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Two Novel Treatments to Reduce Overeating in Overweight Children: A Randomized Controlled Trial

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Abstract

Objective—Our purpose in this study was to examine 2 treatments targeted at reducing eating in the absence of hunger in overweight and obese children.

Method—Thirty-six overweight and obese 8- to 12-year-old children (58% female; mean age = 10.3 years, $SD = 1.3$), with high scores on eating in the absence of hunger, and their parents were randomly assigned to an 8-week children's appetite awareness training or cue exposure treatment—food. Children completed an eating in the absence of hunger (EAH) paradigm, an Eating Disorder Examination interview for children, and three 24-hr dietary recalls, and their height and weight were measured. Parents completed the EAH Questionnaire and the Binge Eating Scale, and their height and weight were measured. Assessments were conducted at baseline, posttreatment, and 6 and 12 months posttreatment.

Results—Results showed that both treatments resulted in significant decreases in binge eating in children over time. Additionally, children in the food cue exposure treatment showed significant decreases in EAH posttreatment and 6 months posttreatment, but children in the appetite awareness training showed no change in EAH. Neither treatment produced significant effects on caloric intake in children or on any of the parent outcomes.

Conclusions—This study demonstrates that training in food cue responsivity and appetite awareness has the potential to be efficacious for reducing EAH and binge eating in children. Because these data are preliminary, further treatment development and randomized controlled studies are needed.

Keywords

childhood; obesity; overeating; eating in the absence of hunger; binge eating

Current data suggest that 32% of children in the United States are overweight or obese (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). To date, the gold standard treatment of childhood obesity is behavior therapy, typically provided to parents and child, weekly for 4 – 6 months. Family-based interventions that combine nutrition education and exercise with behavior therapy techniques (Epstein, 1996) are considered the most effective methods for weight loss. Ten-year longitudinal data show that one third of children who receive behavioral treatment are no longer overweight in adulthood (Epstein, Valoski, Wing, & McCurley, 1990). Although accumulated data from the past few decades have provided a solid basis of support for behavior therapy, not all children respond and other options for treatment are needed.

Reasons for nonresponse to behavioral obesity treatment are unclear. It is possible that the effects of biological and environmental factors cannot be overcome through behavioral therapy or that people who are overweight or obese are a heterogeneous group who do not respond to a single treatment. Thus, it is imperative to develop additional approaches to treat overweight and obese children in order to maximize efficacy for a larger number of patients. One potential approach is to develop specialized interventions for subgroups in which causal and maintenance mechanisms of obesity are targeted. Because obesity is caused by an imbalance in caloric intake and energy expenditure, treatments that reduce overeating could be a viable intermediary target to intervene on weight gain during youth.

One subtype of children that might benefit from targeted treatments is children who eat in the absence of hunger. Eating in the absence of hunger (EAH) is thought to represent a stable phenotypic behavior (Fisher & Birch, 2002; Francis, Ventura, Marini, & Birch, 2007). EAH is a behavioral measure of food consumption beyond subjective ratings of satiety. EAH is measured with a laboratory paradigm and has been linked to parent's restriction of food (Birch & Fisher, 2000; Birch, Fisher, & Davison, 2003; Fisher & Birch, 1999a), maternal prepregnancy weight (Faith et al., 2006), parent weight status (Francis et al., 2007), and maternal disinhibition of eating (Cutting, Fisher, Grimm-Thomas, & Birch, 1999). Most important, high EAH has been found to be associated with a 4.6 times increased risk for overweight at both 5 and 7 years of age (Fisher & Birch, 2002). Based on these data, EAH appears to be a viable target for treatment, and reduction in this type of overeating in childhood could reduce caloric intake and influence current or future obesity status during youth.

EAH is proposed as a key symptom that contributes to an episode of binge eating (Marcus & Kalarchian, 2003) and can be assessed with the laboratory paradigm described above or by the Eating Disorder Evaluation standardized interview for children (chEDE; (Bryant-

Waugh, Cooper, Taylor, & Lask, 1996; Fairburn & Cooper, 1993). The chEDE is used to evaluate overeating (objective and subjective) and the subjective experience of loss of control while eating, in order to diagnose binge eating and other eating disorders. The chEDE yields three subscales related to binge eating, including Objective Bulimic Episodes (OBEs; objective binge eating and loss of control), Objective Overeating Episodes (OOEs; objective binge eating without loss of control), and Subjective Bulimic Episodes (SBEs; subjective binge eating with loss of control). Thus, conceptually, EAH and OBEs, OOE, and SBEs should be highly correlated. However, the OBEs, OOE, and SBEs are self-reported in an interview, and the evaluation of EAH is based on a laboratory paradigm. To date, no studies have evaluated the concordance between the EAH paradigm and the interview assessment of binge eating in children.

Conceptually, decreasing EAH should yield a decrease in calories, which could result in decreased weight gain over time. Schachter's externality theory of obesity (Schachter, 1971; Schachter & Rodin, 1974) states that obese humans are more reactive to external cues to eat (e.g., time, presence and quality of food, situational effects) and less sensitive to internal hunger and satiety signals than their lean counterparts. If the externality theory has validity, children who are more reactive to external cues to eat and less sensitive to internal cues to eat would display eating in the absence of hunger behavior. In general, there is mixed support for the externality theory, as older research failed to demonstrate that overweight individuals are more responsive than their normal weight peers to external cues (Hibbs & Herman, 1977; Hill & McCutcheon, 1975; Meyers, Stunkard, & Coll, 1980; Rodin & Slochower, 1976; Storms & Nisbett, 1970) and more recent data support enhanced food cue sensitivity in overweight children and adults (Ferriday & Brunstrom, 2010; Jansen et al., 2003). It is possible that overweight individuals represent a number of behavioral phenotypes, and etiological models such as externality theory may prove useful for defining distinct subgroups.

The increased reactivity to external cues could be considered a learned response (Gibson & Desmond, 1999). Cues that accompany food—such as the sight, smell, and taste of food; rituals for eating; environment; as well as affective states and food-related cognitions—can be conditioned through Pavlovian learning to elicit physiological responding (Jansen, 1994, Jansen, 1998). In a Pavlovian conditioning model, food intake may be considered an unconditioned stimulus, whereas the metabolic responses (e.g., salivation, insulin release) are unconditioned responses. Over time, cues that signal food intake, such as sight and smell of food, may start to act as conditioned stimuli, which can trigger conditioned responses (e.g., food consumption after viewing a food commercial). Thus, learned cue reactivity could increase the probability of overeating (Jansen, 1994, Jansen, 1998).

In principle, the association between urges to eat and external cues should be amenable to extinction through systematic exposure (Wardle, 1990). Systematic exposure has shown efficacy with drug and alcohol addictions and could logically be applied to the treatment of EAH in children. Treatments that reduce sensitivity to external cues, such as cue exposure treatment and exposure with response prevention, have been found to decrease cue reactivity in alcohol usage (Drummond & Glautier, 1994; Monti & Rohsenow, 1999), drug usage (Childress et al., 1993; Franken, de Haan, van der Meer, Haffmans, & Hendriks, 1999),

nicotine usage (Havermans, Debaere, Smulders, Wiers, & Jansen, 2003; Niaura et al., 1999), and purging (Bulik, Sullivan, Carter, McIntosh, & Joyce, 1998; Carter, Bulik, McIntosh, & Joyce, 2002; Toro et al., 2003). These programs attempt to decrease sensitivity to external cues by extinguishing the relationship between the conditioned stimuli and the unconditioned stimuli, in the presence of the triggering cues. Cue exposure treatments interventions could be used to decrease a child's reactivity when faced with potential binge foods, thus decreasing EAH.

The other target of treatment for overeating in children indicated by Schachter's theory is increasing sensitivity to internal cues of eating and satiety. Appetite awareness training focuses on training participants to regulate their eating by responding to hunger and appetite. This program has been shown to decrease the frequency of binge eating in adults (Craighead & Allen, 1995) and has shown promise with overweight children (Bloom, Sharpe, Heriot, Zucker, & Craighead, 2005). Additionally, a study that focused on enhancing awareness to satiety with preschoolers showed a decrease in overeating following a 6-week program (S. L. Johnson, 2000). These studies suggest that children can potentially respond to training that focuses on responding to internal cues of hunger and satiety and that these programs have the potential to decrease overeating.

In summary, behavioral treatments for childhood obesity show a long-term response in one third of children. However, not all children respond to behavioral treatment. In accordance with the externality theory of obesity, it is possible that two treatments may hold promise for intervening with children who eat in the absence of hunger: cue exposure treatment–food and appetite awareness training. Thus, our purpose in this treatment development study was to evaluate the efficacy and acceptability of these two treatments on overeating and weight gain with children who eat in the absence of hunger.

Method

Participants

Participants consisted of thirty-six 8- to 12-year-old overweight and obese children (58% female; mean age = 10.3 years, $SD = 1.3$), who met study criteria for EAH, and their parent (86% female; mean age = 41.2 years, $SD = 7.0$; see Table 1). Potential participants were initially screened by phone for EAH and were enrolled in the study if they ate more than 10% of their daily caloric intake in the free access paradigm (see Measures section). Participants were recruited from schools, after-school day care programs, medical clinics, newspaper advertisements, and community postings over a 5-month period in 2008. Potential participants were invited to attend an assessment if the child had a body mass index (BMI) percentile ≥ 85 th and the parent reported the child eating in the absence of hunger. Reported weight and height of the child were later verified with clinical measurements. Exclusion criteria included participation in a weight loss program, medication that could influence weight and eating, food allergies or dietary restrictions, or a psychiatric disorder or physical disease for which physician supervision of diet and exercise prescription were needed.

Of the 79 pairs of participants who completed the phone screen, 53 (67.1%) were seen in clinic for an EAH evaluation, and 36 (45.6%) were eligible for randomization (see Figure 1). Participants were randomized by gender of the child. Among the 17 pairs who were not randomized after the initial evaluation, the vast majority were excluded because they did not meet criteria for high EAH (>10% daily caloric needs consumed in the free access period); however, one child who reported self-induced vomiting during the chEDE interview was excluded. At baseline, 14% of the children enrolled in the study endorsed OBEs, 50% of the children endorsed SBEs, and 11% of the children endorsed OOE. Fifty percent of the children endorsed any type of loss of control eating (OBE or SBE), and 22% of the children endorsed any type of objective overeating (OOEs or OBEs). Following the baseline assessment, the project coordinator used a computer-generated randomization table to assign participants to one of two possible treatment conditions (see Table 1). The university institutional review board approved the study protocol. All parents provided written consent, and all children provided written assent.

Description of Interventions

Commonalities between interventions—Both interventions provided weekly treatment for 8 weeks. The treatment was provided in separate but simultaneous parent and child groups of 8–10 members for approximately 45 minutes, and both parents and children were given study specific workbooks and handouts. The content of the groups was similar for children and parents except that the child materials were presented in the form of games and discussion in an age-appropriate manner. In addition, following the separate groups, parents and children participated in an experiential exercise for an additional 30 minutes at each session (see specific descriptions for types of experiential exercises). The two treatments taught the same coping skills in group, including behavioral coping skills (deep breathing, relaxation, imagery, behavioral activation, delay) and cognitive coping skills (distraction, imagery, value statements, self-motivational statements, decision balance, cost–benefit analyses, problem solving). Both groups taught parenting skills, including the use of praise, motivation systems, daily meetings, self-monitoring, modeling, shaping behaviors, and logical consequences. If a family missed an intervention group meeting, the family was called by the group leader and the missed materials were mailed to the family. All the groups were led by doctoral-level psychologists and assisted by master's-level cotherapists and several undergraduate volunteers. All therapists attended a 1-day training regarding the treatments (described below) and attended weekly supervision with the first author.

Specific interventions

Cue exposure treatment—food: These groups, entitled “Volcravo,” used cue exposure treatment in session to reduce the strength of the association between the subjective and physiological experiences when exposed to food cues. We called these experiences “cravings” and described cravings to parents and children as wanting when not physically hungry. Children were provided a toolbox of coping skills to “ride the craving wave.” Participants were provided information about basic learning theory and how physiological responses to food cues develop and can be broken. All sessions focused on recognizing cravings (using the metaphor of a craving volcano, or Volcravo, for the children), identifying antecedents of cravings, and learning strategies to ride out craving waves until

urges diminished. Children were asked to ride out the cravings only when they were not physically hungry. Parents and children self-monitored their cravings outside of sessions.

Experiential exercises were conducted in a group format, and parent–child dyads were used to implement cue exposure treatment. During the first session, parents and children identified seven high-craving foods for the parent and child. During Sessions 2–8, parents and children brought a high-craving food and completed a cue exposure treatment exercise (called “exposures”). During the exposure, parents and children rated their cravings on a 1 to 5 scale while looking at the food, holding the food, smelling the food, and after taking two bites of the food, and then they rated their cravings at 30-s intervals for 15 min. After cravings were reduced to a 2 or lower (on a 5-point scale), the families disposed of the food without eating it. Participants were encouraged to use coping techniques during these behavioral exposure sessions as well as when at home to ride the craving wave. Participants self-monitored their cravings outside of session.

Appetite awareness training: These groups, entitled CAAT (children's appetite awareness training), focused on hunger and used hunger monitoring to increase sensitivity to hunger and satiety as well as coping skills to manage the urge to eat when not hungry. CAAT was adapted from appetite awareness training (Craighead & Allen, 1995), a similar program designed for adults. The overarching goal of CAAT was to increase the child's perceptions of internal states of hunger and satiety to guide amounts of food consumption. All sessions focused on improving awareness to hunger and satiety (using the metaphor of a gas tank in a car) and learning how to monitor these cues (using a 1–5 scale to rate hunger). Parents and children also learned about potential overeating situations in which they might not listen to their body's hunger signals (e.g., eating because of food availability, mood, extreme hunger, or palatability) as well as different coping skills to manage these situations. Parents and children self-monitored their hunger outside of sessions.

Experiential exercises were conducted in a group format and used parent–child dyads to practice monitoring hunger during meals. During Sessions 2–8, parents and children brought dinner and monitored hunger during this meal with prompts from the staff. Hunger was monitored at the start, middle, and end of the meal by parents and children. In addition, participants were prompted to monitor hunger levels 10 and 20 min postcompletion of the meal. Participants self-monitored their hunger outside of session.

Measures

Overview—Participants who completed an initial phone screen were scheduled for an on-site assessment meeting to provide informed consent and assess study eligibility. Each child and parent ate an ad libitum dinner together (cheese pizza, applesauce, carrots, milk, juice, and water) and were encouraged to eat until satiated. The child completed a survey for 10 min and then completed the taste test and the free access EAH assessment. Child participants also completed a chEDE interview and one 24-hr dietary recall in clinic. Two other dietary recalls were completed on the phone during the week. Parents completed a self-administered questionnaire. Independent evaluators trained in the conduct of interview protocols and other assessment devices conducted all the evaluations in this study.

Assessments were conducted at baseline, posttreatment, 6 months posttreatment, and 12 months posttreatment.

Child measures

EAH: The assessment measure of EAH has been described by Birch and colleagues (Birch & Fisher, 2000; Fisher & Birch, 2002) and Faith et al. (2006). Each child participated in a standard ad libitum pizza dinner with his or her parent. Self-reported postmeal satiety was assessed with a cartoon representation of three levels of fullness (Faith et al., 2006) along with two questions regarding each child's level of hunger and fullness via a 1–5 scale (1 = *not at all hungry/full* and 5 = *extremely hungry/full*). Ten minutes following the completion of the meal, each child tasted and rated palatability of small samples of 11 sweet and savory snack foods (popcorn, Cheez-Its, Cheetos, potato chips, pretzels, Skittles, Hershey's bars, chocolate chip cookies, Fig Newtons, jelly beans, M&M's) using cartoon illustrations of faces depicting “yummy,” “just ok,” and “yucky” (Faith et al., 2006). Following the rating of foods, the child was told that the coordinator had work in the next room, and the child was left alone in a room with containers holding generous preweighed portions of the snack foods as well as toys and games. After 10 min, the coordinator returned to the room and ended the free access session. The amounts of remaining food items were measured. The total calories consumed by each child was calculated from the amount-consumed data, and this total was divided by child's estimated daily calorie needs to derive the percent of calorie needs consumed during the free access period. Daily calorie needs were estimated with age-specific formulas for calculating estimates energy requirements according to weight, age, height, and physical activity level. A physical activity level of “low active” was used for all children in this study to be conservative (National Academy of Sciences, Institute of Medicine, Food and Nutrition Board, 2005). In order to qualify for this study, all children had to have EAH > 10% of their daily caloric needs.

Child usual dietary intake: Dietary intake of the child was assessed with three 24-hr dietary recalls at each assessment point on 3 nonconsecutive days. Studies have provided support for the use of this method of dietary assessment for youths (Collins, Watson, & Burrows, 2010; R. K. Johnson, Driscoll, & Goran, 1996; Lytle, Murray, Perry, & Eldridge, 1998). Dietary intake data for each child were collected and analyzed with the Nutrition Data System for Research (NDSR) software version 2007, developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis. Utilizing the multiple-pass system of the NDS-R interview methodology, a trained interviewer conducted one 24-hr recall in person at the assessment visit, along with two subsequent recalls over the phone within the following 2 weeks. During the in-person interview, children used both food models and a food amounts booklet to help them estimate quantities of foods and drinks consumed; the booklet alone was used for the recalls conducted by phone. Parents were consulted to verify aspects of the food (e.g., butter or margarine, brand names). The three dietary recalls were averaged to generate the dietary intake variables associated with that assessment period. Total daily caloric intake was used as a measure of outcome.

Binge eating: The Eating Disorder Examination version (Fairburn & Cooper, 1993) adapted for children (chEDE; Bryant-Waugh et al., 1996) assesses eating disorder symptoms and

was administered to each child (Tanofsky-Kraff et al., 2004). All chEDE interviewers attended a 2-day didactic training by a psychologist with experience and training in the chEDE. The chEDE identifies specific types of eating episodes: objective bulimic episode (OBE; overeating with loss of control) and subjective bulimic episode (SBE; loss of control without objective overeating as assessed by the interviewer but viewed as excessive by the interviewee) and objective overeating episodes (OOE; objective overeating without loss of control).

Anthropometry: Assessors were trained by an experienced faculty anthropometrist, and all research staff established accuracy and reliability with 10 height and weight measurements before measuring children in the study. Child height was measured with a standard stadiometer in duplicate. Children's weight was measured in duplicate on a calibrated slide scale without jackets, outerwear, or shoes. The average of the two values was used for analysis. Children's heights and weights were translated to BMI-for-age percentile scores using the Centers for Disease Control and Prevention growth charts (Kuczmarski et al., 2000) and to BMI z scores. Recent recommendations suggest that BMI z scores are useful for indexing adiposity at any one time and that BMI is recommended for indexing change over time, so both statistics are presented (Cole, Faith, Pietrobelli, & Heo, 2005).

Treatment acceptability: At the postintervention assessment visit, each child participant completed a study evaluation form. This form inquired about the acceptability and enjoyment of the study in general and included more specific questions about particular activities and skills. Both closed and open-ended formats were utilized. In particular, children were asked to report how much they liked their 8-week program overall (1 = *didn't like*, 5 = *loved it*) and whether they thought that the in-session exposure sessions (Volcravo) or hunger monitoring (CAAT) increased their confidence in doing that behavior outside of session (yes/no response).

Parent measures

Demographic characteristics and weight history (baseline only): Each parent completed a demographic questionnaire pertaining to home environment.

Binge eating: Binge eating severity was assessed with the self-reported, 16-item Binge Eating Scale (BES), which assesses binge eating severity on a continuous scale (Gormally, Black, Daston, & Rardin, 1982). Studies have shown that the BES is an acceptable screener for binge eating symptoms, and the sensitivity and specificity for overweight and binge eating populations are considered moderate (Celio, Wilfley, Crow, Mitchell, & Walsh, 2004).

EAH: Parents completed the Eating in the Absence of Hunger Questionnaire for Adults (Tanofsky-Kraff et al., 2008). This questionnaire includes 14 items designed to assess the frequency of eating when one is not hungry, feelings of control over one's own eating, and self-efficacy in high-risk food situations (Shomaker et al., 2010). Three factor-analytically derived, internally reliable subscales were used. In a sample of approximately 300 parents, these scales illustrated good internal reliability (α s > 0.81–0.94) and moderate temporal

stability ($r_s = 0.24\text{--}0.69$) across an average of 21 weeks (Shomaker et al., 2010). The three scales were summed to create an overall score.

Anthropometry: Parent height was measured with a standard stadiometer, and body weight was measured on a calibrated sliding scale in duplicate. The average of the two values was used for analysis. Height and weight were converted to body mass index ($\text{BMI} = [\text{kg}/\text{m}^2]$).

Treatment acceptability: A survey was completed by each parent at the postintervention assessment visit. In particular, parents were asked how much they liked their respective 8-week program overall, how much they thought their child liked the program (1 = *didn't like*, 5 = *loved it*), and whether they thought that the in-session exposure sessions or hunger monitoring increased their child's confidence in doing that behavior outside of session.

Analytic Strategy

Analyses were based on generalized linear mixed model implemented in Proc Glimmix of SAS Version 9.2. Continuous outcomes were modeled with a normal distribution and identity link function. Count outcomes were modeled with a Poisson distribution and a log link function. All observed values at each time point were used, due to the likelihood-based approaches of these models.

For each outcome being modeled, fixed effects included three coefficients for time, one coefficient for condition, and three coefficients to represent the time by condition interaction. For each outcome, selection of a covariance structure for the residuals was based on fitting four structures (compound symmetry, first order autoregressive, Toeplitz matrix, and an unstructured covariance matrix) and selecting the one with the lowest adjusted Akaike's information criterion. For count outcomes, an additional overdispersion parameter was incorporated into the model. Standard errors for fixed effects are based on empirical standard errors estimated with the root sandwich estimator, which makes the standard errors less sensitive to misspecification of the covariance structure and corrects for the bias introduced by the classical sandwich estimator when used with small samples. For noncount outcomes, the raw, Studentized, and Pearson residuals were plotted prior to hypothesis testing using histograms with superimposed normal curves and normal probability plots. In the event of significant deviations from normality, we sought an appropriate transformation of the response.

In general, interest was in change from baseline within each intervention group and between intervention groups for each outcome. In order to reduce the chances of a Type I error resulting from testing each possible “within” and “between” contrast that might be of interest, we first tested for the significance of the time effect within each condition and the time by condition interaction (the condition main effect was not of interest). If the time main effect for either condition was significant, we followed up with contrasts that compared the outcome on changes from baseline at posttreatment, 6 months posttreatment, and 12 months posttreatment. If the time by condition interaction was significant, we followed up with contrasts that compared the two intervention conditions on changes from baseline for posttreatment, 6 months posttreatment, and 12 months posttreatment. We applied corrections for multiple comparisons that maintained the familywise error rate at .10 for global tests

(i.e., time effects within each condition and time by condition interaction) and contrasts conditional on significant global tests. For global tests we employed Hochberg's (1988) alpha adjustment procedure, which performs well with small to medium correlated endpoints (Sankoh, Huque, & Dubey, 1997). For contrasts, a correction to the p value was applied based on a simulated Holm's procedure (Westfall, 1997).

Results

Descriptive Characteristics

Table 1 presents means, standard deviations, and percentages for demographic variables of the sample by group at baseline. Table 2 presents the observed sample means and standard deviations by group and time for the outcomes assessed. In general, the demographic characteristics and outcomes at baseline are similar across the two groups. The model predicted means are reported in Table 3. Although the values used in Table 3 are used for statistical inference, the values reported in Table 2 are important because they are the raw data used to create the statistical model. They provide information on variability and can be used to calculate effect sizes for future meta-analyses.

Child Outcomes

EAH—We considered two models for EAH. One was the general model described, with terms for condition, time, and time by condition interaction; the other included as a time-varying covariate the number of calories eaten at dinner prior to the free access paradigm relative to the child's estimated daily energy requirements. Because the results of these models were virtually identical (see Table 3), we present results only for the model with the time-varying covariate. Because the model residuals displayed a positive skew, we used a log base 10 transformation of EAH, which resulted in a more normal-shaped distribution. For the model that included calories eaten at dinner as a covariate, we used a compound symmetry covariance matrix, resulting in a significant time effect for Volcravo, $F(3, 82) = 5.81, p = .001$, and not for CAAT, $F(3, 82) = 1.81, p = .152$, and a significant time by condition interaction, $F(3, 82) = 4.91, p = .003$. Contrasts were used to evaluate the difference within Volcravo on amount of EAH change from baseline at each subsequent time point. A significant 8% reduction in calorie intake (based on the back-transformed predicted values) from baseline was observed at posttreatment, $t(82) = 4.10, p < .001$, and there was a 5% reduction from baseline at 6 months posttreatment, $t(82) = 2.18, p < .093$. Contrasts were used to evaluate the difference among the intervention conditions on amount of EAH change from baseline at each subsequent time point. The only contrast that was significant was a 10% reduction in EAH in the Volcravo condition relative to CAAT at posttreatment, $t(82) = 3.59, p < .001$.

Binge eating episodes—When we used a Toeplitz covariance structure with OBEs as an outcome, there was a significant time main effect for Volcravo, $F(3, 82) = 135.82, p < .001$, and for CAAT, $F(3, 82) = 22.53, p < .001$, and a significant time by condition interaction, $F(3, 82) = 17.14, p < .001$. Contrasts were used to evaluate the amount of OBE change from baseline within each intervention group. For the Volcravo group there was a significant 1.22 (all reported differences use a difference in back-transformed predicted means from Table 3)

decrease from baseline to 6-month follow-up, $t(82) = 11.07, p < .001$, and a 1.22 decrease from baseline to 12-month follow-up, $t(82) = 9.31, p < .001$. For the CAAT condition there was only a significant 0.89 decrease from baseline to 12 months posttreatment, $t(82) = 2.72, p = .035$. In terms of differences between groups on change from baseline, Volcravo had a 0.77 advantage at 6 months posttreatment, $t(82) = 6.36, p < .001$.

When we used an unstructured covariance matrix with SBE as an outcome, there was a significant time main effect for Volcravo, $F(3, 82) = 45.19, p < .001$, and for CAAT, $F(3, 82) = 10.40, p < .001$, but not a significant time by condition interaction, $F(3, 82) = 1.69, p = .176$. Contrasts were used to evaluate the amount of SBE change from baseline within each intervention group. For the Volcravo group there was a significant 2.21 decrease (all reported differences use a difference in back-transformed predicted means from Table 3) in the number of SBEs from baseline to posttreatment, $t(82) = 3.28, p = .006$; a 3.04 decrease from baseline to 6-month follow-up, $t(82) = 2.82, p = .0173$; and a 3.24 decrease from baseline to 12-month follow-up, $t(82) = 5.76, p < .001$. For the CAAT condition there was a significant 0.78 decrease in SBEs from baseline to posttreatment, $t(82) = 3.55, p = .001$; a 0.90 decrease from baseline to 6 months posttreatment, $t(82) = 2.52, p = .026$; and a 1.23 decrease from baseline to 12 months posttreatment, $t(82) = 2.47, p = .026$.

We additionally analyzed the data for loss of control eating, which is based on the combination of OBEs and SBEs. When a Toeplitz covariance matrix was used, there was a significant time main effect for Volcravo, $F(3, 82) = 12.20, p < .001$, but not for CAAT, $F(3, 82) = 2.62, p < .057$; nor was there a significant time by condition interaction, $F(3, 82) = 1.04, p = .380$. Contrasts were used to evaluate the amount of OBE + SBE change from baseline within Volcravo. There was a significant decrease of 3.36 in the number of OBEs + SBEs from baseline to posttreatment, $t(82) = 2.97, p = .004$; a 4.26 decrease from baseline to 6-month follow-up, $t(82) = 3.17, p = .002$; and a 4.44 decrease from baseline to 12-month follow-up, $t(82) = 5.80, p < .001$.

We also analyzed the data based on the combination of OBEs and OOE (overeating episodes). When a Toeplitz covariance matrix was used, there was a significant time main effect for Volcravo, $F(3, 82) = 49.78, p < .001$, but not CAAT, $F(3, 82) = 1.75, p < .164$, and a significant time by condition interaction, $F(3, 82) = 6.83, p < .001$. Contrasts were used to evaluate the amount of OBE + OOE change from baseline within Volcravo. There was a significant decrease of 1.55 in the number of OBEs + OOE from baseline to posttreatment, $t(82) = 2.68, p = .031$; a 1.48 decrease from baseline to 6-month follow-up, $t(82) = 2.62, p = .031$; and a 1.61 decrease from baseline to 12-month follow-up, $t(82) = 11.61, p < .001$. Contrasts were used to evaluate the difference among the intervention conditions on amount of OBE + OOE change from baseline at each subsequent time point. The only contrast that was significant was a 0.77 reduction in OBE + OOE in the Volcravo condition relative to CAAT at follow-up, $t(82) = 4.13, p < .001$.

Caloric intake—When we used an unstructured covariance matrix with caloric intake as an outcome, there was no significant time effect for Volcravo, $F(3, 34) = 2.06, p = .124$, or for CAAT, $F(3, 34) = 1.74, p = .178$; nor was there a significant group by condition interaction, $F(3, 34) = 0.65, p = .586$.

BMI and BMI z—When we used an unstructured covariance matrix with BMI as an outcome, there was a significant time main effect for CAAT, $F(3, 34) = 6.19, p = .002$, but not for Volcravo, $F(3, 34) = 2.65, p = .065$, and there was no significant time by condition interaction, $F(3, 34) = 0.64, p = .595$. Contrasts were used to evaluate the direction and amount of BMI change from baseline within CAAT. For the CAAT condition there was a significant 0.34 increase in BMI from baseline to posttreatment, $t(34) = 2.17, p = .037$; a 0.79 increase from baseline to 6 months posttreatment, $t(34) = 3.42, p = .005$; and a 1.30 increase from baseline to 12 months posttreatment, $t(34) = 2.86, p = .014$. When we used an unstructured covariance matrix with BMI z as an outcome, there was not a significant time effect for Volcravo, $F(3, 34) = 0.87, p = .466$, or for CAAT, $F(3, 34) = 1.00, p = .405$; nor was there a significant time by condition interaction, $F(3, 34) = 0.56, p = .644$.

Parent Outcomes

When we used a Toeplitz covariance matrix with BMI as an outcome, there was no significant time effect for Volcravo, $F(3, 80) = 0.26, p = .858$, or for CAAT, $F(3, 80) = 1.04, p = .381$; nor was there a significant group by condition interaction, $F(3, 80) = 0.68, p = .569$. When a Toeplitz covariance matrix with binge eating as an outcome was used, there was no significant time effect for Volcravo, $F(3, 77) = 2.84, p = .043$, or for CAAT, $F(3, 77) = 3.99, p = .011$, and there was no significant group by condition interaction, $F(3, 77) = 1.38, p = .256$. When a compound symmetry covariance matrix with EAH as an outcome was used, there was no significant time effect for Volcravo, $F(3, 83) = 1.35, p = .264$, or for CAAT, $F(3, 83) = 3.84, p = .013$, and there was no significant group by condition interaction, $F(3, 83) = 1.16, p = .331$.

Treatment Acceptability

In the posttreatment surveys among the 16 families who completed Volcravo and CAAT respectively, 9 (56%) of the children in Volcravo and 12 (75%) of the children in CAAT liked the program “a lot” or “loved it.” When queried about whether they felt more in control of their eating because of the program, 11 (69%) of the children in Volcravo and 13 (81%) of the children in CAAT reported that this statement was “very true.” Fifteen of the children (94%) in Volcravo and 11 of the children (69%) in CAAT thought other kids would like the program.

In terms of parent responses, 11 (69%) of the parents in Volcravo and 12 (75%) of the parents in CAAT liked the program “a lot” or “loved it.” Seven parents (44%) in Volcravo and eight parents (50%) in CAAT thought their child liked the program “a lot” or “loved it.” Thirteen parents (82%) in Volcravo and 15 (94%) parents in CAAT thought the program taught their child to be more in control of his or her eating (“agree” or “strongly agree”).

Discussion

Our aim in this pilot study was to evaluate two new treatments for overweight and obese children who eat in the absence of hunger. The purpose of this pilot was twofold: to evaluate the feasibility and acceptability as well as the potential efficacy of these interventions. For these reasons, we evaluated the impact of these two 8-week treatments on body weight,

EAH, binge eating, and caloric intake in children and parents and examined the acceptability of these programs. Overall, both interventions were well tolerated and had reasonable acceptability ratings from both parents and children. Our data suggest that Volcravo might be efficacious in the reduction of EAH, considering the significant reduction found at posttreatment and even 6 months posttreatment, but that CAAT had very little effect on EAH. Results of the study also suggest that both Volcravo and CAAT resulted in decreases in binge eating in children. The children who received the Volcravo intervention appeared to have no changes in BMI until the 12 months posttreatment assessment, but CAAT BMI scores increased consistently over time. The BMI data suggest that neither Volcravo nor CAAT in and of themselves would be effective as a weight-reduction intervention, but Volcravo may serve as a weight stabilization intervention.

The impact of Volcravo and CAAT on binge eating was noteworthy. Those in both 8-week treatments reduced reported binge eating in the chEDE interviews, which was a durable effect and lasted throughout the 12-month follow-up assessment period. Although binge eating was a secondary target in this study, both of these interventions showed potential efficacy. In both treatments, SBEs and OBEs reduced to almost zero, with the Volcravo intervention having a greater effect. When we analyzed the data on loss of control eating and overeating episodes, we found that only Volcravo showed a significant decrease over time. A reduction in binge eating and overeating has the implication of preventing weight gain by reducing or eliminating excess caloric intake. Additionally, a reduction in binge eating has the potential to improve co-occurring psychiatric symptoms, as binge eating has been associated with depression (Araujo, Fonseca, & Nardi, 2009; Faith et al., 2006; Linde et al., 2004; Speranza, Corcos, Atger, Paterniti, & Jeammet, 2003), body image disturbance (Mussell et al., 1996), psychological distress (Dalle Grave, Calugi, Petroni, Di Domizio, & Marchesini; Didie & Fitzgibbon, 2005; Faith et al., 2006; Ramacciotti et al., 2008), and weight gain (de Zwaan, 2001; White, Masheb, & Grilo, 2009; Yanovski, 2003) in adults as well as weight gain in children (Decaluwé & Braet, 2003; Morgan et al., 2002; Stice, Presnell, & Spangler, 2002). The decrease in loss of control eating is also important, as loss of control in children has been associated with greater psychiatric comorbidities and the development of psychiatric symptoms over time (Tanofsky-Kraff et al., 2011).

The development of the food cue exposure treatment (Volcravo) in this study is novel, as extinction to food cues has not been tested as an overeating intervention in adults or in children. For this study, we chose to have families bring in seven highly craved foods, and the children learned to habituate to the cravings during only one exposure per food in clinic. Animal research has highlighted a number of problematic processes in the long-term retention of extinction learning. It is now understood that extinction involves new learning (Bouton, 2004; Myers & Davis, 2002), which suggests that the original learning does not disappear but remains available under the right circumstances. In addition, it has been demonstrated that the context (i.e., environment, cues available) in which extinction takes place can affect subsequent long-term retention of extinction learning (Bouton, 2002, Bouton, 2004). In terms of food cues, these two concepts present challenges, as eating environments constantly change and original learning is available to reemerge. Furthermore, animal research suggests that extinction can be optimized by including trial spacing effects, massed extinction trials, counterconditioning, and extinction in multiple contexts (Bouton,

Woods, Moody, Sunsay, & Garcia-Gutierrez, 2006). Studies should evaluate the effect of manipulating the above variables to optimize extinction learning, to improve cue exposure therapies for food cues.

Yet, an alternative explanation is worth considering, given that binge eating behavior reduced and did not reoccur in this sample. Across both conditions, there was training in interoceptive sensitivity (i.e., awareness of the temporal dynamics and physiological experiences of craving or hunger). Over time, children were becoming increasingly sensitized to these internal experiences and learning to differentiate the meaning of these sensations based on context. Thus, although it is seemingly impossible to develop exposure to each novel cue that emerges in the ever-changing food environment, as mentioned above, our strategy of exposure to interoceptive cues (e.g., hunger and satiety or cravings) may facilitate skill generalization irrespective of context.

One of the largest issues with extinction training in psychological treatments is rejection or unacceptability by patients, which results in high dropout rates (Zayfert & Black, 2000). Our anecdotal experience indicates that parents felt supported by having a treatment developed specifically for their child's behavior. Parents reported feeling relieved to learn that their child was not the only one who is "never full" and eats constantly. Parents also reported that prior to receiving treatment in the current study, they were unsuccessful at finding resources through health care providers to effectively help their children. Although the treatments used in this investigation are in relatively early stages of piloting, they represent the first set of treatment development studies targeted at the specific profile of children with EAH.

The influence of Volcravo on eating in the absence of hunger was fairly remarkable posttreatment, resulting in a reduction in EAH by 10% of daily caloric age- and gender-adjusted needs. In a child in this age range, this effect could amount to 150–250 calories reduction per day. However, this effect was not longstanding, as demonstrated by the children's BMI and BMI z at the 12 months posttreatment time point. It is possible that long-lasting BMI changes were not seen due to length or frequency of the intervention or to the lack of strength of the extinction, as described above. It is also possible that these children's BMI would have continued to increase without treatment; however, this is unknown from this study. All of these issues must be addressed in future modifications and tests of these interventions.

Our anecdotal experience in the Volcravo groups suggests that children and parents were able to grasp the concept of craving and to use it to decrease overeating. However, families in the Volcravo condition also reported difficulties in conceptualizing craving without understanding hunger and satiety. Children often reported they were hungry when they actually were craving a food but were not physically hungry. Parents struggled with whether their child was actually hungry or craving. Future studies of extinction interventions should consider integrating techniques that focus on awareness of hunger and satiety, perhaps in the format of the CAAT.

It is important to note that these two programs differ from behavior therapy in several distinct ways, including format, dietary prescription, and physical activity targeting.

Behavior therapy includes parent and child separate but concurrent groups and individual parent-child behavioral coaching, making it more intensive than the current interventions in this study. Additionally, behavior therapy provides a dietary prescription, and parents and children self-monitor dietary intake, caloric intake, and, in the Traffic Light program, “red” foods that should be avoided (Epstein, Myers, Raynor, & Saelens, 1998; Epstein, Roemmich, & Raynor, 2001). The goal of behavior therapy is to improve awareness of eating patterns and to reduce overall caloric intake and increase energy expenditure throughout the treatment. Concerns about restricting what children eat have been raised in the literature, based on associations between parent restriction and EAH and weight gain (Birch et al., 2003; Fisher & Birch, 1999b, Fisher & Birch, 2000) and unfounded concerns of restriction leading to the development of eating disorders (Epstein, Paluch, Saelens, Ernst, & Wilfley, 2001). Neither of the interventions introduced in this article provided a dietary plan or made any specific dietary recommendations. However, learning regarding dietary intake and hunger was promoted through self-monitoring of hunger or cravings. The overarching concept in these treatments was to learn to regulate eating and decrease overeating, which could result in weight management in the future. Last, neither of these treatments provided physical activity prescriptions. Unfortunately, the data from this pilot study did not support the weight management hypothesis, but the treatments did in fact lead to significant reductions in binge eating that may have a longer term impact on weight loss or weight gain prevention.

There are a number of strengths and weaknesses that need to be considered in interpreting the results of this study. With only 36 families randomized, this study had limited power. This may have impacted significance findings, and two families in each arm were lost to follow-up. In addition, both interventions were only 8 weeks and the extinction protocol may not have been optimized, which may have contributed to less powerful results. Our EAH measure, using the free access paradigm, and the ChEDE interview could be susceptible to a social desirability bias or a response bias. Our experience from screening and working with these children suggests that they were still in the age range in which they did not understand that we were measuring food intake in the free access paradigm. Additionally, our assessments were spaced in time (after the posttreatment assessment), and we believe that children in this age range might remember that they ate dinner and did an interview about eating but would not necessarily remember the specific questions. Last, the lack of a control group does not allow for comparisons to participants who did not engage in treatment. It is possible that overweight and obese children with EAH might gain weight faster than the children in this study, but unfortunately this question could not be evaluated, given the limitations of the current design.

The strengths of this study include the use of two novel interventions, both of which are based on theoretical models of causal and maintenance mechanisms of overeating in children. Additionally, we used standardized assessment measures and were able to follow the children for 12 months postrandomization. This study is also novel in that it is the first to recruit, measure, and target overeating in a sample of overweight and obese children. Given these strengths and weaknesses, the interventions tested in this study may serve as the basis for future research examining interventions that target EAH in overweight and obese children.

In summary, this study was the first to develop and test treatment protocols specifically for a behavioral phenotype of over-weight and obese children. Very little is known about EAH in children, and these are the first interventions that specifically target this behavior in overweight and obese children. These two interventions seem promising and are worthy of further development consideration as well as larger randomized controlled trials. Future studies could include optimization of the cue exposure treatment and sensitivity training (Volcravo) intervention by evaluating spacing effects, massed extinction trials, counterconditioning, and extinction in multiple contexts. Additional work could integrate the two treatments, to provide a longer intervention focused on decreasing overeating that includes targets of both hunger and cravings. It is also important to identify potential moderators to determine which obese children might respond best to which approach. Researchers may also consider targeting hunger and satiety as adjunct treatments for behavior therapy in order to address eating patterns while simultaneously promoting more aggressive weight loss.

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Figure 1.

Study recruitment, randomization, and completion of parent-child pairs in Minnesota and San Diego. EAH = eating in the absence of hunger; Volcravo = cure exposure treatment-food; CAAT = children's appetite awareness training.

Table 1

Demographic Characteristics of Children and Parents (N = 36 Pairs)

Group and measure	Volcravo	CAAT
Child		
Gender (% female)	66.7	50.0
Mean age (<i>SD</i>)	10.3 (1.4)	10.3 (1.3)
Race (%)		
Caucasian	38.9	41.2
African American	22.2	11.8
Multirace	22.2	23.5
Other	16.7	23.5
Parent		
Gender (% female)	88.9	83.3
Mean age (<i>SD</i>)	39.8 (7.8)	42.5 (5.9)
Marital status (% currently married)	66.7	83.3
Education (% college graduates)	50.0	61.1
Race (%)		
Caucasian	64.7	66.7
African American	23.5	16.7
Multirace	5.9	5.6
Other	5.9	11.1

Note. Volcravo = cure exposure treatment–food; CAAT = children's appetite awareness training; *SD* = standard deviation.

Table 2

Observed Means (Standard Deviations) for BMI, BMI z Score, EAH, and Binge Eating by Intervention Group and Time

Measure	Baseline	Posttreatment	6 months posttreatment	12 months posttreatment
Child outcome				
EAH				
Volcravo	21% (9%)	12% (8%)	16% (9%)	17% (10%)
CAAT	19% (8%)	20% (9%)	19% (8%)	16% (15%)
SBE				
Volcravo	3.33 (6.10)	1.19 (1.91)	0.31 (0.79)	0.07 (0.28)
CAAT	1.33 (2.87)	0.56 (1.09)	0.44 (1.50)	0.09 (0.30)
OBE				
Volcravo	1.22 (4.25)	0.06 (0.25)	0.00 (0.00)	0.00 (0.00)
CAAT	0.89 (3.53)	0.06 (0.25)	0.44 (1.75)	0.00 (0.00)
OOE				
Volcravo	0.39 (1.04)	0.00 (0.00)	0.13 (0.34)	0.00 (0.00)
CAAT	0.06 (.24)	0.00 (0.00)	0.00 (0.00)	0.09 (0.30)
Loss of control eating				
Volcravo	4.56 (8.05)	1.25 (1.91)	0.31 (0.79)	0.08 (0.28)
CAAT	2.22 (4.68)	0.63 (1.20)	0.88 (3.24)	0.09 (0.30)
Overeating episodes				
Volcravo	1.61 (4.27)	0.06 (0.25)	0.13 (0.34)	0.00 (0.00)
CAAT	0.94 (3.52)	0.06 (0.25)	0.44 (1.75)	0.09 (0.30)
Caloric intake				
Volcravo	1,822 (706)	1,536 (474)	1,474 (466)	1,644 (412)
CAAT	1,784 (544)	1,554 (368)	1,609 (318)	1,559 (316)
BMI				
Volcravo	26.17 (3.21)	26.12 (2.95)	26.55 (3.08)	28.09 (4.50)
CAAT	28.60 (4.57)	28.98 (4.69)	29.44 (4.79)	30.65 (5.07)
BMI z score				
Volcravo	2.00 (0.36)	1.99 (0.34)	1.96 (0.33)	1.98 (0.47)
CAAT	2.22 (0.35)	2.20 (0.34)	2.17 (0.35)	2.22 (0.37)
Parent outcomes				
EAH				
Volcravo	30.39 (9.41)	28.63 (8.11)	27.94 (7.86)	28.00 (8.41)
CAAT	29.00 (10.12)	26.56 (7.55)	27.06 (8.50)	28.50 (8.31)
Binge eating				
Volcravo	13.13 (9.27)	11.73 (10.05)	9.21 (7.28)	9.17 (6.52)
CAAT	12.75 (10.69)	9.50 (7.88)	9.88 (10.15)	10.83 (11.09)
BMI				
Volcravo	32.54 (5.92)	32.74 (5.61)	32.43 (5.29)	33.13 (4.82)
CAAT	31.93 (5.28)	31.78 (5.50)	32.18 (5.92)	32.24 (6.43)

Note. *Ns* for assessment points: Volcravo/CAAT baseline = 18/18; posttreatment = 16/16; 6 months posttreatment = 16/16; 12 months posttreatment = 13/12. BMI = body mass index; EAH = eating in the absence of hunger, expressed as a percent of daily caloric needs; Volcravo = cure exposure treatment–food; CAAT = children's appetite awareness training; SBE = subjective bulimic episode; OBE = objective bulimic episode; OOE = objective overeating episode.

Table 3

Model Predicted Means for BMI, BMI z Score, Binge Eating, and EAH by Intervention Group and Time

Measure	Baseline	Posttreatment	6 months posttreatment	12 months posttreatment
Child outcomes				
EAH				
Volcravo	20%	10% ^{a,b}	13% ^a	15%
CAAT	18%	19%	18%	13%
EAH (w/covariate)				
Volcravo	19%	10% ^{a,b}	13% ^a	14%
CAAT	18%	19%	18%	13%
SBE				
Volcravo	3.33	1.12 ^a	0.29 ^a	0.09 ^a
CAAT	1.33	0.55 ^a	0.43 ^a	0.10 ^a
OBE				
Volcravo	1.22	0.06	0.00 ^{a,b}	0.00 ^a
CAAT	0.89	0.06	0.44	0.00 ^a
Loss of control eating				
Volcravo	4.56	1.20 ^a	0.29 ^a	0.11 ^a
CAAT	2.22	0.60	0.85	0.06
Overeating episodes				
Volcravo	1.61	0.06 ^a	0.13 ^a	0.00 ^{a,b}
CAAT	0.94	0.06	0.44	0.10
Caloric intake				
Volcravo	1,822	1,527	1,466	1,608
CAAT	1,784	1,527	1,584	1,547
BMI				
Volcravo	26.17	26.22	26.65	27.85 ^a
CAAT	28.60	28.94 ^a	29.39 ^a	29.98 ^a
BMI z score				
Volcravo	2.00	1.97	1.95	1.96
CAAT	2.22	2.22	2.20	2.17
Parent outcomes				
EAH				
Volcravo	30.39	28.59	27.90	28.17
CAAT	29.00	25.97	26.47	29.04
Binge eating				
Volcravo	12.73	11.32	8.02	9.74
CAAT	12.46	9.64	10.00	12.00
BMI				

Measure	Baseline	Posttreatment	6 months posttreatment	12 months posttreatment
Volcravo	32.41	32.47	32.36	32.13
CAAT	31.93	31.99	32.38	32.12

Note. EAH and binge outcomes are back-transformed predicted values. BMI = body mass index; EAH = eating in the absence of hunger, expressed as a percent of daily caloric needs; Volcravo = cure exposure treatment–food; CAAT = children's appetite awareness training; SBE = subjective bulimic episode; OBE = objective bulimic episode.

^aStatistically significant within-group difference on change from baseline.

^bStatistically significant between-groups difference on change from baseline.