From Distraction to Mindfulness: Psychological and Neural Mechanisms of Attention Strategies in Self-Regulation

10

Lotte F. van Dillen and Esther K. Papies

10.1 Introduction

> The basic law of the mind:
> *As you see—so you feel*
> *As you feel—so you think*
> *As you think—so you will*
> *As you will—so you act*
> K. Sri Dhammananda

As this quote suggests, stimuli that we perceive in our environment often have seemingly uncontrollable effects on our desires and behavior. This is especially true for affective and motivationally relevant stimuli, like a rich piece of chocolate cake, a pack of cigarettes, or the angry face of our spouse. However, as we will discuss in this chapter, insights from psychology and neuroscience, as well as from Buddhist teachings, show that these processes are not as difficult to prevent or overcome as they may seem, if we know how to regulate the focus and the quality of our attention.

The central aim of the current chapter, therefore, is to investigate attention strategies that may facilitate self-regulation. In this context, the term self-regulation refers to the ability to control one's affective responses and/or behavior in line with one's goals, and self-control refers to the more specific case of resisting an attractive short-term reward in order to ensure attainment of a longer-term goal. In the current analysis, we use the term affect in the broadest sense, encompassing all mental states that can have a positive or negative valence, and that can motivate approach or avoidance behavior. Affective responses play a central role in adaptive behavior, as they direct people's attention to possible threats and incentives in their environment (Bradley 2009). The unfolding of a behavioral response thus starts with the attentional capture of affective information (Gross and Thompson 2007).

The present analysis will focus on the attention strategies of distraction and mindfulness. By distraction, we mean shifting attention from the original object of attention onto a different focal object. Our current use of distraction does not involve *unintentional* attentional capture by a certain stimulus, and it does not involve mind wandering. Rather, distraction depends on the availability of a compelling substitute to occupy one's attention, in order to prevent attention being focused on unwanted content (Gerin et al. 2006). Mindfulness, on the other hand, implies regulating the focus as well as the quality of one's attention. This can imply paying attention to the focal object, but at the same time observing one's own reactions to the object and seeing them as mental events, instead of getting immersed in them as usual.

L. F. van Dillen (✉)
Department of Psychology, Leiden University, P.O. Box 9555, 2300RB Leiden, The Netherlands
e-mail: lottevandillen@gmail.com

E. K. Papies
Department of Psychology, Utrecht University, Postbus 80140, 3508TC Utrecht, The Netherlands
e-mail: e.k.papies@uu.nl

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In the following, we first discuss the basic concepts of attention. We will then continue by reviewing both behavioral and neuropsychological research on why affective responses are difficult to control, and suggest that this can at least partly be explained by the attentional priority of affective information. Next, we describe how affective responses may be regulated through the capture of attention by distracting information, and we will show that loading one's working memory resources with a distracter task can be an effective self-regulation strategy. Then, we will discuss theoretical underpinnings and empirical evidence on the application of mindfulness, which can change the quality as well as the regulation of attention. We will close this chapter by discussing the overlap, differences, and relations between various attention strategies, as well as implications for their application.

10.2 The Attentional Priority of Affective Information

Attention reflects the enhanced processing of some aspects of the environment while ignoring others (Johnston and Dark 1986). As such, attention is used to select the information that is most relevant for an individual's current goals from the constant stream of information that an individual is exposed to. Attention is commonly thought to be controlled by two mechanisms: bottom-up processes that are driven by salient information properties (i.e., stimulus-driven), and top-down processes in accord with people's ongoing plans and behaviors (i.e., goal-driven; Corbetta et al. 2008; Egeth and Yantis 1997; Pessoa and Ungerleider 2004).

Bottom-up attention filters select information on the basis of salient aspects that are likely to be important for adaptive behavior (Egeth and Yantis 1997), such as threat or reward, or other features with a strong biological relevance (Bradley et al. 2009). The nervous system responds to these particular aspects in a powerful and automatic manner, such that they are prioritized in further processing (Knudsen 2007). Top-down attentional control, on the other hand, is directed by the plans and actions people engage in, and may be crucial for flexible, goal-directed behavior (Corbetta et al. 2008). Top-down attentional control has the capacity to modulate or overwrite bottom-up attention filters and prioritizes information most relevant for the current task goal (Knudsen 2007; Pessoa and Ungerleider 2004). Accordingly, top-down attentional control may lie at the heart of effective self-regulation.

The human brain is designed in a way that affective information easily captures attention via bottom-up processes (Anderson and Phelps 2001; Berridge 2009; Bradley 2009). Research has demonstrated how processing of both threat and reward can occur quickly and unintentionally, and triggers responses across a broad array of sensory modalities (Berridge 2009; Bradley 2009; Nolen-Hoeksema et al. 1993). Self-regulation theorists have referred to this affective primacy as the core contributor to self-control failure (Mann and Ward 2004; Metcalfe and Mischel 1999). The "hot/cool model of willpower" (Metcalfe and Mischel 1999), for example, suggests that motivational "hot" cues about a desired object activate arousal, driving individuals to the immediate goal response, and that to override this tendency, informational "cool" cognitive cues about the stimulus are needed to direct attention to maladaptive aspects of the situation. As oftentimes, such "cool" reminders are not present, go unnoticed, or lack urgency, "hot" cues gain primary control over our behavior. For example, when exposed to an attractive piece of chocolate cake at one's favorite coffee house, this may trigger simulations of its creamy texture, the rich chocolate flavor, and the expectation of reward from eating it (Papies 2013) which may capture attention and inhibit thoughts about its calorie content and one's long-term health goals (Papies et al. 2008). Accordingly, self-control can be considered as a "battle" that arises due to conflicting representations that compete with each other to influence behavior, with the affective response, due to its attentional primacy, commonly having a notable advantage (Hofmann and Van Dillen 2012).

Affective information not only draws attention more easily through bottom-up processes, once it gains access to our working memory system, but it also facilitates attention via top-down processes to other affective information (Kavanagh et al., 2005), which may result in a vicious cycle of thinking that can prolong and intensify people's affective states (Kavanagh et al. 2005; Papies et al. 2008; Siemer 2005). For example, individuals, who tend to engage in negative ruminative thinking after an initial negative event, display exacerbated depressive symptoms over time, and are at a higher risk of developing new depressive episodes (Nolen-Hoeksema and Morrow 1993). Similarly, preferential attention for desirable targets enhances the motivation of attaining these targets (Gable and Harmon-Jones 2011), which in turn, has been found to relate to the intensity of cravings (Berridge 2009; Kavanagh et al. 2005), and, ultimately, self-control failures such as relapse (e.g., Field and Eastwood 2005; Franken 2003).

10.3 Distraction as a Tool for Self-Regulation

One explanation for the detrimental effects of affective processing on goal-directed human behavior is the idea that affective responses draw upon limited working memory resources (Kavanagh et al. 2005). More specifically, affect may increase the allocation of attention to affect-congruent information, at the cost of task-related information (Joormann and Siemer 2004). Thus, affect may "hijack" cognitive processing systems commonly engaged in top-down control. Paradoxically, the idea that affect occupies limited mental resources has also been the starting point for research on an effective self-regulation strategy, namely distraction.

Whenever people direct their attention away from a focal event, they engage in distraction. In a series of experiments, popularly known as "the marshmallow test," Mischel and colleagues demonstrated the phenomenon of using distraction for self-regulation in preschool children (Metcalfe and Mischel 1999; Mischel et al. 1989). In this paradigm, a young child can choose a desired treat immediately, such as a marshmallow, but can decide to wait until the experimenter returns in order to get two of the desired treats. Typically, in such experiments, attention to motivational stimuli drives children to choose the immediate reward (i.e., the affective primacy effect). However, children who were encouraged to think about pleasant, distracting thoughts (i.e., "if you want, while you're waiting, you can think about Mommy pushing you on a swing") were more capable of foregoing the immediate reward than children who had not been given this opportunity (Mischel et al. 1989).

Research has demonstrated the effectiveness of distraction by a wide range of activities, such as visualizing neutral scenes (Joormann and Siemer 2004; Rusting and Nolen-Hoeksema 1998), sorting cards (Morrow and Nolen-Hoeksema 1990), responding to colored lights (Christenfeld 1997), playing a game of Tetris (Holmes et al. 2009; Van Dillen et al. 2012), and filling out bogus questionnaires (Glynn et al. 2002). Apparently then, the effects of distraction are not restricted to a specific task type, but rely on more general aspects of attentional processing. Indeed, as we suggest in the present analysis, distraction may reduce bottom-up attention to affective information through the use of limited working memory resources for task-related top-down attentional control processes.

10.3.1 A Working Memory Account of Distraction

The basic assumption of our working memory account (Van Dillen and Koole 2007) is that task-related and affective information compete over working memory resources because working memory capacity is limited. When working memory demands of other activities are low, processing of affective information will by default receive priority due to bottom-up attentional selection, and may accordingly impact people's mental states and behavior. However, when a focal task requires more top-down control, for example, because of its high complexity, more working memory resources are needed to perform the task effectively, such that fewer resources will be available for affective processing (Knudsen 2007). Bottom-up attention to affective stimuli, and the subsequent processing thereof, thus may depend on the availability of working memory resources—even if these stimuli have previously been assumed to automatically capture attention regardless of the current state or mindset of the organism (Pratto and John 1991).

In an initial set of studies testing these hypotheses (Van Dillen and Koole 2009), people categorized the gender of angry and happy facial expressions, while they concurrently performed a more or less demanding focal task, such as solving simple or more complex math equations or rehearsing a one- versus eight-digit number. In this context, the emotional expression of the faces is irrelevant for performance on the gender-naming task. Accordingly, longer response latencies to angry than to happy faces index greater bottom-up attentional interference of negative information (reflecting a negativity bias, Pratto and John 1991). Participants indeed displayed such a negativity bias, but only when working memory load was low. When working memory load was high, participants responded as fast to angry as to happy faces. Moreover, picture negativity did not interfere with performance on the focal digit span task. In an extension of this work, we found that the N2 component and the late positive potential (LPP) complex of the event-related brain potential, an index of motivated attention that commonly displays greater amplitudes to negative as opposed to positive cues, and that emerges at around 250 ms following stimulus presentation, no longer differentiated between angry faces and happy faces under high load conditions and was generally attenuated (Van Dillen and Derks 2012).

In another recent extension of our working memory account to the domain of appetitive motivation (Van Dillen et al. 2013), we demonstrated that loading working memory by means of a digit span manipulation not only reduces the negativity bias but also the attentional bias to attractive compared to neutral stimuli. Specifically, only under conditions of no or low working memory load did participants display an attentional bias to motivationally relevant stimuli, such as attractive food and attractive faces of opposite-sex others. When participants were under high working memory load while processing these stimuli, the attentional bias disappeared. Together, these findings suggest that occupying working memory with a demanding task can reduce bottom-up attentional selection of both aversive and appetitive stimuli. This may have important implications for self-regulation, as we discuss shortly.

10.3.2 Distraction and Affective Responses

In the previous section, we discussed findings that demonstrated that bottom-up attention to affective information requires the use of limited working memory resources, which may underlie the effectiveness of distraction as a self-regulation strategy. If taxing working memory reduces prioritized attention to affective information, this may subsequently impact people's affective responses to this information and their evaluations of this information. Indeed, quite a number of findings now suggest this is the case.

In the first systematic exploration of these mechanisms, Erber and Tesser (1992) examined the effect of the amount of effort that participants invested in a distracter task. Here, participants viewed an emotionally arousing film clip after which they solved math equations for 10 min and then reported their moods. Participants displayed less negative moods in response to the film clip when they were told that effort at the distracter task was instrumental for performance rather than unrelated to performance, or when they solved complex rather than simple math equations. Erber and Tesser (1992) explained their findings in terms of a limited capacity model, arguing that: "…it may be that a task which requires the bulk of people's cognitive resources 'absorbs' moods by preventing further preoccupation with mood-related thoughts" (p. 342).

If affective responses require limited working memory resources, the intensity of the response may not only depend on the presence of a distracter task but also on the degree to which a task incorporates working memory resources. Provided that working memory capacity is a limited, but continuous variable, the involvement of working memory resources by a distracter task should have a gradual impact on people's negative feelings, such that a highly demanding task reduces the intensity of people's negative feelings to a greater degree than a moderately demanding task, whereas a moderately demanding task will still be more effective than a mildly demanding task.

In a set of three experiments (Van Dillen and Koole 2007), we systematically varied working memory load of a distracter task and examined its effect on self-reported negative affect. Participants viewed a series of neutral, mildly negative, or strongly negative pictures, followed by a more or less demanding task (or no task) and a feeling scale. Across the three experiments, variations in working memory load were indeed found to moderate the impact of viewing negative pictures on negative feelings (Van Dillen and Koole 2007). Participants reported less negative feelings after viewing negative pictures when they performed a complex task rather than no task, or a simple task. The moderating effect of performing a task on negative feelings was stronger when the task was unpredictable, than when it was predictable, and was stronger for intensely negative stimuli (which engage more working memory capacity; Siemer 2005) than mildly negative stimuli. In line with a working memory account, these experiments thus demonstrated how the intensity of participants' negative feelings was the result of a dynamic use of working memory resources by both task-related and affective processes.

In a neuroimaging experiment (Van Dillen et al. 2009), with a similar design as the just described series of studies on distraction (Van Dillen and Koole 2007), it was tested more directly whether working memory load modulated affective responses, or, perhaps, simply reduced the accessibility of affective information for conscious reflection. Working memory load again resulted in attenuated self-reported negative feelings. More importantly, working memory load was found to downregulate activity in brain systems engaged in affective processing. Performing a complex task compared to a simple task reduced responses to negative pictures in the bilateral amygdalae, and the right insula. Inversely, performing a complex rather than a simple task resulted in increased activity in regions implicated in cognitive processing, such as the right dorsolateral frontal cortex and superior parietal cortex. The decrease in activity in emotional brain regions was related to the increase in activity in working memory regions of the brain, suggesting that increases in task load actually "tuned down" the emotional brain.

Similar effects have been reported of working memory load on brain responses to painful stimuli (Bantick et al. 2002; Frankenstein et al. 2001). For example, pain intensity scores to thermal stimuli, as well as activity in areas of the pain matrix (i.e., thalamus, insula, the anterior cingulate cortex, ACC), are reduced significantly by high working memory load (Bantick et al. 2002). Novel evidence using spinal high-resolution neuroimaging suggests that the attenuating influence of high compared to low working memory load on pain may reach beyond the brain and moderate responses to incoming pain signals at the earliest stage of central pain processing (Sprenger et al. 2012). In a recent neuroimaging study involving the influence of working memory load on appetitive responses to high-calorie food pictures (Van Dillen and Van Steenbergen 2013), moreover, selective responses to attractive high-calorie foods in so-called hedonic brain regions such as the ventral striatum and the medial prefrontal cortex (Berridge 2009) turned out to be significantly reduced under high compared to low working memory load.

The neuropsychological evidence just described thus provides further evidence that working memory load reduces affective experiences by disrupting actual processing of affective information, and not, for example, by interfering only with the conscious reflection and elaboration on this information.

10.3.3 Distraction and the Regulation of Behavior

Although the regulation of attention and affective responses can be an important goal in itself, self-regulation is often targeted at the control of actual behavior. An important question thus is to what extent distraction can be a helpful tool to regulate (unwanted) behavior. In what follows, we describe research findings that suggest that taxing working memory resources can reduce the impact of affective and motivational cues on (social) judgments and on behavior.

In one study, Bushman et al. (2005) investigated the role of angry rumination in triggered displaced aggression, which is the displacement of anger (and the associated aggressive behavior) in response to an initial provocation to an unrelated mildly annoying event. Previous research has demonstrated that the intensity of angry feelings mediates the relationship between an initial provocation and displaced aggression (Pedersen et al. 2000). Bushman and colleagues, however, showed that any process that distracts processing resources away from an anger provocation effectively decreased triggered displaced aggression. In a similar vein, Van Dillen et al. (2012) showed that the impact of disgust on moral judgments depends on the availability of mental capacity. It has been widely demonstrated that feelings of disgust lead to harsher judgments of moral convictions (Wheatley & Haidt 2005). Van Dillen and colleagues showed that when participants played a game of Tetris (distraction condition) rather than reflecting on their feelings in response to a disgust film clip (rumination condition), they reported less disgust, and, accordingly, made milder judgments about the moral conviction.

Importantly, performing a demanding distracter task may not only affect unwanted affective influences in the interpersonal domain but also in the control of appetitive impulses. In a recent study (Van Dillen et al. 2013, Study 3), participants were exposed to tempting food cues in a categorization task, while they were simultaneously performing a highly demanding distracter task or not. Afterwards, they could choose an attractive unhealthy snack or a healthy snack as a reward from the experimenter. Participants who had been exposed to food temptations while performing the highly demanding distracter task were less likely to select an attractive but unhealthy snack over a less tasty but healthy snack, compared to control participants. This effect was especially pronounced among participants who were generally highly responsive to tasty food cues (i.e., who scored high on the Power of Food Scale, Lowe et al. 2009). These findings again show that high working memory load can prevent elaborations of pleasure and reward in response to attractive food stimuli, so that their impact on the subsequent motivation to actually indulge in them is reduced. Further corroborating this process, being exposed to attractive food pictures while holding a high, compared to a low working memory load, also curbed the development of cravings in response to such food cues. Again, an important mediator of the affect–behavior link seems to be how much working memory resources are available for further elaboration on an affective stimulus.

10.3.4 Distraction's Possible Limitations

As we have seen, distraction can be a powerful self-regulation strategy, as it disrupts the attentional selection and subsequent processing of affective information, and its influence on behavior (Van Dillen et al. 2013). Yet, distraction is unlikely to be the ultimate solution to all of people's self-regulation problems. Indeed, when a strong desire has already been aroused, maintaining a high cognitive load sometimes makes it more difficult to resist temptation (e.g., chocolate cake) and pursue a long-term goal (e.g., dieting; Ward and Mann 2000)—possibly because cognitive load interferes with (top-down) self-control efforts, rather than with the (bottom-up) affective responses that lead to temptation. Working memory load may thus have opposing effects on self-regulation depending on the timing of the distracter task.

Little is known, moreover, about the long-term effects of distraction, with some research suggesting memory costs for the to-be regulated material, due to reduced reprocessing in working memory (Kron et al. 2010; Sheppes and Meiran 2008). Whereas this may have beneficial consequences in some instances (e.g., working memory load during the consolidation of emotional memories can reduce traumatic memory intrusions, Holmes et al. 2009), such memory costs may also preclude learning, and the integration of affective information in a broader context. As the source of affective responses thus remains unchanged, responses to more stable problematic situations may rebound once people cease to distract themselves (but see Bonanno et al. 1995). It is therefore important to consider other forms of attention regulation that allow people to deal in more comprehensive ways with their affective responses.

10.4 Beyond Distraction: Mindfulness

One alternative strategy of regulating attention that has gained increased popularity recently is mindfulness. This approach is based on insights and practices that Buddhist practitioners have developed over thousands of years during meditation and systematic study of the human mind. These insights are increasingly recognized and integrated in Western science, and studied in psychology, neuroscience, and the emerging domain of contemplative science.

The Western term mindfulness is most often used to refer to an open and nonjudgmental form of awareness that is centered on present-moment experiences, including one's thoughts, emotions, and sensations[1] (Kabat-Zinn 2003). A useful operational definition has been offered by Bishop and colleagues (2004). This specifies two components of mindfulness, namely attention regulation, with increased top-down control of attention, and the quality of one's attention, which we refer to as the perspective of *mindful attention*. While both of these components are typically practiced in mindfulness training (such as mindfulness-based stress reduction, Kabat-Zinn 1994), they may have separable effects on attentional processes. We now discuss each of these components and their application to self-regulation.

10.4.1 Training Attention Regulation Through Meditation

Attention regulation refers to top-down control of one's attention such as to maintain it on a chosen object, despite distractions. This can be trained by meditation practice, which is a crucial part of mindfulness training. Here, the practitioner typically focuses attention continuously on a chosen stimulus, such as the breath or a visual object, and returns attention to the focal object once it has inadvertently shifted away. With regular practice, attention becomes increasingly stable, which improves attention and executive control (Lutz et al. 2008). Mindfulness interventions with a focus on attention regulation have shown effects on variety of cognitive tasks that rely on working memory and executive control, reflecting increased control over attention (e.g., Jha et al. 2007; Mrazek et al. 2013; Slagter et al. 2007).

These cognitive benefits of the attention-training component of mindfulness are associated with functional and structural changes in several cortical regions supporting attentional processes. Sustaining attention during meditation has been shown to rely on attention networks involving, among others, the dorsolateral prefrontal cortex (DLPFC) for focused attention, and the anterior insula and dorsal ACC for detecting that one's mind has wandered from the chosen target (Hasenkamp et al. 2012). Using these attention networks for meditation becomes increasingly efficient with experience, such that less activation is required to maintain focused attention (Brefczynski-Lewis et al. 2007). This is also reflected in increased functional connectivity within attentional networks in experienced meditators (Hasenkamp and Barsalou 2012). Extensive meditation practice has been shown to

[1] For a discussion of the use of the term in Buddhhism, see Lutz, Dunne, & Davidson, 2007.

be associated with increased cortical thickness in regions associated with attention, interoception, and sensory processing, including the prefrontal cortex (PFC) and right anterior insula (Lazar et al. 2005). These effects reflect the focus of meditation practice, namely to keep focusing attention on one's breath and sensory experiences for an extended period of time (Lazar et al. 2005).

Thus, the attention training in mindfulness approaches makes it increasingly easy to disengage from distracting thoughts or stimuli and return to one's chosen object of attention. More generally, training attention regulation benefits self-regulation, because effective attentional deployment by increased top-down control over attention allows one to disengage from affective or tempting stimuli, helps to identify and shift attention to other cues, supports cognitive change strategies such as reappraisal or even distraction, and facilitates emotion regulation in other ways (Van Dillen et al. 2012; Wadlinger and Isaacowitz 2011). Indeed, various studies have shown that attention training in the context of mindfulness training benefits emotion regulation and facilitates dealing with stress, illness, anxiety, and other affective challenges (see Wadlinger and Isaacowitz 2011, for a review). Even a 15-min focused attention exercise has been shown to reduce affective responses to strongly valenced stimuli (Arch and Craske 2006). Supporting these psychological effects, neuroimaging findings suggest that mindfulness training increases gray matter density in regions involved in emotion regulation, such as the hippocampus, the posterior cingulate cortex (PCC), and the temporo-parietal junction (TPJ; Hölzel et al. 2011).

In mindfulness practice, people usually train attention regulation to be able to keep attention focused on the present moment, rather than engage in mind wandering or getting immersed in affective states. People typically spend a large amount of time daydreaming or mind wandering, but this mind wandering often makes us unhappy (Killingsworth and Gilbert 2010) and is associated with biological markers of stress (Epel et al. 2013; but see Baird et al. 2012, for how mind wandering can help problem solving). Mindfulness practice has been shown to reduce such mind wandering, including the excessive rumination about past events associated with depression (e.g., Mrazek et al. 2013; Teasdale et al. 2000). Thus, focusing attention on one's present-moment experiences appears to be an effective way to regulate one's overall affective state and well-being (see Brown et al. 2007).

The work on mindfulness discussed so far has suggested that attention training can facilitate self-regulation because it increases top-down control over attention. Research on mindfulness, however, suggests that focusing attention is particularly effective if it is accompanied by adopting a certain perspective on one's experiences, which we call mindful attention. Thus, we now describe the mindful attention perspective on one's experiences in more detail and discuss its implications for self-regulation.

10.4.2 Mindful Attention

Mindful attention refers to the metacognitive awareness that one's experiences are in essence mental events, and transient in nature (Papies et al. 2012). Mindful attention utilizes the uniquely human faculty of being able to observe one's own mental processes, and see their inherent character as mental events (Lutz et al. 2008; Papies et al. 2012; Teasdale 1999). In the mindfulness literature, this metacognitive awareness is also referred to as "decentering," and in self-report measures, this aspect of mindfulness is captured in subscales assessing the nonidentification or nonreactivity to one's experiences (e.g., Baer et al. 2006; Lau et al. 2006). While much empirical work has examined the effects of the attention-training component of mindfulness, the metacognitive awareness component of mindfulness has received little research attention. Therefore, and in order to examine the effects of mindful attention systematically, we recently developed a brief laboratory training procedure (Papies et al. 2012) in which participants learn to apply this perspective to their own experiences. This training allows us to examine the effects of mindful attention in controlled experiments.

In this mindful attention training, participants view a series of stimuli that potentially induce affective or motivational responses, such as pictures of positive and negative scenes, pictures of highly tempting and neutral food objects, or pictures of attractive and less attractive opposite-sex others. While viewing these pictures, participants are instructed to simply observe their reactions to them, and to consider the transitory nature of these reactions as passing mental events, which arise and disappear. Thus, participants are asked to simply observe all of their responses, without avoiding or suppressing them, and to view them as passing mental events.

We assume that typically, when participants view objects and scenes in such pictures, they spontaneously simulate how they would interact with them and what the resulting experiences would be (Barsalou 2009; Papies and Barsalou 2014). When seeing pictures of attractive food items, for example, participants simulate eating and enjoying the food, which is reflected in them representing such food in terms of its taste, texture, and hedonic qualities (Papies 2013), as well as in activations in primary gustatory and reward areas in the brain (Simmons et al. 2005). As discussed above, to the degree that enough cognitive resources are available, these simulations can unfold into full-blown experiences of craving and desire (see Van Dillen et al. 2013), and increase the motivation to obtain the presented stimuli. However, when applying mindful attention, participants actively consider these thoughts and reward expectations, they learn to see how these mental events are triggered by the pictures they are viewing, and they can observe them arise and disappear. As a result of applying this perspective, participants should be less likely to get immersed in vivid simulations of pleasure and reward, and the motivation toward the presented stimuli might be reduced.

The results of a number of experiments indeed confirm these hypotheses. Applying mindful attention to pictures of attractive food eliminated approach impulses toward these stimuli in a reaction-time-based approach-avoidance task (Papies et al. 2012), and reduced choices for attractive, high-calorie food over neutral, healthy food in both a laboratory and a field setting (Papies et al. 2014). In addition, cravings for food were reduced among mindful attention compared to control participants (Papies et al. 2014). Similarly, applying mindful attention to pictures of opposite-sex other reduced the temptation of these stimuli for participants who had a strong motivation for casual sex (i.e., an unrestricted socio-sexual orientation, Simpson and Gangestad 1991). A recent neuroimaging study on this topic showed that mindful attention reduces experienced cravings among cigarette smokers, as well as craving-related neural activity in response to cigarette pictures, particularly in a region of the ACC (the subgenual ACC). Moreover, changes in the connectivity between brain areas implicated in the experience of craving, such as the sgACC and the ventral striatum, suggested that mindful attention may decouple craving neurocircuitry, without active downregulation by PFC regions (Westbrook et al. 2013). Accordingly, these findings suggest that mindful attention may reduce bottom-up attention directly, without the engagement of top-down control networks.

The above studies demonstrate that mindful attention can decrease the motivation for otherwise highly tempting stimuli. As one learns to see one's thoughts of pleasure and reward in response to attractive stimuli as mere mental events, these thoughts become less compelling, and they are less likely to lead to motivated behavior toward these stimuli. Mindful attention reveals that the reward from a stimulus comes merely from one's own thoughts about it, making the stimulus *itself* less attractive, without requiring active downregulation of its reward value.

Some similar findings have been reported from applications of mindfulness for dealing with negative affect. In particular, seeing one's depressed or even suicidal thoughts as mere mental events is crucial for the effectiveness of mindfulness-based approaches to reduce relapse in depression (see Williams 2008). In a recent neuroimaging study, moreover, patients with generalized anxiety disorder (GAD) who followed a mindfulness training showed changes in connectivity between amygdala and PFC regions (i.e., increased positive coupling) which correlated with the strength of symptom improvements (Hölzel et al. 2011). These changes are interpreted as an increased “decentering,” which allows one to observe one’s own experiences as mere mental events, as it is trained in mindful attention. However, more research is needed to systematically examine the application of the mindful attention perspective in this domain.

Together, these studies show that regulating the quality of one’s attention to change one’s relationship with one’s own thoughts and experiences can be an effective strategy to enhance self-regulation and well-being. This applies to reducing the affective and motivational impact of both positive and negative information. Importantly, this does not imply that reactions to affective information are simply attenuated. During painful stimulation, mindful attention has, for example, been observed to result in activations in the ACC, thalamus, and insula—regions associated with primary pain processing, whereas activity in evaluative regions, such as the amygdala and hippocampus, did decrease (Grant et al. 2011). Possibly, mindfulness increases sensitivity to primary affective reactions, which should facilitate adequate self-regulation as one can deal with these reactions before they gain momentum through additional rumination and elaboration (Teper et al. 2013).

10.4.3 Changing the Focus or the Quality of Attention

The attention strategies outlined here, that address the focus, the regulation, and the quality of one’s attention, differ in important ways. As discussed above, changing the focus of attention may contribute to self-regulation in the face of strong affective or motivational stimuli to the degree that it prevents the development of full-blown affective responses and cravings. This suggests that strong affective responses rely on the availability of cognitive resources, and that engaging these in a competing task can therefore promote self-regulation. However, applying distraction is not always possible, and in addition, may be less effective in acute self-control situations (i.e., Ward and Mann 2000). Moreover, the attenuating impact of working memory load on actual sensory experiences may result in compensatory behavior once people indulge in a temptation, for example, by consuming more salty or sugary foods to make up for weakened taste experiences (Van der Wal and Van Dillen 2013). In addition to distraction, changing the focus of attention can also be achieved by training attention regulation, for example, through meditation. However, the ability to do this spontaneously and effectively may develop only with substantial practice (Wadlinger and Isaacowitz 2011).

In contrast, the perspective of mindful attention reduces the intensity of full-blown motivational responses by revealing their nature as passing mental states. Indeed, mindful attention seems to be at its most effective when individuals aremost susceptible to the reward of the presented stimuli, for example, because they are hungry, or because they have a strong interest in casual sex (Papies et al. 2014). Possibly, when one’s desires are most vivid and intense, they are more easily observed, and more easily seen as mere mental events, which arise and eventually dissipate. Therefore, mindful attention might be most effective when temptation is strong. Briefly applying mindful attention to observe one’s experiences as mere mental events may thus also facilitate the application of distraction or other forms of regulating attention, as it may reduce the immersion in one’s initial affective responses (see Papies et al. 2014). However, when affect is too strong, distraction may be the best way to create the opportunity for the application of more effortful techniques. Future research should examine systematically the optimal conditions for the use of each strategy.

Both the attention training techniques of mindfulness and the systematic application of mindful attention to facilitate self-control outside the laboratory may require substantial practice. Once learned, these strategies may have pronounced long-term effects (Wadlinger and Isaacowitz 2011). However, the effort and time required to learn and enact them make them less effective for individuals who are not highly motivated to address their self-control problems. Thus, changing the focus and the quality of attention may both have advantages and disadvantages, suggesting that there is no one-size-fits-all solution for all self-regulation challenges.

Clearly, there may be other attention strategies that enhance self-regulation, and that share features with one or both of the approaches we described. For example, research suggests that taking a global (rather than a local) perspective on emotional information reduces attentional capture of this information (Gable and Harmon-Jones 2012). As with mindful attention, this strategy allows people to view things in a different perspective, while at the same time, attention is paid to other nonemotional information, which is also central to distraction and attention regulation training through meditation.

Another example of such an integrative approach is eye movement desensitization and reprocessing (EMDR) therapy (Lee and Cuijpers 2013). Here, participants are guided to retrieve a painful or otherwise intrusive memory, and while reliving their emotional peak experience, they are instructed to maintain their attention on alternating visual or auditory stimuli. With repeated treatment, the intensity of these memories is commonly strongly reduced. Accordingly, EMDR has proven an effective therapy for treating affective disorders ranging from emotional trauma to addiction (Lee and Cuijpers 2013). The effectiveness of this intervention may depend critically on the combination of both attention to one's affective reactions and distraction, which simultaneously allows the disruption of traumatic recollection in working memory and increased psychological distance from the trauma (Gunter and Bodner 2008). Thus, whereas the application of a specific strategy should be tailored to the context and to the individual's need, distraction, mindful attention, and other attention strategies such as EMDR may prove highly effective self-regulation tools in a variety of domains.

Conclusion

Integrating insights from psychology and neuroscience, in this chapter, we investigated attention strategies that may facilitate self-regulation, namely distraction, training attention regulation (through mindfulness meditation), and mindful attention. We presented evidence that these strategies affect both the focus and the quality of attention, and as a result, the impact of affective information on thoughts, feelings, and behavior. Whereas seemingly opposing in nature, we have found that both distraction and mindfulness can undermine intrusive thinking patterns in response to affective information that normally result in more impulsive behavior.

We have seen, moreover, that the effectiveness of these strategies is reflected not only in behavioral measures of self-regulation success but in neurophysiological indices as well, and how combining these behavioral and neuroscience measures can help to understand underlying mechanisms of attention strategies. For example, neuroscience studies of both distraction and mindfulness point to the involvement of prefrontal control regions along with brain regions engaged in processing of threat and reward, suggesting that these self-regulation strategies may affect (at least in part) the same neural network. These strategies may, however, engage this network in different ways, as distraction seems to involve the increased engagement of prefrontal brain regions for task-related processing, whereas training attention regulation may affect the connectivity between control and affective brain regions. Preliminary evidence, moreover, points to the possibility that specifically mindful attention affects the reactivity of affective and primary sensory regions, even in the absence of top-down prefrontal control. Examining these attention strategies further, especially their neuropsychological signatures and their long-term effects, may provide new insights in what makes them effective for particular self-regulation situations.

At any moment in time, humans can only keep a few things in their minds. Ironically, this fundamental limitation of human information processing may also have some beneficial consequences. Because processing both affective and non-affective information requires the use of limited attention resources, people can control affective processes via the allocation of attention. By either intentionally directing attention away from affective information or by mindfully observing one's own reactions to it, the impact of this information on subsequent thought and behavior can be regulated to facilitate long-term goal pursuit and well-being.

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