly as a result of perceiving themselves as failing on their own test of willpower (Magen & Gross, 2007). For other examples of cognitive change techniques, see Table 16.2.

Response Modulation

There are times when a powerful temptation may strike without warning, or when a situation progresses steadily and unavoidably towards the production of a destructive impulse, without giving one the chance to select or modify the situation, without providing an opportunity to attend to innocuous elements of the situation, and without leaving room for cognitive change. Even at times like these, people do not necessarily give in to the temptations that present themselves. *Response modulation* refers to the family of techniques by which people attempt to directly control their behavior despite the impulse that they experience to act in a certain way, by figuratively (or literally) clenching their teeth and willing themselves to behave in a manner that is more aligned with their own long-term goals. In terms of the cybernetic control model, this technique operates on the *behavior* element of the cybernetic loop.

Robyn is waiting to meet a friend in a café near a book store. The friend calls to say she will be 10 minutes late, and Robyn decides to visit the book store. She notices a new book that she has been eagerly anticipating, and leafs through it. It's entertaining, and she decides that she would like to have it. But, alas, she did not bring her wallet with her. No matter, the familiar voice inside Robyn's head whispers,

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why not just drop the book in her bag and stroll out of the store? She looks around her automatically, and determines that nobody would notice her if she acted then and there. Her pulse quickens. This would be fun, the familiar voice says. You deserve it. Robyn is unable to turn her attention away from the book and does not have the wherewithal to think about the situation in a new way. Instead, she swallows hard, and forces her legs to take her away from the tempting bookshelf and out of the book store. Sitting at a table in the café, Robyn is able to start thinking clearly again.

In this example, Robyn acted in a way that was in opposition to the impulse she was experiencing. After leafing through the book, Robyn experienced a strong urge to steal it (perceiving the book activated a shoplifting goal), but she did not comply with this urge. Unlike any of the other families of self-control methods, this technique does not aim to modify the tempting aspects of the situation—instead, when applying response modulation, one is directly opposing the *reaction* to a temptation that is already powerfully present. This form of self-control has been studied in a variety of contexts (e.g., Muraven, Collins, & Neinhaus, 2002), promoting the theory that the capacity for response modulation relies on a limited internal resource, which becomes depleted as a result of prior efforts, much like a muscle that becomes tired following exertion. According to this approach, depleting self-regulatory resources leads to short-term reductions in the ability to successfully apply this form of self-control (but cf. Martijn, Tenbèult, Merckelbach, Dreezens, & de Vries, 2002). For other examples of response modulation techniques, see Table 16.2.

Situation- and Person-Specific Considerations in Selecting Techniques of Self-Control

The temptations that people face in everyday life are as different from one another as the individuals who face them. It seems safe to assume that some methods of selfcontrol may be better suited to handle certain kinds of temptations, but how can we know which methods to apply in response to a given temptation? In answering this question, we consider the features of two key players of every situation in which a person is tempted, namely (a) the situation and (b) the person. In this section we provide an example of ways to think about matching situations and individuals with methods of self-control, based on the features of the situation in which the temptation arises, as well as the state and personality of the person facing the temptation.

Situation-Specific Considerations

Situational context has proven to be a shy, elusive animal, and social scientists have vet to create a clear system of classifying the infinite number of possible situations

into a finite number of discrete categories (Cantor, Mischel, & Schwartz, 1982; Yang, Read, & Miller, 2006). Conscious of the enormous complexity surrounding this topic, we do not aim to provide a complete and general taxonomy of situational contexts in this chapter. Instead, we will consider only two attributes of situations that give rise to challenges for self-control, namely *predictability* and *duration*. These two factors may vary independently of each other, resulting in four basic scenarios: predictable brief temptations, predictable extended temptations, surprising brief temptations, and surprising extended temptations. We now turn to discuss ways in which varying each of the two factors will influence one's choice of self-control techniques, and then suggest an optimal sequence of self-control techniques for the "worst-case scenario" namely, encountering a surprising, temporally extended temptation.

Predictability. When the time or location of a potential temptation can be predicted, it is possible to take preemptive measures, rather than relying on direct response modulation alone. If Eddie knows that he is prone to surf the Internet instead of practicing his oboe (but believes that practicing his oboe is more important in the long term), he may ask his brother to disconnect the wireless router until the evening (situation modification). This would be preferable to telling himself that when he is tempted to surf the Internet he will simply resist that temptation and practice his oboe (response modulation). By modifying the situation, Eddie can take the sting out of the temptation even before it presents itself. We propose that, in preparing to tackle an approaching temptation, successful interventions include elements of situation selection/modification, as well as cognitive change. Planning to rely on response modulation or attention deployment alone may lead to dire consequences, especially if the approaching temptation is likely to be long-lasting, since these methods are generally difficult to sustain (Muraven & Baumeister, 2000; Muraven, Collins, & Neinhaus, 2002; Shiffman, 1984).

When a temptation appears without warning, the initial choice of self-control techniques is significantly limited, as situation selection/modification is typically impossible, and even attention modulation and cognitive change may not be viable alternatives when one's attention is riveted by the temptation. Learning to apply response modulation is a crucial skill for these situations. Effective response modulation may be sufficient when dealing with a brief challenge of self-control (e.g., having to swallow nasty-tasting cough syrup). However, relying *solely* on response modulation may prove insufficient when dealing with temporally extended temptations, and may even be counterproductive, as we discuss in the "worst-case scenario" section.

Duration. As we have already mentioned, some methods of self-control are more appropriate to use when resisting brief temptations, but may be counterproductive when resisting temptation for long stretches of time. When a self-control challenge is only present for a short while (e.g., having to swallow nasty-tasting cough syrup, donating blood and waiting for the first needle prick) response modulation and attention deployment can be useful and effective, as they can be activated very quickly and

without much preparation (e.g., quickly putting a spoonful of syrup into one's mouth and swallowing, averting one's gaze). However, when the temptation remains present in the environment for an extended period (e.g., getting distracted by a conversation at the next table while dining with a distressed friend), such simple and direct methods of self-control may prove insufficient. For temptations of longer duration, situation selection/modification and cognitive change are more adequate methods of self-control, as they change the reactivity to the object of temptation, rather than only the response to it.

The worst-case scenario. While response modulation in itself may enable one to withstand brief exposures to powerful temptations, exclusive and long-term reliance on response modulation is not likely to be successful (Muraven & Baumeister, 2000; Muraven, Collins, & Neinhaus, 2002; Shiffman, 1984), as it is draining both psychologically (Gross, 2002; Muraven, Collins, & Neinhaus, 2002; Muraven, Tice, & Baumeister, 1998; Richards & Gross, 2000) and physiologically (Gross, 2002). Instead, response modulation can be used as a buffer against the destructive urge, providing one with time to implement more sustainable techniques, such as situation modification or cognitive change.

Based on our analysis, the worst-case scenario involves a surprising, extended exposure to a source of temptation—for example, a person who is trying to avoid caffeine despite loving coffee, whose cup was filled with black coffee by a passing waiter. The aromatic coffee beckons, but he does not want to drink it. He prefers not to get up and leave his table, and spilling the coffee onto the floor doesn't feel like a viable alternative. In a surprising, extended situation such as this, we propose that an optimal response may be to resist the immediate urge through the use of response modulation (e.g., push the cup to the other side of the table, rather than towards oneself), and then reduce the urge through the use of cognitive change (e.g., imagining that the coffee has been sitting in the coffee maker for a long time, or that worms are wriggling at the bottom of the cup) and attention deployment (setting up the menu to hide the coffee, trying to guess how many customers are in the diner), and, when circumstances permit, through situation modification (e.g., asking a passing waiter to remove the coffee cup).

Person-Specific Considerations

A variety of person-specific factors may impact a person's susceptibility to temptation, as well as the ability to successfully apply any particular method of selfcontrol. We broadly divide these internal factors into two groups: (a) transient internal factors (such as cognitive load, intoxication, and sexual arousal), and (b) stable internal factors (such as personality traits and age). We discuss examples from each of these categories, and ways in which internal context informs the choice of self-control methods. *Transient internal factors.* Transient internal states that result in impaired cognition drive people to rely on their environment in order to determine their own behavior to a greater extent than they usually do. When this effect is understood and appreciated, proper planning (in the form of situation selection and situation modification) can help minimize the threat that these situations may pose. However, people often underestimate the magnitude of this effect, resulting in poor preparation and subsequent self-destructive (or other-destructive) behavior.

Certain states of mind are notorious for their deleterious effect on self-control. Psychological researchers are familiar with the notion of generalized cognitive load, and may wonder how it would impact self-control. Two well-established harbingers of poor self-control are intoxication and sexual arousal. Is there a way to prepare for temptations that we may encounter while in those states? In this subsection, we briefly review the relevant research findings and outline possible ways of preparing for such occurrences.

Cognitive load occurs when a person's cognitive resources are taxed (e.g., being asked to hold a random digit string in memory while naming the capitals of different countries). The effect of cognitive load on self-control is not straightforward, but a number of studies suggest cognitively taxed individuals become more reliant upon salient environmental cues to guide their behavior—a reliance which can promote either low or high degrees of self-control, depending on the cues that are present (Mann & Ward, 2004; Parent, Ward, & Mann, 2007; Westling, Mann, & Ward, 2006).

Intoxication impacts self-control in a manner similar to that of cognitive load. Despite the common notion that intoxication leads to impulsive behavior, research suggests that the main effect of intoxication is similar to that of cognitive load (Casbon, Curtin, Lang, & Patrick, 2003; Ditto, Pizarro, Epstein, Jacobson, & MacDonald, 2006; MacDonald, Fong, Zanna, & Martineau, 2000), by causing behavior to become more dependent on external cues. In other words, behavior while intoxicated can become either less or more restrained than behavior while sober, depending on the nature of the environmental cues that are present.

Sexual arousal, as it influences self-control, has only been studied in a small number of experiments. In those studies, sexual arousal had a decidedly deleterious impact on self-control, by heightening impulsive behavior (Ariely & Loewenstein, 2006; Wilson & Daly, 2004). However, we are unaware of studies that tested whether the detrimental effect of sexual arousal on self-control can also be explained in terms of cognitive load and dependence on external cues (i.e., given that sexual arousal is usually the result of exposure to sexually arousing cues, sexually aroused people may be more likely to be surrounded by cues that suggest sexual behavior).

People appear to underestimate the magnitude of the effect that transient internal changes such as cognitive load, intoxication, or sexual arousal will have on them (Gilbert, Gill, & Wilson, 2002; Loewenstein, 1996; Nordgren, van der Pligt, & van Harreveld, 2006). This phenomenon, which Loewenstein (2005) labeled "the empathy gap," may be the most pernicious aspect of transient vulnerabilities of the sort we discuss here. The bulk of the evidence suggests that the best strategy may be to rely heavily on

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situation selection in preparation for times in which cognition may be impaired, and to rely on situation modification while in these states. Thus, before drinking with a group of friends, one would be wise to avoid carrying car keys, credit cards, or large amounts of cash, all of which could lead to a variety of problems in the hands of an individual who is (temporarily) extremely suggestible. Similarly, before going on a date with an attractive but unknown stranger, one would be wise to ensure the availability of contraceptives, rather than relying on their own sound judgment in the moment of truth, should sex become a viable possibility. Unfortunately, people are not likely to create safe environments in advance if they do not realize the extent to which their future behavior will depend on external cues.

Stable internal factors. In contrast with the relatively transient internal states that we reviewed earlier (cognitive load, intoxication, or sexual arousal), some internal factors are much more persistent, thereby constituting a relatively stable personality. We propose that personality and self-control interact with each other in important ways. Specifically, personality plays a key role in determining what constitutes a temptation for a given person, how powerful the temptation is, and which self-control techniques are most helpful in resisting the temptation. In addition, we propose that the flow of influence between personality and self-control is not one-directional, but reciprocal: Over time, the self-control an individual exerts shapes that individual's personality in important ways.

The psychology of individual differences has concerned itself with an astonishing number of putative traits, and considering the significance of even a fraction of those is beyond the scope of this chapter. For illustrative purposes, in the following examples we will refer to the widely used Big 5 dimensions of personality (John & Srivastava, 1999), as well as the more specific traits of impulsivity and temporal discounting. We then turn to discuss lifespan development considerations when choosing specific techniques for self-control.

Personality determines what constitutes a temptation for a given person. We have already defined temptation as a situation in which the goal of experiencing a relatively small short-term gain is competing with the goal of experiencing a relatively large long-term gain. In other words, temptation exists whenever an immediately available outcome is appealing enough to risk abandoning a delayed outcome that would be even more appealing if it were immediately available. Personality traits determine the appeal of both long-term and short-term rewards, thereby determining whether such a conflict exists.

As an example let us return to Eddie, who is sitting in his room, working on his homework for the next day. Eddie promised his parents that he would finish all of his homework before dinner, and knows that his parents will ask him during dinner whether he kept his promise. But the homework is boring and unsatisfying, while outside an exciting street-soccer game is starting to form, and Eddie's friends are playing. Eddie is facing two basic alternatives: go outside and play (and not complete the homework before dinner), or continue working on the homework (and not go out to play).

Consider the different ways in which Eddie may experience his alternatives, based on his personality. If Eddie is highly extraverted, going to play with his friends would seem very appealing. Conversely, if Eddie is very introverted, the game would have no special allure. Similarly, if Eddie is highly conscientious, he may feel bad about breaking his promise to his parents (or lying to them at the dinner table), whereas if Eddie is not conscientious, he would have no compunction about either. Lastly, if Eddie is highly neurotic, the potential of being caught would have a distressing effect on him, whereas if Eddie is not neurotic at all, the risk itself would not be a cause of great distress. In this example, Eddie's extraversion, conscientiousness, and neuroticism operate in concert to determine the appeal of the immediate and the delayed consequences. He may experience no temptation at all (either by not finding the game appealing, or by not seeing any problem with playing and breaking his promise and/or lying about it), or he may experience some temptation (by finding the game appealing, but finding the promise-breaking problematic), depending on how appealing or unappealing each of the consequences appear to him.

Personality also determines how powerful a temptation is for a given person. Since personality traits determine the appeal of the possible consequences, they serve to determine not only *if* a temptation exists, but also the *strength* of the temptation (i.e., the relative appeal of the immediate alternative as compared with the delayed alternative). If Eddie is only somewhat extraverted, the temptation to go out and play would be relatively weak, whereas if Eddie is extremely extraverted, the temptation to go out and play would be relatively strong.

Personality determines which self-control techniques are likely to be most helpful in resisting temptation. Consider two related traits that are often brought up in the context of self-control: impulsivity and temporal discounting. Impulsivity can be broadly defined as "a tendency to act rashly and without consideration of consequences" (Dawe, Gullo, & Loxton, 2004, p. 1394). Temporal discounting (Ainslie, 2001) is related to impulsivity (Kirby, Petry, & Bickel, 1999), and represents the extent to which an individual perceives events in the far future to be less important than similar events in the near future, based solely on the greater time that will pass before they occur.

Individuals who exhibit higher rates of temporal discounting tend to be more influenced by the availability of immediate reward, and may thus experience a greater temptation to choose immediate gratification. However, even when people display high rates of temporal discounting, they are still able to orient towards the larger-later rewards when making choices long before any of the rewards are immediately available (Kirby & Herrnstein, 1995). This suggests that people who are highly impulsive and/or exhibit high rates of temporal discounting may especially benefit from employing pre-emptive techniques for self-control (such as situation selection), as compared with techniques that aim to deal with an already present temptation (such as attention deployment or response modulation). In addition, our group has recently found that changing the meaning or representation of the available alternatives (through cognitive change or situation modification) can effectively reduce rates of impulsive choice when choosing between immediately available small rewards and delayed larger rewards (Magen, Dweck, & Gross, 2008).

An individual's self-control impacts that individual's personality in important ways. Perhaps the most striking example of the reciprocal influence between self-control and personality can be seen in the case of substance abuse. While it is generally accepted that impulsive people are more likely to engage in substance abuse (e.g., Hoffman et al., 2006; Kirby & Petry, 2004; Mitchell, Fields, D'Esposito, & Boettiger, 2005; Reynolds, 2006), a growing body of literature demonstrates that engaging in substance abuse results in increased impulsivity, most likely due to long-term effects on the brain's reward mechanisms (Moeller & Dougherty, 2002).

Lifespan developmental stage. It is important to consider lifespan development when choosing a self-control method to implement when facing temptation. How does the developmental stage of an individual constrain the choice of viable self-control methods? What ways are there to provide adequate support for such developmental limitations? Children as young as 4 years of age may be capable of employing a wide range of self-control methods, including such sophisticated methods as situation selection and cognitive change. However, people who are limited due to developmental constraint will benefit from external initiation of the self-control process, as well as guidance with respect to the details of implementation ("imagine that the pretzels are actually logs" rather than "imagine how crunchy and salty the pretzels are"). In this way, selecting age-appropriate self-control methods, and adapting methods that would be challenging for a given developmental stage (by providing scaffolding in the form of reminders and rehearsals), can improve the likelihood of successfully resisting temptation.

Children are less capable of exerting self-control than adults (Pressley, 1979), a capacity which they develop as they age. When in the presence of an object that implies a certain behavior, even when they are aware that they should not perform it, children are more likely than adults to do so. When children are in the presence of forbidden food, they will eat it; when faced with a forbidden toy, they will play with it (Craik & Bialystok, 2006; W. Mischel, Shoda, & Rodriguez, 1989). In terms of the cybernetic process, such utilization behavior can be described as perception activating a goal, resulting in an impulse to utilize the tempting object, which leads to that behavior.

Some interventions may require modifications when used with children. Because children's behavior is influenced so strongly by their environment, external support and guidance are crucial when helping a child exert self-control. Situation selection / modification remains a viable option for self-control, even for young children, but may require external guidance with young children. Study participants as young as 6–7 years of age have displayed an understanding of factors which may make temptations easier or harder to resist (Choe, Keil, & Bloom, 2005; H. N. Mischel & Mischel, 1983), although younger children tended to believe that counterproductive methods (e.g., watching the tasty forbidden treat) would help them exert more self-control. Supervision by a caretaker may be necessary in order to help children select (or modify) situations in a way that would create an environment that would support their long-term goals.

Cognitive change, another high-leverage method of self-control, requires a measure of cognitive flexibility, an ability which has been consistently shown to be age-dependent,

and to improve throughout childhood. Although children younger than 3 years of age exhibit a limited capacity for set-switching tasks (Zelazo, 2004), some ability is already apparent in children as young as 4 years of age (Deák, Ray, & Pick, 2004). The ability to flexibly switch to a new set of rules reaches adult levels of performance by the age of 12, and the ability to steadily maintain the new representation reaches adult levels of performance around age 14 (Crone, Ridderinkhof, Worm, Somsen, & van der Molen, 2004). These findings correspond with those of researchers studying neurodevelopment, who have shown that the prefrontal cortex—a brain area that is implicated in response inhibition and cognitive restructuring (Ochsner & Gross, 2004), as well as goal updating (Badre & Wagner, 2004)—develops continuously from birth and until young adulthood (Giedd et al., 1999; Sowell, Thompson, Holmes, Jernigan, & Toga, 1999; Thompson et al., 2000).

Social support, through reminders about the new way of interpreting the situation (such as thinking about tasty forbidden treats as pictures or inedible objects), facilitated performance in all cases in which children exhibited any capacity for set-switching (Crone et al., 2004; Deák et al., 2004; Patterson & Mischel, 1976). Goal verbalization (being provided with a concrete phrase to repeat when faced with temptation, which included a reminder of the goal) was of greater benefit than simply being provided with stated goals or with distracting behaviors (Genshaft, 1983; Patterson & Mischel, 1976). These findings suggest that cognitive change could be beneficial even for young children, with the help of caretakers who can remind children of more helpful construals for the situation they are experiencing (Feindler, Marriott, & Iwata, 1984).

Very little is known about changes in self-control throughout the adult lifespan. Although researchers agree that older adults tend to display more utilization behavior than young adults, and that cognitive flexibility diminishes as one progresses through adulthood (Craik & Bialystok, 2006), we have encountered difficulty in finding empirical reports of tests for self-control in older adults. We were able to locate only a single study on this topic, which longitudinally tested for changes in self-reported self-control (Cramer & Jones, 2007). Over the course of approximately 65 years, almost 75% of the participants reported improvement in self-control, while most of the remaining participants reported decrements in self-control. Despite the decline of some cognitive skills, participants reported an improved capacity to exert self-control—an improvement that can perhaps be attributed to the generally recognized improvement in emotion regulation that accompanies aging (Carstensen, Fung, & Charles, 2003; Charles & Carstensen, 2007; Gross et al., 1997).

Concluding Comment

In this chapter we have presented the cybernetic process model of self-control. The model provides a general framework for representing both the emergence and

regulation of temptations. Although a large body of research has examined a multitude of self-control techniques (see Table 16.2), these techniques have been developed separately, without a unifying framework. The absence of a unifying framework has prevented researchers and practitioners from transferring the principles of interventions from a particular domain (e.g., weight management) to novel interventions in a different domain (e.g., aggressive behavior). By grouping the multitude of known theories and interventions into five discrete types of self-control techniques, the cybernetic process model of self-control creates a common language for researchers and practitioners to use when discussing self-control and temptations, thereby enabling the cross-pollination that is critical for the continued growth of behavioral science.

In addition, we proposed a number of considerations to serve as decision aids when selecting self-control techniques for dealing with temptations. Specifically, we suggested that features of the situation (i.e., predictability and duration) as well as those of the person who is facing the temptation (i.e., transient mental state, stable personality traits, and lifespan developmental stage) are important to consider when selecting the optimal combination of self-control techniques. In doing so, we aim for the cybernetic process model of self-control to serve as a vehicle for translating basic psychological theory into real-world interventions for real-world problems. We hope and trust that such an analysis will empower individuals to pursue their own long-term goals through the wise application of self-control skills. Even little Eddie.

Note

1 For further details regarding the development of the model, see Magen and Gross (in press).

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17

Modes of Self-Regulation

Assessment and Locomotion as Independent Determinants in Goal Pursuit

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In a general sense, the notion of self-regulation refers to the governing and directing of attention, resources, or actions towards one's adopted goals. This is consistent with the everyday conception of goal-directed action, in which a person is thought to evaluate available pursuits, select the most desirable option, and engage in behaviors designed to attain the goal. For example, a person may consider various potential life paths following graduation from high school and ultimately decide that he or she would like to earn a bachelors degree, which would then lead to behaviors such as attending (often boring) lectures and reading (often dry) textbooks. Such understanding of self-regulation makes two functions apparent. First, the person *assesses* the value of potential goals and the various means that serve each goal. Second, the individual *locomotes*, or moves away from, the current state towards a desired goal state. As such, assessment and locomotion as a body form part and parcel of all self-regulatory activity.

Assessment refers to a determination of the rate, amount, size, value, or importance of something; it concerns critical appraisal for the purpose of understanding or interpreting, or as a guide in taking action. Thus the value or importance of both the current state and the end state can be independently assessed, and so can the value or utility of the means used to move toward or away from that end state. According to regulatory mode theory, assessment "constitutes the comparative aspect of self-regulation concerned with critically evaluating entities or states, such as goals or means in relation to alternatives in order to judge relative quality" (Kruglanski et al., 2000, p. 794). For example, an individual may assess preferences among alternatives, and how well he or she performed in the past. Individuals strong in assessment mode are preoccupied with these kinds of comparative judgments.