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Ostafin, Brian

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Taming the Wild Elephant: Mindfulness and Its Role in Overcoming Automatic Mental Processes

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Brian D. Ostafin

Wild elephants are formidable creatures that can wreak havoc on human communities. A recent account from Vietnam demonstrates the difficulty of controlling these animals, as bonfire barricades and loud gongs failed to dissuade them from destroying a village's orchards and vegetable fields ("Wild elephants raid fields", 2013). For anyone who has tried to change a behavior such as overeating, smoking, or procrastination, the habits of the mind can feel as powerful and obstinately uncooperative as wild elephants. A wild elephant metaphor of the mind is found in early Buddhist accounts (MN 125.23)[1]:

> Just as…the elephant tamer plants a large post in the earth and binds the forest elephant to it…in order to subdue his forest habits…and to inculcate in him habits congenial to human beings, so these four foundations of mindfulness are the bindings for the mind of the noble disciple in order to subdue his habits.

This chapter uses a cognitive science perspective to review what is known about the mind's unruly habits and how mindfulness may help to counter them.

The Frame Problem and the Problem of Framing

Why does the human mind feel like an untamed elephant? The approach taken here includes the assumptions that reducing the informational complexity of the world is a prerequisite to goal pursuit and that a side effect of this reduction is inflexible responding to the environment[2].

To begin, the goal-oriented nature of humans can be understood as part of the strategy that we use to obtain the necessities of life, such as food and shelter (Klinger, 1998). Unlike plants, which rely on the environment to deliver what they need to survive, animals, including humans, must seek out the goods of life. These goods are represented as goals that are pursued by humans as well as lower animals (Tolman, 1948).

An important obstacle to successful goal pursuit is the vast complexity of the world (Simon, 1972). This obstacle is demonstrated in the *frame problem* from artificial intelligence, which consists of the difficulty of designing robots that can both determine what information is *relevant* (*salient*) for a task and ignore information that is *irrelevant* (*nonsalient*) for the task. Dennett (1984) illustrates the frame problem by describing the difficulties of designing a robot to use a wagon so

[1] MN is the standard abbreviation for the canonical Majjhima Nikāya ("Middle-length discourses") text.

B.D. Ostafin (✉)
Department of Psychology, University of Groningen, Groningen, The Netherlands
e-mail: b.d.ostafin@rug.nl

[2] I follow Vervaeke's (2011) argument regarding the necessity of frames and their costs.

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that it can move a battery from one room to another, in which the battery can be connected to the robot. In addition to representing the intended consequences of its behavior (the battery will come along when the wagon is pulled), the robot must also be able to (a) discriminate between the few relevant unintended consequences of its action (e.g., pulling the wagon is a bad idea because there is also a time-bomb on it) from the infinite number of irrelevant unintended consequences (e.g., the influence of pulling the wagon on air currents that contribute to weather patterns in South America) and (b) ignore the irrelevant information so that it can act instead of being perpetually frozen in a state of computational processing. Relatively complex goal pursuits such as playing a game of chess have similar problems with immense quantities of information, as the number of possible chess games has been estimated to be 10^{120} (Shannon, 1950). Given our limited information processing capacity (Miller, 1956), we are unable to fully consider all possible behavioral alternatives and their consequences. Thus, we cannot play the perfect game of chess or flawlessly pursue more complex goals involved in relationships, childrearing, and one's career. Although it may be impossible to solve the frame problem in artificial intelligence (Dennett, 1984), it is clear that frames, which demarcate the relevant from the irrelevant, are necessary for goal pursuit.

Fortunately, there are a number of adaptations that help to establish relevance. For example, innate parameters in our sensory systems constrain what is perceived and acted upon (von Uexküll, 1957). Importantly, frames are also derived from learning experiences (Rieskamp & Otto, 2006). Such learning creates mental shortcuts in determining what is relevant, thus allowing decisions to be made without an exhaustive search of information related to an action. For example, previous learning means that a desire for a midnight snack does not elicit haphazard foraging through the house but instead prompts a direct path toward the refrigerator. Another example is that chess players who can successfully plan three moves ahead need not demonstrate super-human information processing in order to select advantageous moves. Instead, they use heuristics such as devoting attention to moves that allow the opponent fewer options and to squares that can be influenced by many pieces (Reynolds, 1982; Simon & Simon, 1962). Shortcuts such as walking to the fridge at midnight or attending to chess moves that constrain an opponent become habitual because they facilitate the acquisition of something good or the elimination of something bad (Wood & Neal, 2007). These experience-related frames confer great adaptive advantage due to their speed and efficient use of limited cognitive resources, both of which may contribute to the finding that habitual behavior is associated with less stress than nonhabitual behavior (Wood, Quinn, & Kashy, 2002).

It is an unfortunate fact that everything costs something. The cost of learning-based frames becomes apparent when the environment changes. This is because frames tend to be conservative and are most beneficial if the environment remains constant. For example, the salience of a midnight snack in the fridge may become problematic when the context changes from "eat when hungry" to "going on a diet" (Carels et al., 2001). Frames also impede goal pursuit by blocking the consideration of alternative options, some of which may be more efficient. For example, research has shown that experienced chess players will select a familiar solution to achieve checkmate when a shorter but unfamiliar solution is available (Bilalić, McLeod, & Gobet, 2008). These participants were only able to find the shorter solution when the board was set up so that the familiar solution was no longer an option, indicating that the well-known solution impeded access to the arguably better solution. Further, even though participants stated that they looked for shorter solutions after finding the familiar one, eye-tracking data showed that they continued to primarily look at the squares relevant to the familiar solution.

These examples show that despite intentions to the contrary, frames have a centripetal force that can capture thinking and behavior. Unfortunately, the consequences are often more serious than a poorly played game of chess. The

problem of frames becomes apparent when considering the difficulty of changing self-destructive behaviors:

> Even though in the morning, you say, "I'm not going to drink", then you seem to hit like a blind spot in your brain, where you go on automatic and you're going to have that drink…you're not thinking anymore, "What about the kids? What about the marriage"…You just hit this blank spot and you go to the refrigerator, you open it, and you pull out that bottle of wine (Moyers, 1998).

Treatment outcome research supports the idea that alcohol and drug behavior is hard to change, with relapse rates of 60 % within 4 months post-treatment (Foster, Marshall, & Peters, 2000) and 70 % within the first year (Hunt, Barnett, & Branch, 1971). Similarly bleak results are demonstrated by individuals making New Year's resolutions, with approximately 60 % failing to maintain their resolutions 3 months later (Norcross, Ratzin, & Payne, 1989). These findings illustrate that habits of the mind can indeed act like unruly elephants.

Self-Regulation and Dual-System Models of the Mind

Dual-system (process) models of the mind have helped to provide insight into the role of habits in self-regulation. Although there are a number of variants of dual-system models (Epstein, 1994; Fazio, 1990; Posner & Snyder, 1975; Strack & Deutsch, 2004), they overlap to a considerable extent in the characteristics ascribed to each system. Using the terminology of Stanovich and West (2000), *System 1* is the system of habits and involves information represented in associative links, automatic responses that occur quickly (with the corollary that System 1 is the default system for thinking and behavior), and little demand on executive control resources. In contrast, *System 2* is the system of conscious reflection and involves information represented as propositions (that are operated on with logic), volition, slow response characteristics, and the use of executive (attentional) control. (For a critique of such dual-system models, see Keren & Schul, 2009.)

The Habit System

System 1 (the habit system) is proposed to represent information in an associative network. This network is the storage place for learning-based relevance (frames). From this perspective, the perception of a stimulus automatically activates nodes in an associational network. The nodes can represent a number of things such as concepts (*ice cream—cold*), and affect (*ice cream—hedonic pleasure*). Additionally, the network includes behavioral schemata that encompass the contextual cues of the behavior, the behavior, and consequences related to the behavior (*dessert tray—order and eat dessert—hedonic pleasure*; Strack & Deutsch, 2004). Although some associations in System 1 are part of our genetic makeup, such as loud noises eliciting an orienting response (Sokolov, 1963) or palatable foods eliciting appetitive behavior (Mennella & Beauchamp, 1996), experience is proposed to play a central role in the development of associative networks. Early behaviorist research demonstrated that learning experiences create associations between cues, behaviors, and responses as measured in post-learning actions (Skinner, 1948; Watson & Rayner, 1920). For example, over the course of learning to read, verbal stimuli come to automatically elicit reading behavior such that it becomes more difficult to ignore a word in order to categorize the color in which it is printed (Stanovich, Cunningham, & West, 1981). More recent studies have found that conditioning strengthens mental associations as measured with a reaction time task (Olson & Fazio, 2001).

Stronger associations between nodes are reflected in the automaticity with which one node activates another (Strack & Deutsch, 2004). Research on automaticity (and related functional properties such as speed and efficiency) was advanced with the development of a number of *implicit* (indirect) measures of association, such as the sequential priming task. This task consists of the sequential presentation of two stimuli to examine the influence of the first (prime) on responses to the second (target). Early research demonstrated automaticity with a priming task by first creating an explicit expectancy that a

prime (e.g., the word *body*) would be followed by an unrelated target (e.g., building-related words, such as *door*). Participants were instructed to intentionally shift their attention away from expecting a body-related target and toward expecting a building-related target when they saw a body-related prime. The results showed that when the interval between the prime and target was relatively long (>500 ms), the body prime facilitated recognition of the expected building-related target as a word and inhibited recognition of a target that was related to the prime but unexpected (e.g., *heart*). However, when the interval between prime and target was brief (<500 ms), the body prime no longer facilitated recognition of the expected building-related targets but now facilitated responses to unexpected body-related targets (Neely, 1977). These results show that strong stimulus–stimulus associations are activated automatically, quickly, and that they are difficult to control. Similar findings have been shown with evaluative priming task variants in which attitudes are assessed by examining the influence of primes on target evaluations (Degner, 2009; Fazio, Sanbonmatsu, Powell, & Kardes, 1986).

An important benefit of using implicit measures relates to the concept of transfer-appropriate processing, which is the idea that the greater the overlap between the processes that contribute to a measure and the processes that contribute to real-life behavior, the better the measure will be in predicting the behavior (De Houwer, 2006; Roediger, 1990). The extent to which implicit measures assess automaticity should thus make them valuable in understanding self-regulation failures, as such failures are thought to involve automatic processes (Hofmann, Friese, & Strack, 2009). Along these lines, implicit measures assessing stimulus-affect associations have been shown to predict behaviors that people often have a hard time controlling, including alcohol consumption among heavy drinkers (Ostafin, Marlatt, & Greenwald, 2008) and nonverbal expressions of negative attitudes during innocuous cross-racial interactions (Hofmann, Gschwendner, Castelli, & Schmitt, 2008).

The Reflective System

Although the quick and dirty responses in System 1 can provide effective guidance in goal pursuit, the conservative nature of System 1 means that it is poorly equipped to respond to a dynamically changing environment. The dynamic aspect of the world shows itself in a variety of ways, such as novelty (e.g., an unfamiliar chessboard configuration or symptom presentation) or changes in goals (e.g., deciding to go on a weight-loss diet). System 2 (the reflective system) provides greater flexibility under such circumstances.

The flexibility of System 2 results, in part, from the way that it represents information. In this system, information is represented as propositions with a truth value (Strack & Deutsch, 2004). The representation of propositions allows reasoning to be applied, such as evaluating the proposition "Drinking alcohol tonight is a good idea" against a standard (e.g., consideration of the costs and benefits of one's habit of drinking on Wednesday evenings in light of a job interview the next day). Such reasoning may result in the conclusion that "Drinking alcohol tonight is *not* a good idea," leading to a decision/intention to not drink, which in turn activates appropriate behavioral schemata (e.g., declining a beer; Strack & Deutsch, 2004).

The activity of System 2 is dependent on *executive (attentional) control*, which is the ability to maintain attention on a goal and its object while inhibiting (internal or external) distractions (Barrett, Tugade, & Engle, 2004; Engle, 2002). Executive control must actively represent information so that logical operations can be applied. For example, the behavioral option of drinking alcohol, the standard of doing well on the job interview, and the likely consequences of drinking must all be represented in order for even simple reasoning to occur (e.g., "If I drink my usual six beers, I will feel mentally sluggish at the interview and this will negatively impact my evaluation"). Reasoning will be enhanced to the degree that goal-irrelevant information (e.g., how good it feels to get an alcohol buzz) is inhibited. After making a decision (e.g., "I will have just

one beer and then go home early"), executive control must then represent the intention over the course of the relevant time period (the short stay at the bar) in the face of obstacles to goal completion (e.g., the desire to consume a second beer).

A Dual-System Perspective on Self-Regulation

The classic self-regulation dilemma between temptation and restraint can be understood as conflict between System 1 and System 2, with the outcome being determined by the relative strength of the two systems (Hofmann et al., 2009). Stronger appetitive associations in System 1 will increase the likelihood of yielding to temptation. For example, the automaticity of alcohol-approach associations predicts difficulty controlling drinking behavior (Palfai & Ostafin, 2003). In addition, the ability of System 2 to moderate the influence of automatic responses on subsequent behavior is dependent on at least two factors (Fazio, 1990; Strack & Deutsch, 2004). The first involves the motivation to engage in effortful deliberation. When this motivation is low, behavior consistent with System 1 is more likely. Support for this idea has been found in the literature on automatic associations and prejudicial behavior (Olson & Fazio, 2004). Even when motivation to engage in effortful deliberation is high, deliberation cannot occur without sufficient resources (such as time or executive control). Consistent with this idea, relations between implicit associations and behavior are stronger when the person chronically lacks such resources (Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008), when attention is occupied by another task (Gibson, 2008), and when such resources were recently used and thus in a depleted state (Ostafin et al., 2008).

Self-regulation interventions can be designed to either weaken the operations of System 1 or strengthen the operations of System 2. Regarding System 1, there is evidence that aversive conditioning designed to combat appetitive associations can be effective in reducing the consumption of tempting stimuli such as high-fat foods, alcohol, and cigarettes (Diehl et al., 2010; Erickson, Tiffany, Martin, & Baker, 1983; Hollands, Prestwich, & Marteau, 2011). Further, some research has found that aversive conditioning is mediated by changes in associative networks (Hollands et al., 2011; though see Mitchell, De Houwer, & Lovibond, 2009). A recent extension of the conditioning method involves pairing an incentive with avoidance behavior. For example, instructions to respond to alcohol pictures with an avoidance behavior (pushing a joystick away from the body with a concomitant zoom-out effect) have been found to result in reduced alcohol use (Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011) and this effect is partially mediated by increased alcohol-avoidance associations (Eberl et al., 2013).

Other System 1 interventions are designed to prevent the initial activation of appetitive associations. One example consists of attention training. Such interventions are based on the logic that attention toward a stimulus results in the activation of appetitive responses and, therefore, that training attention away from that stimulus should facilitate self-regulation outcomes (Field & Cox, 2008; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). For example, people might be trained to attend to the area of space occupied by neutral rather than alcohol-related pictures in a visual probe task of attention. Although some studies have demonstrated benefits to such attention-retraining manipulations (Schoenmakers et al., 2010), they may fail to generalize to new appetitive stimuli (Schoenmakers, Wiers, Jones, Bruce, & Jansen, 2007).

Other interventions have instead focused on strengthening System 2 processes. There is evidence that executive control can be enhanced through training (Klingberg, 2010), for example, and an initial study found that such training reduced alcohol use among heavy drinkers (Houben, Wiers, & Jansen, 2011). Also, interventions that include elements designed to reduce errors in reasoning have been shown to improve the self-regulation of a number of behaviors such as alcohol use, binge eating, and gambling (Darkes & Goldman, 1993; Grilo, Masheb, & Wilson, 2005; Ladouceur et al., 2001). Such

cognitive restructuring interventions have also been shown to alter emotional responding (Shurick et al., 2012).

Thus, there are several approaches that appear to work, at least somewhat, in allowing the individual to better resolve self-control dilemmas. Nonetheless, each has important limitations. For example, although extinction procedures may create new associations in System 1, the previously problematic associations remain intact (Bouton, 2004). This state of affairs leaves the individual vulnerable when re-exposed to tempting cues (O'Brien, Childress, Ehrman, & Robbins, 1998) or when stress occurs (Sinha, Shaham, & Heilig, 2011). Stress additionally limits the ability of System 2 to guide behavior, as stressors impair executive control (Qin, Hermans, van Marle, Luo, & Fernández, 2009) and mitigate the effects of cognitive restructuring on emotional response (Raio, Orederu, Palazzolo, Shurick, & Phelps, 2013).

Given such limitations, other approaches to preventing self-regulation failure are desirable. One promising class of strategies aims not to alter the contents of the mind, but rather the individual's relationship to such mental contents (Hayes, 2004). The construct of mindfulness falls into this category.

Mindfulness and Overcoming Automatic Processes: Theory

Defining Mindfulness

A popular definition of mindfulness is that it consists of an *awareness* of immediate experience, and a *nonjudgmental*, *accepting attitude* toward that experience such that experiences are allowed to be as they are independent of an agenda to control them (Kabat-Zinn, 1994). Scholars have suggested that although this definition is related to the original understanding of mindfulness in Buddhism, it obscures other aspects of that understanding (e.g., the positive role of concepts, evaluations and judgments in mindfulness practice; Bodhi, 2011; Gethin, 2011). The nonjudgmental awareness definition will be used in this chapter both because of its relation to early Buddhism (Bodhi, 2011; Gethin, 2011) and because of its widespread usage among researchers (Bishop et al., 2004) and contemporary Buddhist teachers (Gunaratana, 2002), thus aiding communication among different scholarly traditions.

Mindfulness and Habit in the Buddhist Model of Suffering and Freedom[3]

The central concern of Buddhism is the general unsatisfactoriness of life, ranging from minor (but pervasive) irritations, boredom, and unfulfilled expectations to acute and intense forms of suffering such as the death of a loved one. An important cause of suffering is thought to be craving and grasping (the latter of which is a more involved form of craving). From this perspective, the perception of external and internal stimuli is typically accompanied by positive or negative (or neutral) feelings, which in turn trigger craving and grasping. Craving and grasping result in thoughts, impulses, and behaviors that aim to obtain and maintain positive feeling states or reduce and remove negative feeling states. People can become trapped in a positive feedback loop such that thoughts, impulses, and behaviors elicit additional feeling states, subsequent craving and grasping, and so on.

Craving and grasping are thought to lead to dissatisfaction in a variety of ways. Consistently wanting things to be different than they are involves a chronic evaluation of the current state as negative and a concomitant feeling of discontent. Further, the difficulty of controlling the world (both external and internal) means that attempts to obtain the pleasant and remove the unpleasant are likely to lead to persistent frustration. Even when the desired goal is obtained, the fleeting nature of positive experiences means that the interlude of satisfaction will be brief. Finally,

[3] This sketch is abstracted from more comprehensive accounts (Bodhi, 1984; Carrithers, 1983; Goldstein, 1993; Rahula, 1959).

craving and grasping extend the natural life of a negative state through thoughts (e.g., rumination and worry) and behaviors (e.g., acting in anger elicits more conflict).

The trajectory from the perception of stimuli and concomitant feeling state to craving and grasping is understood to be habitual (and would thus involve System 1). The most usual case is that individuals are unconscious of the process. That is, the cognitions and behaviors aiming to increase the pleasant and decrease the unpleasant are not carried out as the result of volitional intention, but instead just automatically happen. A consequence of the repeated acting out of the impulses of craving and grasping is that these responses become reinforced and are even more tightly linked to perception and feeling.

Although the link between feeling and subsequent craving and grasping is habitual, it is not necessary. Mindfulness is proposed to lead to freedom from suffering by cutting this link. One way that mindfulness practice is understood to do so is by focusing awareness on the direct experience of feeling states. As this awareness is intentional, at least in the early phases of practice, it would involve System 2. For example, the meditator may direct attention to body sensations involved in breathing, walking, or sitting for extended periods of time. This sort of "bare attention" includes a nonjudgmental element, in that the sensations are to be observed in their most basic phenomenological form (including whether they are pleasant, unpleasant or neutral) rather than as states that are evaluated as good or bad and therefore things to be sought or avoided. Mindfulness practice also involves a concentration element in which awareness is aimed at either a specific object (e.g., the breath) or ongoing experience (sometimes called "choiceless awareness"). In both cases, instructions are to disengage attention from distractors whenever the mind has wandered.

Mindfulness of feeling states may lessen the likelihood of craving-related behaviors from "just happening" to the degree that that unconsciousness plays a role in their expression. However, the more central mechanism through which the feeling–craving link is broken consists of continued mindfulness of feeling states leading to the insight that they are short-lived. In contrast to intellectual insight, the insight derived from mindfulness practice is understood to be an experiential one that alters the way that stimuli are perceived. With extended practice, such changes in perception may become automatic, thus shifting the action of mindfulness to System 1. Further, such insight eliminates the imperative to do something about the feeling states; that is, the insight is that feeling states resolve themselves without having to do anything about them. As a consequence, the meaning of feeling states is changed in a qualitative manner. This qualitative change has been described as "…all of these changing phenomena as objects of our desire leave us feeling unfulfilled, while as objects of mindfulness they become the very vehicle of awakening" (Goldstein, 2002, p. 32).

As evidence for the benefits of mindfulness has grown, several reviews have examined the mechanisms of mindfulness from the perspective of psychological science (Brown, Ryan, & Creswell, 2007; Hölzel et al., 2011; Lutz, Slagter, Dunne, & Davidson, 2008; Shapiro, Carlson, Astin, & Freedman, 2006; Vago & Silbersweig, 2012). In one recent paper, important mechanisms were proposed to include (1) *what* the mind processes and (2) *how* the mind processes this information (Teasdale & Chaskalson, 2011). These mechanisms of mindfulness may improve self-control outcomes through effects in both System 1 and 2.

Mindfulness Mechanism 1: Executive (Attentional) Control Lessens Problematic Content

As mentioned, mindfulness practice often includes a concentration element (especially early on) and thus can be thought of as a function of System 2 processes. Repeated practice with focusing awareness should lead to an improved ability to resist distraction and sustain attention on intended objects (Lutz et al., 2008). Indeed, there is accumulating evidence that mindfulness training produces this benefit (Jha, Krompinger,

& Baime, 2007; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010). Attentional control should, in turn, facilitate self-regulation (Teasdale & Chaskalson, 2011). For example, each instance of directing one's attention to neutral objects (e.g., the sensations of breathing or walking) is also an instance during which one is not processing problematic stimuli (e.g., cues of food for a dieter). And, as already stated, less attention to problematic (e.g., tempting) stimuli means that automatically triggered associations to such stimuli are less likely to occur (Field & Cox, 2008). It should thus be easier to control one's behavior in the absence of these System 1 thoughts and urges.

The ability to control attention is important, but this mechanism is not unique to mindfulness. Other interventions have been shown to improve self-regulation by strengthening general attentional control abilities (Houben et al., 2011) and attentional control related to specific cues of temptation (Schoenmakers et al., 2010). The novel element of mindfulness is represented in its focus on changing the relation with mental content rather than changing the content itself (Hayes, 2004), as will be covered below.

Mindfulness Mechanism 2: Acceptance Breaks Maladaptive Frames

A second mechanism of mindfulness involves changing the way that the content of experience is processed (Teasdale & Chaskalson, 2011). This is done through an accepting attitude, one that can eventually change the framing of experience in a manner conducive to self-regulation. Similar to learning to drive a car or other types of skill acquisition, an accepting attitude may initially require volition (System 2) but then become automatized (System 1). Two processes through which acceptance may improve self-regulation include giving up a goal to regulate emotional states and the creation of experiential distance from temptation.

The relinquishment of an emotion regulation agenda. As a function of learning, we acquire frames and thus expertise in efficient goal pursuit. However, goals also produce frames that influence what we see and how we interpret what we see. A striking example can be found in the inattentional blindness study of Simons and Chabris (1999). Among participants who had the goal of counting the number of passes among a group of individuals playing catch, approximately 50 % did not perceive the unexpected event of a person in a gorilla suit walking through the middle of this scene. Similarly, research using virtual reality methods has shown that participants who are looking directly at an object in their hand are oblivious to changes of the object's size unless object size is relevant for their goal-directed action (i.e., where to place the object; Triesch, Ballard, Hayhoe, & Sullivan, 2003).

In addition to influencing what we see, goals alter our interpretation of perceived stimuli. For example, a group of small children playing on the sidewalk may elicit a smile if one is out for a Sunday stroll but a curse if they are blocking the quickest route to work when in a rush. That is, goal pursuit figures prominently in whether stimuli are perceived positively, negatively, or as irrelevant (Carver & Scheier, 1990; Frijda, 1988; Löw, Lang, Smith, & Bradley, 2008).

Given the importance of goals to what we feel, changing one's goal from "emotion regulation" to "acceptance" may represent an important route to changing experience and behavior. First, an accepting attitude may result in a stimulus no longer eliciting strong automatic affective responses (i.e., craving and grasping from the Buddhist perspective). As the goal to improve one's state weakens, stimuli may be less likely to be perceived as "something that can improve affect state," thereby losing their motivational imperative. Second, an accepting attitude may delink the relation between automatic affective responses and behavior. For example, an alcoholic drink (for a problem drinker) might still be seen as something that could improve one's affect state but relinquishing the idea that one needs to be as happy as possible means that the stimulus is less likely to be acted upon. Thus the impulse can be allowed to arise and fall on its own accord. In this context, Marlatt (1994) has described the utility of mindfulness as "urge surfing," a metaphor

that contrasts with one of getting swept away by an impulse.

Creation of a decentered perspective. Our normal mode of experience is often characterized by an immersed, first-person perspective (see Nigro & Neisser, 1983). This means that when experiencing temptation, the individual may be absorbed in mental content related to acquiring the tempting stimulus, such as the stimulus itself (e.g., thoughts about how good a cold beer would taste), behavior that would facilitate acquisition of the stimulus (e.g., walking to the fridge), etc. In this way, our perception of the world is overshadowed by our mental content. Such a state can be described as looking *from* our thoughts, much like we look at the world though eyeglasses (Hayes, Strosahl, & Wilson, 1999). Mindfulness helps individuals to disentangle themselves from their mental content by directing attention toward the phenomenology of the present-moment experience. For example, nonjudgmental observation would be directed toward physical sensations involved in an appetitive state, including their location in the body and their qualia (intensity, whether they are sharp, dull, throbbing, etc.). This observation includes noting the dynamic nature of experience, such as how the location and qualia of sensations change over time or how a stimulus-related thought emerges, lingers for a period of time, and then fades. This type of attention in which experience is treated as an object of awareness has been variously described as *decentering* (Teasdale et al., 2002), *re-perceiving* (Shapiro et al., 2006), or *cognitive defusion* (Hayes et al., 1999). The experiential distance involved in decentering represents a shift from identification with (and immersion in) mental content (e.g., believing that one needs to eat a dessert or consume alcohol) to dis-identification, in which the content is experienced as "passing thoughts and feelings that may or may not have some truth in them" (Teasdale et al., 2002, p. 276).

A potential consequence of a decentered perspective is that the relation between automatic appetitive responses and behavior is weakened. For example, with mindfulness practice, the idea that "I need that chocolate cake" (alcohol, etc.) may shift from an immersed perspective in which it is experienced as *a reality that must be made manifest* to a decentered perspective in which it is experienced as *another element of mental content that comes and goes on its own accord*. This shift should subsequently make it less important to act on the impulse. In addition, continued mindfulness practice may result in a decentered *observation* of appetitive mental content replacing *consummatory behavior* as the habitual response to temptation (Breslin, Zack, & McMain, 2002).

Mindfulness and Overcoming Automatic Processes: Evidence

As the discussion in the previous section suggests, there are a number of paths through which mindfulness may allow the individual to rise above the influence of System 1 habit. Recent research supports the idea that mindfulness can indeed help to overcome habit.

Mindfulness and Creativity

The solution to many of life's problems depends upon the prior learning of logical steps designed to reach a goal state (e.g., solving an algebra problem, building a house). However, the automatic cognitive and behavioral reactions (System 1) derived from such learning can impede the solving of problems that require a nonhabitual response (Gilhooly & Murphy, 2005; Knoblich, Ohlsson, Haider, & Rhenius, 1999; Luchins, 1942). Because mindfulness involves a "bare attention"—observing "everything as if it was occurring for the first time" (Gunaratana, 2002, p. 134)—it may facilitate the novel responses required by creativity problems.

Several recent studies have demonstrated a beneficial effect of mindfulness on creativity in a variety of domains. For example, the Einstellung effect occurs when previous experience in solving similar types of problems triggers an initial idea of how to solve a current problem and this idea prevents the consideration of alternatives, even when they are more optimal (Luchins, 1942).

Mindfulness meditation training has been shown to reduce the Einstellung effect, both when comparing meditators and nonmeditators and following participation in an 8-week mindfulness course relative to a control group (Greenberg, Reiner, & Meiran, 2012).

Another index of creativity is divergent thinking, which is the ability to come up with novel ideas (e.g., listing novel uses of a common object; Guilford, 1950). Previous research has shown that compared to control conditions (such as 20 min of resting or completing general knowledge questions), mindfulness training led participants to generate more novel exemplars of categories (e.g., kitchen utensils) when asked to do so (Wenk-Sormaz, 2005). Using a within-subject design, a recent study similarly found that compared to a brief (35 min) focused-attention training (i.e., maintaining attention on parts of the body), a mindfulness intervention increased the ability to generate novel uses of common objects but did not influence performance on a measure of logical thinking (Colzato, Ozturk, & Hommel, 2012). Another recent study found that compared to a brief (20 min) relaxation period, practitioners who completed a meditation intervention demonstrated greater ability to generate higher-order categories that link groups of disparate stimuli (Strick, van Noorden, Ritskes, de Ruiter, & Dijksterhuis, 2012). Strick et al. further noted that the meditation group responded more quickly, which may suggest greater access to the correct answers generated by nonconscious processes.

A third measure of creativity is represented by insight problems. These are problems in which previous experience biases the representation of a problem so that it is difficult to solve. This difficulty results in an impasse, after which the problem may be restructured, allowing an insight into the solution (Knoblich et al., 1999). For example, the difficulty of solving the classic 9-dot problem may be partly due to habitual focus on dots rather than blank spaces as "places to pivot" (Kershaw & Ohlsson, 2001). A recent pair of studies found that (a) trait mindfulness predicts insight but not noninsight problem solving, (b) compared to a control condition, a brief (10 min) mindfulness intervention increased insight but not noninsight problem solving, and (c) such training effects were partly mediated by increased state mindfulness (Ostafin & Kassman, 2012). These results have been extended with the finding that mindfulness training outperforms a relaxation control condition in insight problem solving (Walsh & Greaney, 2014).

Mindfulness and Attentional Flexibility

A second category of studies has examined the relation between mindfulness training and the ability to overcome the extent to which salient stimuli capture attention. The rapid serial visual presentation (RSVP or "attentional blink") task represents one approach to assessing the extent to which stimuli capture attention (Raymond, Shapiro, & Arnell, 1992). The dual-target RSVP consists of presenting a rapid stream of stimuli with instructions to identify two targets (e.g., numbers) among a series of distractors (e.g., letters). Raymond et al. found that the second target is more difficult to identify when it is presented approximately < 500 ms after the first, indicating the time it takes to shift from automatic (System 1) to volitional (System 2) processing. Performance on the RSVP has been shown to improve in a group after an intensive 3-month meditation retreat (Slagter et al., 2007). The results further showed that a neural indicator of attention allocation (the P3b event-related potential) was reduced in the intensive meditation group and that this change was correlated with improved RSVP performance.

Other research has shown that target detection can be impaired when participants are instructed to identify only a single target. For example, distractors that have negative emotional content have been shown to impair detection of targets that are presented <500 ms after the distractor (Most, Chun, Widders, & Zald, 2005). Brief mindfulness training has been shown to reduce the attentional capture of negative stimuli in the single-target RSVP paradigm (Ostafin, Verwoerd, & Wessel, 2014). Specifically, the results showed

that that distractors consisting of aversive pictures created less impairment in target detection for participants receiving two 10-min sessions of mindfulness training compared to a control condition.

Mindfulness and Automatic Responses

A third category of studies has examined the relation between mindfulness and the ability to overcome automatic (System 1) responses elicited by salient stimuli. A thought-provoking example consists of a case study that examined the startle reflex, an innate and involuntary response to sudden loud noises, in a practitioner with over 40 years of meditation practice (Levenson, Ekman, & Ricard, 2012). The results showed that indices of the startle response, including facial expression and physiological measures, were greatly reduced in the subject in a mindfulness meditation period compared to a distraction period.

Other research has shown that mindfulness training can help to overcome automatic responses that have developed through previous learning. For example, learning experiences can lead to automatic approach responses to appetitive food cues (Van Gucht, Vansteenwegen, Van, & Beckers, 2008). A recent series of three studies examined the influence of mindfulness training on approach-related processes of this type (Papies, Barsalou, & Custers, 2012). This research used a variant of the affective Simon task, in which participants are instructed to categorize stimuli based on a nonaffective feature (e.g., frame color) while ignoring stimulus affect (see De Houwer, Crombez, Baeyens, & Hermans, 2001). Previous research has shown that stimulus affect influences such approach-avoidance responses despite the irrelevance of this feature to the instructions (De Houwer et al., 2001). Papies et al. (2012) found that training participants to allow and observe thoughts and impulses related to attractive food reduced automatic food-approach responses.

The influence of learning on automatic responses has also been demonstrated in the color-word Stroop task (Stroop, 1935). The common finding in the Stroop task is that it takes longer to name the ink color of color words when these dimensions are incongruent rather than congruent. Because word reading has become automatic through practice, a smaller Stroop effect is consistent with the ability to overcome (versus get stuck in) the habitual response of reading (De Houwer, 2003a). It is therefore of interest that experienced meditators demonstrate less Stroop interference than nonmeditators (Moore & Malinowski, 2009). Similar findings have been shown with an intervention design. In this research, participants receiving three 20-min sessions of mindfulness training showed less Stroop interference compared to two different control conditions (Wenk-Sormaz, 2005). Although one subsequent study did not replicate these findings (Anderson, Lau, Segal, & Bishop, 2007), it included modified Stroop tasks, which prevent direct comparison to the standard Stroop task (Algom, Chajut, & Lev, 2004; De Houwer, 2003b).

Several studies have also shown that mindfulness moderates the relation between automatic affective responses and variables related to behavior or conscious thought. These studies have assessed automatic associations with the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). The IAT consists of categorizing stimuli from two target categories (the category of interest such as *alcohol* and a comparison category such as *water*) and two attribute categories (such as *positive* and *negative*) by pressing one of two response keys. The logic of the IAT is that the stronger the association between two categories (e.g., *alcohol* and *positive*), the faster they can be classified when paired with the same response key. That is, the irrelevant (affective) feature of a target (e.g., the positive valence of alcohol stimuli) may automatically activate affective responses, leading to faster response times when the irrelevant feature matches the extrinsic valence of the response key (De Houwer, 2003b). Evidence for the IAT as a measure of automatic processes includes the IAT placing low demand on executive control resources, as a cognitive load does not eliminate

IAT effects (Cunningham, Preacher, & Banaji, 2001), and the difficulty of controlling the IAT effect, as faking instructions have less success with the IAT compared to explicit (paper and pencil) measures (Steffens, 2004).

Mindfulness has been found to moderate relations between alcohol IATs and drinking-related outcomes in several studies. For example, the relation between automatic alcohol-approach associations and problem drinking behavior was shown to be considerably weaker at higher levels of trait mindfulness (Ostafin & Marlatt, 2008). Parallel findings have been shown with a mindfulness intervention (Ostafin, Bauer, & Myxter, 2012). Participants in this study completed an alcohol-approach IAT, three sessions of mindfulness training (versus a control condition), and then a follow-up session in which they reported their drinking over the previous week. The results showed that the baseline IAT predicted drinking at follow-up in the control condition, but not in the mindfulness condition. Furthermore, mindfulness has been shown to moderate the relation between an alcohol IAT and preoccupation with alcohol-related thoughts (Ostafin, Kassman, & Wessel, 2013). The results showed that the IAT predicted preoccupation with alcohol-related thoughts in participants with low but not high trait mindfulness. The study also found that trait mindfulness was related to executive control but that the moderating role of mindfulness still existed when controlling for individual differences in executive control. The latter results suggest that the role of mindfulness in decoupling impulse from behavior is not simply due to stronger inhibitory control.

Mindfulness training may help to decouple automatic affective responses from behavior in other domains. One recent study examined the influence of mindfulness on the relation between automatic race attitudes and race behavior (Ostafin & Friese, 2014). Participants in this study completed a race IAT to assess White-favoring (Black-disfavoring) attitudes, were randomly assigned to a 10-min mindfulness intervention or a control condition, and then completed a modified "cyberball" task (Williams, Cheung, & Choi, 2000). Participants were told that the ball-tossing task was web-based and that they would see the pictures of two other online players. One of the other "players" was depicted to be Black and the other to be White. Relative ball tosses to the two targets served as the dependent measure. The results showed that the IAT predicted a greater likelihood of tossing the ball to the White player in the control condition but not in the mindfulness condition. In sum, the alcohol and race behavior studies suggest that mindfulness may play a general role in freeing individuals from automatic responses.

Conclusions

Without the ability to determine relevance from irrelevance, humans could float in endless thought about behavioral options. Fortunately, past learning allows us to automatically know what to think and what to do in many situations. Unfortunately, the automaticity of our thoughts and behaviors means that they have a gravitational force that can be difficult to escape when the context requires a novel response. To illustrate, craving responses to food are essential to survival but become problematic for obese individuals trying to lose weight. Mindfulness meditation was developed to counteract habitual desire for the present to be different than it is (Rahula, 1959). The whole of the practice has been described as transforming such habitual desire that contributes to suffering to a more wholesome desire for well-being (Sucitto, 2010). Evidence for the ability of mindfulness to overcome habit is represented by the studies reviewed in this chapter showing mindfulness to influence automatic attentional and behavioral responses related to self-regulation outcome.

Although promising, the studies reviewed here represent a first step that should be furthered with research designed to examine several pressing questions. One question is whether mindfulness reduces the strength of automatic responses or reduces the relation between these responses and downstream phenomena such as overt behavior (or both). Evidence for the former includes results showing that mindfulness training reduces

automatic responses (Papies et al., 2012; Wenk-Sormaz, 2005) and attentional biases (Ostafin et al., 2014; Slagter et al., 2007). Evidence for the latter includes findings that mindfulness training weakens the relation between automatic affective responses and overt approach behavior (Ostafin et al., 2012; Ostafin & Friese, 2014), though it should be noted that neither of the latter studies assessed the influence of mindfulness training on the strength of automatic responses.

A second question concerns the mechanisms through which mindfulness influences automatic processes. Executive control is an attractive candidate given its role in moderating automatic appetitive processes in self-regulation (Barrett et al., 2004; Hofmann, Schmeichel, & Baddeley, 2012) and the increasing body of evidence showing that executive control can be strengthened by mindfulness training (Jha et al., 2007; Zeidan et al., 2010). The benefits of mindfulness may extend beyond executive control, however (Ostafin et al., 2013). A central focus in mindfulness training is to foster an accepting attitude, which may decrease the motivational imperative of impulses, create the insight that impulses do not last, or increase a decentered relation with impulses. These mechanisms can be viewed as involving a shift in frames from one in which relevance is represented as appetitive content to one in which relevance is represented as deconstructed phenomenology (qualia, wave-like dynamics, etc.). Finally, a benefit of continued nonjudgmental awareness may simply consist of the substitution of acting on an impulse with observing that impulse.

A third question regards the extent to which the effects of mindfulness can be shifted from System 2 to System 1. Initial practice will involve System 2 in that volitional control of attention is needed in order to maintain awareness on the selected object (e.g., sensations of the breath) and to apply an accepting attitude toward current experience. Continued practice should shift the effects of mindfulness to System 1, much like training automatizes cognitive and motor skills (Logan, 1988). This shift will benefit self-regulation attempts, as the executive control resources of System 2 are limited (Baumeister, Schmeichel, & Vohs, 2007). Future research would benefit by examining whether amount of practice increases the automaticity of mindfulness. For example, it would be of interest to examine whether executive control costs of mindfulness practice decrease as one develops expertise. It would also be of interest to examine whether the automatization process can be speeded up with strategies such as implementation intentions (Gollwitzer, 1999).

A final area for future research will be to examine whether the influence of mindfulness on automatic processes actually improves self-regulation outcomes. That is, are the beneficial effects of mindfulness training on dysregulated appetitive behavior (Bowen et al., 2009; Brewer et al., 2011; Kristeller, Wolever, & Sheets, 2014) and aversive emotion (Hofmann, Sawyer, Witt, & Oh, 2010) mediated by changes in automatic processes? Despite these and other questions that remain, the studies reviewed here provide evidence that mindfulness may indeed help to tame the elephantine habits of the mind.

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