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HOW MINDFULNESS ENHANCES SELF-CONTROL

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Self-control features prominently in the everyday life of the modern human. Eating healthy, exercising consistently, completing chores, doing our jobs well, and remaining patient in trying circumstances are just a few examples of behaviours that self-control makes possible. A growing body of research suggests that mindfulness training and mindful personality traits are related to better self-control, both in and outside of the laboratory (see Karremans & Kappen, Chapter 8 in this volume; Mrazek et al., Chapter 10 in this volume; Papies, Chapter 7 in this volume). Here, we elaborate on the mechanics behind this relationship.

Converging evidence suggests that the present-moment awareness and non-judgemental acceptance intrinsic to mindfulness enhances one's sensitivity to the affective cues that direct self-control processes. Rapid and transient affect is produced when one is at risk of not meeting one's goals, and this affect serves as a signal that alerts the brain that the self-control is needed. As the cultivation of mindfulness promotes the employment of a non-judgemental attention towards primary affective and sensory experiences (e.g. Farb, Segal, & Anderson, 2013), mindfulness training enhances affect's ability to energize controlled processes in the service of goal-directed behaviour. In the following chapter, we discuss new findings that illuminate how affect guides self-control processes, and how the cultivation of mindfulness refines the relationship between affect and self-control.

Self-control and mindfulness training

We define self-control – referred to more colloquially as willpower and more formally as cognitive control – as the mental processes that allow one to override thoughts, emotions, or behaviours that differ with one's overarching goals. At its core, self-control is instigated when individuals experience conflicts between opposing desires, competing response tendencies, or anticipated and actual

outcomes. Controlled processes may be initiated, for example, when someone on a diet is offered a delicious but unhealthy piece of cake; or when a quitting smoker is handed a cigarette at a party; or even when a psychology study participant is tempted to *read* a colour word in a Stroop task, rather than correctly name the font colour. These situations consist of immediate desires or prepotent responses (e.g. eating the cake, smoking the cigarette, reading the word) that conflict with behaviours that are consistent with overarching goals (e.g. "eat healthy", "don't smoke", "name the font colour"). Effective self-control can be thought of as the successful inhibition and substitution of these automatic behaviours with more deliberate behaviours that are in line with one's long-standing goals (see also Barsalou, Chapter 3 in this volume).

This definition of self-control can be most closely related to the inhibitory component or aspect of what researchers call the *executive functions*. These executive functions are comprised of the "higher-level" cognitive mechanisms that the brain uses to control other "lower-level" processes, largely in the service of complex behaviour like planning, reasoning, problem-solving, and goal pursuit. In one prominent model, the primary executive functions include maintaining information in working memory, flexibly switching between task sets or rules, and – most germane to our definition of self-control – inhibiting or suppressing dominant responses (Miyake et al., 2000; Miyake & Friedman, 2012). Our discussion of self-control in this chapter will be most closely related to this third executive function: the inhibition of prepotent responses and desires. This definition allows us to distinguish it from similar constructs like self-regulation (Vohs & Baumeister, 2011), which more broadly refers to any regulatory behaviour motivated by abstract and self-related goals. Through the inhibition of prepotent and impulsive behaviour, however, we can classify self-control as being one of a number of ways that self-regulation may be accomplished (Fujita, 2011).

Importantly, mindfulness training has been associated with enhanced executive functioning. In the laboratory, for example, meditators show less interference from conflict and make fewer errors in the Stroop task than controls (Chan & Woollacott, 2007; Moore & Malinowski, 2009; Teper & Inzlicht, 2013; Van den Hurk et al., 2010; Wenk-Sormaz, 2005). Similar improvements have also been observed in the Attention Network Test (Fan et al., 2002), where meditators show an enhanced capacity for monitoring conflict (Jha, Krompinger, & Baim, 2007; Tang et al., 2007). In both of these tasks, individuals must override learned, natural response tendencies that conflict with their intentions. This kind of conflict parallels the self-control struggles that people face outside of the laboratory, where desires and cravings conflict with long-term goals. Accordingly, more hours of formal and informal meditative practice have been related to better outcomes in smoking cessation (e.g. Elwafi et al., 2013; Tang, Tang, & Posner, 2013) and alcohol use (e.g. Bowen et al., 2006), and preliminary evidence suggests that mindfulness meditation may be an effective treatment for substance abuse disorders (Chiesa & Serretti, 2014).

So, how then does mindfulness meditation bring about its fortuitous effects on self-control? The overarching goal of mindfulness is to attend to moment-to-moment

experiences with a non-judgemental and non-elaborative mindset. We propose that in cultivating greater attention and acceptance towards thoughts and feelings in the experiential field, mindfulness meditators are better prepared to acknowledge moment-to-moment affect that signals the need for self-control (Teper & Inzlicht, 2013). To explore this idea further, we must first understand the emotional underpinnings of self-control processes.

Emotion and emotional episodes

Historically, emotions have been cast as a principal antagonist of self-control and of cognition more broadly. From Stoic philosophy, to Cartesian dualism, to the Freudian psyche, and into modern theory (e.g. Metcalfe & Mischel, 1999), emotions have been variously described as opposing rationality, deliberation, contemplation, calculation, and virtuous decision-making. However, most contemporary theorists do not view cognition and emotion as opposable or mutually exclusive constructs at all. Indeed, many have suggested that they are fully integrated and only minimally decomposable (e.g. Frijda, 1988; Ochsner & Gross, 2005; Parrott & Schulkin, 1993; Pessoa, 2008). Naturally, while research in the past two decades has extensively outlined the cognitive and neural underpinnings of self-control (e.g. Botvinick, Braver, Barch, Carter, & Cohen, 2001; Carver & Scheier, 1998; Hofmann, Friese, & Strack, 2009), recent work has also characterized self-control as an emotional process that may be likened to an emotional episode (Inzlicht, Bartholow, & Hirsh, 2015; Saunders, Milyavskaya, & Inzlicht, 2015).

We can define an emotional episode as consisting of an antecedent event of some motivational significance – such as the appearance of a bear while hiking, or being kissed by a intimate partner – that produces a cascade of physiological, phenomenological, behavioural, and cognitive changes apropos of that antecedent event (Russell & Barrett, 1999). We are likely to undergo a complex series of changes across our physical and experiential systems upon, for example, smelling something rancid when opening the refrigerator after a vacation. Physiologically, we may observe variations in heart rate, skin conductance, and respiration (Stark, Walter, Schienle, & Vaitl, 2005); phenomenally, we may experience revulsion and a strong desire to avoid the smell; behaviourally, we may physically recoil and express disgust in our bodies and faces (Stark et al., 2005; Vrana, 1993); and cognitively, we may engage in processes like attribution and appraisal to determine the source to the smell ("the potato salad") and what to do next ("throw it out!"; Schachter & Singer, 1962; Gross, 1998; Russell, 2003). In this way, we can view emotional episodes as states that prepare individuals to act or respond to motivationally significant stimuli in the immediate environment, and facilitate goal-related action concerning those stimuli (Frijda, 1988).

In what way may one consider self-control an emotional process? We propose that *conflict* between goals and desires can be considered the antecedent event of an emotional episode, where rapid and transient negative affect is produced as a function of the context and magnitude of that conflict (Inzlicht, Bartholow, & Hirsh,

2015). This conflict-related negative affect serves to mobilize self-control processes by orienting individuals toward the source of the affect (i.e. the conflict), alerting them to the possibility that their goals are at risk of not being met, and motivating them to engage in behaviour that will reduce the negative affect. Thus, just as emotions arise as an adaptive response to motivationally significant events in general, this rapid and transient negative affect arises as an adaptive response to conflicts.

Control begins with conflict, and conflict produces negative affect

Evidence across multiple domains of scientific inquiry suggests that conflict-related negative affect is instrumental to self-control (Inzlicht et al., 2015). From social psychology to cognitive neuroscience, a diverse literature supports the idea that negative affect from conflict acts as a kind of signal or "alarm" that current behaviour is no longer sufficient for maintaining goal pursuit, and that changes and adjustments are necessary for goals to be met. Accordingly, the kinds of conflicts that can produce this negative affect are broad, and go beyond abstract goal conflicts: They can include conflicts between opposing impulses, between competing response tendencies, between incompatible mental representations, between expected and actual outcomes, and so forth. In all cases, conflicts that fail to produce enough of this negative affect reduce the chance that one will shift behaviour from routine and automatic to deliberate and controlled.

We can see this idea reflected in behavioural and pharmacological work done in humans and rodents, for example, where *revised reinforcement sensitivity theory* has described an instrumental role for negative affect in control. In this theory, conflicts between goals of the appetitive and avoidance motivational systems produce anxiety, which inhibits present behaviour and initiates a process of risk assessment to determine subsequent behaviour (Gray & McNaughton, 2000). If a smoker is trying to quit and is offered a cigarette, for example, their overarching avoidance-goal to quit smoking will conflict with their automatic approach-goal to smoke. This conflict produces anxiety, which facilitates the inhibition of prepotent behaviour (smoking cigarettes, in this case) as the brain assesses whether "smoking" or "not-smoking" is the most optimal course of action. In support of this theory, researchers have shown that septo-hippocampal lesions and anti-anxiety drugs – but not anti-fear ones – impair inhibition and conflict resolution in response to goal conflicts (Perkins et al., 2009; Perkins et al., 2013). In revised reinforcement sensitivity theory, conflict-related anxiety acts as both an inhibitor of current behaviour and an initiator of risk assessment, providing clear support for the notion that negative affect can be instrumental in self-control processes.

Research in cognitive neuroscience also points toward an integral role for anxiety and negative affect in self-control, where errors in task performance constitute their own kind of conflict. The consumption of alcohol, for example – which has potent anxiolytic properties (e.g. Donohue, Curtin, Patrick, & Lang, 2007; Levenson, Sher, Grossman, Newman, & Newlin, 1980; see also Lee,

Greely, & Oei, 1999) – has been shown to impair behavioural and neural measures of error-monitoring during self-control tasks (Bailey, Bartholow, Saults, & Lust, 2014; Bartholow, Henry, Lust, Saults, & Wood, 2012). In these studies, participants performed a self-control task following the administration of an alcoholic, placebo, or non-alcoholic beverage. They also provided reports of their emotional state and perceived accuracy in terms of task performance. The authors found that both subjective and physiological measures of negative emotion mediated the relationship between beverage consumption and behavioural adjustments after errors, such that consumers of alcohol reported less negative emotion and less post-error adjustment compared to consumers of other beverages. Critically, alcohol consumers were just as accurate at realizing when they had made errors as the other beverage consumer groups, suggesting that their reduced adjustments after errors could not be explained by impairments in attention or awareness (Easdon, Izenberg, Armilio, Yu, & Alain, 2005; Ridderinkhof et al., 2002; Yeung, Ralph, & Nieuwenhuis, 2007). It appeared that the negative emotions that arose from making a self-control error – and not simply the awareness of having made one – were important for being able to compensate after failures of self-control.

Reinforcement sensitivity theory and the effects of alcohol on error-monitoring comprise only a fraction of the literature that supports an instrumental role for negative affect in self-control. However, each of these areas of investigation illustrate a unique mechanism by which negative affect can facilitate controlled processing. In the case of reinforcement sensitivity theory, negative affect disrupts automatic or routine behaviour and draws attention toward goal conflicts. In the case of error-monitoring, the aversive quality of negative affect motivates individuals to adjust their behaviour. These unique mechanisms will be important to remember in the next sections of this chapter, where we will explore how two major facets of mindfulness – moment-to-moment awareness and non-judgemental acceptance – enhance self-control through conflict-related negative affect.

Awareness and acceptance of conflict-related affect

A central feature of mindfulness is a present-moment awareness of elements in the experiential field (Brown & Ryan, 2003; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008; Deikman, 1996; Roemar & Orsillo, 2003). During mindfulness meditation, practitioners actively deploy their attention towards primary visceral sensations, emerging thoughts, and affective feeling-states of the present moment. Whether focusing attention on the breath in many traditional forms of meditation (e.g. Hart, 2011), or focusing on ruminating thoughts in mindfulness-based therapy, or focusing on the whole viscera in the "body scans" of secular practice, mindfulness includes a directed, inquisitive, and open attention to interoceptive signals and internal experiences.

Importantly, this attention is also accompanied by a fundamental attitude of non-judgement, non-elaboration, and acceptance (Hayes, 1994; Kabat-Zinn, 1994; Marlatt & Kristeller, 1999; Roemer & Orsillo, 2003). When spontaneous thoughts,

emotions, or memories inevitably draw attention away from the present moment, practitioners are instructed to be open, equanimous, and non-reactive towards these experiences, allowing them to capture attention without extended elaboration, narrativization, or regulation. In effect, mindfulness cultivates an awareness and acceptance to momentary experiences without letting any one sequence of sensations, emotions, memories, or thoughts dominate the experiential field.

How do these two elements of mindfulness – *awareness* and *acceptance* – support the implementation of control? First, through repeatedly centring attention on internal sensations during meditation, individuals develop the capacity to become spontaneously aware of those sensations also outside of meditation, in their everyday lives and happenings. When this cultivated awareness draws conscious attention to the negative affect of goal conflicts, individuals have greater leverage in responding to that affect in a controlled manner (Barrett, Gross, Christensen, & Benvenuto, 2001). Second, through repeatedly considering moment-to-moment sensations with a mindset of curiosity and acceptance, physical and experiential magnitude increases, which affords a greater chance of evolving towards whatever functional ends that are adaptively served. In the case of self-control, a cultivated acceptance elevates negative affect's propensity to disrupt routine behaviour, draw attention to goal conflicts, and motivate behavioural adjustments. When awareness and acceptance are then combined, the individual's chance of detecting transient affect and responding to it in a goal-congruent manner becomes greatly improved.

Awareness

Many mindfulness practices involve a sustained attention to subtle interoceptive sensations, such as respiration, proprioception, affective "twinges", and so forth. If it is the case that mindfulness cultivates a superior awareness of internal sensations, then we might expect to see this refinement reflected in the brains, behaviour, and subjective experiences of those who cultivate it. Accordingly, a number of studies have described such an enhanced sensitivity among mindfulness practitioners, suggesting that they may also have a greater chance of detecting and identifying the negative affect intrinsic to goal conflicts.

For example, when their self-reports of tactile sensation during meditation are compared to objective measures of tactile sensitivity, expert meditators display better introspective accuracy compared to novices (Fox et al., 2012). Meditators may also perform better on interoceptive breathing tasks than controls (Daubenmier, Sze, Kerr, Kemeny, & Mehling, 2013; Levinson, Stoll, Kindy, Merry, & Davidson, 2014), although this work requires further validation (Davidson & Kaszniak, 2015). In a task where participants reported their emotional reactions to masked and unmasked pictures, long-term meditators with greater "emotional clarity" were more likely to accurately discriminate the valence of masked, unpleasant stimuli (Nielsen & Kaszniak, 2006) than non-meditators, or meditators with less emotional clarity.

These subjective and behavioural differences are also supported by neuroimaging studies. When asked to focus on the breath or bodily experiences, individuals

with mindfulness training have increased activation in neural regions associated with primary viscerosomatic sensation, like the insula, inferior parietal lobule, and somatosensory cortex (Farb et al., 2007; Farb et al., 2013). Similarly, when subjected to unpleasant electrical shocks, meditators show greater activation in regions related to the primary processing of pain, like the anterior cingulate cortex, thalamus, and insula (Gard et al., 2012; Grant, Courtemanche, & Rainville, 2011). In all of these studies, this increased activity was concurrent with decreases in areas related to rumination, evaluation, and self-referential processes, such as the medial prefrontal cortex, amygdala, and hippocampus. This suggests that mindfulness specifically fosters an interoceptive awareness of sensation that is not obfuscated by cognitive appraisals (Farb et al., 2015) or by high-order regulatory processes. Thus, we suspect that meditators and mindful individuals are uniquely predisposed to become aware of the sensory and affective cues that signal the need for self-control, in spite of the simultaneous presence of other sensations and thoughts in the experiential field.

Once individuals become aware of conflict-related affect, they may have a better chance of responding to it in a goal-congruent manner. Mindfulness is correlated with greater emotional awareness (Baer, Smith, & Allen, 2004) and differentiation (Hill & Updegraff, 2012), both of which are related to positive regulatory outcomes (e.g. Erbas, Ceulemans, Lee Pe, Koval, & Kuppens, 2014). When individuals become aware of emotions and can distinguish between them ("I feel *angry*"), they facilitate their adaptive regulation ("I need to *calm down*"; Barrett et al., 2001; see also Karremans & Kappen, Chapter 8 in this volume).

However, awareness of negative emotions does not always lead to adaptive outcomes. Panic disorder is associated with heightened interoceptive awareness (Ehlers & Breuer, 1992, 1996), for example, and attention to pain is related to emotional distress and psychosocial disability in patients with chronic pain (McCracken, 1997). It may be the case that interoceptive awareness can just as easily promote rumination and anxiety as it does goal-congruent regulation. Thus, we argue that awareness is best accompanied by another fundamental component of mindfulness in order to facilitate self-control: non-judgemental acceptance.

Acceptance

While enhanced awareness may bring negative affect into the forefront of consciousness and allow people to respond to it adaptively, a keen negative affect can mobilize control without conscious awareness. We propose that a non-reactive acceptance toward conflict-related negative affect can amplify its instrumental quality, in that "accepted" affect has an intensity and clarity that is more likely to disrupt routine behaviour, draw attention to conflict, and motivate compensatory control than affect that is not explicitly accepted. Whether through the attenuation of cognitive processes that might diminish it, or simply through increasing sensitivity to negative affect, acceptance nurtures the functional capacity of negative affect to recruit self-control.

This facilitative effect of acceptance is perhaps best illustrated in studies of error-monitoring, where participants' errors in self-control tasks are accompanied by an evoked brain potential called the *error-related negativity* (ERN; Gehring, Goss, Coles, Meyer, & Donchin, 1993). The ERN is thought to represent the activation of a neuroaffective system that monitors and adjusts for conflicts and errors, and its magnitude reflects both cognitive (Botvinick et al., 2001; Holroyd & Coles, 2002) and affective (Hajcak & Foti, 2008) features of making an error. Some theorists argue, for example, that the ERN at least partially represents a distress- or threat-related response to errors (Weinberg, Riesel, & Hajcak, 2012) that is experienced as aversive (Proudfit, Inzlicht, & Mennin, 2012). Interestingly, both dispositional and experimentally induced acceptance toward errors is associated with larger ERNs and improved self-control. In a recent study, meditators reported greater emotional acceptance, larger ERNs, and fewer Stroop errors compared to non-meditators (Teper & Inzlicht, 2013). Critically, acceptance was also positively correlated with ERN amplitudes, and it mediated the relationship between hours of meditation and Stroop error rate such that the greater emotional acceptance predicted better self-control. These findings are consistent with another study that explicitly manipulated acceptance and openness to threat, where participants who engaged in a self-affirmation exercise had larger ERNs and fewer errors in a self-control task than participants who engaged in a non-affirming exercise (Legault, Al-Khindi, & Inzlicht, 2012).

How can acceptance account for larger neural responses and improved performance on self-control tasks? Because mindfulness practices foster openness and non-judgement towards primary affective cues, meditators may experience the affective consequences of errors more keenly and purely, permitting negative affect to deploy self-control with greater efficiency. By being more accepting of the "pang" of negative affect at the moment of the error, one affords it a higher chance of disrupting routine behaviour, capturing attention, and motivating compensatory processes that prevent its future reoccurrence.

The complementarity of awareness and acceptance

We believe that, far from serving as merely independent and sequential contributors to self-control, both facets of mindfulness work jointly to enhance negative affect's instrumental relationship with self-control (Teper et al., 2013). Both awareness and acceptance seem to be involved in earlier and later stages of the affect-control relationship, and it may be that the order of their effects is contextual.

In one direction, interoceptive awareness is likely involved in the early detection and recognition of affective cues from goal conflicts, while a mindset of non-judgemental acceptance then allows such cues to unfold in the experiential field without cognitive intrusion. For example, if a person who wants to manage their anger at work is attuned to their internal experiences, they will be more likely to notice incipient affective cues (e.g. "pangs" of anxiety or guilt) indicating that their present behaviour is socially inappropriate. If that person is also accepting and open towards their primary affective experiences, then those affective cues will

have a higher likelihood of recruiting self-control without interference from other moment-to-moment thoughts or appraisals. In such a case, awareness enables the recognition of affective cues that may be subtle, while acceptance allows those cues to retain their instrumental quality against processes capable of diminishing it.

In the other direction, a cultivated acceptance and openness to primary experiences may strengthen and intensify the affective cues that accompany goal conflicts, affording them greater visibility among the assortment of sensations, emotions, and thoughts present in the experiential field. When this is combined with a cultivated interoceptive awareness, a person trying to control their anger may have greater leverage in spontaneously shifting their conscious attention towards the strong affective cues indicating the need for self-control. In this case, acceptance amplifies the affective cues from goal conflicts, while awareness increases the chance that those amplified cues will capture attention.

Our model does not specify which of these descriptions is more plausible; they are not mutually exclusive, so it is even possible that both are correct. Importantly, both views highlight the complementary relationship between awareness and acceptance, and imply that the cultivation of only one component is less likely to facilitate self-control.

Conclusions and future directions

In this chapter, we have sketched a basic model that outlines the facilitative effect of mindfulness on self-control. When we view self-control as a fundamentally emotional process, it follows that movers of emotion – like mindfulness – will influence it. Evidence suggests that the interoceptive awareness and non-judgemental acceptance fostered by mindfulness practice can moderate response to conflict-related affect, or moderate conflict-related affect itself. Importantly, our model goes beyond the conventional perspective that mindfulness improves behavioural outcomes primarily through attenuating maladaptive thought processes or negative emotions over time. On the contrary, we believe that it can also heighten our sensitivity to rapid and transient negative emotions, allowing them to mobilize self-control processes that realign our behaviour with our goals.

However, our model leaves a number of questions about mindfulness, affect, and self-control unanswered. For instance, does non-judgemental acceptance primarily function to enhance affective cues, or primarily function to protect those cues from cognitive obfuscations? Do the contributions of awareness and acceptance vary based on context or their degree of cultivation? How do awareness and acceptance relate to the positive and rewarding aspects of unhealthy stimuli that cause goal conflicts in the first place? Future studies may begin to answer these questions by investigating the temporal dynamics of acceptance and awareness during circumstances that require self-control. This could be ideally accomplished in longitudinal designs that combine clinical, physiological, and experience sampling methods.

Our theoretical approach may also prove fruitful for examining the therapeutic effects of awareness and acceptance on patients with characteristically poor

self-control. Is merely awareness or merely acceptance sufficient for the best therapeutic outcomes, or are both truly necessary for long-lasting change? Several studies that have investigated the effects of Acceptance Commitment Therapy on self-control–related disorders, such as alcohol abuse (Heffner, Eifert, Parker, Hernandez, & Sperry, 2003) and eating pathologies (Juarascio, Forman, & Herbert, 2010), suggest that at least in some cases, acceptance alone may be sufficient for self-control improvement. From a theoretic standpoint, however, practitioners have warned against cultivating either skill set in isolation. In psychotherapy, for instance, awareness without acceptance may leave the patient unequipped to deal appropriately with negative affect (see Cardaciotto et al., 2008). Cultivating acceptance without awareness, conversely, may foster a complacency of emotional discomfort (Siegel, Germer, & Olendzki, 2009). In sum, a more thorough exploration of the independent pathways from awareness and acceptance to self-control is needed in both the experimental and clinical sciences before moving forward.

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