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Positioning self-control in a dual-systems framework

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In this chapter we will discuss different perspectives on how self-control can be positioned in dual-system theories of information processing and behavior. Self-control has been defined as one's capacity or ability to overrule one's inner, impulsive responses, as well as to interrupt undesired behavioral tendencies (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Tangney, Baumeister, & Boone, 2004). However, this definition lacks an essential aspect, and a necessary component of self-control: the notion that a long-term goal is involved that makes it 'worth' inhibiting those impulses that can be rewarding in the shorter term (Carver & Scheier, 1981; De Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012). Recently, definitions of self-control therefore also include the ability to resolve self-control dilemmas (De Ridder, Kroese, Gillebaart, & Adriaanse, 2016; Fujita, 2011; Myrseth & Fishbach, 2009), and different strategies for handling self-control dilemmas have been a novel self-control research focus (Ent, Baumeister, & Tice, 2015; Gillebaart, Schneider, & De Ridder, 2015; Myrseth & Fishbach, 2009). Self-control dilemmas are situations in which competing behavioral tendencies exist, fostering a (response) conflict that has to be resolved by acting on one of these tendencies.

This recent shift in the definition of self-control as centering on how people handle self-control dilemmas holds implications for how self-control can be positioned within dual-systems approaches on behavior. The distinction between dual behavioral systems, one focusing on impulse (which we will call System 1 according to Kahneman's (2011) distinction), and the other around reason (System 2), is essential when discussing self-control. From a more classic perspective, self-control has been interpreted in terms of an 'executive function' that is part of a system that guides reasoned behavior, designed to control impulses stemming from an impulsive system. Elements of this classic conception are still present in the current view on self-control, implying that, without self-control, we are directed solely by impulses that trigger behavior that is immediately gratifying in some way. Only by engaging in self-control are we able to inhibit these impulses and do 'the right thing'.

Although the view of self-control as an effortful process of controlling the impulsive system lies at the basis of much of self-control theory and research, recent developments into the working mechanisms and conceptualization of self-control do call for a revision of this perspective. We will integrate these new insights from recent research with dual-systems theories in this chapter to give an up-to-date, integrative dual-systems perspective on self-control. To start,

a framework will be provided in which dual-systems theories and their nuances will be introduced. Next, different views on how self-control relates to these dual-systems theories will be discussed. Finally, we will introduce a perspective on self-control as being neither exclusively part of System 1, nor of System 2, but rather as an emergent quality of the dual-systems approach, having its place in both systems.

Dual-systems theories

The notion of two distinct systems underlying human behavior is one of the most influential ideas in psychology, with a number of paramount papers in the last 20 years that have greatly shaped our way of thinking about thought, emotion, and behavior (e.g., Kahneman, 2011; Kahneman & Frederick, 2002; Strack & Deutsch, 2004). The basic premise of dual-systems perspectives is that our behavior is governed by a reflexive, impulsive, associative, 'hot' system (System 1) on the one hand, and a reflective, deliberate, rational, 'cool' system (System 2) on the other. System 1 and System 2 are assumed to be two distinct, structurally different systems by which information is processed (Evans, 2008). It has also been proposed that different brain areas are responsible for the separate systems (Bechara, Noel, & Crone, 2006), accentuating that the two systems are separate pathways toward behavior, although this notion is still in need of further substantiating (Kelley, Wagner, & Heatherton, 2015).

In System 1, also referred to as the impulsive system, the reflexive system, the fast system, or the hot system, impulses (unintended, sudden urges or desires to act) are the most dominant input for behavior. System 1 is input-based, in the sense that it is proposed that associative networks and activation thereof following (real or imagined) stimulus input are what triggers behavior (Metcalfe & Mischel, 1999; Strack & Deutsch, 2004). These associative networks can be evolutionarily prepared, as is for instance the case with certain fear–behavior links, but associations are also formed and strengthened over time and with repetition. For instance, one may have a nice glass of wine after a busy day at work, leading to a feeling of relaxation, which is a form of positive affect. Positive affect is considered pleasant, and a motivator for behavior, causing the behavior to be repeated. Because of the repeated link between the cue (coming home from work), the behavior (having a glass of wine), and the emotion (positive affect), these concepts may become connected as part of an associative network. The associative network is triggered when, for instance, the cue (coming home from work) is present. Since no intent or deliberation is necessary for associations to be triggered, the likelihood of the behavior accompanying that glass of wine (pouring, drinking) *automatically* occurring after a busy day at work (the cue) will increase.

Although this particular example of associating a specific cue (coming home from work) with a specific behavior (having a glass of wine) may not highlight a particularly healthy outcome of a System 1 process, System 1 is of course invaluable in terms of evolution and adaptation: if it would not have been for the fast associations and impulsive behaviors that follow from this system, we would for instance not have learned our innate fear responses to dangers in our environment such as snakes or spiders (LeDoux, 2000), nor would we have helpful associations concerning food (you only have to suffer the consequences of food poisoning once to have a life-long resistance to the food that (presumably) triggered it). Moreover, the fact that System 1 allows for *automatic* behavior means that System 1 is not only important when our health and well-being is in (imminent) danger, but that System 1 is vital to our everyday functioning.

Although 'automatic behavior' is often used interchangeably with 'impulsive behavior' when adopting a dual-systems perspective, automaticity is in fact more than just that: System 1 also comprises other types of automatic behavior besides impulsive behavior, such as habits and decision

making based on heuristics, and other types of 'fast thinking' (Kahneman, 2011). We need to make a myriad of decisions each day (just food decisions add up to about 200 a day; Wansink & Sobal, 2007). Considering the relative slowness and resource-dependence of System 2, we cannot use deliberate, conscious rationalization for all of these decisions. As such, we need to rely on System 1 for guiding our behavior during a large part of our day, and a large part of our behavioral repertoire as well. Indeed, the automatic processes, habits, and heuristics from System 1 guide a lot of decisions, including decisions regarding our health (Hofmann, Friese, & Wiers, 2008). System 1 thus allows for relatively directed (by habits, intuition, and 'rules of thumb') behavior in situations in which there is a lot of input and distraction or if people experience stress, are cognitively busy, or tired. Luckily, these seemingly 'irrational' decisions are actually not inherently bad or unhealthy at all, but are in fact a matter of processing mode, which, like 'rational' decisions, can lead to positive as well as negative outcomes (Ariely, 2008).

Still, System 1, being based on associations, heuristics, but also on impulsive urges, can cause our behavior to be less than optimal when it comes to health. Our impulses are frequently based on short-term rewards, as is illustrated in instant gratification studies in which an immediately gratifying, small reward must be forgone to receive a larger reward later (Metcalfe & Mischel, 1999). System 1 associates certain stimuli with reward (e.g., positive affect, taste, satiation, hedonic pleasure), and thus triggers our behavior toward these stimuli. Unfortunately, many stimuli that are rewarding in the short run may not be in line with our long-term goals of health and well-being. For instance, a glass of wine after a busy day may be rewarding, but a glass of wine every day, or more times a day, or every time we experience negative affect, may not be all that healthy at all. Similarly, people are surrounded by high-fat, high-sugar food items in their obesogenic environment all the time. If it were up to System 1, due to the reward-association that comes with these types of foods, people would be triggered to behave in a way that facilitates them eating these unhealthy food items continuously (e.g., Lowe et al., 2009; Stok, De Vet, Wardle, Chu, De Wit, & De Ridder, 2015). Likewise, impulsive spending can lead to debt (Vohs & Faber, 2007), and impulsivity is associated with substance abuse (Moeller & Dougherty, 2002).

System 2, on the other hand (also referred to as the rational system, the reflective system, the slow system, or the 'cool' system), is not governed by associations, impulse, and automaticity like System 1, but rather consists of rational, deliberate considerations that subsequently guide behavior. System 2 thus entails higher-order mental processing than System 1, serving long-term self-regulatory goals that do not play a part in System 1 (Strack & Deutsch, 2004). Whereas System 1 is largely based on associative networks, System 2 makes use of executive functions like judgment and decision making, planning, and inhibiting impulses coming from System 1. Because certain resources are required for these kinds of controlled processes, System 2 operates slower than System 1, but is also more flexible in terms of responsivity: instead of leaning on associations formed by, for instance, previous repeated cue-behavior links, System 2 also allows for guiding behavior that is in line with long-term regulatory goals when the appropriate behaviors do not emerge from System 1. While System 1 continuously provides input for behavior due to its cue-response nature, System 2 requires a deliberate attempt to guide behavior and requires available resources. This means that in situations in which we are fatigued, unmotivated, or depleted, System 2 performance is impaired, and System 1 gains more control over our behavior (Hofmann, Friese, & Strack, 2009).

The exact role of System 2 in regulating our behavior away from System 1 impulses toward more goal-directed behavior has been the subject of debate. There is, on the one hand, a slightly Freudian approach in which System 1 is dominant and System 2 is basically continuously hanging on by a thread, being a relatively weak system in terms of its resource dependency and the

fact that it requires consciousness and expended effort to operate (e.g., Carver, 2005; Metcalfe & Mischel, 1999). In this view, we need System 2 to keep an eye on what our goals are in the long run, and overrule impulses that stem from System 1. However, Kahneman's formative work on thinking fast and slow actually does not assume such a hierarchic distinction between System 1 and 2 (Kahneman, 2011). Kahneman's distinction between System 1 and System 2 is not so much focused around short-term gratification and long-term goals, but rather describes two 'modes of thinking' that are similar to the layman distinction between intuition and reasoning (Kahneman, 2003; see also Epstein, 1985). These two systems are in fact equals in the sense that they are both necessary for certain decisions and actions. For instance, we use System 2 for doing our taxes and solving the Sunday paper crossword, and we use System 1 when we express amusement while absentmindedly watching a sitcom, and when we base our decisions on heuristics rather than conscious deliberation. According to this perspective, System 2 is not a regulatory force over System 1 per se, although a monitoring quality is assigned to System 2 in this model as well. The important distinction between these two approaches lies in the fact that whereas in the former, Freudian approach, there is an 'untamed' System 1, with System 2 trying to control it, in the Kahneman approach, the two systems are much more in sync, and there is much less of a tug-of-war between the two. This difference holds implications for how one positions self-control in a dual-systems approach.

Taken together, System 1 and System 2 are different pathways by which behavior is determined. Both systems are useful and have their advantages: immediate reactions to certain stimuli in our environment are useful, especially in threatening situations that require immediate action, and the habitual, automatic behavior routines we have are useful in our everyday lives where we do not have the time or resources to consciously think about every decision we make. Rational decisions, on the other hand, hold us from impulsive behaviors that may harm our health and well-being. Both systems also have disadvantages: impulsive behaviors triggered by the environment and set in motion by System 1 may lead to overeating, over-drinking, expressing emotions that are not appropriate, et cetera. System 2, on the other hand, is not always available and requires effort and resources to function. Thus, both systems are essential to human behavior, and have their strong and weak points.

Because the notion of dual systems governing our behavior has been strongly embedded in the psychological literature over the past decades, it is an important perspective to consider when discussing the concept of self-control. There is sometimes an implicit assumption that self-control is a part of System 2, but this may be oversimplifying the matter: especially with new insights into different self-control strategies that can be either effortful or effortless, a more thorough examination of how self-control relates to both systems is needed. We will continue this chapter by discussing different views on self-control in a dual-systems perspective, including the state-of-the-art in self-control research.

Self-control and dual systems: the classic perspective

Although it is mostly implied rather than explicitly stated, a common way to consider self-control in the framework of dual-systems theories is to regard self-control as part of System 2: the 'cool' system that is able to override impulsive output from System 1. Although there are different perspectives on System 2's role in relation to System 1, this categorization of self-control as a System 2 component is in line with previous definitions of self-control and System 2. Self-control is often defined as 'the effortful inhibition of impulses' (Baumeister & Heatherton, 1996; Metcalfe & Mischel, 1999; Loewenstein, 1996). Similarly, although Kahneman, for instance, does not assume such hierarchy per se, System 2 is regularly considered the *regulatory, controlling*

system that controls impulses that come from System 1's associative processing of the environment (Hofmann et al., 2009; Smith & DeCoster, 2000; Strack & Deutsch, 2004). In this framework, regarding self-control as inherent to System 2 is evident.

A very illustrative example of this perspective on self-control as being effortful is the well-known strength model of self-control (Baumeister et al., 1998; Baumeister, Vohs, & Tice, 2007), according to which self-control capacity is dependent on a self-control resource that is limited in nature. This resource is generalized in the sense that there is one resource for all self-control behavior, which will eventually deplete after usage. Implications from this model are that self-control cannot infinitely be (successfully) mobilized: once the resource is depleted, self-control cannot take place, or at least not as successfully as it can when the resource is still full. Furthermore, the model states that because of its uniformity, a self-control act in one area of behavior has carry-over effects to other areas of behavior, since all self-control draws from the same resource. An abundance of studies has supported notions from the strength model (Baumeister et al., 1998; Muraven, Tice, & Baumeister, 1998; see Hagger, Wood, Stiff, & Chatzisarantis, 2010 for a meta-analysis). These studies usually consist of a dual-task paradigm. In this paradigm, participants are instructed to either use their self-control (e.g., by suppressing their emotion or not touching candy that is right in front of them) or not (e.g., by freely expressing their emotion, or having as much candy as they want) in a first task. Then, participants perform a second task requiring self-control, often in an unrelated domain (e.g., solving unsolvable puzzles for an unlimited amount of time, doing a taste test with delicious ice cream). Results typically show that a first instance of self-control mobilization causes impaired self-control performance at a later point in time: participants who had used their self-control in the first task performed worse (i.e., by showing less persistence in unsolvable tasks, or by eating more ice cream in a taste test) than participants who had not used their self-control in the first task.

Following this model of self-control, there is again an apparent position for self-control with certain aspects of System 2. As System 2 requires effort and resources, it is not always operational, as is self-control according to the strength model of self-control. For instance, research has shown that System 2 performance requires access to the limited working memory (Evans, 2008). Moreover, depletion of self-regulatory resources, as in resource depletion in self-control research, potentially impairs System 2 functioning: a number of studies showed that depletion of self-regulatory resources leads to less System 2-congruent behavior like impaired rational thinking (Schmeichel, Vohs, & Baumeister, 2003) and more System 1-congruent behavior like impulsive spending (Vohs & Faber, 2007), and overeating among dieters (Vohs & Heatherton, 2000), suggesting that System 2 covers long-term interests (e.g., long-term goals, rational decisions), while System 1 is focused on the here and now (e.g., immediate gratification). This is in line with literature on self-control stating that self-control is required and exerted when there is a dilemma between a short-term goal (e.g., a hedonistic goal of enjoying the taste of chocolate, or being tempted by the ease of ordering in dinner) and a long-term goal (e.g., a self-regulatory goal of maintaining a healthy weight or a healthy financial balance), in order to perform the behaviors that are in line with long-term goals.

In the perspective of self-control 'belonging' to System 2, self-control failures result in System 1 dominating behavior. We know from self-control research that, indeed, a lack of self-control leads to maladaptive, often impulse-based behaviors such as unhealthy food choices (Vohs & Heatherton, 2000), substance abuse (Tangney et al., 2004), criminality (Gottfredson & Hirschi, 1990), and lower performance on a range of tasks (Duckworth & Seligman, 2005; Tangney et al., 2004).

Although there may be overlap between System 2 and self-control, this is only one of multiple possible perspectives on this relationship. It is also possible, and plausible, that self-control is not inherent to System 1 or System 2 per se, but rather serves as an *emergent quality* of a dual-systems

approach in which System 1 and System 2 interact. It must be noted that the strength model of self-control has been the focus of current debate regarding the underlying process of the ego depletion phenomenon. Recent theorizing, for instance, has led to the perspective that the basis for the self-control resource is thought to lie in attention and motivation: when self-control has been exerted, one's motivation shifts from control to rewards, with an accompanying attentional shift from monitoring control cues to attending to reward cues (Inzlicht & Schmeichel, 2012; Schmeichel, Harmon-Jones, C., & Harmon-Jones, E., 2010), implying that self-control may be employed differently once a first self-control task has been performed, namely to gain (immediate) rewards. Interestingly, this also takes self-control away from its position in System 2, and rather assumes self-control as a mechanism that can change 'position' in terms of System 1 and System 2 based on interaction between these systems.

Summarizing, there are different ways to position self-control with regard to System 2 in a dual-systems approach. One could propose self-control as a component of System 2, or even equal to System 2 in terms of its dependence on resources and its regulatory function. A slightly different perspective would be to consider self-control as being able to shift basic processes like attention and motivation, in an interaction between System 2 and System 1. A common denominator in these perspectives is that self-control is *not* related to, or seated in, System 1. However, there are developments in the field of self-control research that offer potential for another, more integrative perspective on self-control as being inherent to both System 1 and System 2 that we will now further discuss.

Dual systems and self-control: an integrative view

Because the effects of self-control on human behavior, health, and well-being are so widespread and pervasive, self-control has been at the core of an abundance of research in the area of psychology. The different angles and perspectives that exist on the topic of self-control have, in recent years, led to more integrative theories on the conceptualization of self-control as well as its underlying processes. This also has consequences for the position self-control holds in a dual-systems perspective. Up until this point, we have mainly discussed how self-control relates to System 2 specifically. However, we will continue with a more integrative perspective in which both System 1 and System 2 are connected to self-control.

A first development in self-control research that may have implications for its positioning in a dual-systems perspective is the integration of *initiation of behavior* in the definition of self-control, whereas more classic definitions focus solely on *inhibition of behavior*. Self-control has a wide range of positive life outcomes such as satisfying interpersonal relationships (Vohs, Finkenauer, & Baumeister, 2011), academic success (Duckworth & Seligman, 2005; Tangney et al., 2004), better health (Moffitt et al., 2011), and even increased happiness (Cheung, Gillebaart, Kroese, & De Ridder, 2014; Hofmann, Luhmann, Fischer, Vohs, & Baumeister, 2014). Inhibition of tempting impulses is of course adaptive in achieving these outcomes: not giving in to temptations or infatuations that come and go in long-term relationships, resisting the temptation to play video games instead of study, and keeping an imaginary lock on the cookie jar are all examples of inhibitory behaviors that contribute to the positive outcomes of exerting self-control. However, these inhibitory behaviors are probably not solely responsible for these positive outcomes. For instance, for a relationship to be satisfying, one needs to initiate certain behaviors that may be a matter of self-control as well, like asking your partner how their day was and listening to their story while you are winding down from a tiresome day at work yourself. Academic success (mostly) only comes to those who invest time studying, and to be healthy and fit, vegetable and fruit intake are at least as important as staying away from unhealthy snacks.

Importantly, initiatory behavior is not simply the counterpart of inhibiting opposite behaviors: refraining from eating cookies does not mean one's fruit intake is increasing, nor is not yelling at one's partner equivalent to paying them a compliment. Initiatory self-control entails desirable behaviors that contribute to people's long-term goals, like doing homework, exercising, and healthy food intake (De Ridder et al., 2011).

Indeed, De Ridder, De Boer, Lugtig, Bakker, and Van Hooft (2011) were able to distinguish between an inhibitory and initiatory component of self-control in the often-used Self-Control Scale (Tangney et al., 2004) for measuring trait self-control. Additional support for a perspective integrating initiation into the self-control concept comes from a meta-analysis by De Ridder, Lensvelt-Mulders, Finkenauer, Stok, and Baumeister (2012). In this meta-analysis 102 studies on the effect of self-control on behavior were investigated. Results revealed that self-control affects the initiation of desired behavior just as much as it affects the inhibition of undesired behaviors in terms of effect size. Thus, self-control seems not to be a generalized inhibition mechanism supporting System 2 in overriding System 1, but appears to be far more complex. In terms of a dual-systems perspective, one could nevertheless still consider self-control as a component of or largely overlapping with System 2 when integrating initiation as part of self-control. The impulsive behaviors that come from System 1 would often be at odds with the desirable behaviors that need to be *initiated* to be successful at self-control. For instance, one may, triggered by a Netflix suggestion, impulsively want to watch a new episode of a TV show, while one actually needs to prepare for a work meeting the next day. In this case, the self-control required to initiate the appropriate behavior may still be interpreted as a deliberate, effortful way of exerting self-control in line with System 2's mode of processing and goal-directed function.

The fact that inhibition of impulses is deemed effortful when defining self-control (Baumeister & Heatherton, 1996; Muraven & Baumeister, 2000) makes its link to System 2 rather obvious since System 2 likewise requires access to resources to function (Strack & Deutsch, 2004). However, taking a broader perspective on self-control and effort also offers a broader perspective of self-control's relation to System 1 and System 2. Besides the integration of initiation and defining self-control as more than the inhibition of impulses (Fujita, 2011), one area of self-control research has recently focused on another aspect of self-control's definition that may need broadening: effort. This research allows for a perspective in which System 1 and self-control are not as irreconcilable as was previously assumed.

Self-control is often defined as involving an 'active self' (Baumeister et al., 1998) that mobilizes effort and resources to inhibit impulses or initiate desired behavior. This conceptualization, together with the strength model of self-control, implies that, basically, self-control is hard work. It costs effort, it depletes resources, and it would therefore be prone to failure. As illustrated by dual-task paradigm studies, using self-control at time 1 impairs self-control at time 2, implying that in daily life, we have a severely limited capacity for self-control. In theory, this would lead to a significant amount of self-control failures throughout our lives. However, although there are, for instance, health issues that can be attributed to a lack of self-control, like binge eating and substance abuse (Tangney et al., 2004), people are also often successful in their self-control: people with a higher level of self-control are healthier (Moffitt et al., 2011), more successful in their work as well as their personal life (Tangney et al., 2004), and happier (Cheung et al., 2014; Hofmann et al., 2014). This implies that people with a higher level of self-control are not as prone to failure as one might think based on previous accounts of self-control.

Gillebaart and De Ridder (2015) proposed that in addition to effortful self-control, there may also be more effortless routes to successful self-control. First evidence for this idea came from a meta-analysis by De Ridder et al. (2012). In their analyses, De Ridder et al. discerned between effects of self-control on *effortful* and *automatic* behaviors. Automaticity refers to thoughts,

processes, and behaviors that take place outside of conscious awareness, without deliberation, intention, or effort (Bargh, 1994). Automatic processes are thus the opposite of rationalized, controlled processes set in motion by System 2. Automaticity has not been a significant part of the field of self-control research, and the results from the meta-analysis were therefore surprising: the effect size for automatic behaviors was in fact bigger than for effortful behavior. Thus, self-control is important for behaviors that are considered automatic, and part of System 1, like habits, and stimulus-response sequences. Of course this does not mean that self-control's effect on effortful, controlled behaviors is to be neglected, but it does imply that there is a whole other leaf on the stem of self-control: automaticity and effortlessness.

Self-control can be considered in different ways: there is a temporary *state* of self-control, fluctuating over time, and under the influence of variables like fatigue, previous attempts at self-control, and emotions. This type of self-control is often investigated in controlled laboratory settings, since it offers possibilities for manipulation and thus experimental set-ups. However, when discussing self-control and its relation to effort and automaticity, *trait* self-control may be equally or even more important. Trait self-control is considered a personality trait, stable over time, and differing between rather than within individuals (Rothbart, Ahadi, & Evans, 2000; Tangney et al., 2004). It is trait rather than state self-control that is predictive of positive (with high levels of self-control) and negative (with low levels of self-control) outcomes in terms of health, well-being, and happiness. Based on the aforementioned meta-analysis, Gillebaart and De Ridder (2015) suggest that people with high trait self-control may not effortfully resist impulses and temptations as they come across them, leading to depletion and failure, but may rather use automatic and thus effortless strategies for navigating through temptation-rich environments. The fact that people with more self-control may use automatized strategies or pathways to self-control would explain their apparent immunity from depletion and subsequent failure: the self-control resource would not be depleted if no effortful inhibition or initiation is instigated.

In line with this notion, Baumeister and Alquist (2009) have proposed that one of the things that set people with high self-control apart from those who lack self-control may be the ability to automatize behavior. Similarly, Fishbach, Friedman, and Kruglanski (2003) demonstrated that 'successful self-regulators' have stronger automatic activations of long-term goals when confronted with temptations. Automatizing of behavior can happen through repetition of certain behaviors in response to certain cues (Lally, Van Jaarsveld, Potts, & Wardle, 2010). A number of studies have explored how repeating self-control-related behavior affects one's self-control level. Although one recent study demonstrated no generalized self-control improvement following self-control training (Miles, Sheeran, Baird, Macdonald, Webb, & Harris, 2016), another study showed that squeezing a handgrip twice a day for two weeks – a self-control behavior often used in ego depletion studies – resulted in higher GPA scores by the end of the academic year (Job, Friese, & Bernecker, 2016). Further research is thus needed to establish whether repeated self-control exertion leads to improvements in self-control. This line of research may provide further information on the notion that automatizing behavior by repeatedly performing the behavior, which would lead this behavior to be directed by System 1 rather than System 2, may be a fruitful self-control strategy by which self-control success may be achieved without depending on the necessary resources for System 2 to operate adequately.

Gillebaart and De Ridder (2015) offer a number of suggestions for what these automatized behaviors may be, starting with avoidance. One can imagine a self-control dilemma arising on the way to work, walking past a fresh bakery spreading a delicious odor of freshly baked croissants. In general, a croissant is considered a very tasty treat, but it is also a temptation to be avoided, as they are very high in fat and usually sugar. Overcoming this dilemma would take effort: the contextual triggers (e.g., smell, sight) will trigger associations in System 1 that will

cause an impulse to go inside the shop and treat oneself to a croissant (and maybe a latte, while you're there). System 2 would have to mobilize resources to suppress or override this impulse. The outcome of this process depends on a number of variables, but will certainly not always be in favor of the long-term goal of health. However, if one takes another way to work to begin with, and does not walk past said bakery, the dilemma does not occur, meaning that the temptation will, in 100% of the cases, be 'resisted', without having to employ scarce self-control resources. Indeed, trait self-control seems to be correlated to avoidance of temptation, and the use of avoidance strategies (e.g., choosing a setting without distractions, Ent et al., 2015). Avoidance is not effortful or effortless per se: rather, it is the automatizing of avoidance in a routine or habit that would form an effortless strategy for self-control.

Of course, although avoidance may be highly effective in terms of self-control outcomes, it is not always possible, or at least not to an extent that there is no confrontation with temptations whatsoever. However, other automatized strategies can help in situations in which avoidance is not possible as well, like in the form of *habits*, or routines. A first study in this direction was reported by Adriaanse, Kroese, Gillebaart, and De Ridder (2014). They demonstrated, using self-report measures for self-control and habit strength and a snacking diary, that strength of snacking habit mediated the association between (higher) self-control and (lower) unhealthy snack intake. This mediation was replicated in the area of exercise (Gillebaart & Adriaanse, 2017), suggesting that habits may be a general, effortless strategy used by those with high self-control. Galla and Duckworth (2015) reported a set of studies on the associations between self-control, habits, and behavioral outcomes further supporting this notion. They were able to demonstrate that students with higher self-control are more engaged in classroom activities, and that this effect was mediated by the strength of study habits these students had. Furthermore, their set of studies offers insight into further underlying processes in this mediation, by demonstrating that habits were associated with greater ability to work under sub-optimal circumstances, and less motivational interference measured by the number of intrusive thoughts, level of distractibility, and behavior impairment resulting from a work–leisure conflict. There are thus strong indicators that self-control is not just effortful hard work inhibiting impulses and initiating 'appropriate' behaviors, but that rather self-control may, in part, depend on the automatized, habitual strategies that people have formed.

The fact that self-control affects habit strength, and that habits may be the means by which self-control affects behavior, has imperative implications for its interpretation in terms of dual-systems theories. Habits are cue-behavior associations that are automatically triggered when the cue is encountered. As such, a habit is a stimulus-driven, 'impulsive' process that guides behavior. System 1 is defined as being exactly this: stimulus – or cue – driven, and automatically triggered by input from the environment. Research demonstrates that habits are an important part of how self-control operates to serve goal-directedness. While thus far we have discussed self-control as mainly residing in System 2, the work on self-control and habits leads to the conclusion that self-control is actually situated in System 1 as well.

Summary and conclusions

In this chapter, we have discussed how self-control can be positioned in dual-systems theories. Dual-systems theories are among the most influential in the field of psychology. Self-control is a key human trait with effects on behavior in every area one can think of. As such, dual-systems theories and self-control are inextricably connected. We have discussed fundamental research on self-control leading to a perspective of self-control residing in System 2: the rational, deliberate systems that formulate and pursue long-term goals and need to override System 1 from time

to time to get ahead. In the second part of this chapter, we have integrated this view with novel insights from a recent development in self-control research about the possibility of effortless self-control. An emerging area of research reveals that successful self-control may not (only) lie in effortful control over impulses, but may just as much be due to automatic, effortless behavioral patterns, like habits, and self-control may therefore just as well be connected to System 1. Integrating the literature discussed in this chapter, we conclude that self-control may not be inherent to either of the two systems in dual-systems theories, but may rather be an *emergent property*, arising from a broad perspective in which System 1 and 2 are both represented and interact with one another. Especially in the light of Kahneman's view on dual systems as *processing modes*, or fast and slow thinking (Kahneman, 2011), rather than considering the two systems as a hierarchical regulatory system per se, the fact that successful self-control can be achieved through effortful as well as effortless strategies makes it evident that we need to consider the whole of both systems to be able to embed self-control in such a perspective.

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