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Research report

# A pilot study evaluating a one-session attention modification training to decrease overeating in obese children ☆

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ABSTRACT

There are a number of neurocognitive and behavioral mechanisms that contribute to overeating and obesity, including an attentional bias to food cues. Attention modification programs, which implicitly train attention away from specific cues, have been used in anxiety and substance abuse, and could logically be applied to food cues. The purpose of this study was to evaluate the initial efficacy of a single session attention modification training for food cues (AMP) on overeating in overweight and obese children. Twenty-four obese children who eat in the absence of hunger participated in two visits and were assigned to an attention modification program (AMP) or attentional control program (ACC). The AMP program trained attention away 100% of the time from food words to neutral words. The ACC program trained attention 50% of the time to neutral and 50% of the time to food. Outcome measures included the eating in the absence of hunger free access session, and measures of craving, liking and salivation. Results revealed significant treatment effects for EAH percent and EAH kcal (group by time interactions $p < .05$). Children in the ACC condition showed a significant increase over time in the number of calories consumed in the free access session (within group $t = 3.09$, $p = .009$) as well as the percent of daily caloric needs consumed in free access (within group $t = 3.37$, $p = .006$), whereas children in the AMP group demonstrated slight decreases in these variables (within group $t = -0.75$ and $-0.63$, respectively). There was a trend suggesting a beneficial effect of AMP as compared to ACC for attentional bias (group by time interaction $p = .073$). Changes in craving, liking and saliva were not significantly different between groups ($ps = .178$–$.527$). This is the first study to demonstrate that an AMP program can influence eating in obese children. Larger studies are needed to replicate and extend these results.



## Introduction

Recent data suggest that 31% of children in the United States are overweight or obese (Ogden, Carroll, Kit, & Flegal, 2012), which translates to 4–5 million children in the United States. Overweight and obese children are at an increased risk for many negative health complications in childhood and adulthood, including orthopedic and endocrine conditions, cardiovascular disease, cancer and all-cause mortality (Biro & Wien, 2010; Franks et al., 2010; Lobstein, Baur, Uauy, & TaskForce, 2004; Reilly & Kelly, 2011). Additionally, these children are at risk for psychosocial consequences in childhood and adolescence, including poor self-esteem, teasing and verbal abuse (Puhl & Latner, 2007; Wardle & Cooke, 2005) and isolation from social networks (Strauss & Pollack, 2003). Healthcare and hospital costs are higher for overweight and obese children compared to those who are healthy weight (Estabrooks & Shetterly, 2007; Hampl, Carroll, Simon, & Sharma, 2007; Wang & Dietz, 2002) and the number of hospitalizations among children who are obese nearly doubled from 1999 to 2005 (Trasande, Liu, Fryer, & Weitzman, 2009).

There are a number of neurocognitive and behavioral mechanisms that contribute to overeating, or eating past nutritional needs, which can lead to obesity. These processes which are involved in mobilizing behavior to obtain and eat food include attention to food cues (Nijs & Franken, 2012), learned relationships between the seeing the food cue and the taste (classical and operant conditioning) (Martin-Soelch, Linthicum, & Ernst, 2007; Rozin & Zellner, 1985), cognitions about the food (Higgs, 2008),

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activation of neural circuits in the brain associated with reward (Berridge, 1996, 2009; Wise, 2006), and decreased inhibitory mechanisms (Hofmann, Friese, & Roefs, 2009; Volkow, Wang, Fowler, & Telang, 2008). Responsiveness to food and the general processing of reward and pleasure is considered to be mediated by dopamine in the mesocorticolimbic system (Kelley & Berridge, 2002). Dysregulated dopamine-based reward circuitry has been implicated in overeating and obesity (Volkow, Wang, Fowler, Tomasi, & Baler, 2012). The incentive sensitization theory, which has recently been applied to obesity, proposes that attention biases for food cues result from repeated pairings of food cues with food intake (Berridge, 2009). Over time through associative conditioning, dopamine based reward circuitry becomes hyper-sensitized to stimuli associated with food, resulting in biased attentional processing toward food related cues (e.g. the sight or smell of highly palatable foods). Food cues become "attention grabbing" in vulnerable individuals, and trigger a motivational state of "wanting" that increases the likelihood of behavioral approach and consumption. Given the ubiquity of food cues in today's environment, an attentional bias to food cues may play a critical role in the development and maintenance of overeating and obesity, and could be considered an index of individual differences in saliency and reward to food.

In general, data suggests that an attentional bias to food cues exists in adults with obesity, but like other fields, there are some mixed results. In two studies with normal weight college students, attentional bias for pictorial food cues was associated with eating in response to food cues (external eating) (Brignell, Griffiths, Bradley, & Mogg, 2009; Hou et al., 2011). In two visual search experiments, detection times were faster when targets were food rather than non-food items, and the detection for food items were negatively correlated with BMI (Nummenmaa, Hietanen, Calvo, & Hyona, 2011). Using an eye tracking paradigm and a pictorial dot probe, obese and normal weight individuals had increased gaze during for food compared to non-food images in the fasted state (Castellanos et al., 2009). When fed, obese individuals had increased attention to food images, while normal weight individuals had similar gaze duration for food and non-food images. A visual probe task showed a bias in initial orientation to food cues in overweight participants compared to lean participants, but did not show a bias in maintained attention to food cues (Nijs, Muris, Euser, & Franken, 2010). Some studies have failed to find this relationship. Using a Stroop task, no differences were seen in interference in color-naming food words between obese and healthy weight adults (Phelan et al., 2011). One study using eye movement during a visual probe task with food pictures showed that overweight participants showed an approach-avoidance pattern of attention toward high-fat food pictures (Werthmann et al., 2011). However, more recent studies suggest that attentional biases for food cues could be more idiosyncratic than considered beforehand, and vary based on internal perceptions, including chocolate craving and self-permission to eat (Werthmann, Roefs, Nederkoorn, & Jansen, 2013).

Less is known about attentional biases for food cues in youth. In one study, overweight and normal weight children completed a Stroop task containing food-related words, negative emotional words, and control words in an effort to assess information processing biases for food-relevant stimuli. Results revealed the obese children were slower in naming the color of food words than the color of control words compared to their normal weight counterparts, suggesting an interference of food cues on attention to the task (Braet & Crombez, 2003). However, in a later study with 87 adolescents (45 overweight and 42 normal weight) no relationship was found between overweight status and interference for food words in an imbedded food word task (Soetens & Braet, 2007). In a prospective study with 35 adolescent girls ranging from lean to obese using an attention network task involving food and neutral stimuli, results showed that BMI correlated positively with attentional bias to appetizing food stimuli but not neutral stimuli (Yokum, Ng, & Stice, 2011). Taken as a whole, this emerging body of research suggests that attentional biases to food cues are associated with obesity, increased eating and increased BMI, however more studies are needed to draw more firm conclusions. Recent studies show that internal factors play a role in attentional bias, and the idiosyncratic nature of attentional biases to food cues has yet to be fully explored.

To modify attentional biases, researchers have developed programs that automatically divert attentional resources away from salient stimuli by implicitly training individuals that if a salient and neutral stimuli are present, the neutral stimulus has better signal value (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). Attention modification programs (AMP) improve an individual's ability to disengage attention from cues and have been related to changes in activation of the prefrontal cortex to emotional stimuli, implying better top down control of attention as a result of attention training (Browning, Holmes, Murphy, Goodwin, & Harmer, 2010). AMP programs have been applied primarily in anxiety disorders (Amir, Beard, Burns, & Bomyea, 2009; Amir, Beard, Taylor, et al., 2009; Eldar et al., 2012; Heeren, Reese, McNally, & Philippot, 2012; Schmidt, Richey, Buckner, & Timpano, 2009). Although data on attentional biases in anxiety disorders is also mixed, with some studies failing to find expected groups differences between AMP and control conditions (Boettcher, Berger, & Renneberg, 2012; Boettcher et al., 2013; Neubauer et al., 2013), metanalyses show that AMP programs have statistically large and reliable effects in changing attentional bias in anxiety (Beard, Sawyer, & Hofmann, 2012; Hakamata et al., 2010; Hallion & Ruscio, 2011). A smaller but growing body of literature suggests that AMP programs may be useful in appetitive disorders (e.g. alcohol and cigarettes; (Attwood, O'Sullivan, Leonards, Mackintosh, & Munafo, 2008; Schoenmakers et al., 2010), although findings have also been mixed (Field & Cox, 2008; McHugh, Murray, Hearon, Calkins, & Otto, 2010). Thus, a recent review highlighted the need for increased research on the efficacy of AMP for appetitive disorders (Beard et al., 2012). To date no published study has evaluated an AMP program to train attention away from food cues in overweight and obese individuals.

Considering the plethora of food cues in the environment, and the importance of training children to address responsivity to food cues in their natural environment, it would be valuable to begin to develop interventions to address these neurocognitive processes, including attentional bias. To address this gap, this project tested a one-session attention modification program to examine its effect in reducing responses to food cues in overweight and obese children. We hypothesized that children in the AMP condition, relative to the control condition, would show a decrease in attention bias, eat less and would report decreased cravings, liking of foods and salivation following the AMP program.

## Methods

### *Participants*

We recruited overweight and obese 8–12 year old children from listserves, primary care clinics, and from other advertisements in the community in San Diego, CA. Inclusion criteria included child BMI% > 85th, consent from parents, assent from child, and commitment to attend both visits. Because we wanted to look at overeating in our laboratory, we only included children who ate a minimum of 5% of their daily caloric needs in the free access EAH paradigm (see 'Measures' section). Exclusion criteria included: