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Enhancing inhibitory learning to reduce overeating: Design and rationale of a cue exposure therapy trial in overweight and obese women

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ABSTRACT

The prevalence of overweight and obesity has increased substantially over the last decades. Weight loss attempts in overweight individuals are common, though they seldom result in successful long-term weight loss. One very promising treatment is food cue exposure therapy, during which overweight individuals are repeatedly exposed to food-associated cues (e.g., the sight, smell and taste of high-calorie foods, overeating environments) without eating in order to extinguish cue-elicited appetitive responses to food cues. However, only few studies have tested the effectiveness of cue exposure, especially with regards to weight loss. For exposure treatment of anxiety disorders, it has been proposed that inhibitory learning is critical for exposure to be effective. In this RCT, we translated techniques proposed by Craske et al. (2014) to the appetitive domain and developed a novel cue exposure therapy for overeating aimed at maximizing inhibitory learning. The current RCT tested the effectiveness of this 8-session cue exposure intervention relative to a control intervention in 45 overweight adult (aged 18–60) females at post-treatment and 3-month follow-up, of which 39 participants completed the study. Weight loss, eating psychopathology, food cue reactivity, and snacking behaviour were studied as main treatment outcomes, and mediators and moderators of treatment effects were studied. The presented study design represents an innovative effort to provide valuable clinical recommendations for the treatment of overeating and obesity.

1. Introduction

A large proportion of overweight and obese individuals engage in weight loss attempts [1]. However, successful long-term weight loss seems very difficult to achieve: it has been estimated that only 20% of overweight individuals are successful at losing at least 10% of their initial weight and maintaining this loss for at least one year [2]. A major cause of eating more than physiologically needed is thought to be an increased reactivity to food cues. This food cue reactivity includes anticipatory psychological (i.e., craving) and physiological (e.g., increased salivation) responses that prepare an organism for food intake and promote (over)eating [3]. Overweight individuals and binge eaters show greater reactivity to food cues (e.g., [4,5]), while reactivity seems to be reduced in successful weight loss maintainers [6]. This suggests that aiming to diminish food cue reactivity during treatment might effectively reduce overeating and promote weight loss.

Food cue reactivity is at least partly learned (e.g., [7]): food cues (conditioned stimuli or CSs; e.g., the smell and sight of food) have become associated with eating (unconditioned stimulus or US) through repeated pairings, and these CSs can subsequently elicit cue reactivity. Similarly, learning models predict that extinction of cue reactivity can be achieved through repeated exposure to CSs without the US (eating), thereby lowering cue-elicited motivation to eat (e.g., [8,9]). This is the aim of cue exposure therapy, in which individuals with overweight and/or eating disorders are repeatedly exposed to their personal food cues without eating. Studies on cue exposure therapy are scarce, though the limited findings indeed show substantial reductions in cue-elicited cravings and eating binges (e.g., [10-15]). However, whether cue exposure is also effective in facilitating weight loss remains unclear. Moreover, although a long-term abstinence of binge eating has been found [11,15], returns of cravings and overeating at follow-up have also been reported [10], suggesting that cue exposure therapy might require optimization in order to have long-lasting effects.

The finding that appetitive responses can return after treatment is line with the idea that during extinction, the original CS-US association is not destroyed. Rather, a new association is formed: CS means no US [16,17]. This inhibitory CS-noUS association is relatively fragile and context-dependent, which is why responses can return even when they have been successfully extinguished. Hence, strengthening inhibitory CS-noUS associations in cue exposure therapy may help improve long-term outcome. For the treatment of anxiety disorders, Craske and colleagues [18] have recently proposed a number of exposure techniques to achieve this. One example is to design exposure sessions in a way that maximizes the violation of CS-US expectancies – if the non-occurrence of the US is surprising, this should strengthen (inhibitory)

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learning. In cue exposure, this may be achieved by identifying a patient's specific overeating cues that are linked to strong eating expectancies [e.g., "If I am home alone and I feel sad (CS), I will have an eating binge (US)"] and exposing the patient to these exact cues while facilitating attention to both the cues and the non-occurrence of the US (eating). This expectancy violation approach contrasts with the classical habituation approach, in which exposure sessions are targeted on lowering anxiety (or eating desires). Habituation during exposure sessions has been shown to be non-predictive of treatment outcome [14,19], though it remains an empirical question whether expectancy violation *is* important for treatment outcome in cue exposure therapy. Another interesting technique proposed by Craske and colleagues is occasional reinforced extinction: occasionally reinforcing the CS-US contingency might allow reinforced trials to be associated with extinction, leading to attenuated returns of responses. In cue exposure therapy, occasionally eating small amounts of food may reduce overeating by associating eating a small amount of food with no further intake (see [20,21]).

1.1. Objectives

The main aim of this RCT was to investigate the effects of a cue exposure intervention that is based on the inhibitory learning-based techniques proposed by Craske et al. [18] and aimed at achieving long-term reductions in overeating and weight in overweight individuals. An active control intervention was included aimed at improving lifestyle. As primary objective, it was studied whether participants who received the cue exposure vs. control intervention would lose more weight, show larger reductions in eating psychopathology and food cue reactivity, and consumed less high-calorie snack foods, both at post-treatment and at follow-up. As a secondary objective, it was studied whether the cue exposure vs. control intervention would show increased response inhibition and self-control, and less attentional bias towards high-calorie foods. Further, it was studied whether the effects on treatment outcome were mediated by expectancy violation, while habituation was not expected to play a role in treatment outcome. Finally, response inhibition and self-control, good sleep, and attentional bias were expected to be treatment outcome moderators.

2. Material and methods

2.1. Overview of study design

Participants were screened for eligibility and randomized to either an 8-session cue exposure intervention or an active control intervention (Lifestyle+). Measurements were conducted at pre-measurement, during the intervention, at post-measurement, and at three months follow-up (Fig. 1). The study was approved by the Ethical Committee of the Faculty of Psychology and Neuroscience of Maastricht University (148_07_10_2013_A3).

2.2. Participants and inclusion/exclusion criteria

Participants were overweight and obese individuals. The inclusion criteria included: a female gender, a Body Mass Index (BMI) of at least 27, and an age between 18 and 60 years. A BMI cut-off of 27 was used to avoid including participants who were borderline overweight. Females were included to facilitate comparability with a previous study [14], and to reduce variability in responses. Participants were also required to be highly motivated to lose weight: motivation to lose weight was verbally indicated on a 10-point scale, and participants had to indicate a minimum motivation of "8" to be eligible for participation. In addition, participants had to indicate experiencing a clear difficulty to refrain from eating palatable high-calorie snack foods. The exclusion criteria were: suffering from self-reported smelling problems (indication of anosmia) since smelling is an important part of the cue exposure intervention, pregnancy, currently receiving psychotherapeutic or psychopharmacological treatment, bariatric surgery (pre and post-operative), and insufficient time for the intervention and measurements. As shown in Fig. 1, of 75 interested participants that were informed about the study, 49 participants were eligible based on the abovementioned criteria.

2.3. Recruitment and retention

Participants were recruited in and around Maastricht through advertisements in local newspapers and gyms, and through flyers. Interested participants were carefully screened for eligibility during a phone interview. Participants received € 25, - for every completed measurement (pre, post, and follow-up). At follow-up, participants received another € 25, - as an additional incentive if they had attended all therapy sessions and measurements. In order to minimize drop-out after the post-measurements, participants were contacted by phone one month before the follow-up measurements to plan the last sessions, and to underline the importance of completing the study. The study was conducted from January 2015–December 2015.

2.4. Procedure

For each measurement (pre, post, and follow-up), participants attended the university on two separate sessions. It was attempted to minimize the time between both sessions, with a maximum of two weeks.

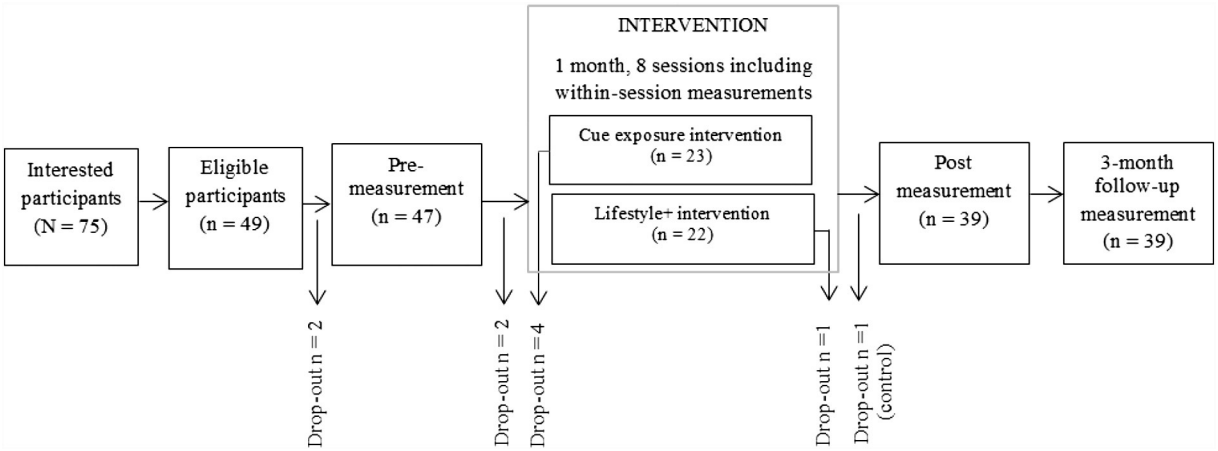

Fig. 1. Overview of the study design and sample size.