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The Effects of Mindfulness-Based Intervention on Emotion-Related Impulsivity in Addictive Disorders

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Abstract

Purpose of Review Emotion-related impulsivity is a well-established risk factor for a multitude of addictive disorders. Mindfulness-based interventions (MBIs) target a number of interrelated processes involved in both impulsivity and addiction, suggesting that they may be especially well-suited to address this confluence. The aim of this paper was to review the effects of MBIs on emotion-driven impulsivity in addiction.

Recent Findings Mindfulness training has been shown to counter a number of neurocognitive mechanisms linked with addiction and emotion-driven impulsivity, including cognitive control, attention regulation, response inhibition, negative urgency, and positive urgency.

Summary Interventions that address emotion-driven impulsivity may offer substantial benefits across a wide range of addictive disorders. MBIs have emerged as a promising means for countering impulsivity in addiction. However, more research is needed to better understand how MBIs may impact emotion-related impulsivity and, in turn, how these changes impact addictive behaviors.

Keywords Automaticity · Cognitive control · Mindfulness · Reward · Substance use disorders

Introduction

Addiction is a pervasive issue that has a devastating impact on individuals, families, and communities across the United States (U.S) and worldwide. According to the most recent National Survey on Drug Use and Health, over 44 million Americans aged 12 or older struggle with a past-year substance use disorder (SUD) [1]. The opioid epidemic, in particular, has garnered significant attention due to its catastrophic effects, with over 92,000 deaths occurring in 2020 alone—a historical and unprecedented high [2]. To curb this rapidly accelerating public health epidemic, interventions are needed to address the causes and associated factors underlying addiction.

Chronic exposure to addictive substances leads to changes in stress and reward neurocircuitry that sensitize individuals to emotional distress and pain while blunting the pleasure derived from natural rewards. The resulting allostatic shift produces a hedonic deficit and a dearth of positive affect that motivates drug use as a means of preserving a dwindling sense of well-being. Paradoxically, such palliative coping exacerbates negative mood states while disrupting prefrontal brain regions implicated in emotion regulation and cognitive control, driving the loss of control over drug use that is characteristic of addiction [3••].

Recurrent substance use also drives changes in the mesocorticolimbic dopamine system that increase the motivational salience of cues associated with past drug use, which come to automatically capture attention and elicit a conditioned craving response [4]. Indeed, associations between drug-related attentional bias and craving have been found among individuals with alcohol, tobacco, opioid, and other SUDs [5–7]. Moreover, stress and negative affect facilitate attentional processing of drug-related cues, biasing behavioral responses towards overlearned habitual responses for

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drug seeking and consumption [5, 8]. As such, controlled, volitional drug use may eventually become an automatic behavior, executed impulsively despite aversive consequences or the conscious intention to remain abstinent.

Impulsivity and Addiction

Impulsivity has been identified as a key risk factor for addiction, substance use, and substance misuse—a term that, in this article, refers to the use of a substance in ways that are problematic for health or social functioning [9]. Broadly defined as a person's propensity toward rapid, unplanned, or reward-driven action without appropriate consideration of consequences, impulsivity is widely understood to be a multidimensional construct involving personality traits and behavioral states [10]. Impulsive states are thought to vary across time, manifesting as maladaptive behaviors executed in an unplanned manner without consideration of consequences. Such behaviors are most often assessed via experimental paradigms such as delay discounting, which indexes the impulsive choice of smaller, immediate rewards over those that are larger yet delayed [11]. By contrast, impulsive traits are considered to be relatively stable characteristics typically measured using self-report surveys [12].

One of the most widely used measures for assessing trait impulsivity is the Urgency/Premeditation/Perseverance/Sensation Seeking/Positive Urgency Impulsive Behavior Scale (UPPS-P) [13]. The UPPS-P identifies five interrelated traits thought to contribute to impulsive behavior: lack of premeditation (the tendency to act without thinking), lack of perseveration (difficulty maintaining focus on a task one finds boring or difficult), sensation seeking (a tendency to pursue novel and exciting experiences), negative urgency (the tendency to act impulsively in the face of negative states), and positive urgency (the tendency to act impulsively in the face of positive affective states, e.g., when appetitive motivations/cravings are activated).

While impulsivity is robustly associated with SUDs generally [14], evidence suggests that the UPPS-P emotion-related impulsive traits of positive and negative urgency play a unique and clinically significant role in a wide range of addictive behaviors [15••]. Meta-analytic research has found that of the UPPS-P traits, positive and negative urgency have the strongest relationships to problematic alcohol consumption [16] and are robustly associated with marijuana [17], nicotine [18], and substance use generally [19]. Moreover, emotion-related impulsivity may be a key mechanism contributing to the transition from occasional, controlled substance use to the loss of behavioral control over substance seeking and use that is characteristic of addiction.

Neuroadaptations engendered by chronic exposure to addictive substances are closely related to those proposed to underlie emotion-driven impulsivity [20]. For example, both addiction and negative urgency involve dysfunctions in prefrontal cognitive control regions, i.e., inferior frontal gyrus (iFG) and anterior cingulate cortex (ACC) [21]. Such impairments may reduce top-down modulation over bottom-up affective responses to emotionally salient stimuli; and indeed, urgency has been linked to increased activation in limbic regions associated with emotional reactivity [22]. As addiction progresses, diminished executive functioning may reduce inhibitory control over attentional bias to substance-related cues in the natural environment, manifesting as heightened cue reactivity and craving—phenomena that are positively linked to negative and positive urgency [23, 24].

Growing recognition of the centrality of emotion-related impulsivity in addiction has energized efforts to understand its effects on SUD treatment outcomes. For example, one meta-analysis concluded that negative urgency is minimally impacted by existing SUD treatments and associated with poorer SUD treatment outcomes [25]. These findings suggest that many existing SUD interventions may not be targeting key mechanisms of change and that individuals with higher levels of emotion-related impulsivity may not benefit from these interventions to the same extent as their less-impulsive counterparts, underscoring the critical importance of novel treatment approaches that can target impulsivity in addiction.

Mindfulness-Based Interventions

The concept of mindfulness is rooted in 2500-year-old contemplative traditions that have gained significant attention in clinical research and practice in the last 30 years. In its contemporary context, mindfulness (like impulsivity) is conceptualized as a transient *state* and a dispositional *trait*. The *state of mindfulness* involves meta-awareness and acceptance of present-moment thoughts, emotions, and sensations without reactivity. This state is cultivated through mindfulness *practices* such as focused attention (e.g., focal and sustained attention on the sensations of the breath) and open monitoring (i.e., cultivating an ambient form of attention to both the contents of consciousness as well as the field in which those contents arise) meditation techniques. These meditation practices engage various neurocognitive processes crucial to the regulation of impulsive behaviors that underlie addiction, including self-awareness, inhibitory control, attention regulation, and emotion regulation [26–28].

Over time, repeatedly engaging in the state of mindfulness through mindfulness practice has been shown to enhance the dispositional propensity to exhibit mindful qualities in daily life (i.e., *trait mindfulness*) [29], providing a potentially critical buffer against the automated, habitual processes that drive addiction behaviors. By enhancing cognitive control and self-regulation, trait mindfulness may provide an effective strategy for combating impulsivity in addictive behaviors. A continuously expanding body of research supports this contention, demonstrating negative associations between trait mindfulness and emotion-related impulsivity [30], addiction attentional bias [31, 32], autonomic indices of drug cue-reactivity [33], substance craving [34], and substance use [35].

Mindfulness-based interventions (MBIs) provide training in mindfulness meditation practices designed to cultivate trait mindfulness by inducing the state of mindfulness. The two most prominent and empirically supported MBIs utilized in treating addiction, Mindfulness-Based Relapse Prevention (MBRP) [36••] and Mindfulness-Oriented Recovery Enhancement (MORE) [37], involve specific mindfulness techniques tailored to target pathogenic mechanisms implicated in impulsivity and addiction.

Therapeutic Mechanisms of Mindfulness as a Treatment for Impulsivity in Addiction

A growing body of early-stage randomized controlled trials (RCT) demonstrate the therapeutic effects of MBIs across a diverse array of addictive disorders including alcohol [38], stimulants [39], opioids [40], tobacco [41], and internet gaming disorder [42], among others. Moreover, several full-scale, high-impact clinical trials ($N \geq 250$) published in *JAMA Psychiatry* and *JAMA Internal Medicine* have shown long-term therapeutic effects of MBIs for substance use and misuse [43, 44••]. These findings have been further supported by meta-analytic evidence indicating that MBIs are associated with improvements in addiction-related outcomes, including substance craving, use, and misuse [45–47].

Given the accumulation of evidence supporting the efficacy of MBIs for SUDs, researchers have increasingly sought to clarify the mechanisms by which these interventions improve addiction-related outcomes. Increasingly, this research suggests that mindfulness training targets a number of interrelated cognitive, affective, and psychophysiological processes implicated in emotion-driven impulsivity and addiction [48, 49]. Although few studies have examined the effect of MBIs on explicit measures of impulsivity in people with SUDs, several studies have investigated the effects of MBI effects on neurocognitive mechanisms linked with emotion-driven impulsivity, including cognitive control, attention regulation, response inhibition, negative urgency, and positive urgency. Here, we review what is known in that regard.

Cognitive Control

Individuals with SUDs show impaired performance in tasks involving cognitive control, such as attention regulation and response inhibition [50, 51]. Such changes are mediated by deficient activity in the dorsolateral, medial, orbitofrontal, and anterior cingulate cortices (ACC), as well as the hippocampus [52]. Garland, Froeliger, and Howard's neurocognitive framework of mindfulness-centered regulation posits that MBIs may strengthen the capacity for top-down cognitive control instantiated in prefrontal brain networks that become dysregulated during the process of addiction, enhancing self-control over impulsive behaviors subserving addiction [48]. By enhancing executive functioning, MBIs may provide a bulwark against impulsivity in addiction while more effectively engaging highly impulsive individuals in treatment.

In novice practitioners of MBIs, effortful top-down control is required to learn and train, which is supported by the prefrontal and anterior cingulate cortex (PFC and ACC). As mindfulness becomes a more automated practice, this activation is theorized to shift to the posterior cingulate cortex (PCC) and striatum/insula [53••]. Increased frontal midline theta (FMT) activity, an established biomarker of cognitive control [54], has been observed in several studies of MBIs versus active control conditions [36, 55•, 56]. Tang et al. linked this increase in FMT with heightened ACC activation and parasympathetic responses [56], suggesting that heightened cognitive control may mediate enhanced regulatory capacity during mindfulness training. More recently, Hudak et al. found that the effects of MORE on reducing opioid use through a 4-month follow-up were mediated by increased FMT during mindfulness meditation [55•]. This finding was later replicated in the largest neuroscientific study of mindfulness as a treatment for addiction conducted to date ($N = 165$), in which Garland et al. found that the effects of MORE on reducing opioid misuse through a 9-month follow-up were mediated by mindfulness-induced FMT [36]. Taken together, these findings suggest that enhancing executive functioning through mindfulness training may be an efficacious means of remediating top-down cognitive control deficits associated with emotion-related impulsivity.

Attention Regulation

Attentional bias is a common phenomenon that occurs in individuals struggling with addiction that is characterized by an involuntary and automatic focus on substance-related stimuli rendered motivationally salient through mesocorticolimbic sensitization [57]. This attentional fixation can activate automatized sequences of behavior, occasioning a conditioned craving response that compels drug seeking and use [5, 58].

Emotion-related impulsivity may reduce cognitive control over reactivity to substance-related stimuli in the natural environment—particularly during heightened mood states. Individuals with high impulsivity exhibit greater attentional bias towards drug-related cues [59] and cue-elicited craving responses [60, 61] than those with low impulsivity levels. Negative urgency, in particular, has been shown to play an important role in this process and is associated with neural responses to alcohol cues in the left caudate nucleus [62] and ventromedial prefrontal cortex [24]—brain regions involved in cue reactivity and relapse. Research has also found associations between negative urgency and alcohol cue-elicited craving following negative, but not neutral mood induction, suggesting that urgency may increase alcohol seeking and consumption by enhancing emotional reactivity [63].

According to the neurocognitive framework of mindfulness-centered regulation, mindfulness may counter addiction attentional bias by enhancing the ability to regulate attention when confronted with cues associated with past use, helping individuals disengage their focus from drug-related stimuli and redirect it towards neutral or health-promoting objects and events [48]. Generally, MBIs target attentional dysregulation via focused attention and open monitoring practices shown to promote adaptive regulation of attention [64].

In many MBIs, mindfulness meditation begins with the practice of focused attention to provide training in attentional control, during which dorsolateral PFC and other lateral PFC structures are recruited [65]. The attentional stability cultivated during focused attention may then be used for the more advanced practice of open monitoring. The ACC is a dominant driver of the monitoring processes and thus is likely to be strengthened [27]. Indeed, functional magnetic resonance imaging (fMRI) studies have found greater ACC activation in experienced mindfulness practitioners relative to novice practitioners [66]. Moreover, mindfulness training has shown the ability to improve attention and reduce stress reactivity via enhanced ACC activation during the Attention Network Task, a performance-based measure of attentional control [67•].

Among individuals with SUDs, research suggests that strengthening attentional control via mindfulness training may reduce bias towards cues that can promote addictive behaviors. For example, among individuals with alcohol use disorders (AUD), MORE is associated with significant alterations in alcohol attentional bias [68]. MORE has also been found to reduce attentional bias toward opioid cues [69] among chronic pain patients prescribed long-term opioid therapy (LTOT), a population at heightened risk for opioid misuse and use disorder (OUD). The effects of other MBIs on addiction attentional bias have not yet been examined.

Response Inhibition

From a neuropsychological perspective, impulsivity may stem from diminished inhibitory control over cognitive processes crucial for exerting inhibitory control over substance use [15••, 70]. One cognitive process theorized to contribute toward impulsivity is *impulsive action*, defined as a tendency towards immediate action without foresight or sufficient regard for current situational demands [71]. During states of heightened emotion, difficulty exerting cognitive control over addictive behaviors may indicate a lack of response inhibition, an aspect of impulsive action characterized by the ability to deliberately suppress a prepotent or automatic response [72]. Response inhibition is a well-established risk factor for addictive behaviors that has been shown to be negatively impacted by exposure to emotionally salient stimuli [73•]. Moreover, prior studies have found that higher levels of emotion-driven impulsivity are associated with reduced performance on behavioral paradigms assessing response inhibition, such as the Go/No-Go and antisaccade tasks [74], particularly under conditions of heightened arousal [75].

Research suggests that response inhibition is an important mechanism targeted by MBIs. Prior studies have found an association between mindfulness training and decreased reaction time metrics [76] and neural indices of emotional interference [77] on an Affective Stroop task. More recently, participation in a brief MBI has been shown to enhance response inhibition indicated by neural markers of response inhibition during a Go/NoGo task among individuals with tobacco use disorder [78]. Among chronic opioid users, relative to an active control condition, MORE led to significantly greater improvements in accuracy on NoGo trials with negative emotional images relative to trials with neutral distractor during a Go/No Go task [79]. Collectively, these findings suggest that mindfulness may reduce negative emotional interference during response inhibition. However, more research is needed to understand how such improvements may correspond to subsequent reductions in substance use.

Negative Urgency

Dual-process models of emotion regulation suggest that proactive modulation of affective experiences arises from interactions between top-down cortical systems subserving executive function and bottom-up subcortical neural systems subserving emotional processes [80, 81]. When the balance between the two systems becomes dominated by bottom-up processes, emotional dysregulation may ensue [82], and indeed, individuals who suffer from addiction show hypoactivation in prefrontal circuitry. In the absence of proactive emotion regulation processes such as positive reappraisal, individuals suffering from addiction may be unable to effectively regulate negative affect stemming from stressful circumstances and more likely to engage in impulsive behaviors.

Evidence suggests that emotion regulation and negative urgency—an emotion-related impulsivity trait identified by the UPPS-P model [12]—are highly interrelated constructs [83, 84]. Both emotional dysregulation and negative urgency are associated with the onset and severity of substance use [85, 86], and research has shown that many individuals engage in substances as a means of coping with negative emotions and stress. For instance, OUD and opioid misuse are associated with impaired capacity to regulate negative emotions and exaggerated negative emotional reactivity that promotes cue-elicited drug craving [87]. By way of another example, alcohol-using adults with higher levels of negative urgency have higher blood alcohol levels and more alcohol seeking following negative mood induction than those with lower negative urgency [63]. Thus, improving emotional regulation and decreasing the tendency to engage in substance use under conditions of heightened stress represent fruitful targets for interventions aiming to reduce addictive behaviors among highly impulsive individuals.

Mindfulness may reduce negative urgency by enhancing adaptive responses to negative affective states. In that regard, MBIs have consistently been shown to enhance emotional regulation and reduce stress [88]. From a psychological perspective, the Mindfulness-to-Meaning Theory (MMT) posits that mindfulness promotes negative emotion regulation by enhancing interoceptive awareness of breath and body sensations and facilitating metacognition—processes that in turn promote adaptive reappraisals of stressful life circumstances [89]. By cultivating mindfulness, individuals can learn to become aware of and disengage from automatic responses to stress appraisals that otherwise would stimulate strong negative emotions. The metacognitive stance engendered during mindfulness is thought to broaden the scope of attention to encompass previously unattended information regarding the self and world from which adaptive reappraisals may be constructed. In turn, such positive reappraisals are believed to reduce negative emotional reactivity to stressful life events. The MMT has been supported by numerous empirical studies [89–92].

From a neurocognitive perspective, MBIs dampen negative emotions via top-down prefrontal cortical regulation of limbic networks associated with the processing and experiencing of emotions [27]. For example, among novice meditators, Mindfulness-Based Stress Reduction (MBSR) is associated with increased prefrontal cortical (PFC) and reduced amygdala activation during the practice of mindfulness and during rest [93]. Among people with social anxiety, MBSR enhances dorsolateral (dlPFC), dorsomedial (dmPFC), and ventrolateral PFC and ACC responses during reappraisal of negative emotional stimuli [94]. Increased activation of dlPFC and dmPFC in novice meditators has also been observed during processing of emotional imagery [95] and emotional Stroop tasks [76]. However, in advanced meditators, dlPFC activation decreases relative to novice meditators during emotional image viewing reduction—suggesting that meditative expertise reduces cognitive effort and facilitates automatic emotion regulation in the absence of top-down control [96].

With regard to substance use, specifically, among people who misuse opioids, multiple clinical trials have demonstrated that participation in MORE is associated with reductions in stress [40] and negative affect [44••] while enhancing positive reappraisal [40]. Moreover, a recent RCT found that increases in cognitive reappraisal mediated the effects of MORE on posttraumatic stress symptoms, which, in turn, mediated reduced opioid misuse following MORE [97].

Self-reported reductions in stress and negative affect among MBI participants have been corroborated by experimental paradigms and cue reactivity tasks examining measures of autonomic regulation (e.g., parasympathetically mediated heart rate variability), which have found that MORE and other MBIs improve stress reactivity and regulation among individuals who use a wide array of substances, including alcohol, opioids, and nicotine [38, 98–101]. These findings have been further strengthened by studies using stress biomarkers, which have found that MBI treatment is associated with reductions in hair and salivary cortisol [102, 103•].

Although research directly examining the effects of mindfulness on negative urgency is scant, one RCT compared MBRP for young adults receiving inpatient SUD treatment to treatment as usual. Participants in MBRP reported reductions in positive and negative urgency, which were the only UPPS-P impulsivity traits found to mediate the relationship between treatment and subsequent substance use [104••], supporting the importance of targeting emotion-related impulsivity in SUD programs.

Positive Urgency

Positive urgency is a more recently defined construct than negative urgency within the UPPS-P model [105]. Consequently, research regarding this emotion-related impulsivity trait is less developed than that of negative urgency. Nevertheless, poor control over emotionality appears to be a major risk factor in addictive behaviors, regardless of affective valence [16]. Moreover, past studies have shown that positive urgency is associated with greater substance use following positive mood induction, regardless of baseline mood state [106, 107], indicating the importance of targeting positive as well negative urgency in SUD treatment. For individuals who use substances in positive emotional contexts (e.g., socializing, parties, musical concerts), positive urgency may trigger addictive behaviors.

Moreover, positive urgency might be triggered by appetitive motivations (e.g., craving) elicited by drug cues, especially when competing non-drug reinforcers are devalued. That is, recurrent substance use can lead to changes in corticostriatal functions that amplify the salience of drug-related stimuli relative to natural reward cues, intensifying the urge to use drugs while concurrently reducing hedonic responses to salutogenic, non-drug rewards [108]. This shift from valuating natural rewards to valuing drug-related rewards may be a critical turning point that contributes to the inability to regulate drug consumption—a defining feature of addiction [3••, 109].

The *restructuring reward hypothesis* posits that mindfulness may reduce the overvalued salience of drug cues while increasing sensitivity to natural rewards, thereby lessening the impulsive pull of substance-related stimuli [110, 111]. Several studies have shown that mindfulness training increases the pleasure derived from natural rewards such as food [112, 113] and day-to-day activities [114]. Moreover, mounting evidence suggests that by increasing natural reward processing, MBIs may reduce craving and addictive behavior.

Unlike other MBIs, MORE provides training in mindful *savoring*, a practice that involves directing one's attention towards natural rewards (e.g., a beautiful natural landscape or the feeling of connection with a loved one) while cultivating metacognitive awareness of one's positive emotional responses to these experiences [37]. Savoring has been highlighted as a possible intervention for positive urgency [85], and research suggests that the synergy of mindfulness and savoring via MORE produces significant effects on reward processing and substance use.

Studies utilizing ecological momentary assessment (EMA) data have found that MORE increases moment-to moment positive affect throughout the course of treatment [115–117]. With these changes predicting subsequent decreases in opioid craving [116] and misuse [115]. Moreover, these EMA findings have been supported by a number of studies using psychophysiological measures. In several studies of people who misuse opioids, MORE has been shown to increase cardiac autonomic responses to natural reward stimuli that mediated the effect of MORE on decreasing opioid craving and misuse [100, 118]. Further, MORE has been shown to increase electrocortical responses (i.e., the late positive potential [LPP] of the EEG) during viewing and savoring of natural reward cues while dampening the LPP to opioid cues [119•, 120••, 121]. Although the underlying neural mechanisms of these effects remain unknown, in a pilot study of MORE for smoking cessation, MORE led to greater reductions in ventral striatal and medial PFC responses to cigarette cues than a time-matched comparison condition, while increasing responses in these same corticostriatal brain regions during savoring of natural rewards [122]. These neural changes were found to predict increases in positive affect and reductions in the tobacco use throughout the course of treatment, providing neurobiological support for the effects of MORE on restructuring reward responses. Collectively, these studies suggest that combined training in mindfulness and savoring may moderate the impact of positive urgency on substance use by altering the relative reward value of drug and non-drug rewards.

Future Directions and Conclusions

Over the past several decades, MBIs have emerged as an efficacious treatment for SUDs and behavioral addictions. During this time, a parallel body of research has provided evidence for the existence of linkages between SUDs and emotion-related impulsivity [14, 15••, 123], as well as the promise of MBIs in addressing emotion-related impulsivity among individuals with SUDs [104••]. However, to better understand the psychophysiological and neural mechanisms by which decreases in impulsivity may improve addiction-related outcomes, additional and more rigorous research is needed in several areas.

Progress in understanding the relationship between impulsivity and SUDs has been slowed by a lack of consensus regarding how to conceptualize and measure this multidimensional construct [124]. To date, emotion-driven impulsivity has most commonly been indexed via self-reported measures of trait impulsivity. However, many trait-based assessments of impulsivity demonstrate poor psychometric properties, compromising the ecological validity of study results. Moreover, laboratory behavioral measures (e.g., Go/No Go) often focus on a single aspect of impulsive behavior [125••]. To maximize the validity of inferences that may be drawn regarding impulsivity, SUDs, and mindfulness, researchers should assess impulsivity using a combination of psychometric instruments and behavioral tasks to disaggregate multidimensional measures of impulsivity and examine how these dimensions differentially impact addiction-related outcomes [12, 16].

Despite a large body of research establishing emotion-driven impulsivity as a risk factor for substance use, there is limited data on how such findings extend to clinical practice. Very few studies have specifically examined the effects of an MBI on emotion-related impulsivity among individuals with SUDs [104••]. As such, RCTs are clearly needed to examine the ways in which MBIs impact processes salient to emotion-driven impulsivity and how, in turn, these changes mediate the effects of MBIs on addiction.

It also remains to be seen whether the effects of MBIs on emotion-driven impulsivity and addiction may also be augmented by novel therapies that directly modify associated neural circuitry (e.g., pharmacotherapies, neurofeedback, or brain stimulation). For instance, neurofeedback interventions can target specific neural mechanisms involved in addiction and impulsivity and may represent a promising adjunct to extant MBIs. In that regard, we have begun to study MORE combined with prefrontal cortical neurofeedback to restructure reward processing and modulate positive urgency, with preliminary findings suggesting this work has significant promise.

Conclusion

These advances notwithstanding, emotion-related impulsivity represents a significant clinical risk factor for a wide range of addictive behaviors. Consequently, treatments that address this dimension of impulsivity may offer substantial benefits across a multitude of SUDs. By targeting neurocognitive processes crucial to the regulation of impulsive behaviors that underlie addiction, MBIs may ultimately provide an efficacious means of addressing emotion-related impulsivity contributing to addictive disorders.

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Declarations

Conflict of Interest Eric Garland, PhD, LCSW is the Director of the Center on Mindfulness and Integrative Health Intervention Development. The Center provides Mindfulness-Oriented Recovery Enhancement (MORE), mindfulness-based therapy, and cognitive behavioral therapy in the context of research trials for no cost to research participants; however, Dr. Garland has received honoraria and payment for delivering seminars, lectures, and teaching engagements (related to training clinicians in MORE and mindfulness) sponsored by institutions of higher education, government agencies, academic teaching hospitals, and medical centers. Dr. Garland also receives royalties from the sale of books related to MORE. Dr. Garland is also a consultant and licensor to BehaVR, LLC.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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