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SPOTLIGHT

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Mindfulness-based interventions for eating disorders: The potential to mobilize multiple associative-learning change mechanisms

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Abstract

Mindfulness is a two-component skill that includes *mindful awareness* (attentional monitoring of present moment experience) and *mindful acceptance* (adopting an attitude of acceptance toward this experience). Although mindfulness-based interventions (MBIs) are efficacious for many conditions, there is a lack of research on MBIs for eating disorders (EDs). We propose that MBIs may be promising for EDs given their potential to mobilize not one, but multiple *associative-learning change mechanisms* in EDs–defined as adaptive processes of change involving one of two forms of associative-learning: Pavlovian and operant learning. We hypothesize how MBIs–via increasing either mindful awareness or mindful acceptance–may mobilize up to eight associative-learning change mechanisms, two involving Pavlovian learning, and six involving operant learning. We also elaborate on similarities and differences between MBIs and CBT approaches for EDs, as well as opportunities for synergy. Finally, we present recommendations for future research related to the development and evaluation of novel MBI interventions for EDs and the testing of mechanisms and patient-treatment matching hypotheses.

KEYWORDS
associative-learning, eating disorders, mindfulness, mindfulness-based intervention, operant learning, Pavlovian learning

1 | INTRODUCTION

Mindfulness is a two-component skill including: (a) *mindful awareness*—attentional monitoring of present moment experience, and (b) *mindful acceptance*—adopting an attitude of acceptance toward this experience (Lindsay & Creswell, 2017). Many interventions incorporate mindfulness training—including mindfulness-based stress reduction (MBSR), mindfulness-based cognitive therapy (MBCT), mindfulness-based relapse prevention (MBRP), acceptance and commitment therapy (ACT), and dialectical behavior therapy (DBT)—and are in the family of mindfulness-based interventions (MBIs). MBIs are efficacious for numerous conditions, including affective disorders, addiction, and chronic pain (A-tjak et al., 2015; Goldberg et al., 2018; Panos, Jackson, Hasan, & Panos, 2014). However, MBIs have not been studied extensively for eating disorders (EDs)—binge-eating disorder being the one exception; see Turgon, Ruffault, Juneau, Blatier, & Shankland, 2019). EDs can become chronic-relapsing disorders and have high rates of psychiatric comorbidity (Bardone-Cone, Hunt, & Watson, 2018). The lack of research on MBIs for EDs is surprising given MBIs are efficacious for other chronic-relapsing conditions (Goldberg et al., 2018), and for subpopulations with psychiatric comorbidities (Roos, Bowen, & Witkiewitz, 2017). Although limited, research on MBIs for EDs shows promise. Randomized trials (see Linardon, Fairburn, Fitzsimmons-Craft, Wilfley, & Brennan, 2017) of

DBT and ACT show encouraging results among heterogenous ED samples. Furthermore, a meta-analysis shows that trait mindfulness has medium-size negative associations with ED pathology (Sala, Shankar Ram, Vanzhula, & Levinson, 2020).

We propose that MBIs are promising for EDs given their potential to mobilize multiple *associative-learning change mechanisms*—adaptive processes of change involving Pavlovian or operant learning (Murray et al., 2018; Schaumberg et al., 2020). First, we review the theorized role of Pavlovian and operant learning in EDs. Then, we hypothesize how MBIs—via enhancing mindful awareness or mindful acceptance—may mobilize up to eight associative-learning change mechanisms. We also elaborate on similarities/differences between MBIs and CBT for ED and opportunities for synergy. Finally, we provide recommendations for future research.

2 | ASSOCIATIVE LEARNING IN EDs

Pavlovian learning. Pavlovian learning/classical conditioning occurs when associations are formed between *once-neutral stimuli* and *naturally salient stimuli* (rewarding or aversive), resulting in the neutral stimuli eliciting an appetitive or threat-based response. Pavlovian learning may underlie EDs (Anderson, Berg, Brown, Menzel, & Reilly, 2021; Murray et al., 2018; Schaumberg et al., 2020; Zucker & Bulik, 2020). For example, associations between thinness/weight-loss and perceived/actual social praise about one's body may be formed, resulting in conditioned appetitive urges for more social praise when exposed to thinness/weight-loss cues. Associations between weight gain/overweight status and perceived/actual social rejection may be formed, resulting in conditioned fear responses to weight gain (Murray et al., 2018). Individuals with EDs may learn associations between foods and digestive discomfort, resulting in conditioned fear or disgust responses to and avoidance of food (Anderson et al., 2021; Zucker & Bulik, 2020). Finally, individuals may learn associations between food-related cues (e.g., fast-food restaurant) and the rewarding effects of binge eating, resulting in conditioned appetitive urges for food when exposed to cues.

Operant learning. Operant learning/instrumental conditioning occurs when associations are formed between *behaviors* and *consequences*, influencing the probability of these behaviors recurring. *Reinforcement* occurs when associations are learned between a behavior and desirable consequences—increases in rewarding experiences (positive reinforcement) or decreases in aversive experiences (negative reinforcement)—whereby the likelihood of the behavior recurring increases.

Operant learning may underlie EDs (Haynos, Lavender, Nelson, Crow, & Peterson, 2020; Schaumberg et al., 2020; Walsh, 2013). Research suggests that individuals with EDs engage in ED behaviors (e.g., excessive exercise, vomiting) to increase positive emotions (Selby et al., 2014, 2015) and decrease aversive cognitive, affective, and interoceptive experiences (Engel et al., 2013; Fitzsimmons-Craft, Ciao, & Accurso, 2016; Levinson et al., 2018; Levinson, Williams, & Christian, 2020; Sala, Brosof, & Levinson, 2019).

3 | THE POTENTIAL OF MBIs TO MOBILIZE MULTIPLE ASSOCIATIVE-LEARNING CHANGE MECHANISMS

Drawing upon research on mechanisms of MBIs (Barney, Murray, Manasse, Dochat, & Juarascio, 2019; Brewer, Elwafi, & Davis, 2014; Garland et al., 2010; Kristeller & Wolever, 2010; Levin, Luoma, & Haeger, 2015; Lindsay & Creswell, 2017; Ludwig, Brown, & Brewer, 2020; Shapiro, Carlson, Astin, & Freedman, 2006; Vanzhula & Levinson, 2020), we hypothesize how MBIs may mobilize multiple associative-learning change mechanisms in EDs.

Disrupting maladaptive Pavlovian learning. MBIs, primarily via increasing mindful acceptance of distressing experiences (e.g., fear, urges) elicited by cues, may reduce engagement in ED behaviors when exposed to cues. Not engaging in ED behaviors when exposed to cues can disrupt maladaptive Pavlovian conditioning via extinction, the reduction over time in a conditioned response to cues. For example (see Figure 1a), accepting difficult thoughts and emotions as they are may facilitate eating meals with others (rather than avoiding/escaping meals), which may reduce conditioned fear responses to meals. Or, when driving by a fast-food restaurant, accepting and not acting on urges to binge may subsequently reduce conditioned urges to binge when exposed to fast-food restaurants.

Facilitating adaptive Pavlovian cue-food reward associations. MBIs, primarily via increasing mindful awareness, may facilitate Pavlovian learning of associations between eating cues (e.g., presence of food) and food-related rewards that increase regular eating patterns (see Figure 1b). For example, focusing attention on sensory experiences (e.g., smell, taste, sight) when in the presence of food may facilitate associations among food, appetitive desire to eat, and rewarding eating experiences.

Disrupting maladaptive negative reinforcement of ED behaviors. MBIs, primarily via increasing mindful acceptance of distressing experiences (e.g., negative emotions, ED cognitions, physical discomfort), may reduce engagement in ED behaviors to alleviate distress, thereby disrupting negative reinforcement (see Figure 2a). There is preliminary evidence that MBIs may weaken or "decouple" the associations between distress and subsequent problematic behaviors (Levin et al., 2015). For example, practicing mindful acceptance may involve allowing thoughts and emotions to arise and letting them be, instead of vomiting to alleviate the distress, thereby preventing negative reinforcement.

Disrupting maladaptive positive reinforcement of ED behaviors. MBIs, primarily via increasing mindful awareness, may prevent automatic engagement in ED behaviors to increase/sustain positive affect, thereby preventing positive reinforcement. When experiencing an urge to keep running (to maintain/increase positive affect) after already running for an hour, practicing mindful awareness (e.g., consciously pausing, focusing on the breath) may prevent additional running, thereby preventing positive reinforcement of excessive exercise (see Figure 2b).

Facilitating more accurate operant-based associative-learning. MBIs, primarily via increasing mindful awareness, may facilitate more

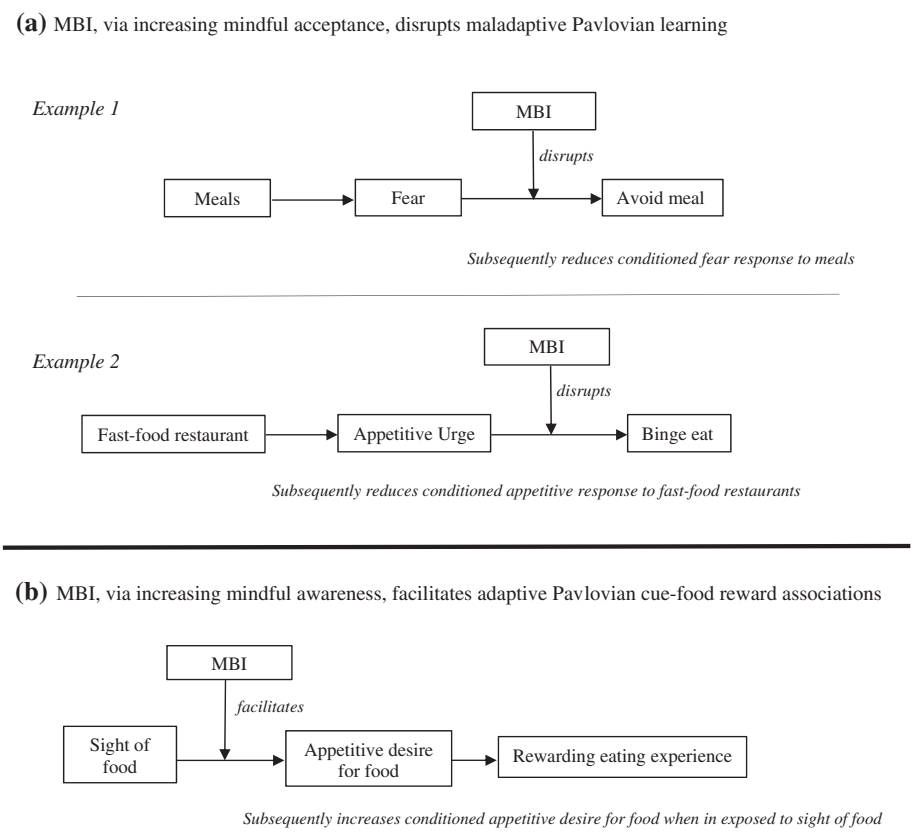

FIGURE 1 Hypothesized mechanisms in which MBIs, via increasing mindfulness skills, modify Pavlovian learning among individuals with EDs

accurate recognition of experiences after engaging in ED behaviors, which may be critical for updating associations between ED behaviors and consequences in a manner that reduces the composite motivational value of the behavior (based on anticipated rewards/aversive experiences; Ludwig et al., 2020). After skipping meals, focusing attention on momentary experiences may facilitate greater direct recognition that initial increases in positive affect are short-lived, and that aversive experiences (fatigue/irritability) arise soon afterwards, thereby reducing the motivational value of skipping meals (see Figure 2c).

Facilitating reinforcement of adaptive strategies for regulating distress. MBIs, primarily via mindful acceptance, may facilitate use of other adaptive regulatory strategies (e.g., cognitive reappraisal), which are reinforced because these strategies produce desirable outcomes (e.g., decreases in distress). Practicing mindful acceptance when exposed to stressors may reduce "bottom up" affective reactivity to stressors (Lindsay & Creswell, 2017), which may minimize the degree to which negative affect interferes with "top down" cognitive control during stressor exposure. This in turn can maximize opportunities to deploy CBT skills (such as cognitive reappraisal) that depend on "top-down" cognitive control and recruitment of the prefrontal cortex (Kober, Buhle, Weber, Ochsner, & Wager, 2019).

Facilitating reinforcement of eating. MBIs, primarily via increasing mindful awareness, may increase reinforcement of eating (see Figure 2e). First, MBIs may increase awareness of natural hunger cues (Kristeller & Wolever, 2010), which may increase eating when hungry, thereby increasing the reinforcement value of eating (e.g., relief of hunger and/or increase in satiation). Second, MBIs may increase positive affect during/after eating (which positively reinforces eating) via directing attention to pleasant present-moment sensory and affective experiences while eating (Garland et al., 2010).

Facilitating reinforcement of other non-ED daily activities. MBIs, primarily via increasing mindful awareness of pleasant external and internal experiences, may increase positive reinforcement of other non-ED activities (see Figure 2f), such as listening to music, going on a nature walk, or spending time with family, friends, or pets. Enhancing recognition of positive emotions themselves may be particularly important given emerging research showing that low positive emotional differentiation (difficulty distinguishing among discrete positive emotions) may underlie EDs (see Selby & Coniglio, 2020).

4 | COMPARING MBIs TO COGNITIVE-BEHAVIORAL THERAPY (CBT) APPROACHES FOR EDs

Similarities and differences. MBIs and CBTs are similar because both focus on skills development. However, CBT teaches a different set of skills, including cognitive reappraisal, meal planning, self-monitoring/tracking, environmental stimulus control, cue exposure and response prevention, problem solving, active communication, and activity planning. Similar to MBIs for EDs, CBTs are also theorized to modify associative-learning change mechanisms (Murray et al., 2018; Schaumberg et al., 2020). Overall, we propose that CBT and MBIs for

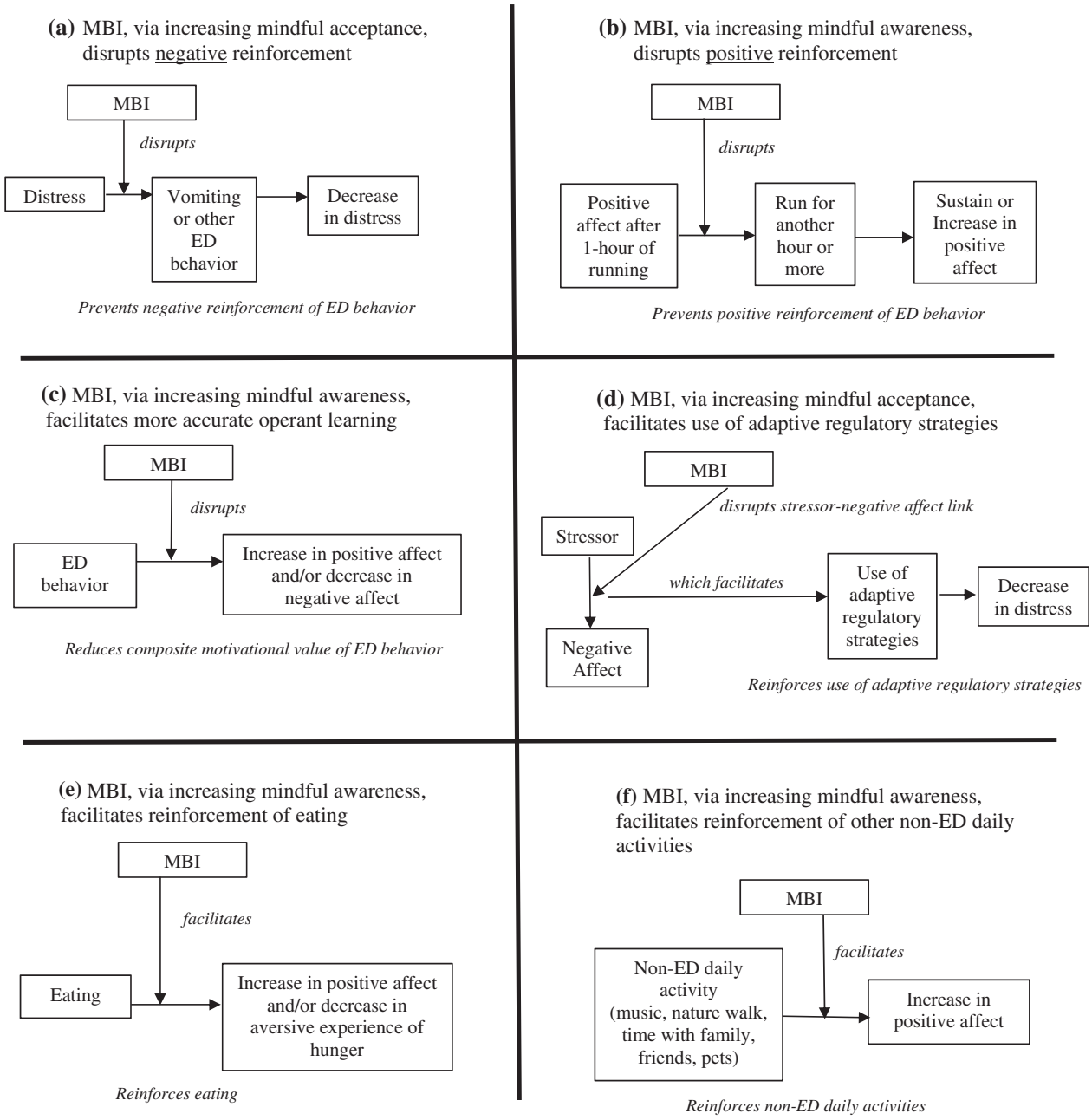

FIGURE 2 Hypothesized mechanisms in which MBIs, via increasing mindfulness skills, modify operant learning among individuals with EDs

EDs are similar in that they exert their therapeutic effects by modifying Pavlovian and operant learning mechanisms, but are different in that they do so by enhancing different target proximal skills.

Potential synergy. First, given that MBIs and CBTs may modify associative-learning change mechanisms via distinct pathways (i.e., use of different skills), delivering MBI and CBTs *together* may offer a potent, well-rounded dose of skills training to produce durable changes in associative-learning change mechanisms. Second, MBIs may increase use of CBT skills. Implementing mindful acceptance when exposed to stressors may reduce affective reactivity (Lindsay & Creswell, 2017), thereby minimizing the extent to which negative affect interferes with "top down" cognitive control, and maximizing opportunities to deploy CBT skills that rely of substantial cognitive resources (Roos, Bowen, & Witkiewitz, 2020). Third, MBIs may potentiate the efficacy of CBT skills. For example, mindful awareness may potentiate the efficacy of positive activity planning. Increased attentional engagement during planned activities may maximize increases processing of rewards during/following these activities. Fourth, MBIs may potentiate the efficacy of CBT exposure/response prevention procedures (Treanor, 2011). Practicing mindful acceptance during exposure to a feared cue can prevent overt (walking away) and covert attempts (cognitive distraction) to avoid the cue, thus augmenting inhibitory learning. Moreover, mindful awareness may enhance accurate recognition of consequences following exposure to feared cues,

thereby maximizing expectancy violations (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014).

5 | RECOMMENDATIONS FOR FUTURE RESEARCH

Next, we provide specific recommendations to guide future research on the application of MBIs for EDs.

Developing and evaluating novel interventions. Development of mindfulness-based *aftercare* treatments for preventing relapse is a promising next step. Future trials could compare a mindfulness-based aftercare intervention to a CBT-based aftercare intervention (e.g., Fichter et al., 2012). Delivering an MBI for EDs after weight restoration (in the case of anorexia nervosa) and/or completion of acute care may be suitable because individuals may have greater cognitive capacity and motivation to fully engage in an MBI. Future research could also evaluate if MBIs are differentially efficacious at varying phases of ED treatment.

Given the potential synergy of MBIs and CBT for EDs (as discussed above), another valuable direction is the development of novel interventions that combine MBI and CBT components into one protocol (e.g., mindfulness meditation training prior to exposure and response prevention).

Technology-based MBIs for EDs may be promising. Web- and app-based MBIs are efficacious among clinical populations (Spijkerman, Pots, & Bohlmeijer, 2016). Web-based MBIs, such as online mindfulness-based cognitive therapy (MBCT) for depression (see Segal et al., 2020), circumvent the need for therapist training and can be made widely available. Smartphone apps (although more expensive to develop than web-based program) have the key advantage of being able to track fluctuating states and situational contexts and then provide in-the-moment intervention, such as prompting individuals to use mindfulness skills during critical high-risk moments—which may directly modify associative-learning change mechanisms in daily life. Finally, virtual reality may be a promising approach for creating highly evocative exposures in which individual can practice mindfulness skills.

Research is needed to clarify the limitations of MBIs for EDs, such as whether MBIs are safe, acceptable, and efficacious among adolescents with EDs or when delivered as stand-alone interventions. Potential harms of MBIs need to be considered too. Mindful acceptance could be used to "accept" hunger and not eat. Qualitative data could reveal potential harms or misuse of mindfulness skills.

Testing mechanisms. Ecological momentary assessment (EMA) (i.e., intensive longitudinal measurement via smartphone) may be particularly useful for studying the hypothesized mechanisms proposed in this article. EMA can illuminate *intra-individual processes* (how variables are related to each other within the same person over time) and can be integrated into clinical trials to capture how change unfolds over time within individuals. For example, EMA could be used to evaluate whether MBIs "decouple" the intra-individual associations between triggers (e.g., meals, negative affect, urges) and subsequent ED behaviors in daily life. For further guidelines on using EMA to study mechanisms related to regulatory skills, like mindfulness, see Roos, Kober, et al. (2020).

Testing patient-treatment matching hypotheses. We hypothesize that MBIs for EDs (as adjunctive interventions) will have the most pronounced therapeutic effects among a subpopulation of individuals with "complex EDs," who are characterized by more severe ED pathology and comorbid affective disorders. First, as others have proposed (Haynos & Fruzzetti, 2011), CBT alone for EDs may not adequately target emotion dysregulation. Second, MBIs have been shown to enhance emotion regulation across many clinical populations (Lindsay & Creswell, 2017), sometimes to a greater extent than CBT (Kober, Brewer, Height, & Sinha, 2017). Third, others have theorized that MBIs are most effective among subpopulations in which affective distress drives psychopathology (Creswell & Lindsay, 2014). Fourth, preliminary empirical evidence shows that MBRP for substance use disorder may be more efficacious than CBT among individuals with affective comorbidities (Roos et al., 2017).

Finally, deploying mindfulness to regulate emotions/cravings *does not* appear to rely on recruitment of the prefrontal cortex (Kober et al., 2017, 2019; Westbrook et al., 2013). This stands in contrast to the CBT strategy of cognitive reappraisal, which does rely on the recruitment of the prefrontal cortex (Kober et al., 2010; Suzuki et al., 2020). This is critical because individuals with complex EDs may be susceptible to stress interfering with top-down regulation of ED urges, and may thus particularly benefit from strategies such as mindfulness that may work less via top-down mechanisms and more via "bottom-up" mechanisms (i.e., reduced neural activity in subcortical affective regions).

6 | CONCLUSIONS

MBIs for EDs (except for binge-eating disorder) remain underresearched despite promising preliminary findings. In this article we: (a) delineated our hypotheses about how MBIs for EDs may mobilize multiple associative-learning change mechanisms; (b) explored similarities and differences between MBIs and CBTs for EDs, and opportunities for synergy; and (c) provided specific recommendations for future research. We hope this article is helpful for advancing research on the application of MBIs for EDs.

DATA AVAILABILITY STATEMENT

N/A

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