Automatic self-regulation: From habit to goal pursuit

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Traditionally, self-regulation, or the regulation of one's behavior in the pursuit of personal goals, has been assumed to happen in a consciously controlled fashion, including the willpower needed to overcome one's initial impulsive reactions to stimuli (Mischel, Cantor, & Feldman, 1996; Muraven & Baumeister, 2000). These goal-directed processes of regulation have been contrasted with automatic processes that follow an individual's impulses (e.g., Metcalfe & Mischel, 1999; Muraven & Baumeister, 2000; Strack & Deutsch, 2004). Over the course of about the last three decades, however, evidence has been accumulating that much of the goal-directed regulation of cognition and behavior can also occur in an automatic fashion. Here, we use the term "automatic" to refer to the fact that people may engage in regulating their behavior without conscious awareness of the triggers and of the processes guiding their behavior. While other features of automaticity may also apply to self-regulation they are not the focus of the current chapter (see Moors & De Houwer, 2006, for a detailed discussion).

In other words, this chapter discusses research suggesting that even complex behaviors in pursuit of a wide range of goals in people's dynamic daily lives can be activated and executed effectively without the need for conscious awareness (e.g., Dijksterhuis & Aarts, 2010; Van Gaal & Lamme, 2012; Hassin, 2013). In light of a general crisis of confidence in scientific findings, some of the specific findings on nonconscious processes have recently been questioned in terms of their robustness and reliability (e.g., Doyen, Klein, Pichon, & Cleeremans, 2012; Newell & Shanks, 2014). However, evidence is still accumulating for a wide variety of adaptive and powerful nonconscious influences on human behavior, supporting the original notion of William James that the largest part of behavior is guided by automatic regulatory processes, saving the resources of humans' limited consciousness for the intervention in urgent and exceptional matters (James, 1890). Here, we will use the latest advances in the field of automatic self-regulation to elucidate to some degree how it is possible that our motivated behavior can direct people towards their goals so effectively, and yet, do so without their conscious awareness. We will illustrate the fundamental processes discussed with research findings from, among others, health behavior and interpersonal relationships.

To be sure, there can be no doubt that conscious awareness is often associated with goal pursuit, and can be extremely helpful for attaining one's goals. For example, conscious awareness of one's goals, and of the obstacles that keep one from attaining them, allows one to mobilize and integrate one's resources in a novel way, to set out a completely new course of action if needed (Dijksterhuis & Aarts, 2010), or to contemplate, set, pursue and monitor

abstract goals across long periods of time (Baumeister, Masicampo, & Vohs, 2011). Conscious planning has been shown to be useful for goal attainment, even when this requires a course of action that implies a diversion from one's habitual behavior (Gollwitzer & Sheeran, 2006; Holland, Aarts, & Langendam, 2006; Papies, Aarts, & de Vries, 2009). Furthermore, using conscious awareness in an effortful fashion, such as in mindfulness and meditation training, can facilitate self-regulation by strengthening the executive control processes required to effectively support one's goal pursuit, and can reduce the temptation of attractive alternatives for one's long term goals (e.g., Hasenkamp & Barsalou, 2012; Papies, Barsalou, & Custers, 2012; Papies, Pronk, Keesman, & Barsalou, 2015; van Dillen & Papies, 2014; Teper & Inzlicht, 2013). Despite the important role for consciousness, however, recent developments in the literature suggest that across situations in daily life, people can effectively pursue many of their goals effectively without necessarily having to rely on conscious awareness and control of their behavior.

Approaching self-regulation from this perspective touches upon intriguing questions regarding the origin of control over such processes, and regarding the role of the "self" as the consciously active agent of regulation (see for example Bargh & Ferguson, 2000; Baumeister, 1998; Baumeister, Schmeichel, & Vohs, 2007). Specifically, whereas people often derive the sense of self-regulation ("It's me who is doing the control") from their conscious experiences of self-agency, recent research suggests that such self-agency experiences can originate in the unconscious and are the result of an inference that occurs fluently and perfunctorily after action performance. Thus, how do conscious experiences of agency relate to the fact that much of the regulation of behavior unfolds outside conscious awareness? We will briefly address this issue in the last part of this chapter. In the meantime, however, we will treat self-regulation as the regulation of cognition and behavior that occurs within a given individual in the service of goal pursuit.

Chapter Overview

In this chapter, we will examine automatic self-regulation by analyzing the ways in which we can pursue our goals without conscious awareness of the triggers and of the processes engaged in the pursuit of the goal at hand. Thus, we will start out by examining how goals are represented in order to determine which features of goal representations actually motivate human behavior nonconsciously. Here, we will show that both the accessibility of the specific content of the goal, as well as an affective cue signaling its desirability, are crucial for triggering nonconscious motivation to pursue the goal. Next, we

will discuss how goal pursuit can be triggered by environmental cues. Then, we will discuss how goal-directed behavior can be performed nonconsciously by addressing the role of habits both for selecting and executing goal-directed actions. We will then address how adaptive cognitive processes facilitate and protect goal pursuit in dynamic circumstances. These mechanisms include, among others, the active maintenance, shielding, and monitoring of one's goals, changes in the perception of and attention to goal-relevant stimuli, and evaluative processes, all contributing to self-regulation without the need for conscious awareness. Finally, we will examine how nonconscious self-regulation relates to the experiences of self-agency that accompany much of human behavior and discuss how the desire to feel in control over one's actions deals with instances of nonconscious goal pursuit.

How goals are represented

The goals that people pursue in their daily lives can differ widely in their level of abstractness: while socializing or having a slim figure are representations of complex goals that usually require a series of behaviors to be achieved, getting hold of a bottle of water or producing matching symbols on a slot machine are results which can be attained by a simple hand movement or a button press. Across such instances, goals can be conceptualized as mental representations of certain behaviors or outcomes that are desirable to engage in or to attain (Bargh, 1997; Custers & Aarts, 2005; Fishbach & Ferguson, 2007).

Research in several domains of psychology has confirmed the original ideomotor notion of William James and shown that human actions are represented in the brain in terms of their observable effects, associated with the motor program needed to produce the effect (Hommel, Musseler, Aschersleben, & Prinz, 2001; Jeannerod, 2001; Prinz, 1997; Vallacher & Wegner, 1987). As a consequence, merely thinking about a certain outcome can activate the behavioral program needed to achieve that outcome. In addition, representing actions in terms of their potentially desirable results allows people to direct their behavior by anticipating its effect. This way, goals can serve as the standard and reference point for behavior, making sure that the ongoing actions actually produce the desired results.

However, not every behavior or outcome that is represented in terms of a result of concrete actions actually operates as a true goal for an individual. An outcome is much more likely to motivate behavior to attain it if it is perceived to be rewarding by the individual. How is the rewarding value of an outcome actually determined, and how is this is done in the absence of conscious deliberation? Following the conceptualization of a goal as a desired outcome or behavior, recent research into the underlying mechanisms of nonconscious goal

pursuit has focused on the role of positive affective signals as indicators that a given state is worth pursuing (e.g., Custers & Aarts, 2005; Ferguson, 2007; see also Förster, Liberman, & Friedman, 2007).

Affective signals play a fundamental role in directing human behavior and are processed quickly and without the need for conscious awareness upon the perception of a stimulus (Chen & Bargh, 1999; Damasio, 1994; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Zajonc, 1980). Positive affect has been shown to play a central role in incentive learning and the neurological mechanisms involved in reward processing and motivation (see Berridge, 2007), suggesting that positive affective signals may be crucial for conveying information about the desirability and thus the motivational value of a potential goal state. We conceptualize a goal, therefore, as consisting of the cognitive representation of an outcome or behavior, which can serve as a reference point for one's actions, coupled with a signal of positive affect which indicates that this reference point is desirable to attain. In other words, the positive affective signal turns a behavior representation into a goal representation and helps to recruit resources toward actually pursuing it when the goal is activated.

Activating goal representations and goal-directed behavior by external cues

An abundance of empirical evidence shows that activating a behavior representation that is associated with positive affect can indeed lead to goal-directed behavior. In one of the first series of studies on this topic, Bargh and colleagues (Bargh et al., 2001) subtly activated the goal of achievement, which is assumed to be positive for university students, by asking student participants to solve word puzzles in which words related to achievement (e.g., strive, succeed) were included or not, without drawing participants' attention to it. They observed that these participants later displayed more motivated behavior to perform well on an intellectual task than control participants. Fitzsimons and Bargh (2003) and Shah (2003) later showed that the motivation to achieve could also be triggered when participants were primed with the name of a significant other who was strongly associated with the goal of doing well in college, such as one's mother or father (see also Kraus & Chen, 2009). Other studies have confirmed that a variety of social cues, such as the names of attachment figures, the goal-directed behavior of other people, the experience of social exclusion, names and exemplars of social categories, religious cues, or cues related to power or to mastery, can function as primes to trigger motivated behavior in participants (e.g., Aarts, Chartrand et al., 2005; Aarts, Gollwitzer, & Hassin, 2004; Custers, Maas, Wildenbeest, & Aarts, 2008; Galinksy,

Gruenfeld, & Magee, 2003; Gillath et al., 2006; Lakin, Chartrand, & Arkin, 2008; Moskowitz, Gollwitzer, Wasel, & Schaal, 1999; Moskowitz & Ignarri, 2009; Randolph-Seng & Nielsen 2007; Stajkovic, Locke, & Blair, 2006; Thompson & Musket, 2005), even in children (e.g, Over & Carpenter, 2009 a, b).

Other studies have examined whether goal-directed behavior is more likely to result from an external cue when the activated goal state is relatively more positive. In one set of studies, Ferguson (2007) measured participants' implicit affective responses towards potential goals, for example the goal of being thin, and found that participants who valued this goal relatively more strongly than other participants displayed more goal-directed behavior towards it, such as resisting high-fat food in daily life and consuming less fattening food in a taste test in the laboratory.

Extending these findings, a series of recent field experiments has shown that mere activation of the goal of being thin leads diet-motivated participants to pursue consume less high-fat food and to buy fewer unhealthy snacks in a grocery store, while it does not affect control participants who are less motivated to watch their weight and who presumably associate less positive affect with the concept of dieting (Papies & Hamstra, 2010; Papies, Potjes, Schwinghammer, & van Koningsbruggen, 2014; Papies & Veling, 2013). In one study, for example, participants who entered a grocery store were handed either a flyer that contained words related to the goal of dieting or a control flyer. After they finished grocery shopping, their purchases of unhealthy snack foods were assessed, together with a number of control variables. Results showed that overweight participants, for whom dieting is more likely to be a desirable behavior, bought fewer unhealthy snacks when the dieting goal had been activated by the flyer they received, while normal-weight participants were not affected. Importantly, while some participants were more likely to think about the flyer than others, this did not moderate the effects of the exposure to the goal-related cues, suggesting that no conscious awareness was necessary for the goal cues to trigger goal-directed action (Papies et al., 2014).

In studies that manipulated rather than measured whether a behavior is represented as desirable for a person, Custers and Aarts (2005) showed that the exposure to a behavioral state which is initially neutral can trigger motivated behavior, but only when it is unobtrusively coupled with positive affect, for example through an evaluative conditioning procedure (Custers & Aarts, 2005). Finally, a study building on these findings (Aarts, Custers, & Marien, 2008) directly demonstrated that actual goal-directed behavior requires the motivating power of positive affective signals, rather than merely relying on the

ideomotor principle of triggering a behavior by means of the common code for the results of one's action and their motor programs (Hommel et al., 2001; Jeannerod, 2001). Here, words related to the concept of exertion (e.g., exert, vigor) were paired with positive words, or with neutral words. Subsequently, participants were given a handgrip and instructed to squeeze this handgrip in response to a cue they saw on the computer screen. Participants who had been exposed to the concept of exertion started squeezing the handgrip earlier than participants who had not been exposed to this concept, suggesting that the exposure to the concept of exertion prepared the associated motor program to be ready to implement motor behavior upon request. However, participants for whom the concept of exertion had also been paired with positive affect also displayed motivated behavior in terms of increased effort: they exerted more force than the other participants when squeezing the handgrip. This additional effect of positive affective signals shows that outside participants' awareness, positive affect served to motivate participants, so that they put additional effort into their behavior, going beyond the mere activation of a neutral end state (see also Takarada & Nazaki, 2014, for a replication).

In sum, the broad array of studies on external cues affecting motivated behavior shows that to the degree to which a goal is desirable, and thus associated with positive affect, external goal-related cues not only activate the mental representations of outcomes, but trigger actual motivation. Thus, when a behavioral state is represented as actually being desired, activating it by means of external cues triggers the motivation to pursue it as a goal.

The role of habits in selecting goal-directed behavior

In addition to being represented as outcomes or behaviors which are associated with positive affect, goals are embedded in knowledge structures containing goal-relevant information, which are crucial for automatic self-regulation. Indeed, when activating a goal in social-psychological studies, researchers most likely do not prime a single concept, but rather a rich conceptual structure containing, among others, behavioral, motor, affective, and interactional information (Bargh, 2006). In other words, goal representations – like other representations in human memory – are situated, based on an individual's earlier experiences (Papies & Barsalou, 2015; see also Barsalou, 2003). Thus, these knowledge structures also include situational and contextual cues indicating opportunities and means for goal pursuit (Aarts & Dijksterhuis, 2000; Austin & Vancouver, 1996; Bargh, 1990, 1997; Bargh & Gollwitzer, 1994; Cooper & Shallice, 2006; Kruglanski et al., 2002). For example, the goal of socializing can be mentally associated with contextual cues such as bars and with

behaviors like buying a round of drinks (Sheeran et al., 2005), and a delicious chocolate cake can be associated with social events like birthday parties (Papies, 2013) and the goal of hedonic enjoyment, or, conversely, the goal of following a diet and consequently, with the behaviors of approaching it or of rejecting it in favor of healthier alternatives (e.g., Bargh et al., 2001; Fishbach, Friedman, & Kruglanski, 2003; Papies & Barsalou, 2015; Papies, Stroebe, & Aarts, 2007, 2008b).

These knowledge structures containing environmental cues, goal representations, and means and procedures for goal pursuit, are crucial for automatic self-regulation as they enable people to pursue goals nonconsciously and without the need for deliberation. Repeatedly pursuing a goal in a given context via a certain course of behavior forges a strong cognitive link between the goal representation and the representation of this behavior. When the goal later becomes activated again in the same context, this can automatically lead to the activation of the habitual means for goal pursuit. Thus, automatic self-regulation heavily relies on habits, which have been defined as goal-directed behaviors that can be triggered by contextual cues (Aarts & Dijksterhuis, 2000). This way, for example, people do not have to think deliberately every day about how to get to work in the morning, but they will automatically grab the car keys or get on their bikes, based on what they have done before in a similar situation.

The important role of habits in automatic self-regulation has received empirical support in a number studies, for example in the domain of personal transport during one's daily activities (e.g., Aarts & Dijksterhuis, 2000). Here, priming participants with certain destinations in the context of going there (e.g., going to follow a lecture, going shopping) triggered the activation of certain means for personal transport (e.g., biking). However, this effect occurred only among those participants who habitually used that means of transport (i.e., bicycle) to reach their personal transport goals during their daily activities. Similarly, words denoting potential locations for running have been shown to prime the activity of running, but only among participants who habitually run as a form of exercise (Neal, Wood, Labrecque, & Lally, 2012). In the domain of the habitual drinking of alcohol among students in the UK (Sheeran et al., 2005), activating the goal of socializing increased the accessibility of the concept of drinking, but only among those student participants who were regular drinkers of alcohol in social situations. In addition, after a socializing prime, these students were more likely to choose a voucher for alcohol rather than for coffee or tea as a reward for their participation in the experiment. Finally, a large number of studies examining behaviors that are performed frequently in one's daily life and in stable contexts, such as purchasing

food, physical exercise, or seat belt use, have shown that the performance of these behaviors is to a large degree predicted by the strength of one's habits towards them (e.g., Ouellette & Wood, 1998; van 't Riet, Sijtsema, Dagevos, & de Bruijn, 2011; Wood, Tam, & Wit, 2005).

At the same time, conscious intentions have been found to be predictive of such behaviors as well. In other words, some part of human behavior is under conscious control – but habits can take over if they are sufficiently strong (e.g., Danner, Aarts, & de Vries, 2008; Norman, Armitage, & Quigley, 2007; Ouellette & Wood, 1998). Indeed, research on the interplay between habits and intentions has shown that intentions are predictive of behavior when habits are weak – for example because the behavior is not performed frequently or is performed in a variable context – but they do not predict behavior when habits are strong, i.e., when behavior is performed frequently in a stable context (Danner et al., 2008; Norman & Conner, 2006; Ouellette & Wood, 1998; Verplanken, Aarts, van Knippenberg, & Moonen, 1998; Wood, Tam, & Guerrero Witt, 2005). Thus, as a goal-directed behavior is executed more frequently in a stable context and increases in habit strength, conscious intentions tend to become less influential in guiding it.

One can easily imagine that habits can have beneficial effects in daily life, as was predicted early on by William James, who emphasized the important role of habits for freeing up mental capacities for processes that require conscious awareness (James, 1890). Recent work indeed points towards such benefits of habits, such that habits mediate the effects of self-control on a number of positive outcome measures like eating healthy, exercising, and studying, and are associated with high experienced automaticity of these behaviors (e.g., Galla & Duckworth, 2015). In other words, individuals with good self-control are good at achieving their behavioral goals because they can rely on good habits that make choosing goal-directed behaviors less effortful. Similarly, recent work has shown that habits can lead to beneficial outcomes (e.g., eating a healthy breakfast) even when a person's self-control resources are temporarily low (e.g., due to being in a stressful exam week), because the habitual behavior is triggered automatically (Neal, Wood, & Drolet, 2013). At the same time, strong habits can make it difficult to change one's behavior, as contextual cues will keep triggering one's habitual courses of action despite conscious intentions to do otherwise. Indeed, a meta-analysis of behavior change studies showed that behaviors that are susceptible to habit formation are much less likely to be changed by means of conscious intentions than behaviors that are less susceptible to habit formation (Webb & Sheeran, 2006). Thus, habits play an important role in nonconscious self-regulation by allowing for the instigation of goal-

directed behavior without the need for conscious deliberation, but they can also limit the effectiveness of intentions for behavior change.

The role of habits in executing goal-directed behavior

Goal-directed habits are crucial also for the efficient execution of behavior, which relies on the routinization of skills. At the lowest level of analysis, habits can be regarded as stimulus-response links that are established and reinforced by rewards which follow certain responses to a stimulus. If, for example, one feels nicely refreshed after drinking a glass of water on a hot day, the sight of a glass of water may later evoke the action of grabbing it in order to drink. Eventually, when a behavior has repeatedly and successfully been executed in response to a certain stimulus and the stimulus-response association has become well-engrained in procedural memory, the perception of the stimulus may automatically trigger the execution of the associated behavior. In other words, once the habit is sufficiently strong, it can operate independently of the reward that initially served to reinforce the link between the stimulus and the response (Dickinson, Balleine, Watt, Gonzales, & Boakes, 1995). This enables the efficient performance of instrumental actions in a similar context later on, without the need for conscious awareness and intentions (see also Wood & Neal, 2007).

However, not all behaviors can be executed successfully by such single responses to certain stimuli. If a behavior is more complex, it may require skills which consist of several sequential responses, with one response triggering the next in an effortless fashion, and often in highly dynamic circumstances (Aarts & Custers, 2009; Cooper & Shallice, 2006). Researchers have suggested that habitual behavior then operates via a feedback control system, in which one's actions can be adjusted in an ongoing manner. More specifically, the sensory and perceptual result of one action forms the input for the next one, thereby allowing for constant adjustments and efficient regulation of skillful actions in changing circumstances (e.g., Fourneret & Jeannerod, 1998; Frith, Blakemore, & Wolpert, 2000; Powers, 1973). When driving one's car, for example, the required behavior is largely the same every time one takes the usual route to work. Still, slightly different actions are needed on different occasions, such as when the traffic light is red instead of green, there is a slow car in front, or a steady side wind requires adjusting one's steering wheel. Such adjustments of one's habitual behavior can be made in a nonconscious manner by monitoring the results of one's actions and using perceptual feedback to fine-tune the execution of the necessary skills and responses (Aarts & Custers, 2009; Bargh & Ferguson, 2000). Thus, once a course of action is triggered to reach a certain goal, the execution of habitual goal-directed behavior is

monitored and adjusted by nonconscious processes of self-regulation, so that the same goals can be attained under different circumstances.

In sum, habits are crucial mechanisms for navigating complex and challenging environments that most people live in, as they allow for the efficient selection of goal-directed behaviors once a goal has been activated, and they then ensure the smooth execution of behavior to attain the goal.

Adaptive cognitive processes supporting automatic self-regulation

Thus far, we have discussed how goals are represented, how they can be activated by external cues, and how their pursuit often relies on habits that have been established by previous instances of successfully pursuing the goal in a similar context. Sometimes, however, successful self-regulation cannot rely on past behavior, or the pursuit of a goal has to be postponed, shielded from distractions or from tempting alternatives, or monitored over an extended period of time. Recent research has identified how adaptive perceptual and cognitive processes support self-regulation in those circumstances without the need for conscious awareness, specifically by following the principles of executive control (Aarts & Hassin, 2005; Bargh, 2005; Dijksterhuis & Aarts, 2010; Hassin, Aarts, Eitam, Custers, & Kleiman, 2009; Miller & Cohen, 2001). We will briefly discuss these processes next.

Research on working memory processes has revealed that adaptive cognition and behavior benefit from three essential functions of the so-called "workspace of the mind": the active maintenance of relevant information, the allocation of attention to task-relevant information and inhibition of task-irrelevant information, and processes of monitoring and feedback-processing (Hassin et al., 2009; Miller & Cohen, 2001; Miyake & Shah, 1999). Such processes also seem to play a role in automatic self-regulation. Automatic self-regulation, however, also benefits from other adaptive processes in perception and evaluation, which further support the efficient pursuit of goals in dynamic circumstances. In the next section, then, we will discuss research that has shown, for example, that the activation of a goal leads to the active maintenance of this goal in mind, to perceiving one's environment in goal-congruent ways, and to the nonconscious monitoring of relevant processes in the service of goal pursuit.

Once a goal is activated, its representation in working memory is likely to be kept cognitively accessible, in order to facilitate goal pursuit once a suitable opportunity arises. In several studies it has been shown that exposure to cues that activate goals in an individual's mind causes sustained activation of that goal, even in relatively long windows (several

minutes) between the moment of goal activation and measuring its operation (Aarts et al., 2004; Bargh et al., 2001; Fishbach, Friedman, & Kruglanski, 2003; Papies et al., 2014). Crucially, such sustained activation distinguishes the processing of goals from mere semantic knowledge, which remains active for only a short period and then quickly dissipates (Atkinson & Birch, 1970; Higgins, Bargh, & Lombardi, 1985; Srull & Wyer, 1979). One can easily see why it would be beneficial to keep the representation of a goal that has motivational, rewarding significance mentally active over an extended period of time: even when goal pursuit is not immediately possible, this allows one to monitor one's environment for new opportunities and grab them once they arise, thus increasing the chances for goal attainment.

Automatic self-regulation further benefits from processes of perception and attention in line with one's goal pursuit. Fundamental research on visual perception, for example, has shown that how we perceive our physical environment depends on our current goals and the state of our body. Thus, a hill seems steeper to us when we have less resources available for climbing it, presumably in order to make smart decisions on how to spend these resources (Proffitt, 2006; Schnall, Zadra, & Proffitt, 2010). Goal-instrumental objects are perceived as larger in size when the relevant goal has been activated, presumably in order to increase the likelihood of acting on them (van Koningsbruggen, Stroebe, & Aarts, 2011; de Ridder, Kroese, Adriaanse, & Evers, 2015; Veltkamp, Aarts, & Custers, 2008). Similarly, active goals can make ambiguous stimuli seem more goal-congruent, such that, for example, a half-smile is perceived as friendlier and other people are perceived as physically closer when one is motivated to experience social connectedness (Bélanger, Kruglanski, Chen, & Orehek, 2014; Pitts, Wilson, & Hugenberg, 2014; see also Balcetis & Dunning, 2006). In addition, goal-relevant stimuli attract increased visual attention, for example as dieters look longer at highly desirable food words than at other stimuli (Papies, Stroebe, & Aarts, 2008a; see also Moskowitz, 2002; Raymond & O'Brien, 2009). Without the involvement of conscious awareness, such effects on perceptual and attentional processes support automatic self-regulation by making it more likely that an individual will effectively detect and use goal-relevant means and opportunities in the environment.

Similar effects on the automatic evaluation of goal-relevant stimuli further support automatic self-regulation. When pursuing a goal (e.g., quenching one's thirst), even when this happens nonconsciously, objects that might facilitate this pursuit (e.g., water) are evaluated more positively compared to when one is not pursuing that goal and compared to less relevant objects (e.g., coffee; Ferguson, 2008; Ferguson & Bargh, 2004). Conversely,

stimuli that might interfere with one's goals are processed less positively. In the domain of interpersonal relations, for example, individuals who are committed to an ongoing romantic relationship derogate the attractiveness of potential alternative partners, pay less attention to them, and also implicitly represent these potential mates as less attractive, thereby protecting their current commitment (Karremans, Dotsch, & Corneille, 2011; Maner, Gailliot, & Miller, 2009; Meyer, Berkman, Karremans, & Lieberman, 2011; Miller, 1997; Ritter, Karremans, & van Schie, 2010). However, while these processes may occur nonconsciously, they nonetheless require cognitive resources, as they only occur when enough resources are available or when individuals are high in executive control (Meyer et al., 2011; Pronk, Karremans, & Wigboldus, 2011; Ritter et al., 2010; see also Bélanger et al., 2011).

Effective goal pursuit also benefits from inhibition mechanisms that shield one's focal goal from distractions, such as attractive opportunities for pursuing alternative goals. Shah and colleagues (Shah, Friedman, & Kruglanski, 2002), for example, showed that exposing participants to cues that activate a personal goal (e.g., studying) led to the inhibition of an alternative goal that could not be pursued at the same time (e.g., socializing; see for similar findings: Fishbach et al., 2003; Papies et al., 2008b). Similarly, once a goal has been attained, goal-related information is no longer relevant, and is inhibited in order to prevent interference with other processes (see Förster et al., 2007). Finally, in support of nonconscious monitoring processes during goal pursuit, it has been shown that participants who are chronically working on a certain goal (e.g., the goal of looking neat) spontaneously activate actions to reach this goal (e.g., ironing) when it appears necessary, i.e., when they are confronted with a situation that is discrepant with that goal (e.g., wearing a wrinkled shirt; Custers & Aarts, 2007a; see also Fourneret & Jeannerod, 1998; Hassin, Bargh et al., 2009).

In sum, a variety of cognitive processes, ranging from perception, attention and inhibition to evaluation and feedback processing, support automatic self-regulation in dynamic circumstances, even when people are not consciously aware of the goals they are currently pursuing. This suggests that the mere activation of a goal instigates executive control processes, presumably because they are recruited for the maintenance and possible pursuit of the goal (Hassin, Aarts, et al., 2009; Marien, Custers, Hassin, & Aarts, 2012; Masicampo & Baumeister, 2011; Megías et al., 2015; Soto, Mäntylä, & Silvanto, 2011; Shah & Kruglanski, 2002). Importantly, however, these processes are not "free" and without any effort, as they do require mental resources. Accordingly, while contemporary social cognition research often assumes that nonconscious processes are efficient and do not claim mental resources, the findings of studies cited here suggest that engaging in automatic self-

regulation does have costs. Specifically, the execution of the processes described above renders them less available for other tasks (e.g., Marien et al., 2012), and is compromised by potential lack of resources (e.g, Meyer et al., 2011, Ritter et al., 2010). These mechanisms supporting automatic self-regulation thus represents a class of mental processes in which awareness and mobilization of effort can divert and do not neccesarily go hand in hand (Aarts, 2007; Badagaiyan, 2000; Hassin, Aarts, Eitam, Custers, & Kleiman, 2009; Lau, Rogers, Haggard, & Passingham, 2004). This concurs with recent views suggesting that consciousness and attention are distinct faculties (Dijksterhuis & Aarts, 2010; Koch & Tsuchiya, 2007; Lamme, 2003). Importantly, although it seems likely that nonconscious and conscious processes involved in self-regulation both operate on a platform that uses mental resources, it is currently unknown how much this platform shows overlap between unconscious and conscious self-regulatory processes, and whether the amount of resources to work on this platform differs between the two types of regulation. These are key questions for future research to advance the understanding and examination of the human capacity to regulate and pursue goals in daily life.

The sense of agency in automatic self-regulation

Up to now we have discussed how people can regulate their goal pursuit outside of conscious awareness. However, the idea that goal pursuits materialize unconsciously is not without problems and may even sound counter-intuitive. After all, the actions people conduct and the outcomes that these actions produce are often accompanied by conscious experiences of self-agency. This experience of self-agency – i.e., the feeling that one causes one's own actions and their outcomes – has an intimate relationship with self-awareness and constitutes an important building block for our concept of free choice and the belief that one's behavior is governed by "consciousness" or some other type of inner agent, such as "the will" or "the self". How, then, can we reconcile the findings that much of human behavior unfolds and is regulated outside of conscious awareness with the fact that people have those pervasive agency experiences?

One way to address this issue is by arguing that nonconscious goals do not reach self-agency experiences, and hence, self-agency only emerges from intentional action: people consciously intend to produce a specific action or outcome, and when the perception of the action or outcome corresponds with this intention, they feel self-agency (e.g., Bandura, 1986; Carver & Scheier, 1998; Deci & Ryan, 1985). In this view, experiences of self-agency would be the obvious result of consciously forming and pursuing one's goals. Although the

establishment of self-agency resulting from intentional action requires specific mechanisms which have been elucidated only recently, research adopting this perspective has shown that the processing of self-agency draws on a variety of authorship indicators (Wegner & Sparrow, 2004), such as direct bodily feedback (e.g., Gandevia & Burke, 1992; Georgieff & Jeannerod, 1998), direct bodily feedforward signals known as efference copies (e.g., Blakemore & Frith, 2003; Blakemore, Wolpert, & Frith, 2002), and other indirect feedback derived from the external world (e.g., Daprati et al., 1997). In essence, these signals all provide a person with information about the intended outcome of their actions.

However, while dismissing the possibility that self-agency does not involve and ensue from nonconscious goal-directed processes may be one strategy to solve the fundamental issue of how we establish a sense of personal authorship, recent research offers a somewhat different perspective. This research argues that our conscious experience of self-agency is an inference that occurs fluently and perfunctorily after action performance (Prinz, 2003; Wegner, 2002). This inferential character of experiences of self-agency has become apparent in a large number of recent studies (Aarts, Custers, & Wegner, 2005; Aarts, Oikawa, & Oikawa, 2010; Belayachi & van der Linden, 2010; Custers, Aarts, Oikawa, & Elliot, 2009; Dannenberg, Förster, & Jostmann, 2012; Desantis, Roussel, & Waszak, 2011; Dijksterhuis, Preston, Wegner, & Aarts, 2008; Jones, de-Wit, Fernyhough, & Meins, 2008; Moore, Wegner, & Haggard, 2009; Ruys & Aarts, 2012; Sato & Yasuda, 2005; Van der Weiden, Aarts, & Ruys, 2013; Wegner & Wheatley, 1999), which demonstrate that agency experiences are the result of a match between the outcome of an action and knowledge about the outcome that was active just prior to its occurrence.

In one study showing this effect (Aarts, Custers et al., 2005), participants and the computer each moved a single gray square in opposite directions on a rectangular path consisting of 8 white tiles. Participants could press a key to stop the rapid movement of the squares, which would turn one of the eight tiles black. From a participant's perspective, this black tile could represent the location of either her square or the computer's square at the time she pressed the stop key. Thus, the participant or computer could have caused the square to stop on the final position (outcome), rendering the exclusivity of causes of outcomes ambiguous (Wegner & Wheatley, 1999). In fact, however, the computer always determined the stops, so actual control was absent. In this task, participants either consciously set the intention to stop on a specific position, or they were subliminally primed with that position just before they saw the presented stop on the corresponding location. To measure experiences of self-agency, participants then rated the extent to which they felt to have

caused the square to stop. Results showed that both intention and priming lead to an increased sense of self-agency, suggesting that on-line self-agency experiences were primarily based on a match between pre-activated and actual outcomes, irrespective of whether the source of this activation was a conscious intention or an unconscious prime. This, together with other findings, indicates that agency experiences not only arise from conscious goals, but accompany the unconscious activation of goal representations as well. This, in turn, can lead people to believe that the outcomes of their behaviors were consciously intended, whereas in fact, they were influenced by cues in the environment without being aware of it.

It is important to emphasize that considering oneself as the cause of one's own actions and the resulting outcomes is not necessarily illusory, as desired outcome representations (i.e., goals) that are activated outside awareness are also more likely to guide the actions that produce that outcome than when these representations are not activated (Aarts et al., 2004; Bargh et al., 2001; Custers & Aarts, 2007b). If, for instance, you want another person to like you, this changes your behavior toward that person in the service of the given goal, even though you may not be aware of the goal and the effects it has by pursuing it. Hence, self-agency and nonconscious goal pursuit may go hand in hand as nonconscious activation of goals promotes both goal attainment as well as agency experiences. As a result, agency experiences in such situations may not be deceptive, but rather an accurate assessment of the source that produced the outcome. Thus, whereas the experience of self-agency can be a guess, sometimes this guess is right. In that case, experiences of self-agency may serve humans well because they can help to identify the results of one's actions in social situations when one lacks conscious knowledge of producing them. More importantly, the experience of agency, deriving from either conscious intentions or nonconscious goals, is a crucial source for people's general belief that they can and do have an influence on their own behavior, which has been shown to be associated with increased health and well-being (e.g, Taylor & Brown, 1988).

In addition, the belief of having control over one's behavior and its outcomes can also motivate people to look ahead and to consciously plan their actions. As discussed above, this can be beneficial for self-regulation in many circumstances, for example when a situation demands a completely new course of action, when previous goal-directed actions were obstructed, or when long-term efforts are required. Action planning can then facilitate goal achievement by creating new action representations which include sensori-motor information regarding one's future behavior, as well as information regarding situational cues which can serve to initiate and guide behavior without much conscious thought (e.g., Gollwitzer &

Sheeran, 2006; Papies et al., 2009). Indeed, without repeatedly experiencing a sense of control over important outcomes, people may be much less likely to see the point of reverting to such an effortful means of directing their behavior, which can clearly help successful goal pursuit. Future research may increase our understanding of how conscious planning can interact with automatic self-regulation, and provide demonstrations of how such knowledge can be applied to enhancing self-regulation in important domains such as health behavior (see also Papies et al., 2015).

Summary and Conclusions

In the present chapter, we have examined automatic self-regulation by analyzing the cognitive processes that allow people to pursue their goals in daily life without relying on conscious awareness. We have seen that goals can be conceptualized as mental representations of outcomes or behaviors that are associated with positive affect, and which can be activated by external cues. Goals are embedded in rich knowledge structures that include contexts for pursuing the goals, as well as effective means and procedures for goal pursuit, all based on an individual's earlier experiences. To the degree that they have been automatized as habits by frequent past performance, goal-directed actions can be triggered once a goal is activated, and they support effective goal pursuit independent of conscious intentions. We have further seen how automatic processes of attention, perception, evaluation, and executive control support automatic self-regulation by ensuring privileged processing of goal-relevant information and making sure that people recognize opportunities to pursue their current goals. Finally, we have examined the occurrence of experiences of self-agency with regard to behaviors that are produced by automatic processes of self-regulation. Specifically, although people often experience agency concerning their own behavior, these experiences might emerge from performing and observing actions and the results they produce, rather than reflecting the actual cause of the mechanisms driving goal-directed actions.

Together, the processes of automatic self-regulation that we have discussed in this chapter elucidate how people can function so effectively in their dynamic living environments: the pursuit of many daily-life goals, such as socializing, travelling to work, or eating healthy, or can be "outsourced" to processes that do not require conscious awareness. This way, humans can focus on less ordinary endeavors, such as finding a romantic partner, writing an article, or cooking a Thanksgiving dinner. While the processes that support this automatic self-regulation often let people perceive the world in a somewhat inaccurate and

biased way, they are functional, for example in that they increase the likelihood of their detecting and acting on good opportunities. A potential downside of automatic self-regulation may be that habits make us conservative: once a habit has developed, changing it by means of conscious intentions becomes increasingly difficult, even if the habitual behavior has become undesirable. When sufficient resources are available, however, conscious processes can intervene to change behavior, so that ultimately self-regulation can be automatized again in new, desirable ways.

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