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Integrating Models of Self-Regulation

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Abstract

Self-regulation is a core aspect of human functioning that helps facilitate the successful pursuit of personal goals. There has been a proliferation of theories and models describing different aspects of self-regulation both within and outside of psychology. All of these models provide insights about self-regulation, but sometimes they talk past each other, make only shallow contributions, or make contributions that are underappreciated by scholars working in adjacent areas. The purpose of this article is to integrate across the many different models in order to refine the vast literature on self-regulation. To achieve this objective, we first review some of the more prominent models of self-regulation coming from social psychology, personality psychology, and cognitive neuroscience. We then integrate across these models based on four key elements—level of analysis, conflict, emotion, and cognitive functioning—specifically identifying points of convergence but also points of insufficient emphasis. We close with prescriptions for future research.

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INTRODUCTION

Self-regulation: the dynamic process of determining a desired end state and taking action to move toward it while monitoring progress along the way

Conflict: the discrepancy between goals that are simultaneously active, mutually exclusive, and competing for a single response

Self-regulation is a boon to the well-functioning person, if not a well-functioning society. As connections between self-regulation and outcomes affect domains as disparate as health, longevity, criminality, financial savings, job performance, and relationship satisfaction (to name but a few), it is no wonder the lay public and scholars alike are keen to understand and cultivate it (Baumeister et al. 1994, Moffitt et al. 2011). Despite this interest (or perhaps because of it), progress in understanding self-regulation has been hampered by too many models and theories, each describing self-regulation at different levels of analysis with not enough integration.

Some models, for example, focus entirely on goals (Kruglanski et al. 2002, Locke & Latham 2006), whereas others focus on the fragility of willpower (Baumeister et al. 2007). Some models center on human personality and traits (Roberts et al. 2014, Whiteside & Lynam 2001), whereas others focus on conflicts between goals and temptations (Hofmann et al. 2009). Still others construe self-regulation as dependent on a self-monitoring process (Carver & Scheier 1998), whereas others construe it as a series of learnable strategies (Duckworth et al. 2016a). All of these models provide insights about self-regulation, but sometimes they talk past each other, make only shallow contributions, or make contributions that are underappreciated by scholars working in adjacent areas.

Here we attempt to remedy this situation by integrating across different models of self-regulation coming from disparate research traditions in social psychology, personality psychology, and cognitive neuroscience. Such integration will allow us to identify not only where models

converge, but also where there has been insufficient emphasis. Critically, highlighting how the various models fit together can clarify concepts that have proved perplexing because of the imprecise use of terminology. Perhaps the clearest example of such confusion is with the term self-regulation itself. We thus begin with a few definitions of overlapping terms.

DISTINGUISHING BETWEEN SELF-REGULATION, SELF-CONTROL, AND COGNITIVE CONTROL

Although the two terms are often used interchangeably (e.g., Vohs & Baumeister 2004), we suggest that self-regulation and self-control refer to distinct processes (Milyavskaya et al. 2019a), both of which resemble but are not isomorphic with cognitive control (Cohen 2017). Self-regulation is a broad term that refers to the dynamic process of determining a desired end state (i.e., a goal) and then taking action to move toward it while monitoring progress along the way (Carver & Scheier 1998). Self-regulation involves steering one's behavior toward a desired end state. End states, or goals, can be defined as specific desired behaviors (e.g., physical exercise), thoughts or attitudes (e.g., being compassionate), or emotional states (e.g., being content). Self-regulation, therefore, subsumes the regulation not only of behavior but also of thoughts and emotions (e.g., Gross 2015). Self-regulation can be thought of as an umbrella term that includes a wide array of goal-relevant activities, such as deciding which goal to pursue, planning how to pursue it, implementing these plans, shielding goals from competing concerns, and sometimes even abandoning goals (Fujita 2011, Gollwitzer 1999, Ludwig et al. 2019, Shah et al. 2002, Wrosch et al. 2003). For example, setting a goal to jog at 6 a.m. is an act of self-regulation, as is planning to go to bed early the night before to avoid being tired and as is temporarily abandoning one's jogging goal when one is sick.

Self-regulation includes the various ways in which people modify their thoughts, feelings, and behaviors in the service of a personal goal, including engaging in effortful self-control. Self-control represents one form of self-regulation, but not all forms of self-regulation entail self-control (Fujita 2011). We define self-control as the process of resolving conflict (real or anticipated) between two competing goals. For example, when deciding between a delicious poutine and a healthy salad for lunch, self-control is recruited to resolve the conflict between the short-term goal of eating delicious food and the long-term goal of being healthy and fit.

Self-control is often characterized as pertaining exclusively to resolving conflicts between goals that are temporally asymmetric, that is, between goals with small immediate rewards and goals with larger yet delayed rewards (Ainslie 1974, Duckworth et al. 2016a, Fujita 2011). Self-control, according to this view, is demonstrated when a person resists the desire for the small immediate reward in favor of the larger later reward. Here, however, we relax the assumption of temporal asymmetry and count as self-control the resolution of conflict between any two goals, be they goals that pit short- and long-term rewards against each other (e.g., eating poutine versus eating salad) or goals that produce long-term rewards that compete for one's limited time (e.g., studying for a test versus hanging out with friends).

Self-control has typically been characterized by the effortful inhibition of impulses, including effortfully overriding unwanted thoughts, feelings, and behaviors (Baumeister 2014). More recently, the concept of self-control has expanded to include any means to advance one motive over another (Fujita 2011), including means that do not involve effort (Galla & Duckworth 2015, Gillebaart & de Ridder 2015, Hennecke et al. 2019), means that involve inhibiting something undesired or enacting something desired (de Ridder et al. 2011, Gillebaart 2018), or means that involve reactive inhibition or more proactive forms of resolving conflict (Duckworth et al. 2016a, Fujita 2011). Our definition of self-control, therefore, expands on prior definitions by including more varieties of goal conflicts and more varieties of means to resolve goal conflicts.

Self-control: the process of advancing one goal over a second goal when the two come into conflict

Cognitive control: the flexible allocation of attention in the service of goal-directed behavior in the face of more habitual or immediately compelling behaviors

Goal: the cognitive representation of a desired end state that a person is committed to attain

In sum, what differentiates self-control from self-regulation is the presence of conflict between motives (Fujita 2011). Self-control refers to all means of resolving conflicts between competing goals (including, but not limited to, inhibition), whereas self-regulation can be conflict-free, refers to the broader process of steering one's behavior toward a desired end state, and includes setting goals, monitoring goal progress, and acting in accordance with goals (Carver & Scheier 1998, Gillebaart 2018).

Stemming from cognitive neuroscience is the related concept of cognitive control or executive function. Cognitive control refers to the attentional processes that allow behavior to vary from moment to moment based on current goals rather than remain rigid and inflexible; it is the flexible allocation of attention in the service of goal-directed behavior in the face of more habitual or immediately compelling behaviors (Cohen 2017). This emphasis on modifying some aspect of the self in service of meeting a goal bears a striking similarity to the definition of self-regulation; in fact, self-regulation was long thought to rely on the more basic attentional components of cognitive control (Hofmann et al. 2012). More recently, however, scholars have come to question the reliance of self-regulation on cognitive control, mostly because measures of each construct are unrelated (Dang et al. 2020, Eisenberg et al. 2019, Saunders et al. 2018). Typically, the term cognitive control is used when describing the flexible use of low-level cognitive operations like attention and working memory, whereas self-regulation is used when discussing the flexible adjustment of behavior in the real world.

An influential account indicates that cognitive control consists of the three distinct (yet related) factors of inhibition, attentional shifting, and working-memory updating (Miyake & Friedman 2012, Miyake et al. 2000; but see Doebel 2020). Despite the widespread appeal of this definition, however, there is a growing sense that cognitive control (or executive function) might be indistinguishable from general intelligence or the broad abilities (e.g., processing speed, memory) that constitute general intelligence (Conway et al. 2003, Engelhardt et al. 2016, Jewsbury et al. 2016). If cognitive control is indistinguishable from intelligence, even at the level of genetic overlap (Engelhardt et al. 2016), it should perhaps be treated independently from self-regulation, which is sometimes referred to as the noncognitive factor important for success (Duckworth et al. 2019).

MODELS OF SELF-REGULATION

Much like there are many different perspectives and definitions of what constitutes self-regulation, so are there various models that seek to explain various aspect(s) of the regulatory process. In this section, we provide a nonexhaustive list and summary of these models, focusing on those that make general contributions to the process of self-regulation (cf. Neal et al. 2017).

Cybernetic Control

Cybernetics is the science of control in animals and machines (Wiener 1948). Perhaps the most influential general model of self-regulation (Carver & Scheier 1998), cybernetic control is based on simple feedback loops that contain four key elements: (*a*) a goal, set point, or standard; (*b*) input about the current state of the organism with regards to the set point; (*c*) a system that monitors for conflicts or discrepancies between the set point and the current state of the organism; and (*d*) a system that implements changes that reduce the discrepancy between current and desired states. Critically, these elements are connected to one another via a feedback loop (see **Figure 1**). The output of the implementing system feeds back to change the current state of the organism, after which the current state is again compared to the goal state by the monitoring system. This process is repeated until the discrepancy between the goal state and the current state is reduced to some acceptable level.

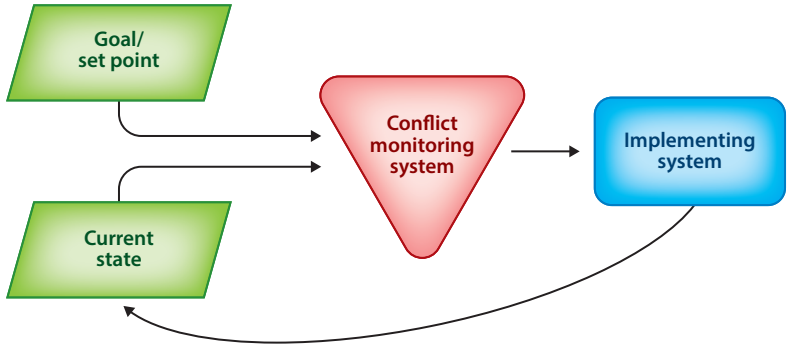

Figure 1

Cybernetic model of self-regulation.

For example, students struggling to get their homework done can set a goal to do it after dinner. Once dinner passes, they evaluate whether their current behavior matches their goal (e.g., I am watching Netflix but I should do my homework). When a discrepancy is detected, they implement a new behavioral course congruent with their goals (e.g., I am going to close the computer and open my books) and repeatedly monitor their behavior until the desired task is complete.

Cybernetic feedback principles are also at the heart of dominant models of control from cognitive neuroscience, which place special importance on the neural systems responsible for monitoring conflicts between competing response tendencies (Botvinick et al. 2001) or between predictions and outcomes (Alexander & Brown 2011, Holroyd & Coles 2002). Conflict monitoring theory, for example, focuses on how a monitoring system generated by the dorsal anterior cingulate cortex scrutinizes action tendencies for potential conflicts so that control mechanisms generated by the dorsolateral prefrontal cortex can override unwanted tendencies to promote effective goal pursuit. More recent computational models of cognitive control elaborate further on the precise function of these neural substrates, but one constant is that detecting and responding to conflict, discrepancies, or prediction errors appear critical (Shenhav et al. 2013, Vassena et al. 2017).

Goal Systems Theory

Another model focusing specifically on the goal concept is goal systems theory (Kruglanski et al. 2002). Similar to the cybernetic model, this model broadly defines goals as cognitive representations of desired end states; however, rather than focusing on feedback loops, this approach emphasizes how the structural organization of goals and the means by which they can be attained affect the process of self-regulation. Goals and their associated means (i.e., the different pathways by which people can attain their goals) make up a hierarchical interconnected network called a goal system, and the strength of the various goal–means associations is what ultimately drives behavior. In other words, means that are more strongly associated with a specific goal are more likely to be selected than means that have a weaker connection.

The strength of connections within a goal network depends on the uniqueness and substitutability of a given means for that specific goal; that is, having many means attached to a particular goal dilutes the strength of each individual goal–means connection (therefore decreasing the likelihood of any particular means being selected), whereas goals with fewer, more unique means have stronger connections (therefore increasing the likelihood of behavioral enactment) (Kruglanski et al. 2002). For example, if a person has a very specific goal to attend an exercise class

that they signed up for, there are limited means that can be used to enact this goal (i.e., the only viable option is to simply attend the class as planned). Because alternative means are not readily available, the strength of the association between the goal to attend the class and the means of going to the gym will be quite strong. By contrast, a less specific goal typically has many means associated with it. For the broader goal to be healthy, one could attend an exercise class, cook a healthy meal, meditate, make time to relax with friends, schedule a doctor's appointment, and so on. Because there are so many equally viable options to enact this goal, the strength of the association between each individual means and the target goal gets diluted.

When a goal is considered particularly important, people select means that are most instrumental to (or most strongly and uniquely associated with) pursuing that goal. Means that advance a single goal are called unifinal means: For example, if one has the goal of having fun, and riding a roller coaster is the means most strongly and uniquely associated with this goal, one is likely to select this option. However, if one has additional goals that impose restrictions on the means available, riding a roller coaster is unlikely to be selected. For example, if one has the goal of having fun but also has the goal of staying socially connected, a roller coaster may not be the best option to advance both goals. Instead, one may select a multifinal means (Köpetz et al. 2011), or a means that advances multiple goals simultaneously; for example, they may choose the means of playing a card game with a friend, which advances both the goal of having fun and the goal of being socially connected. Multifinal means satisfy multiple goals in one fell swoop, constituting greater "bang for the psychological buck" (Kruglanski et al. 2002, p. 358).

Dual Systems Models

From Plato to Saint Augustine, from Descartes to Freud, as long as scholars have put pen to paper (or quill to parchment), they have described behavior as being a product of two distinct mental operations. Indeed, dual systems models of self-regulation remain more popular than ever (Cohen 2017, Heatherton & Wagner 2011, Hofmann et al. 2009, Kahneman 2011, Metcalfe & Mischel 1999, Thaler & Shefrin 1981). While there are many flavors to these models, they all share the notion that two distinct systems—unimaginatively named System I and System II—regulate behavior.

First, there is System I, also known as the impulsive system, automatic system, hot system, reflexive system, or the doer. System I is a fast system that is responsive to the immediate environment, especially stimuli with high incentive value, for example, stimuli we might describe as temptations. This system responds to stimuli that are temporally and spatially near, serves short-term gratification, and produces behaviors that are rigid and habitual—most often an urge to approach and act on the temptation at hand (Hofmann et al. 2009). System I devalues stimuli that are temporally distant (Ainslie 1974, Mischel et al. 1972) or are contingent on effort (Apps et al. 2015, Westbrook et al. 2013). This impulsive system is associated with activity in subcortical regions of the brain involved in reward and emotion, such as the nucleus accumbens in the ventral striatum, the amygdala, and the insula (Heatherton & Wagner 2011, Lopez et al. 2014).

Next, there is System II, also known as the control system, deliberate system, cold system, reflective system, or the planner. System II is a slow system that carefully and effortfully deliberates among possible response options and is responsible for higher-order mental operations, such as making deliberate judgments and evaluations, setting goals, and creating strategies for goal pursuit (Hofmann et al. 2009). Unlike System I, this system is influenced by long-term goals to flexibly respond to the environment, including overriding behavioral tendencies from the impulsive system. Also unlike System I, the control system processes stimuli sequentially, meaning that it is limited by a person's attentional capacity, which can fluctuate from moment to moment based on

concurrent processing demands (Cowan 2001). This control system is associated with regions of the lateral prefrontal cortex (Berkman et al. 2011, Heatherton & Wagner 2011).

Dual systems accounts suggest that behavior is jointly produced by these two independent systems that might be mutually supportive or might be in conflict. When the two systems are aligned—for example, when the goal of driving home is supported by the urge not to crash into a snowbank—behavior is determined by an unconflicted self-regulatory process. Self-control dilemmas arise, however, when the two independent systems conflict—for example, when a dieter is offered delicious yet unhealthy poutine. In such a dilemma, the behavioral option that is selected (e.g., eating poutine versus refusing it) is determined by a winner-takes-all competition between the two systems, with the more strongly activated and recruited system typically determining behavior (Hofmann et al. 2009). These self-control dilemmas, in other words, are conceived as a seesaw between the two opposing modes of processing, where either the impulsive system is dominant or the control system overrides and inhibits the impulsive system and wins out (Lopez et al. 2017). Critically, the balance between the two opposing systems can be disrupted by various dispositional moderators, such as individual differences in impulsivity and restraint (Carver 2005) or by situational moderators, such as fatigue, mood, stress, alcohol consumption, and brain damage (Heatherton & Wagner 2011).

Impulsivity: the tendency to act on immediate urges, either before or despite consideration of the possible negative consequences

Cognitive control is also described as a dual process model whereby an automatic (i.e., heavily trained) process is pitted against a controlled (i.e., flexible, yet effortful) process (Kool & Botvinick 2018, Shenhav 2017). Attributes that distinguish automatic from controlled processes include speed of processing, flexibility, susceptibility to interference from other ongoing processes, and reliance on a central, limited-capacity operator. The color-naming Stroop task highlights a number of these criteria: Color-naming is slower than word-reading; reading interferes with color-naming, but color-naming does not interfere with reading; and other controlled processes, for example, mental arithmetic, interfere with color-naming (Cohen 2017). A central question in this research tradition is what moves a person from default habitual processing to flexible yet costly controlled processing. The answer is typically some form of conflict, be it a conflict between intended and actual responses (i.e., errors), between predicted and actual outcomes (i.e., prediction errors), or between mutually incompatible response options (i.e., response conflict) (Kool et al. 2017).

Choice Models

In contrast to dual process models—which suggest that self-control consists of a battle between impulsive and deliberative processes, like the metaphorical devils and angels on one's shoulders vying for dominance—choice models posit that self-control is nothing more than the behavioral enactment of some value-based choice (Berkman et al. 2017a, Buckholtz 2015, Neal et al. 2017). According to this view, control is the product of a single valuation process wherein various response options are assigned some subjective value and then a decision about which option to act upon is made through a dynamic integration of these competing values. Self-control thus involves calculating a value for each option by integrating the benefits of each option minus their attendant costs and then enacting the most valued option (Berkman et al. 2017a). Interestingly, the value ascribed to future (versus present) outcomes appears especially critical for successful self-control not only in the lab but also in the real world (Kronke et al. 2020).

The calculation of option benefits is based on things like monetary incentives, social approval, proximity to core values, and the extent to which the option is self-determined (Berkman et al 2017b, Ryan & Deci 2000). Option costs are based on features like the delay and abstractness of the expected reward, the effort required to gain the reward, and the opportunity costs (Ainslie 2001,

Fujita et al. 2006, Kurzban et al. 2013, Thaler & Shefrin 1981, Westbrook et al. 2013). Critically, the calculations of benefits and costs are subjective, noisy, and vary by person and context. These calculations also vary by time such that the same response options might be given different weights by the same person depending on time of day or day of the week, or even based on what that person did before (Inzlicht et al. 2014b, Kool et al. 2010, Kurzban et al. 2013). Contemporary work in neuroeconomics indicates that this noisy integration of value signals is implemented by the ventromedial prefrontal cortex (Hare et al. 2009), though other work has also implicated the dorsolateral prefrontal cortex (Tusche & Hutcherson 2018).

Some choice models (e.g., Berkman et al. 2017a) seek to redefine control as nothing more than value-based choice; that is, they seek to eliminate control as a unique process separate from more habitual forms of responding. This view has not been without controversy, however (Shenhav 2017). In contrast, other choice models strike a middle ground, being firmly dual process in their preservation of automatic and controlled processes, yet adding a dimension of choice to the typical dual process mix (Shenhav et al. 2013). According to this view, self-control is a special case of decision making about whether or not to exert cognitive control. Habitual and controlled forms of processing still compete for dominance in this view, but whether or not someone allocates control is based on the expected value of control as calculated by integrating its expected payoff, the amount of control needed, and the inherent cost in terms of cognitive effort (Shenhav et al. 2013). The dorsal anterior cingulate plays a special role in specifying the currently optimal allocation of control by determining its overall expected value (Frömer et al. 2020, Shenhav et al. 2016). If control is deemed worthwhile by the dorsal anterior cingulate cortex, it justifies costly effort (cf. Inzlicht et al. 2018).

Resource Model of Self-Control

The resource model or strength model, perhaps the best-known model of self-regulation in social psychology, was first celebrated (Baumeister et al. 2018), then heavily criticized (Friese et al. 2019, Inzlicht & Friese 2019). The resource model makes two broad points about self-control, defined as the capacity to override undesired behavioral tendencies (Tangney et al. 2004). First, self-control is based on some central resource that powers all sorts of controlled behavior, be that picking broccoli over chocolate, treating a racial outgroup in an egalitarian fashion despite prejudicial impulses, or naming the color of words despite habitual word-reading responses. Second, this central self-control resource is limited and runs out with use, like a sort of mental fuel that powers the will.

The most celebrated finding of the resource model is the so-called ego depletion effect, whereby engaging control at Time 1 is thought to deplete the central resource and reduce control at Time 2. For example, in the very first demonstration of ego depletion, people who forced themselves to eat radishes instead of chocolates subsequently quit faster on unsolvable puzzles than people who did not have to exert self-control (Baumeister et al. 1998).

The resource model is primarily a model about time: Self-control wanes over time, such that people exert less control at Time 2 if they have been continuously exerting control at Time 1. Though most studies suggest depletion can occur in as little as a few minutes, more rigorous studies suggest that one (Randles et al. 2017) or four hours (Blain et al. 2016) might be necessary. Likewise, while initial theorizing suggested that what is especially depleting of subsequent control are tasks requiring the inhibition of a learned habit (Baumeister 2014), more recent work suggests that any effortful task will do (Kool & Botvinick 2014, Lin et al. 2020). This effectively reduced depletion to a form of mental fatigue and, possibly, boredom (Hockey 2013, Kurzban et al. 2013, Milyavskaya et al. 2019b).

Although it has inspired an entire generation of scholars, the resource model has been dogged by numerous controversies, leaving more questions than answers (Inzlicht & Berkman 2015). The main controversy concerns whether the basic ego depletion effect is even replicable, a question that might seem preposterous given the mountain of apparent support (Baumeister 2019, Hagger et al. 2010). Nonetheless, modern meta-analyses and large preregistered replications suggest that the ego depletion is either very small or nonexistent (Carter et al. 2015, Hagger et al. 2016). A second controversy concerns how to explain the ego depletion effect, assuming it is real. While the resource model indicates that some real metabolic resource is diminished by control, alternative accounts attribute the effect to changes in motivation and willingness (Inzlicht & Schmeichel 2012, Kool & Botvinick 2014, Kurzban et al. 2013).

We note that despite the enthusiasm with which it was met, the resource model contributes rather narrowly to our understanding of self-regulation. It suggests merely that control wanes with continued use, something anticipated by classic work on mental fatigue (Thorndike 1900) and the vigilance decrement (Mackworth 1948).

Process Model of Self-Control

As the field shifts away from the notion of effortful inhibition, recent theorizing suggests that self-control can also be more effortless as a function of using different strategies that prevent the experience of temptation (or conflict) in the first place (Duckworth et al. 2016a, Gillebaart & de Ridder 2015, Hofmann & Kotabe 2012). While there is a lot of emerging work examining which strategies people may use in the pursuit of their goals (e.g., Duckworth et al. 2018, Hennecke et al. 2019, Hofmann & Kotabe 2012), the most prominent framework that lays the foundation for more strategic self-control is the process model of self-control (Duckworth et al. 2016a).

According to various strategy models, strategies are either preventive (proactive) or interventive (reactive) (Braver 2012, Hofmann & Kotabe 2012). Preventive strategies (called situational strategies by the process model) are anticipatory techniques used to minimize the extent to which a desire may emerge at a later point in time. In other words, preventive strategies are tools that people can use to avoid conflict before it even emerges. According to the process model, such strategies include situation selection (i.e., intentionally choosing to be in an environment that is aligned with one's goal and/or eliminates temptation) and situation modification (i.e., changing some aspect of the environment to reduce or remove temptations). For example, a person can avoid the bakery section at the grocery store and simply not buy cookies in the first place (situation selection), or, if the cookies are already in their home (e.g., because their spouse loves cookies), they can be placed in the back of the cupboard so they are out of sight, out of mind (situation modification).

Because it is not always possible to prevent self-control conflicts entirely, interventive strategies (called intrapsychic/cognitive strategies in the process model) can be used to cope with existing temptations that conflict with important goals. In other words, interventive strategies are tools that people use to manage already existing conflicts. According to the process model, such strategies include attentional deployment (i.e., directing attention away from a temptation), cognitive change (i.e., focusing on the positive aspects of restraining and/or the negative aspects of giving in), and response modulation (i.e., using willpower or inhibition to resist). A person, for example, may avoid looking at cookies on the table when having dinner (attentional deployment), they may think about how calorific the cookies are and how guilty they would feel for cheating on their diet (cognitive change), or they can just say no and try their best to not eat the cookies (response modulation).

Conscientiousness: the propensity to follow socially prescribed norms for impulse control, to be goal directed, to plan, and to delay gratification

A core feature of strategy models is their ability to describe an array of tools that people can use in order to regulate or minimize their experience of temptation and therefore facilitate goal attainment. Another feature that is unique to the process model, and perhaps one of the reasons it has become so prominent, is the idea that impulse generation develops in an iterative cycle and so the earlier one intervenes, the more effective the corresponding strategies are. That is, the impulse or desire for the temptation becomes stronger as one moves through the cycle, and so intervening earlier means that the desire is weaker and therefore the chances of success are higher (e.g., it is easier to resist the temptation of buying cookies than it is not to eat them once they are in the house). Although there is some evidence supporting this model (Duckworth et al. 2016b), few empirical investigations have actually compared the effectiveness of different strategies.

Trait Models of Impulsivity

In contrast to the previous models that focus on within-person processes, trait models focus on differences between people. Whiteside & Lynam (2001) set out to organize the family of trait measures most typically used in personality and clinical psychology to assess impulsivity and then map out how those reorganized dimensions fit in the space of the Big Five. Like other areas of psychology that have attempted to tackle defining and operationalizing constructs like impulsivity, personality and clinical psychology have failed to reach a quick and early consensus on definitions, leading to a proliferation of trait measures with mostly murkily overlapping content and little or no clarity on definitional coverage. Relying on theories and measures spanning from the work of clinicians like Cloninger (Cloninger et al. 1991) to Gray's neuropsychological system (Gray & McNaughton 2000), Whiteside & Lynam (2001) factor analyzed multiple measures and arrived at a four-factor solution to the riddle that is impulsivity. These four facets consist of premeditation (planfulness), sensation seeking (the appetite for excitement and risk taking), urgency (the propensity to act rashly often in response to strong emotions), and perseverance (similar to the industriousness facet of conscientiousness). Although this urgency-premeditation-perseverance-sensation seeking (UPPS) system has been updated and improved upon, it remains largely similar in content to this day.

Unlike other systems that have tried to fit impulsivity into a single dimension, the system developed by Whiteside & Lynam (2001) adopts a multidimensional perspective on impulsivity that is best understood in the context of the relations between these four domains and the Big Five. In particular, premeditation and perseverance lie in the domain of conscientiousness; sensation seeking corresponds most strongly to extraversion; and urgency appears to lie somewhere between neuroticism and conscientiousness, as this facet assesses not simply whether people act rashly, but whether they act rashly in response to feeling bad. In later versions of this system, the authors have recast this as negative urgency and added a positive urgency dimension, but they readily admit that these two scales correlate at the limits of reliability (D.R. Lynam, personal communication).

Carver (2005) conducted a similar, if not more exhaustive, review of the literature on impulse and constraint in an attempt to arrive at a personality model of impulse control. Drawing from Freud's theorization (e.g., id, ego, superego), classic models like the Big Five model of personality, developmental approaches like Rothbart's temperament model (Derryberry & Rothbart 1997, Rothbart et al. 2003), Epstein's rational-experiential model (Epstein 1973, Epstein et al. 1992), and biological models (e.g., Gray & McNaughton 2000), Carver arrived at a model of impulse and constraint that is similar to, but not perfectly overlapping with, the one proposed by Whiteside & Lynam (2001). He identified a tripartite model consisting, first, of a control mechanism, corresponding to constructs like effortful control and conscientiousness in other models, that countermands impulses for short-term positive rewards in consideration of larger but delayed rewards.

The second component of the model is an undercontrol or appetitive system, somewhat akin to extraversion or behavioral activation, that acts to spur people toward short-term positive rewards. Third, there is an overcontrol or braking system, corresponding to behavioral inhibition or fear-based mechanisms that override approach behaviors. In Carver's system, then, impulsive behaviors can be stopped two ways: either because fear of negative repercussions outweighs the rewarding nature of the short-term gains or because of a calculating executive system that weighs costs and benefits in order to prioritize long-term gains.

The two major personality models of self-regulation and self-control, therefore, share much in common. Both systems incorporate a regulatory function that roughly corresponds to the Big Five domain of conscientiousness, with the UPPS system breaking that down into the two facets of premeditation and perseverance, and the Carver system identifying it in its developmental precursor of effortful control. Both systems also incorporate a proxy for the impulse-seeking or excitement-craving component of impulse control in the form of sensation seeking in the UPPS and behavioral activation in the Carver system. Where the two systems differ is in how they conceptualize the function of negative affect. In the UPPS system, rather than being a braking system, negative affect contributes to more impulsive actions, whereas in the Carver system, negative affectivity in the form of fear inhibits action as people do not act rashly because of the potential negative consequences. Carver does discuss the possibility that negative affectivity may contribute to impulsive action, but in the end he emphasizes the potential braking role that fear performs in the impulse and constraint system.

Both the UPPS and the Carver models of self-regulation are notable for concluding that self-regulation and self-control are not unidimensional constructs. There will be little solace for those looking for a simple model of self-regulation encapsulated in one dimension of the Big Five (e.g., conscientiousness). They are also consistent with many dual-system approaches in social psychology in that they include an emotion-based system that drives people toward or away from action and a cool, calculating component that serves to manage these emotion-based impulses.

INTEGRATING DIFFERENT PERSPECTIVES ON SELF-REGULATION

In this section we try to integrate the models of self-regulation described so far along four dimensions: (*a*) levels of analysis, (*b*) role of conflict, (*c*) role of emotion, and (*d*) role of cognitive functioning. We not only describe how the models converge and diverge but also illuminate potential blind spots (see **Table 1** for an overarching summary).

Levels of Analysis

Some of the most confusing discrepancies among models of self-regulation exist because the models focus on incommensurate levels of analysis. At the broadest level, trait models describe how individuals differ on dimensions related to control and regulation (e.g., impulsivity, conscientiousness), while all the other models describe intrapsychic processes occurring within individuals (e.g., making goal-related decisions in the moment), though even these intrapsychic models sometimes focus on different aspects of self-regulation.

A number of models focus on goals, intended as cognitive representations of desired end states. The basic unit of analysis for the cybernetic model (Carver & Scheier 1998, Wilkowski & Ferguson 2016), which is perhaps the broadest intrapsychic model, is the goal or set point. This model places great importance on conflict monitoring and cognitive operations, but both of them revolve around goals. Similarly, goal systems theory (Kruglanski et al. 2002), as the name implies, is all about goals: how goals are cognitively represented, how they can be achieved, how they

Table 1 Comparing models of self-regulation along the dimensions of level of analysis, role of conflict, role of emotion, and role of cognitive functioning

Theory/model and key reference(s)	Level of analysis	Conflict	Emotions	Cognitive functioning
Cybernetic model (Carver & Scheier 1998)	Goal: The focus is on the target goal or set point, with feedback loops comparing current and desired states.	Conflict is represented as a discrepancy between current and desired end states.	Positive emotions arise when the discrepancy between current and desired states is sufficiently reduced; negative emotions occur when discrepancy reduction is not met.	Although involved in many aspects of this model, cognitive functioning is most prevalent during goal setting and when monitoring goal progress.
Goal systems theory (Kruglanski et al. 2002)	Goal: The focus is on the structure of goals and the means to achieve them.	Conflict is not explicitly mentioned, but the idea of goal conflict is inherently assumed (e.g., having to choose between conflicting goals or means).	Positive emotions arise as a function of goal attainment; negative emotions emerge from experiences of failure.	Cognitive functioning is necessary when trying to decide between goals and the means to pursue them.
Resource model of self-control (Baumeister et al. 2018)	Time: The focus is on how self-control or willingness to exert effort wanes over time.	The traditional view suggests that the ability to inhibit conflicting desires wanes over time; alternate views suggest that effort is more central, although both conflicted and unconflicted effort are possible.	Continuous exertion of self-control leads to negative emotions (e.g., frustration, boredom).	The role of cognitive functioning is unclear; it is not clear whether it is cognitive function or volitional (i.e., noncognitive) processes that decline with exertion.
Dual process models (Hofmann et al. 2009)	Conflict: The focus is on the conflict between hot (System I) and cold (System II) processes.	System I is dominant in the absence of conflict to preserve System II resources; when conflict arises, System II becomes activated in order to combat temptations.	Conflict is inherently aversive and therefore generates negative emotions, whereas temptations generate appetitive emotions (e.g., desire).	Cognitive function is housed within System II (i.e., the more deliberate and controlled system).
Process model of self-control (Duckworth et al. 2016a)	Conflict (anticipated or actual): The focus is on strategies that help avoid or reduce conflict.	Conflict between a temptation and a long-term goal, either anticipated or actual, is a necessary requirement for self-control (e.g., goal-goal conflicts are separate and do not require self-control).	Conflict is aversive and therefore generates negative emotions, whereas temptations generate appetitive emotions (e.g., desire).	Cognitive functioning is necessary when trying to decide which strategies to use in response to a (potential) temptation.
Choice models (Berkman et al. 2017a)	Choice: The focus is on how people weigh the different options that are saliently available to them and select the most valued option.	Conflict is not required, but it can manifest if different choice options are similar in value, thus making it hard to choose one over the other.	Having choice options that are similarly valued generates negative emotions (e.g., anxiety), even when both options lead to positive outcomes.	Cognitive functioning is necessary when trying to decide between different choice options.
Trait models of impulse control (Roberts et al. 2014, Whiteside & Lynam 2001)	Trait: The focus is on individual differences in general self-regulatory dimensions (e.g., conscientiousness).	Conflict is not prominently featured, but it might stem simply from the need to regulate a desire; traits may also aid in conflict avoidance.	Both positive and negative emotions play a role in self-regulation, although both can either facilitate or hinder self-regulation.	Individual differences in cognitive ability and in self-regulation independently predict many of the same outcomes.

are prioritized, and how they are shielded from competitors. Work on implementation intentions nicely complements this literature by illustrating an effective intervention to help people commit to goal-congruent actions (Gollwitzer & Sheeran 2006).

Numerous models focus on conflict, typically between abstract, long-term goals and immediately gratifying temptations. Dual process models focus on conflicts between automatic and impulsive systems (i.e., between Systems I and II) in a winner-takes-all battle (Hofmann et al. 2009). These models are primarily used to explain outcomes in so-called self-control dilemmas involving the existence of some degree of conflict in a particular moment. The process model of self-control (Duckworth et al. 2016a) similarly centers on actual or anticipated conflict between mutually exclusive behaviors, one that is expected to bring immediate gratification and one that furthers more important goals.

Choice models (Berkman et al. 2017a, Hare et al. 2009, Sullivan et al. 2015) focus on how people decide between the various response options available to them at a particular time. Choices are made based on a calculation of costs and benefits for the different response options, including how they do or do not relate to valued goals. Finally, the resource model (Baumeister et al. 2007) and its competitors (e.g., Inzlicht et al. 2014b, Kool & Botvinick 2014) focus on time, examining how control and effort willingness change (typically dwindle) with time on task.

One challenge is represented by the sometimes inconsistent patterns that emerge when comparing between people (i.e., traits) and within people (i.e., states). For example, one of the more interesting recent findings is that people who are higher in trait self-control and conscientiousness actually engage in less self-control in any particular moment, mostly because they do not need to (Hill et al. 2014, Hofmann et al. 2012). Similarly, given its association with better outcomes in school, work, relationships, and health (Moffitt et al. 2011, Roberts et al. 2014), self-control is unambiguously positive at the trait level, whereas the act of wrestling with temptations in the moment is often associated with negative outcomes, including more negative affect (Inzlicht et al. 2015, Kurzban 2016, Saunders et al. 2015). How can one reconcile these conflicting patterns?

One argument would be that the different levels of analysis reflect qualitatively different systems. Think, for example, of the difference between weather and climate. While climate reflects broad patterns that slowly change over time (i.e., traits), weather (i.e., states) changes day to day; and while on average weather is related to climate, it is relatively unrelated at any given moment. For example, it might be distressing to forgo an immediate reward in the moment, like ice cream, but in the aggregate and over time, people are generally satisfied when they meet their dieting goals.

Alternatively, it is increasingly common to conceptualize the various levels represented by these models as part of the same system. For example, models that treat traits as density distributions of states (Fleeson 2001) conceive of the lower-order processes as potential components of a broader, complex system of related modules. These models presume less distance between the higher and lower levels of the system than the climate/weather analogy would indicate. It would be like finding a rain forest that has a preponderance of dry weather on any given day of the year. For the models, then, finding opposing patterns at the state and trait level, as have been found by research on self-control, would be problematic. At this time, we do not feel there is sufficient information in the empirical data to know which one of these perspectives is more correct.

Role of Cognitive Conflict

We might describe numerous models as conflict models, because conflict is a necessary feature of what is to be explained. The process model explains the various strategies people use to control themselves, and it defines control as the conflict between proximal and distal motives (Duckworth

et al. 2016a). The process model, in other words, begins with conflict: Without actual or anticipated conflict, there is nothing to be explained. Dual process models of control also begin with conflict, during so-called self-control dilemmas in which there is tension between the habitual and control systems (Heatherton & Wagner 2011, Hofmann et al. 2009). Without conflict, the habitual system is dominant, as the control system is used sparingly given its inherent costliness (Cohen 2017). According to conflict monitoring theory (Botvinick et al. 2001), conflict is what instigates the control system; later refinements to this model have broadened the scope of conflict to include performance errors, prediction errors, and expectancy violations (Kool et al. 2017). The cybernetic model (Carver & Scheier 1998) also poses conflict detection as a central feature, though what is being detected here is softer than conflict and might be better construed as a discrepancy between desired and current states. The point here is that numerous models center on conflict; without conflict, the models either are silent or suggest that control is not engaged because default habitual responding predominates.

It might be tempting to call the resource model a conflict model, since it describes the inhibition of conflicting desires that wanes over time (Baumeister 2014). Without conflict, in other words, there is nothing to restrain and nothing that wanes over time. However, alternatives to the resource model (Inzlicht et al. 2014b, Kurzban et al. 2013) focus less on inhibition and suggest instead that it is the provision of effort, even unconflicted effort (e.g., driving during a snowstorm), that wanes over time (Lin et al. 2020).

It is important to note that in the conflict models above, conflict is limited to the battle between proximal and distal motives, between immediate urges and enduring goals, or between System I and System II. However, given that time is limited and that every choice of action comes at the cost of other possible actions (i.e., opportunity costs), conflicts between two enduring goals also arise. Yet these models are silent about goal/goal conflicts—for example, between finishing a manuscript and cooking an elaborate family meal. Choice models (Berkman et al. 2017a, Hare et al. 2009), in contrast, do not dichotomize processes as habitual or automatic, and as such they can accommodate a wider variety of conflicts, the resolution of which determines behavioral enactment.

A number of models avoid the conflict trap, accommodating both conflicted and unconflicted goal pursuit. Choice models, for example, do not require conflict at all, as they view control as the product of value-based decisions. Thus, some decisions are easy and relatively unconflicted, while others are harder because the values of the various response options are similar in expected utility. Because they do not pose conflict as necessary, these models have a broader applicability.

Goal systems theory also does not focus on conflict, though it can readily accommodate it when incompatible goals are activated within a goal network (Kruglanski et al. 2002). Goal conflict produces an aversive state (Proulx et al. 2012) that must be resolved either by selecting a multifinal means to advance both goals simultaneously or by devaluing one goal to give precedence to the other. Goals differ in importance, with important goals being prioritized automatically and shielded from interference by competing goals. For example, if the goal to eat healthy is salient, not only will this activate the corresponding means (e.g., eating salad), but it will also deactivate means for the alternative goal to eat tasty food (Shah et al. 2002).

Although not entirely absent, conflict plays a less prominent role in trait models. More accurately, trait models assume conflict in the structural dimensions that make up the models of self-regulation. For example, Carver (2005) highlights how the interplay between approach, avoidance, and regulatory mechanisms is predicated on the existence of a stimulus that would lead one to want to do something and to potentially need to regulate that desire. Similarly, the UPPS model (Whiteside & Lynam 2001) assumes that urgency clashes with factors like premeditation in guiding behavior when faced with highly tempting stimuli like drugs and alcohol. What is lacking in

each of these models is an explicit conceptualization of conflict: How is conflict processed by an individual? How do components of the model combine or interact to resolve that conflict?

Another aspect of trait models is the idea that certain people can effectively avoid conflict and thereby appear to be more self-regulated. In particular, conscientiousness, the core component of self-control, is thought to lead to patterns and outcomes that simply avoid any conflict dilemmas. For example, the invest-and-accrue model of conscientiousness (Hill & Jackson 2016) suggests that by putting effort into socially valued actions like achievement in school and at work, conscientious people avoid temptations that would otherwise prevent them from reaping rewards such as better socioeconomic status and higher relationship satisfaction. Similarly, it is thought that conscientiousness leads to better relationship outcomes, not only because conscientious people value positive relationship behaviors but also because they avoid actions, like infidelity, that typically cause relationship distress (Hill et al. 2014). Conscientious people can therefore reap positive rewards through their ability to sidestep conflict. In this sense, effective self-regulation might be better understood as avoiding conflict rather than overcoming it (Hofmann et al. 2012a).

Role of Emotion

The role of emotion in self-regulation has been underdeveloped in the literature; it has been typically implied but seldom stated explicitly. The major exception to this pattern comes from trait models. In broad terms, certain people are dispositionally appetitive and thus have stronger cravings for actions that undermine long-term goals. The two trait models we discussed above, by Carver (2005) and Whiteside & Lynam (2001), differ only in how they conceptualize negative affect as playing a role in avoidance or approach, respectively.

There are, however, other emotional aspects of the components of self-regulation, especially conscientiousness, that complicate the role of emotions. In particular, high conscientiousness is positively associated with both positive affect (Fayard et al. 2012) and life satisfaction (DeNeve & Cooper 1998). This complicates our understanding of the Carver and UPPS models of self-regulation, as positive emotions are typically thought to be the reason people choose short-term actions over long-term outcomes. Of course, these associations may be the result of individuals navigating life more effectively and subsequently feeling good about their successes (Hill & Jackson 2016). At a minimum, it seems that positive emotions facilitate both impulsive short-term actions and long-term achievements that necessitate successfully delaying gratification.

What is more interesting is that conscientiousness and related traits (e.g., self-control) are strongly associated with both positive and negative self-conscious emotions. Self-conscious emotions reflect one's concern about the self in relation to letting down or impressing others (Tracy & Robins 2004). Highly conscientious individuals, for example, tend to be more guilt-prone, even as they actually experience fewer episodes of guilt (Fayard et al. 2012). For example, highly conscientious people may actively avoid situations that might make them feel guilty (e.g., being late to an appointment) in part because their higher level of guilt serves as a form of punishment. Conversely, these individuals feel more authentic pride than others. So the control aspect of self-control appears to be unambiguously related to positive and negative affect; yet some aspects of emotion have not been previously considered in self-control models.

Although prior trait models did not formally incorporate the emotional topography related to self-regulation, findings about emotions may clarify how a self-regulating system works. For example, there is little evidence that a fear-based braking mechanism (Carver 2005) coheres with the other elements of self-regulation, such as urgency and conscientiousness. However, construing the braking system as guilt provides insight into how a braking mechanism would work. People avoid doing rash things in part because of the perceived social consequences that could diminish

their reputation, whether real or imagined. The broader positive affective correlates of traits like conscientiousness also provide a much-needed mechanistic insight into the reasons people would delay gratification. If the habit of delaying gratification results in increased pride and life satisfaction, this would explain why people learn to avoid temptation as they come to understand that the long-term affective consequences of self-control exceed the short-term positive affect that comes from indulging in momentary desires.

Emotion is thus at the core of trait models, clarifying that positive emotion is involved both in tempting people away from their goals and in rewarding people for persistence; these models also clarify the facilitating role of negative emotion, specifically the anticipation or experience of guilt (Fayard et al. 2012). In contrast to these nuanced contributions, intrapsychic models provide only modest insights about the role of emotion. The process model and dual process models both describe temptations as typically appetitive emotions that detract from goal pursuit (Duckworth et al. 2016a, Hofmann et al. 2009). These conflict models further suggest that conflict is aversive, bringing up feelings of anxiety, frustration, and effort (Dreisbach & Fischer 2015, Saunders et al. 2016, Spunt et al. 2012), which potentially explain why such conflicts tend to be avoided (Kool et al. 2010). Similarly, choice models describe options that are similarly valued as generating feelings of anxiety, even when both choice options lead to positive outcomes (Lin et al. 2018, Shenhav & Buckner 2014). Finally, alternatives to the resource model suggest that the continuous exertion of self-control produces feelings of fatigue, frustration, and boredom (Lin et al. 2020, Milyavskaya et al. 2019b), which act as stop signals that incite the search for more gratifying pursuits (Hockey 2013). In sum, these intrapsychic models mostly suggest that emotion interferes with self-regulation: Emotions are at the root of temptations, arise with conflict, and demotivate effort expenditure over time.

Other intrapsychic models view emotions more completely. Goal systems theory indicates that positive affect arises through goal attainment, whereas negative affect arises with failure (Kruglanski et al. 2002). The specific emotions experienced range from relief to guilt and from pride to disappointment, depending on whether the goals relate to avoidance and approach, respectively (Higgins et al. 1997). More complete still, the cybernetic model suggests that the feedback process is accompanied by attendant feeling states that are produced by a second-order feedback system (Carver & Scheier 2011). This second-order system computes the rate of reduction in the discrepancy between desired and actual states and compares it to a desired rate. When the actual discrepancy reduction rate meets or exceeds expectations, positive affect arises; when the discrepancy reduction rate is lower than expected, negative affect arises. These emotions signal to a person that they are doing better or worse than expected, which might impel them to engage less or more effort, respectively.

Role of Cognitive Functioning

Cognitive functioning refers to the processes of reasoning, planning, thinking, solving problems, understanding, and learning (Gottfredson 1997). Just like self-regulation can be construed as either traits or states, cognitive functioning can refer either to individual differences in intelligence or cognitive ability or to the cognitive processes recruited in the moment to solve specific self-control dilemmas.

At the trait level, there is a long history of examining and comparing trait measures of self-regulation (e.g., conscientiousness) and intelligence on various beneficial life outcomes, such as academic achievement, health, and occupational status (e.g., Chamorro-Premuzic & Furnham 2008; Duckworth et al. 2012, 2019). Two themes emerge from these analyses. First, both cognitive ability and self-regulation (the so-called noncognitive factor) independently predict life outcomes.

That is, both the ability to doggedly pursue goals and the ability to reason and learn are important longitudinal predictors of success (e.g., Duckworth et al. 2019). Second, empirical study after empirical study has shown near zero or even negative associations between traditional measures of cognitive ability or intelligence and self-regulation (Chamorro-Premuzic & Furnham 2008, Moutafi et al. 2004, Zajenkowski & Stolarski 2015).

Intrapsychic models of self-regulation focus less on individual differences in cognitive ability and more on the various cognitive processes that contribute to self-regulation in the moment. The clearest articulation of cognitive functioning comes from dual process models, in which cognitive functioning represents the deliberate and controlled System II battling against the more habitual, emotional, and automatic System I. Habitual responses are the default in this view, with cognitive processes only coming online when some form of conflict is detected (Botvinick et al. 2001).

The process model makes a similar point: Indulging in temptations is the default, mindless habit; cognitive processes only come into play when conflict is experienced or anticipated and therefore require the use of self-control strategies (Duckworth et al. 2016a). The process of choosing between competing options is also where cognitive functioning resides in choice models. This process consists of calculating and integrating the various costs and benefits of each option and then selecting the one with the greatest value (Berkman et al. 2017a). Choice is again at the center in goal systems theory, in which cognitive processes take the form of choosing between the various means to pursue a given goal (Kruglanski et al. 2002). However, there is considerable variation in the ability to choose between various means to pursue goals, as a function of either within-person fluctuations (e.g., fatigue, inebriation) or between-person differences (e.g., intelligence). This means that some people, some of the time, are better able to pursue multiple goals via multi-final means while experiencing relatively little conflict. The act of choosing between various options, then, is the principal cognitive process for the process model, choice models, and goal systems theory.

Cognitive functioning is arguably located in every element of the cybernetic feedback loop, but especially during goal setting and progress monitoring (Carver & Scheier 1998). Attempting to reduce the discrepancy between the current and desired state might involve cognitive functioning—for example by making choices, paying deeper attention, or suppressing conflicting desires—but it could also involve less cognitive and more motivational processes. Finally, cognitive functioning plays an unclear role in the resource model. Inhibitory control is thought to decline over time, but it is unclear whether this decline occurs in the various cognitive processes that facilitate control (Baumeister et al. 2007) or in the volitional processes that shape the degree to which control is engaged (Inzlicht & Schmeichel 2012).

PRESCRIPTIONS FOR FUTURE RESEARCH

By discussing each of the models with respect to level of analysis, conflict, emotion, and cognitive functioning, we have identified several commonalities and points of convergence. More important, perhaps, our discussion pinpoints areas that have been insufficiently explored and may constitute fruitful avenues for future research.

Level of Analysis

Each of the models address self-regulation from a different levels of analysis: from a focus on differences between people at the broadest level to a focus on goals at the narrowest level, with attention to time, conflict, and choice lying somewhere in the middle (see **Table 1**). That each model covers a different focal point is a strength of the literature, which assures that self-regulation

is described in all its facets. Problems arise, though, when models talk past one another because of inadequate integration across levels of analysis or when findings from one level of analysis are assumed to generalize to a separate level. Such problems have already arisen, most notably when discrepancies were discovered between trait models and state models.

For example, after noting robust associations between various trait measures of self-regulation and important life outcomes (Duckworth & Seligman 2005, Moffitt et al. 2011, Tangney et al. 2004), scholars attributed poor outcomes to people's failure to engage (state) self-regulatory processes in the moment (Duckworth & Seligman 2005) and variously recommended that people use more (state) self-control in their daily lives (Baumeister & Tierney 2011, Inzlicht et al. 2014a). These conclusions are contingent on strong coherence between trait and state self-regulation; they assume that people high in trait measures of self-control also use more self-control in the moment. Recent research, however, suggests that people high in trait measures of self-regulation actually engage in less state self-control (Hill et al. 2014, Hofmann et al. 2012a); there is also preliminary evidence that, in contrast to trait self-control, state self-control (specifically inhibition) is unrelated to goal attainment (Milyavskaya & Inzlicht 2017). Thus, people high in trait measures of self-regulation are likely more successful because they find alternative ways to self-regulate. The point here is that ignoring differences between levels of analysis has consequences.

We need to respect these different levels of analysis but also work harder to bridge across them. It would be ideal if researchers would systematically incorporate different levels of analysis in their research. By this we do not mean that dispositional self-control researchers should use experiments in their broad surveys or that experimentalists should measure traits. Instead, we propose that a true integration and testing of these perspectives would come only from assessing molecular, putatively process-oriented models over very long periods of time so as to empirically identify the different levels in the system (see Roberts 2018). That is, we recommend that scholars start assessing the various processes thought to underlie self-regulation (e.g., value-based choices, declines in effort willingness over 30 minutes) repeatedly over many months and even years, and then determining how these processes change over time within people as well as how they cohere between people.

Conflict

Conflict plays an important role in nearly all the models we reviewed. Some models place conflict at the center, describing how conflict (real or anticipated) is resolved (Duckworth et al. 2016a, Heatherton & Wagner 2011, Hofmann et al. 2009), how successful conflict resolution wanes over time (Baumeister et al. 2007), or how conflict is monitored (Carver & Scheier 1998). In contrast, goal systems theory, choice models, and trait models place comparatively less emphasis on conflict. These models can accommodate conflict, but they do not privilege it. Given the centrality of conflict to so many models, some scholars, including ourselves, have made the bold claim that resolving conflict is at the heart of self-regulatory success (e.g., Inzlicht et al. 2015).

We now wonder, though, whether conflict has been overemphasized and whether the nearly exclusive focus on resolving conflict by many models has been to the field's detriment. Indeed, new work suggests that the biggest drag on goal attainment is not the inability to resolve conflict (i.e., a lack of self-control), but rather the presence of conflicting desires and temptations to begin with (Milyavskaya & Inzlicht 2017; see also Wilkowski et al. 2018). Once conflict is present, in other words, successful self-control in the moment does not necessarily translate into successful self-regulation in the end. Further, as mentioned above, the people who are most skilled at self-regulation are actually spending less time overcoming conflict, not more (Hill et al. 2014). One

reason they might spend less time overcoming conflict is that they adaptively jettison goals that are unattainable or that conflict too much with current states (Wrosch et al. 2003). Effective self-regulation, in other words, involves not only doggedly pursuing goals but also knowing when to abandon them (e.g., when they require too much effortful control). Our nearly exclusive focus on conflict and overcoming conflict might have been a distraction.

Models that describe goal pursuit more generally (e.g., Berkman et al. 2017a), without such a focus on conflict, are therefore of great benefit. The process model, for example, offers strategies (e.g., situation selection) that describe how conflict can be avoided before it arises (Duckworth et al. 2016a). Older work on the concept of precommitment similarly promises effective self-regulation without the need to overcome conflict in the moment (Ariely & Wertenbroch 2002, Crockett et al. 2013). Even more useful, we think, is work focused on the motivational structure of people's goals (Ryan & Deci 2000). When people truly identify with their goals, when they truly want to accomplish them for autonomous reasons, they are not tempted or conflicted by other desires (Milyavskaya et al. 2015, Werner & Milyavskaya 2019). This suggests they can accomplish such goals without the need for control (Berkman et al. 2017b, Ryan & Deci 2000). People who are skilled self-regulators seem to know this, as they naturally identify autonomous reasons for their actions (Converse et al. 2019), thereby structuring their goals to be resistant to conflict. Finally, we advise greater attention not only to how people set goals (Locke & Latham 2006) but also to how people make plans to accomplish them (Ludwig et al. 2018, 2019). While such plans can involve anticipating and planning for conflicts (Duckworth et al. 2011, Oettingen et al. 2009), planfulness also involves conflict-free cognitive orientations, such as valuing the future self and considering the future implications of one's present behavior. We thus prescribe less focus on self-control and a greater focus on conflict-free means of self-regulation.

Emotion

In stark contrast to the overemphasis on conflict, we believe the role of emotion has been underdeveloped, if not caricatured. For millennia, emotion has been seen as the enemy of rational pursuits, including self-control. We can see this legacy of classical thought most clearly in dual process models, some versions of which suggest that behavior is determined by some battle between hot emotion and cold cognition (Kahneman 2011). But even when emotion is viewed with a modern constructionist lens, emotion is still equated with temptation, that is, with the thing that distracts people away from their goals (Duckworth et al. 2016a, Gross 2015). One notable exception is work on traits, which views emotions more neutrally and more completely: Emotions are parts of the mind and body that both detract from (e.g., impulsive desire) and enhance (e.g., guilt, anxiety) self-regulation.

Given the overemphasis on emotion as the enemy of control, we advise more research on how emotion is integrated with and perhaps sometimes facilitates control. Recent work on the affective signaling hypothesis, for example, suggests that emotions can indicate both when cognitive control is needed and when conflict is resolved (Dignath et al. 2020). Other exciting work indicates that real-world self-control failure is predicted by the extent to which the brain's valuation system (i.e., the ventromedial prefrontal cortex) responds to the anticipated long-term consequences of present-moment behavior (Kronke et al. 2020). In other words, the more people value and presumably respond emotionally to anticipated future outcomes, the more self-control they tend to have. Finally, emotion can facilitate self-control to the extent that people avoid behaviors that generate negative feelings. We already mentioned guilt and the fact that conscientious people are more guilt prone and thus tend to avoid behaviors that may lead them to feel guilty (Fayard et al.

2012). A similar dynamic may be at play with regret, which not only spoils the pleasure of giving into temptation (Hofmann et al. 2013; but see Becker et al. 2019) but might also steer people away from giving into temptation as they anticipate regret in the future (Vosgerau et al. 2020).

Cognitive Functioning

Psychometricians sometimes talk about jingle-jangle fallacies. The jingle fallacy manifests itself when two constructs are thought to be the same because they bear the same name, but they are actually different. For example, it was long assumed that self-control and cognitive control referred to the same general construct (e.g., Inzlicht et al. 2014b), though there is now strong evidence that measures of each are unrelated to one another (Dang et al. 2020, Saunders et al. 2018). The jangle fallacy, in contrast, happens when two highly similar things are thought to be wholly distinct because they bear different names. Here, we wonder if some researchers committed the jangle fallacy by thinking that they were studying self-regulation when in fact what was being studied was intelligence (e.g., Mischel et al. 1989). After all, both self-regulation and intelligence independently predict important life outcomes (Duckworth et al. 2019), yet they mostly appear unrelated, at least at the trait level (e.g., Zajenkowski & Stolarski 2015).

Given that self-regulatory ability and cognitive ability are distinct yet predict many of the same outcomes, confusion can arise when measuring one without the other. For example, one could mistakenly assume that self-regulation is important for various beneficial outcomes when in reality cognitive ability or intelligence is the key. For example, when measures of cognitive control or executive function predict important real-life outcomes, it is tempting to make inferences about the power of self-regulation (e.g., Hofmann et al. 2012b). However, despite their definitional similarity, measures of cognitive control are more closely related to general intelligence (Engelhardt et al. 2016, Jewsbury et al. 2016) than to various measures of self-regulation (Eisenberg et al. 2019, Saunders et al. 2018). That is, many of us have gone to great lengths to study cognitive control, believing it would say something meaningful about self-regulation; instead, we now wonder if we were studying the broad abilities that underlie intelligence instead (Jewsbury et al. 2016).

Similarly, despite the wildly popular work linking children's ability to delay the gratification of eating marshmallows with later cognitive and socioemotional development (Mischel et al. 1989), this work might say remarkably little about self-regulation. While a large replication of this seminal work confirmed the basic connection between delay time in childhood and some (though not all) of the original outcome measures later in life, when controls for cognitive ability (and socioeconomic factors) were included, delay time was no longer predictive (Watts et al. 2018). That is, unlike other longitudinal work suggesting that childhood self-control predicts important life outcomes over and above the effect of intelligence (Moffitt et al. 2011), the marshmallow studies could not. These findings suggest that cognitive ability, as well as other factors, plays a much larger role than previously anticipated (Watts et al. 2018).

Our point here is that we need to avoid the jangle fallacy, specifically by avoiding the conflation of self-control and intelligence. To accomplish this, not only should scholars routinely assess intelligence in studies of self-regulation, as is common among trait researchers (Duckworth & Seligman 2005, Moffitt et al. 2011), but they should also incorporate intelligence in their theorizing about self-regulation. Is it possible that the various processes thought to underlie and describe self-regulation (e.g., choosing the best means to achieve a goal, overcoming short-term temptations) are actually different aspects of intelligence? This departs from the way self-regulation has been discussed in the past. We do not want to overstate things—trait studies have indicated that both cognitive and noncognitive factors are important (Duckworth et al. 2019)—but we do believe that the overlap between intelligence and self-regulation has been underemphasized, and we encourage better integration of these concepts in the future.

CONCLUSION

In discussing the various models of self-regulation side by side, it is tempting to try to combine them into a single comprehensive model. We avoided such temptation here because, in our view, some of the models have too little contact with one another to make combination useful. This was most evident in the gulf between trait models and more process-oriented accounts. Instead, and as a first step, we compared the models on four dimensions to identify points of convergence and points that need to be developed further. Such an analysis yielded a number of novel insights. These include the need to examine the processes underlying self-regulation longitudinally, the need to move beyond conflict, an appreciation for how emotions facilitate self-regulation, and a need to integrate the processes underlying self-regulation with those underlying intelligence.

People high in self-control and low in impulsivity live the good life. They are healthier, happier, wealthier, and more law abiding than their less controlled, more impulsive peers (Moffitt et al. 2011). The question we asked here is what research has to say about why they live the good life and how they make better choices. By contemplating how various research traditions differentially construe the concept of self-regulation, we hope a truly comprehensive account will one day emerge.

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