# The Mind Your Health Project: A Randomized Controlled Trial of an Innovative Behavioral Treatment for Obesity

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**Objective:** To determine whether acceptance-based behavioral treatment (ABT) would result in greater weight loss than standard behavioral treatment (SBT), and whether treatment effects were moderated by interventionist expertise or participants' susceptibility to eating cues. Recent research suggests that poor long-term weight-control outcomes are due to lapses in adherence to weight-control behaviors and that adherence might be improved by enhancing SBT with acceptance-based behavioral strategies.

**Design and Methods**: Overweight participants ($n = 128$) were randomly assigned to 40 weeks of SBT or ABT.

**Results**: Both groups produced significant weight loss, and when administered by experts, weight loss was significantly higher in ABT than SBT at post-treatment (13.17% vs. 7.54%) and 6-month follow-up (10.98% vs. 4.83%). Moreover, 64% of those receiving ABT from experts (vs. 46% for SBT) maintained at least a 10% weight loss by follow-up. Moderation analyses revealed a powerful advantage, at follow-up, of ABT over SBT in those potentially more susceptible to eating cues. For participants with greater baseline depression symptomology, weight loss at follow-up was 11.18% in ABT versus 4.63% in SBT; other comparisons were 10.51% versus 6.00% (emotional eating), 8.29% versus 6.35% (disinhibition), and 9.70% versus 4.46% (responsivity to food cues). Mediation analyses produced partial support for theorized food-related psychological acceptance as a mechanism of action.

**Conclusions**: Results offer strong support for the incorporation of acceptance-based skills into behavioral weight loss treatments, particularly among those with greater levels of depression, responsivity to the food environment, disinhibition, and emotional eating, and especially when interventions are provided by weight-control experts.

## Introduction

Standard behavioral treatments (SBT) for obesity (i.e., lifestyle modification programs) typically include dietary and physical activity (PA) regimens. Those who fully adhere to these regimens experience large weight losses and minimal weight regain.[1] Yet, participants in behavioral treatments, on average, fall far short of maintaining prescribed calorie and PA levels, and lose far less weight than would be expected given these prescriptions.[2,3] Moreover, most experience significant weight regain within a year and substantial, if not full, regain within 5 years.[4] While changes in metabolic efficiency occur during weight loss, these do not fully explain weight

regains.[5] Thus, fundamentally, the failure of behavior treatments stems from difficulty making and/or maintaining recommended changes in dietary and PA behavior.

Existing behavioral interventions may be limited in effectiveness because they do not cultivate the psychological tools necessary to initiate and maintain weight-control behaviors in the face of powerful, innate countervailing drives. Moreover, existing programs teach participants to exert direct control over the content of thoughts or feelings (e.g., distraction-based strategies), which can be ineffective or even have the paradoxical effect of increasing distressing internal experiences.[6] The accumulating evidence that people formulate

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verbal constructions only after they have implicitly made decisions[7] also calls into question the efficacy of cognitive targets of standard interventions. Moreover, empirical work suggests that the more cognitive "work" (e.g., solving puzzles) in which a dieting individual engages, the more disinhibition of eating occurs, raising the possibility that cognitively intensive strategies may *reduce* self-regulation rather than enhance it.[8]

An acceptance-based behavioral program has the potential to provide individuals the psychological tools necessary to achieve dietary and PA goals within an obesogenic environment. Acceptance-based strategies are a key feature of several novel, "third-generation" behavior therapies, such as dialectical behavior therapy,[9] Marlatt's relapse prevention model,[10] and acceptance and commitment therapy (ACT).[11] The goal of acceptance-based strategies is not to reduce the frequency of aversive experiences; rather, the aim is to foster willingness to experience potentially aversive internal experiences while simultaneously promoting behavior that is consistent with desired goals and values.[12] Mindful awareness and a better "meta-cognitive" understanding of our decision-making processes are also likely to result in decreased "mindless" eating[13] and increased behavioral adherence.[14]

Several analog studies have demonstrated the advantages of acceptance-based versus standard cognitive-behavioral approaches for coping with food cravings, especially among those showing high emotional eating, responsivity to the food environment, or disinhibited eating.[15-17] Two workshop studies and two uncontrolled trials have obtained support for acceptance-based approaches to weight control. In one study, 84 individuals in a self-selected weight loss program (e.g., Weight Watchers) were randomized to a 1-day ACT workshop or to a waitlist control. At 3-months follow-up, waitlisted participants regained weight while those in the ACT condition continued to lose weight.[18] In another workshop study, 62 women were randomized to four 2-hour ACT workshops or to a control condition. At 6 months, ACT participants, relative to control, showed increases in PA and decreases in BMI, at least when nonparticipating participants were excluded.[19] In a different, uncontrolled trial, 21 participants with high internal disinhibition received a 24-week acceptance-based intervention. Participants demonstrated larger-than-usual weight losses (10.2 ± 8.2 kg) at a 9-month follow-up.[20] In our own pilot study, we assigned 19 overweight women to a 12-session acceptance-based intervention and observed robust weight loss at postintervention and at 6-month follow-up (8.1% and a 10.3%).[21] In another trial, a short acceptance-based intervention increased objectively measured PA bouts relative to an education control group.[22]

Acceptance-based interventions focus, in part, on developing the ability to better tolerate internal experiences, such as food cravings, emotion, and fatigue, such that a healthy rather than an unhealthy behavior is chosen. As such, these interventions might be particularly effective in individuals who are especially reactive to food stimuli, prone to disinhibited and/or emotional eating behavior and who suffer from mood disturbance. In fact, some initial support for this theoretical notion is found in the analog craving studies[15-17] and open trial results[20] reported above.

Given resource limitations in place for most healthcare settings, the field has a growing interest in increasing the disseminability of weight-control programs in part through administration by less intensively trained interventionists. In fact, the current trial was resourced such that only some of the interventionists had extensive weight-control expertise; the remaining interventionists were novice. This dichotomy in expertise raises the question of whether treatment effects would be moderated by interventionist expertise. Cognitive-behavioral weight-control interventions require knowledge about nutritional, behavioral, cognitive, and motivational principles. The ability to synthesize sophisticated acceptance-based psychological and behavioral principles might require particularly sophisticated clinical skills. In fact, a difference in long-term results between two similar randomized controlled trials of ABT for emotional disorders could conceivably be attributed to differences in the expertise of the therapists.[23,24] On the other hand, when ABT is employed as a manualized treatment, expert status may be less critical.

The current study represents the first randomized controlled trial of a full-scale acceptance-based behavioral treatment (ABT) for obesity. We aimed to evaluate the feasibility and acceptability of the treatment and its short- and moderate-term effectiveness relative to the current gold standard SBT. As just described, another specific aim was to evaluate the effectiveness of ABT with varying levels of interventionist expertise. In addition, given theoretical notions and findings described above, we sought to test whether the effectiveness of ABT would be moderated by mood disturbance, emotional eating, disinhibition, or susceptibility to food stimuli.

## METHODS AND PROCEDURES

### Participants

Participants were required to have a BMI between 27 and 40 kg/m$^2$, be 21-65 years of age, and have the ability to engage in PA. Individuals were excluded from participation if they had a medical or psychiatric condition that may have limited their ability to comply with the behavioral recommendations of the program or posed a risk to the participant during weight loss; were pregnant or planning to become pregnant in next 18 months; reported recently beginning a course of or changing the dosage of prescription medications that can cause a significant change in weight or appetite; or were participating in or planning to participate in another weight loss program in the next 18 months. The study was advertised in local newspapers and radio stations, and recruitment flyers were mailed to health-care providers in the community.

### Study design

Participants were assigned to SBT or ABT via computer-based random allocation, with blocking by baseline BMI. Treatment was group-based and held weekly during weeks 1-20 and bi-weekly in weeks 21-40, for a total of 30, 75-min sessions. Interventionists were either *novice* (i.e., advanced doctoral students who had received specific training in both ABT and SBT but who had limited experience conducting behavioral weight loss interventions; $n = 6$, mean number of prior groups led = 2.63, mean years of clinical experience = 2.67) or *expert* (i.e., clinical psychologists with experience administering behavioral weight-control interventions; $n = 2$, mean number of groups led = 32.50, and mean years of clinical experience = 7.00). Interventionists administered ABT and SBT groups, and assignment was balanced by expertise level. In terms of allegiance, 20% reported having been trained first in acceptance-based principles, 50% in standard CBT principles (100% of expert therapists), and 30% received both types of training simultaneously.

Sample size, the number of groups, and total number of waves were determined by an *a priori* power analysis. This trial was conducted from September 2009 to November 2011.

*Shared components of treatment*. The SBT and ABT treatment manuals shared many components. The nutritional education, expectations for daily self-monitoring of calorie intake, and prescriptions for a balanced-deficit diet were identical (1200-1500 kcal/day for most participants, depending on weight, and ≤25% of calories from fat). The progression of PA goals (i.e., gradual increase to 200 min/week of brisk walking or the equivalent by week 22) and expectations for self-monitoring structured and lifestyle activity (in minutes per day and with a pedometer, respectively) also were identical. Stimulus control, behavior shaping, behavior analysis, and relapse prevention strategies were taught. Participants learned to identify triggers for overeating and barriers to PA and engage in problem solving to address these. Interventionists also encouraged participants to obtain social support for behavioral changes.

*SBT-only components*. The SBT manual was based on existing behavioral treatment manuals for obesity, especially the LEARN and Diabetes Prevention Program weight loss and maintenance protocols.[25,26] Components of SBT not included in ABT were introduction of the traditional cognitive-behavioral model, which indicates that changing the content of one's thoughts can produce behavior change; cognitive restructuring; building self-efficacy and positive self-esteem; and learning to cope with food cravings by distracting from and psychologically confronting cravings.

*ABT-only components*. ABT was behavioral at its core, but with a heavy focus on acceptance- and commitment-based strategies designed to facilitate participants' dietary and PA adherence. The novel components were adapted in large part from the treatment descriptions by Hayes and colleagues.[11] Strategies were designed to operate on three key factors of noncompliance: erosion of commitment, distress intolerance, and mindless eating. Consistent with principles of ACT[11] and intrinsic motivation theory,[27] ABT emphasized that participants must choose weight-related goals that emanate from freely chosen, personal life values (e.g., health). A structured process for the identification of such life values was followed. Participants were helped to recognize the connections between these values and day-to-day eating and PA behaviors. These strategies were integrated into the treatment materials through hand-outs, tip-sheets, and problem-solving techniques. Participants were helped to appreciate that commitment to difficult behavioral goals, especially those that contain sustained exposure to unpleasant experiential states, is only likely to be maintained when one connects psychologically with life values important enough and meaningful enough to make such an effort and sacrifice worthwhile. The intervention also helped participants be aware of their moment-by-moment behavior choices and to increase the likelihood they reflect one's ultimate goals (or values), rather than a more immediate wish to decrease an aversive state.

The intervention aimed to help participants recognize that eating-related mental experiences (urges to eat, hunger, cravings, deprivation, and eating visualizations) are bound to occur with high intensity and frequency in today's obesogenic environment, and generally cannot be suppressed or controlled, and that their attempts to control these experiences were often ineffectual or even counterproductive. A core component of ABT was the teaching of skills to improve tolerance of aversive internal states that include eating-related states as well as affective states such as boredom, sadness, and anxiety. Similarly, participants were helped to better tolerate PA-related distress (e.g., through in-group moderate PA and simultaneous mindful awareness of the sensations generated). Participants were helped to recognize that attempts to modify aversive states (i.e., experiential avoidance related to intolerance of distress) is often associated with food intake since eating is a method of altering the internal experience, as well as with the cessation or avoidance of PA. Experiential acceptance was framed as a more adaptive alternative since it need not involve unhealthy eating nor avoidance of activity, and skills to enhance willingness to experience unpleasant states were taught. One such skill is "urge surfing"[28] in which participants are trained to "ride" (i.e., to observe from a distance without acting on or attempting to change) their eating-related urges. A related skill crucial to the ABT program is "defusion," that is, the ability to distance oneself from thoughts and feelings to see them as "merely" transient psychological experiences that need not be believed, acted on, controlled, or suppressed. The notion of uncoupling internal experiences and externalized behaviors was heavily emphasized. To facilitate the acquisition of defusion and uncoupling, simple demonstrations were performed, such as exposure to food cues designed to provoke thoughts (e.g., "That will taste so wonderful, I can always make up for the calories later") and feelings (e.g., powerful urge to eat the food) that usually lead to unhealthy eating. Simultaneously, participants practiced distancing themselves from these thoughts and feelings (e.g., explicitly recognizing a thought and its status as merely a thought) in a way that enhances willingness to experience the thoughts/feelings thereby reducing the necessity of acting (i.e., eating) to alter them.
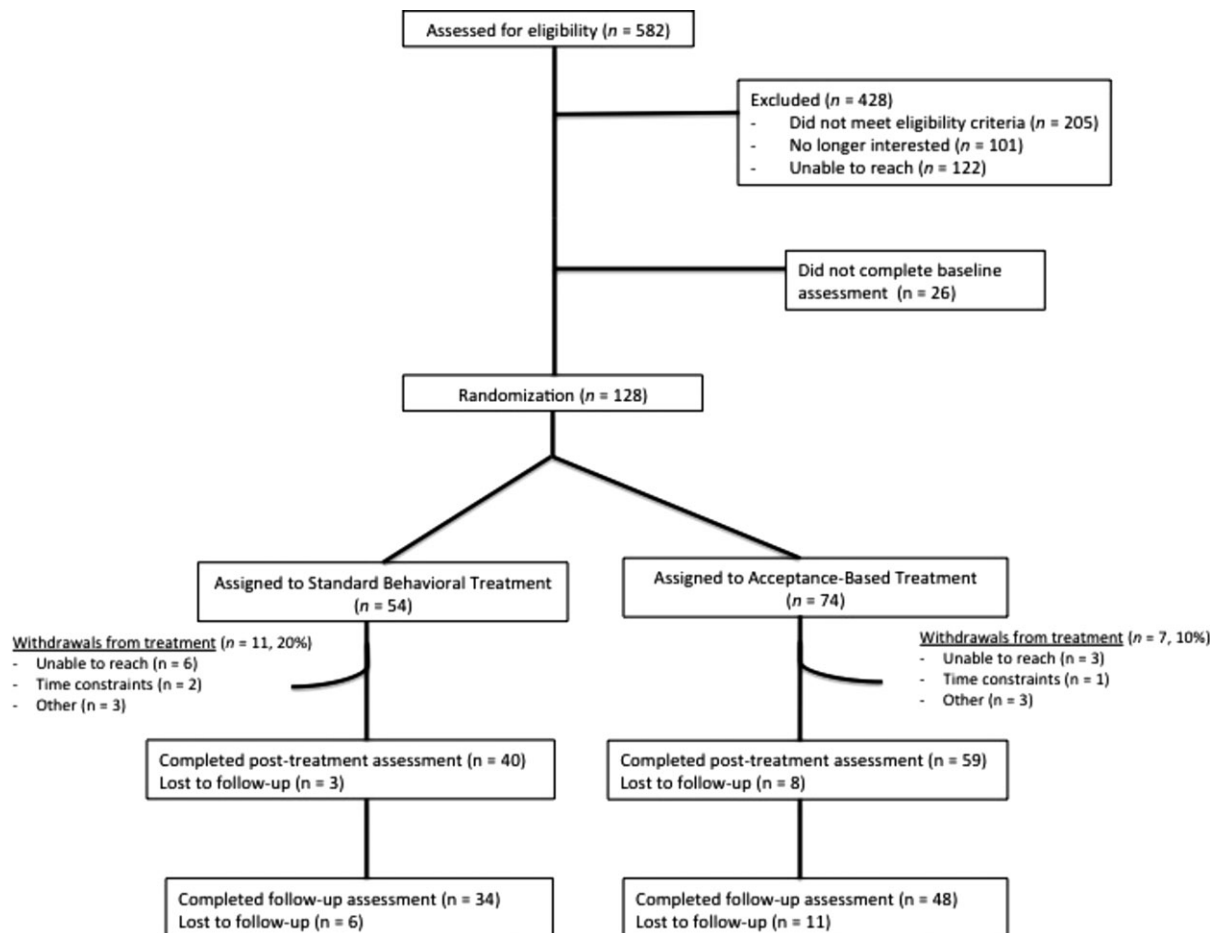
An important component of ABT was training in experiential awareness. The intervention incorporated mindfulness training designed to help individuals increase awareness of their perceptual, cognitive, and affective experiences. Metaphors and experiential exercises were utilized to train participants to become more present-centered and aware, thereby reducing the likelihood that they would engage in "mindless" behaviors. The intervention had a major focus on helping participants more consistently make "mindful" and deliberate behavioral (i.e., eating and PA) choices. Participants learned to attend to behaviors, thoughts, and feelings that triggered weight regain in the past.

## Measurement

Assessments were conducted at baseline, 10 weeks, 20 weeks, 40 weeks, and 6-month follow-up.

*Outcome variables*. Weight was measured with the participant in street clothes (without shoes) using a standardized Seca scale accurate to 0.1 kg. Height was measured with a stadiometer to establish BMI. The Quality of Life Inventory (QOLI)[29] measured the degree of importance and level of satisfaction in multiple life domains. The QOLI has good internal consistency, test–retest reliability, and convergent, discriminant, and criterion-related validity.[29] Treatment acceptability was measured with ratings of treatment helpfulness, satisfaction, and willingness to recommend the program to a friend.

*Moderator variables*. The Power of Food Scale[30] assessed the extent to which the availability or presence of highly palatable foods influences a person's food-related thoughts and feelings. The PFS has adequate internal and test–retest reliability and convergent and discriminant validity. Mood disturbance was measured with the

**FIGURE 1** Participant recruitment, withdrawals, and collection of weight measurements through 6-month follow-up.

Beck Depression Inventory-II (BDI-II) a self-report measure of depression symptomatology in the previous two weeks. The BDI-II has adequate test–retest reliability and high internal consistency, and convergent validity has been established.[31] Emotional eating was measured with the Emotional Eating Scale (EES), a reliable measure of eating in response to negative mood states.[32] Disinhibition (i.e., eating in response to cues) was measured with the Eating Inventory (EI), which also has strong psychometric properties.[33]

*Mediator variable.* The Food Acceptance and Awareness Questionnaire (FAAQ)[34] was administered to measure acceptance of urges and cravings to eat and the extent to which individuals might try to control or change these thoughts. The FAAQ has been validated across clinical and normative samples and has adequate convergent and divergent validity and internal consistency.[34]

*Statistical analyses.* Main outcome analyses were conducted using a series of one-way ANOVAs controlling for baseline weight, with additional variables added to the model for moderation analyses. Both intent to treat and completer analyses (defined as attending 20 or more treatment sessions) were conducted. Based on recommendations by Wing et al. (2006)[35], dropouts were assumed to have

regained 0.3 kg per month. To examine whether emotional eating, susceptibility to the food environment, disinhibition, or depression moderated the effect of condition on weight loss, baseline values of the above variables and the interaction between the variables and condition were added to the original ANOVAs. Mediation analyses were conducted using bootstrapping methods to assess indirect effects.[36]

## RESULTS

### Baseline characteristics

A total of 128 individuals provided written consent, completed baseline assessments, and were randomized to ABT or SBT using a five ABT groups (total $n = 74$) to four SBT groups ($n = 54$) split. See Figure 1 for a consort diagram. (We were recruiting an odd number of groups, and it was decided that more would be learned from a split resulting in more ABT participants.) The sample was primarily Caucasian (62.3%; African American: 24.6%; Asian: 1.6%; Hispanic: 3.8%) with a mean age of 45.69 ± 12.81 years and mean starting BMI of 34.10 ± 3.64 kg/m$^2$. A series of independent samples *t*-tests were used to examine whether groups were equivalent on relevant psychological and behavioral variables at baseline.

**TABLE 1** Baseline characteristics of sample

| Variable | ABT[a] | | SBT[b] | | Group difference | | |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | t | df | P |
| Age | 46.21 | 12.91 | 44.98 | 12.76 | 0.53 | 126 | 0.59 |
| BMI[c] | 34.43 | 3.62 | 33.64 | 3.65 | 1.21 | 126 | 0.22 |
| QOL[d] total | 59.88 | 15.87 | 59.07 | 15.25 | 0.27 | 126 | 0.78 |
| PFS[e] total | 58.48 | 15.74 | 56.09 | 19.21 | 0.77 | 126 | 0.44 |
| BDI[f] | 29.04 | 6.16 | 30.20 | 7.41 | −0.96 | 125 | 0.33 |
| EES[g] total | 55.28 | 18.51 | 57.75 | 21.72 | −0.61 | 125 | 0.49 |
| EI[h] disinhibition | 9.79 | 3.25 | 9.48 | 3.30 | 0.53 | 126 | 0.59 |
| FAAQ[i] total | 28.01 | 6.66 | 27.79 | 7.15 | 0.17 | 126 | 0.86 |

[a]$n = 74$; [b]$n = 54$; [c]BMI = body mass index; [d]QOL = quality of life index total score; [e]PFS = power of food scale; [f]BDI = Beck depression inventory; [g]EES = Emotional eating scale, [h]EI = eating inventory, [i]FAAQ = Food acceptance and awareness questionnaire total score.

Overall, comparisons revealed that groups were equivalent on all outcome and process measures at pre-treatment (Table 1).
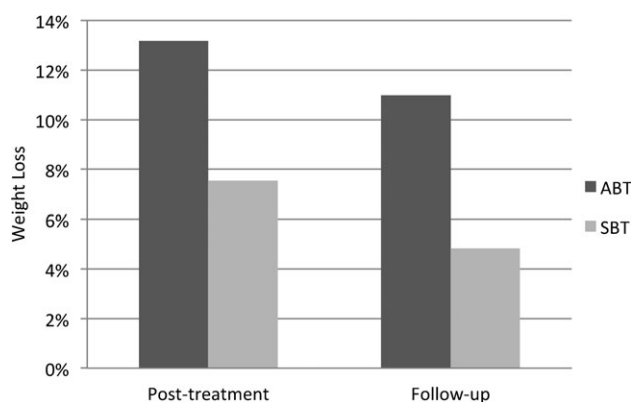
## Treatment acceptability and program attendance

On a 1 (lowest) to 5 (highest) rating scale, ABT participants demonstrated high satisfaction ($M = 4.50\pm0.69$) and helpfulness ratings ($M = 4.50\pm0.74$), as did SBT participants ($M_{satisfaction} = 4.29\pm1.03$; $M_{helpfulness} = 4.21\pm1.16$). No group by expert status effect on satisfaction [$F(1, 88)=0.348, P = 0.54$] or acceptability [$F(1, 88) = 0.47, P = 0.50$] was evident. Session attendance was also fairly high across both groups ($M_{ABT} = 21.08\pm5.47, M_{SBT} = 19.96\pm8.02; t(126) = −0.93, P = 0.31$) when considering the intention-to-treat sample. Overall, 77.0% of the ABT participants and 70.4% of SBT participants attended the vast majority (i.e., 25 or more) of the 30 scheduled groups ($\chi^2=1.67, P = 0.19$). Attendance did not differ between conditions [$t(126)= −0.93, P = 0.31$].

## Weight loss

Overall, participants experienced a $10.17\pm8.36\%$ (95% CI: 9.27, 11.07) weight loss by post-treatment and an $8.16\pm8.57\%$ (95% CI: 7.46, 8.86) weight loss by follow-up. For completers ($N_{ABT}=50$,





**FIGURE 2** Weight loss by treatment group when treatment provided by expert clinicians.

$N_{SBT}=37$), weight loss was $13.29\pm 7.10\%$ (95% CI: 12.58, 13.98) by post-treatment and $11.06\pm7.67\%$ (95% CI: 10.26, 11.86) by follow-up. Exactly 50% of participants experienced 10% weight loss or more by follow-up. In terms of group effects on weight loss, ABT had a small and insignificant advantage at post-treatment [$M_{ABT} = 10.90 \pm 8.32$; 95% CI: 11.86, 9.94; $M_{SBT} =8.74 \pm 8.38\%$; 95% CI: 7.78, 9.78; $F(1126) = 1.35, P = 0.24, \eta_p^2 = 0.01$] and at follow-up [$M_{ABT} =9.16 \pm 8.33\%$; 95% CI: 8.02, 10.03; $M_{SBT} = 7.36 \pm 8.98\%$; 95% CI: 6.16, 8.56; $F(1126) = 0.81, P = 0.37, \eta_p^2 = 0.006$]. However, as hypothesized, expert status moderated the treatment group effect [post-treatment: $F(3124) = 5.70, P = 0.02, \eta_p^2 = 0.04$; follow-up: $F(3124) = 5.70, P < 0.01, \eta_p^2 = 0.07$] such that advantage of ABT was more pronounced when treatment was provided by weight-control experts. In fact, when provided by experts, ABT ($n = 28$) produced significantly more weight loss at post treatment: $13.17 \pm 9.50\%$ (95% CI: 9.59, 16.75) versus $7.54 \pm 7.75\%$ in SBT ($n = 29$) [95% CI: 4.66, 10.42; $F(155) = 6.01, P = 0.01, \eta_p^2 = 0.10$]. At follow-up, ABT, when provided by experts, resulted in $10.98\pm9.11\%$ weight loss (95% CI: 7.54, 14.42) versus a $4.83\pm7.54\%$ weight loss for SBT [(95% CI: 1.56, 6.99); $F(155) = 7.73, P < 0.01, \eta_p^2 = 0.12$; Figure 2]. This pattern repeated among those who completed the treatment, with ABT demonstrating a $16.09 \pm 8.45\%$ post-treatment weight loss (95% CI: 12.49, 19.69) versus $11.76 \pm 5.46\%$ for SBT [95% CI: 9.26, 14.26; $F(139) = 3.65, P = 0.06, \eta_p^2 = 0.08$]; at follow-up ABT demonstrated a $13.52 \pm 8.39\%$ weight loss (95% CI: 9.94, 17.10) versus $5.78 \pm 6.07\%$ for SBT [95% CI: 4.94, 11.34; $F(139) = 4.57, P < 0.05$,

**TABLE 2** Interaction effects of proposed moderators on the main effect of treatment group on weight loss

| Moderating variable | F | P | $\eta_p^2$ |
|---|---|---|---|
| BDI[a] | 4.98 | 0.02 | 0.04 |
| EES[b] total | 3.52 | 0.06 | 0.03 |
| EI[c] disinhibition | 2.09 | 0.08 | 0.02 |
| PFS[d] | 4.15 | 0.04 | 0.03 |

[a]BDI = Beck Depression Inventory, [b]EES = emotional eating scale, [c]EI = eating inventory, [d]PFS = power of foods scale.

TABLE 3 Weight loss by treatment group at post-treatment and follow-up amongst participants high in hypothesized moderators

| | Post-treatment | | | | | | | Follow-up | | | | | | |
| | ABT | | SBT | | | | | ABT | | SBT | | | | |
| | Loss (%) | SD | Loss (%) | SD | $F$ | $P$ | $\eta_p^2$ | Loss (%) | SD | Loss (%) | SD | $F$ | $P$ | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High depression[a] | 13.35 | 8.61 | 6.65 | 9.03 | 4.91 | 0.03 | 0.11 | 11.18 | 7.99 | 4.63 | 10.04 | 5.14 | 0.02 | 0.11 |
| High emotional eating[b] | 12.68 | 8.65 | 8.21 | 9.27 | 3.88 | 0.05 | 0.06 | 10.51 | 8.76 | 6.00 | 9.45 | 3.83 | 0.05 | 0.06 |
| High disinhibition[c] | 12.38 | 7.97 | 10.40 | 7.90 | 4.38 | 0.04 | 0.06 | 8.29 | 7.79 | 6.35 | 9.05 | 3.84 | 0.05 | 0.05 |
| High food responsivity[d] | 11.91 | 8.71 | 7.04 | 8.51 | 3.62 | 0.06 | 0.06 | 9.70 | 8.63 | 4.46 | 8.31 | 5.72 | 0.02 | 0.09 |

[a]$n_{ABT}$= 20, $n_{SBT}$=22; [b]$n_{ABT}$=41, $n_{SBT}$=26; [c]$n_{ABT}$= 37, $n_{SBT}$=26; [d]$n_{ABT}$=38, $n_{SBT}$=26.

$\eta_p^2 = 0.10$]. In terms of clinical significance, 64% of those receiving ABT from experts maintained at least a 10% weight loss by follow-up, whereas this figure was 46% for those receiving SBT.

## Moderation analyses

Examining the full intent-to-treat sample, the effect of treatment group on weight loss was significantly moderated by mood disturbance and susceptibility to the food environment and showed a trend toward significance for emotional eating and disinhibition (Table 2). Results were equivalent when using only those receiving treatment by expert clinicians, and therefore only the full intent-to-treat sample analyses is presented. To examine these effects, moderator variables were dichotomized, and post-hoc tests were conducted examining weight loss by treatment group in participants who were in the higher ranges. (BDI was dichotomized using the BDI>12 clinical standard, and the non-clinical measures were dichotomized via a median split.) For example, among those with clinically significant depression (BDI>12), weight loss at 6-month follow-up was 11.18% in ABT versus 4.63% in SBT. Amongst those with higher emotional eating, higher disinhibition, and higher susceptibility to the food environment, the pattern was similar (Table 3, Figure 3).

## Mediation analyses

A series of mediation analyses were conducted, examining whether changes in psychological acceptance of food-related internal experiences (as measured by the FAAQ) from the pre-treatment assessment to the mid-treatment assessment mediated the advantage of ABT over SBT. No evidence of mediation was obtained. However, when hypothesized moderators (depression, emotional eating, disinhibition, and susceptibility to the food environment) were added to the mediation model to assess for moderated mediation, it emerged that psychological acceptance of food-related internal experiences was a mediator only amongst those high in emotional eating (i.e., moderated mediation was observed; 40 week: low EES= −1.83, CI: −5.28 to 0.08, high EES = 2.16, CI: 0.05-6.18; 6 month: low EES = −1.56, CI: −4.98 to 0.06, high EES = 1.85, CI: 0.01-6.02).
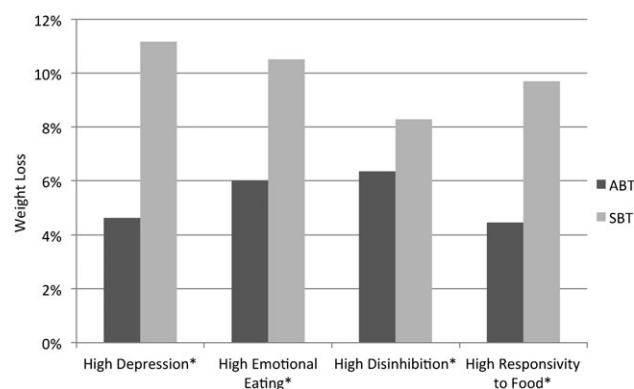
## Other outcomes

Quality of life (QoL) was also assessed as an outcome variable using a mixed design multivariate GLM analysis. Results revealed a strong main effect for time [$F(297) = 29.56$, $P < 0.001$,

$\eta_p^2 = 0.23$) but no interaction effect [$F(297) = 0.25$, $P = 0.61$, $\eta_p^2 = 0.003$), suggesting that while QoL did improve significantly during the course of treatment, the improvements were similar across condition.

## DISCUSSION

The current study provides support for the use of an acceptance-based treatment for weight loss. We established treatment acceptability, including higher average levels of reported satisfaction and feasibility within a large sample of overweight and obese individuals. In particular, ABT was found to be highly satisfactory by participants, and attendance rates were high.

Although there were no significant differences in weight losses between the groups overall, ABT proved superior to SBT when delivered by weight-control experts, suggesting that acceptance-based approaches require a certain degree of weight-control experience (or, alternatively, clinical experience, as these were confounded) to be delivered faithfully. When delivered by experts, differences were particularly acute at follow-up, with ABT producing 2.5 times the weight loss of SBT, indicating that behavioral



FIGURE 3 Weight loss at 6-month follow-up among those at higher levels of hypothesized moderators. *Note:* * indicates statistical significance at the $P < 0.05$ level.

approaches to weight maintenance can potentially be significantly improved by incorporating newer, mindfulness, acceptance, and commitment components. These findings are consistent with previously reported improvements in weight outcomes when incorporating acceptance-based skills in workshops targeting overweight and obesity.[18,19] Similarly, a recent study revealed that a six-session mindfulness-based intervention targeting eating habits at restaurants in perimenopausal women resulted in significantly greater weight loss and less mean fat and calorie intake compared to a control group.[37] Recently, Hooper and colleagues demonstrated that those who received an acceptance-based intervention consumed less chocolate during a taste test compared to those who received a thought-suppression intervention.[17] Our results are also consistent with data from our pilot study,[21] providing further support for the feasibility, acceptability, and effectiveness of acceptance-based behavioral weight-control programs.[18-21,37]

As hypothesized, and echoing previous findings,[15] ABT was more efficacious for those with higher levels of mood disturbance and higher levels of responsivity to cues such as emotions, cravings, and food. The pattern of results thus suggests that those who are prone to eating in response to internal and external cues may display greater benefits when taught acceptance-based strategies, which is consistent with ABT's focus. Specifically, it is possible that those whose eating behavior is dependent on reducing negative internal experiences (e.g., sadness, anxiety, cravings, and urges to eat), particularly benefit from acceptance-based strategies that aim to increase willingness to experience discomfort while acting in ways that are consistent with one's values (e.g., living a healthy life). In fact, in the current study, psychological acceptance mediated the benefit of ABT over SBT in participants with higher emotional eating and disinhibition. Previous research has also demonstrated that increases in psychological flexibility and acceptance mediate changes in BMI following an acceptance-based workshop.[38]

Developing interventions that are particularly beneficial for those with greater susceptibility to eating-related cues is particularly important, as it has been found that those with high disinhibition display poorer outcomes in weight loss programs.[39,40] Our findings are consistent with the previous literature, which reveal greater efficacy of ABT for those with higher levels of responsivity to cues. For example, we have previously shown greater efficacy of an analog acceptance-based intervention for coping with food cravings, compared to a standard intervention, in those with greater responsivity to their food environment.[15] As research continues to grow in this area, matched treatment assignment may be an effective way to better target obesity in those whose eating is susceptible to internal (e.g., emotions) and external cues (e.g., food). For example, an acceptance-based behavioral program was designed specifically for those with high internal disinhibition and displayed impressive weight loss (12.0 kg) that persisted 3 months after the intervention (12.1 kg).[20]

While the current study has a number of strengths, several limitations should be acknowledged. Most importantly, the length of post-treatment follow-up (i.e., 6 months) did not allow an investigation of efficacy of long-term maintenance. In addition, potentially mediating variables were measured by self-report and were thus subject to bias and limited by participants' ability to report. The use of novice interventionists, while allowing an investigation of the impact of expert status, can also be viewed as a limitation. Finally, while we attempted to ensure fidelity through the monitoring of audio recordings and close oversight, we have no formal ratings of fidelity.

In conclusion, results from this randomized trial offer strong support for the incorporation of acceptance-based skills into behavioral weight loss treatments. It appears that these strategies would be particularly beneficial for those with greater levels of depression, greater responsivity to the food environment, and greater susceptibility to eating in response to cues other than physical hunger.O

## Acknowledgments

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