



Expectancy violation, reduction of food cue reactivity and less eating in the absence of hunger after one food cue exposure session for overweight and obese women



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ABSTRACT

The present study investigated whether a single-session of food cue exposure for overweight women would decrease 'if CS then US' expectancies, cue reactivity and eating in the absence of hunger (EAH). EAH was measured in a behavioural paradigm that enabled to also investigate whether the cue exposure effects were specific for exposed foods or would generalise to food items that were not present during exposure. Overweight women were randomly assigned to either the cue exposure intervention or a control intervention that focused on body image. In line with the hypotheses, results showed that cue exposure induced a significant decrease in 'if CS then US' expectancies, in contrast to the control intervention. It was also found that, compared to the control intervention, desires to eat initially increased during cue exposure while gradual extinction was observed towards the end of the intervention. No extinction of increased salivation responses was found. Regarding EAH, the intake of the exposed food item was significantly less in the exposure condition than in the control condition, whereas total caloric food intake was not different between conditions, indicating that cue exposure was effective in reducing intake but did not generalise to the intake of other food items.

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Overweight and obesity prevalence's pose a serious problem worldwide. In the Unites States, more than two-third of the adult population is overweight of which approximately half is obese (Ogden, Carroll, Kit, & Flegal, 2014). In European countries, as much as 50% of the adults population is overweight, including obesity prevalence's of 20% in men and 23% in women (WHO., 2014). Eating more than needed is primarily caused by hedonic eating or, put differently, eating for pleasure in the absence of (physiological) hunger (Lowe & Butryn, 2007). A cause of eating in the absence of hunger (EAH) is increased reactivity to food cues (Jansen, Havermans, & Nederkoorn, 2011a; Jansen et al., 2003). Food cue reactivity refers to anticipatory bodily reactions that prepare for food intake, such as saliva production, gastric activity and insulin rise, as well as psychological reactions such as a strong desire to eat the food (e.g. Jansen, 1998; Jansen et al., 2011a). Jansen (1998) theorized that most cue reactivity is classically conditioned. In classical conditioning, neutral stimuli (conditioned stimuli; CS) can

become associated with food intake (unconditioned stimulus; US) and, after a process of classical conditioning, just the confrontation with CSs can elicit conditioned responses (CR) as preparation for food digestion (Pavlov, 1927). With regard to human cue reactivity, stimuli such as the smell and sight of food (CS) that acquire predictive value of food intake (US) will easily elicit cue reactivity (CR), including increased eating desires and salivation (Jansen, 1998). Indeed, conditioning studies in animals and humans have found that after repeated pairings of neutral stimuli (CS) with food intake (US), CSs are able to elicit increased eating desires and bodily responses to prepare for food intake (e.g. salivation), and may stimulate overeating (e.g. Boggiano, Dorsey, Thomas, & Murdaugh, 2009; Bouton, 2011; van den Akker, Havermans, & Jansen, 2015; van den Akker, Havermans, Bouton, & Jansen, 2014; van den Akker, Jansen, Frentz, & Havermans, 2013). In line with these findings, it was found that healthy-weight non-restrained eaters showed increased gastric activity, heart rate and saliva production during exposure to food cues (CSs) (Nederkoorn & Jansen, 2002).

According to Jansen's (1998) model, increased cue reactivity makes it harder to resist palatable food. This was indeed confirmed by a study in healthy-weight students, who received 10-min

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exposure to food cues, and on a separate day, a 10-min control task. Food intake was measured after both tasks. Results showed that students consumed more food after food exposure than the control task (Jansen et al., 2011b). Ferriday and Brunstrom (2011) investigated cue reactivity and food intake in healthy-weight and overweight individuals, and found that one minute of food exposure led to increased desire to eat and food intake in both groups. However, food exposure led to significantly larger salivation and desire to eat in the overweight individuals as compared to the healthy-weight individuals. Along the same lines, a study that compared 10-min food exposure in overweight children versus healthy-weight children found that overweight children overate after food cue exposure, compared to healthy-weight children who successfully controlled their food intake. Moreover, food cue-induced salivary flow in the overweight children, and not in the healthy-weight children, was significantly positively related to food intake (Jansen et al., 2003). These findings show that exposure to food cues increases cue reactivity and food intake in healthy-weight participants – it is a normal response – while the effects are significantly stronger in overweight participants, making it more difficult for overweight people to resist tasty foods.

Circumstantial evidence for the hypothesis of cue reactivity playing a role in overeating comes from a pilot cue reactivity study in successful dieters (formerly obese) and unsuccessful dieters (still obese). The successful dieters had a current BMI <25, had achieved a mean weight loss of 27% of their original body weight and had maintained this weight loss for at least half a year, whereas unsuccessful dieters had a current BMI of >30 despite serious weight loss attempts. It was found that the unsuccessful dieters displayed a significant increase in salivation response to tasty food pictures relative to baseline salivation, whereas the successful dieters showed a significant decrease in salivation (Jansen, Stegerman, Roefs, Nederkoorn, & Havermans, 2010). These findings suggest that successful refraining oneself from high-caloric foods eventually may result in decreased cue reactivity. As the authors suggested, decreased cue reactivity might, in turn, make it easier to resist foods and to maintain the weight loss. Reducing cue reactivity could therefore be helpful to lose weight and to successfully prevent relapse. In cue exposure, the clinical proxy of extinction, participants are exposed to non-reinforced CSs predicting US, in order to decrease cue reactivity (CR). For example, participants smell, touch and lick the tasty foods (CSs) while actual food intake (US) is not permitted. Some small clinical studies with bulimia nervosa patients suggest that cue exposure can be very effective in reducing food cravings and binge eating (Jansen, Broekmate, & Heymans, 1992; Jansen, Van den Hout, De Loof, Zandbergen, & Griez, 1989; Martinez-malle et al., 2007; Toro et al., 2003). A clinical study by Boutelle et al. (2011) showed that an 8-session cue exposure treatment in obese children and their parents was more effective to decrease EAH compared to an appetite awareness intervention. In another, 16-session intervention study in which cue exposure and appetite awareness components were combined, no direct effects after therapy were found on EAH compared to a no treatment control group, but significant lower EAH was found at follow-up (Boutelle et al., 2014). Though food cue exposure is a promising intervention that seems to be effective in reducing eating desires and EAH, knowledge about its working mechanisms is still lacking.

It is now generally acknowledged that exposure therapy works through inhibitory learning (Craske et al., 2008; Craske, Liao, Brown, & Vervliet, 2012). Though it was originally assumed that by exposure to the CS without the occurrence of the US, the original CS – US association could be destroyed, this appears not to be the case: extinction does not destroy the original CS – US bond, but creates a new learning pathway; the CS means that the US will not follow (CS – no US). In other words, the CS acquires two meanings:

CS means US and CS means no US (Bouton, 1993; Bouton & King, 1983). Exposure should aim to make the new association (CS – no US) stronger than the old association (CS – US). Exposure should therefore be designed to optimally learn the new CS – no US association, that is, the client learns that the US will probably not occur in the presence of the CS. This is also called CS – US expectancy violation (Craske et al., 2012; Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). Craske et al. (2012; 2014) argue that CS – US expectancy violation during exposure is the key element for exposure to be effective: the more violation, the more treatment effect. This approach contrasts the habituation model, in which the central idea is to stay in the situation until fear (or in this case: the desire to eat) declines. Indeed, habituation either within and between exposure trials and ending fear levels have shown *not* to be a good predictor for treatment outcome (for review see Craske et al., 2008).

The primary aim of the present clinical experiment is to investigate whether food cue exposure is effective in reducing 'if CS then US' expectancies (i.e., expectancy violation), cue reactivity (saliva production and self-reported desires to eat), and eating in the absence of hunger (EAH) in overweight and obese females. 'If CS then US' expectancies are implicitly but not explicitly challenged in the present experiment. It is hypothesised that cue exposure significantly reduces 'if CS then US' expectancies, compared to the control condition (Rijkeboer & Van den Hout, 2014). Regarding cue reactivity, it is expected that cue exposure significantly increases salivation and the desire to eat in the beginning of the exposure, followed by extinction during prolonged exposure. The cue exposure condition is further hypothesized to show less eating in the absence of hunger (EAH) compared to the control condition, both for the exposed food item chocolate mousse and total consumption (generalisation). Finally the role of habituation vs. inhibition learning regarding treatment outcome (EAH) is investigated: EAH is expected to be positively associated with post-intervention 'if CS then US' expectations if inhibition learning is critical, whereas EAH is expected to be related to within-session habituation (WSH) of cue reactivity if habituation is critical for extinction.

1. Method

1.1. Participants

Participants who were motivated to lose weight were recruited via posters that were displayed in supermarkets and gyms. Fifty-four overweight women (Body Mass Index > 25) aged between 18 and 65, who were not pregnant, and were able to smell, participated in this study. Participants were told that the study's aim was to investigate the effects of a single-session psychological training to cope with food temptations. Participants were randomly assigned to the cue exposure condition ($n = 26$) or the control condition ($n = 28$), by assigning the first six participants who could make it on the same intervention date to the cue exposure condition, the six next participants to the control condition, and so on. The study was approved by the Ethical Committee of the Faculty of Psychology and Neuroscience of Maastricht University.

1.2. Assessment

1.2.1. 'If CS then US' expectancy

The following 'if CS then US' statement for overeating was used: 'If I have tasty food in front of me, then I can not resist to eat it'. The believability of this statement at the present moment was rated on a 0 (not at all) to 100 mm (very strong) Visual Analogue Scale (VAS).

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