Appetite 89 (2015) 226–236

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

Emotional eating and Pavlovian learning: Does negative mood facilitate appetitive conditioning? ☆

Peggy Bongers *, Karolien van den Akker, Remco Havermans, Anita Jansen

CPS, Department of Eating Disorders and Addiction, Faculty of Psychology and Neuroscience, Maastricht University, P.O. Box 616, Maastricht 6200 MD, The Netherlands

ARTICLE INFO

Article history:
Received 21 August 2014
Received in revised form 5 February 2015
Accepted 11 February 2015
Available online 16 February 2015

Keywords:
Emotional eating
Appetitive conditioning
Mood
Impulsivity
Cue reactivity

ABSTRACT

Objective: Emotional eating has been suggested to be a learned behaviour; more specifically, classical conditioning processes might be involved in its development. In the present study we investigated whether a negative mood facilitates appetitive conditioning and whether trait impulsivity influences this process. *Method:* After undergoing either a negative or neutral mood induction, participants were subjected to a differential classical conditioning procedure, using neutral stimuli and appetizing food. Two initially neutral distinctive vases with flowers were (CS+) or were not (CS–) paired with chocolate mousse intake. We measured participants' expectancy and desire to eat (4 CS+ and 4 CS– trials), salivation response, and actual food intake. The BIS-11 was administered to assess trait impulsivity. *Results:* In both mood conditions, participants showed a classically conditioned appetite. Unexpectedly, there was no evidence of facilitated appetitive learning in a negative mood with regard to expectancy, desire, salivation, or intake. However, immediately before the taste test, participants in the negative mood condition reported a stronger desire to eat in the CS+ compared to the CS– condition, while no such effect occurred in the neutral group. An effect of impulsivity was found with regard to food intake in the neutral mood condition: high-impulsive participants consumed less food when presented with the CS+ compared to the CS–, and also less than low-impulsive participants. *Discussion:* An alternative pathway to appetitive conditioning with regard to emotions is that it is not the neutral stimuli, but the emotions themselves that become conditioned stimuli and elicit appetitive responses.

Introduction

Emotional eating (i.e., eating in response to negative emotions) is a contributing factor in obesity and eating disorders (Hays & Roberts, 2008; Polivy & Herman, 2002). Several studies have shown overeating after the experience of negative emotions, such as stress, anxiety or sadness, in dieters (Cools, Schotte, & McNally, 1992; Heatherton, Herman, & Polivy, 1991; Loxton, Dawe, & Cahill, 2011; Wallis & Hetherington, 2004), obese people (Patel & Schlundt, 2001; Schneider, Appelhans, Whited, Oleski, & Pagoto, 2010), and obese binge eaters (Agras & Telch, 1998; Chua, Touyz, & Hill, 2004). However, it is unknown how emotional eating originates or how it is maintained.

It has been suggested that emotional eating is a learned behaviour, as the natural response for most people in the face of adversity is to *decrease* food intake (Wardle, 1990). Specifically, classical or Pavlovian conditioning has been proposed to be the involved mechanism (Greeno & Wing, 1994; Jansen, 1998; Jansen, Havermans, & Nederkoorn, 2011; Wardle, 1990). In classical conditioning, food intake is regarded as an unconditioned stimulus (US), eliciting unconditioned physiological responses (URs), such as insulin release, blood sugar increase and salivation. Over time, stimuli that are systematically paired with food intake can start to predict intake, thereby becoming conditioned stimuli (CS). After learning that the CS predicts the occurrence of the US, CSs are capable of eliciting appetitive responses, such as a conditioned desire to eat (i.e., cue reactivity). Virtually any stimulus in the environment can become a food-signalling CS, including the sight or smell of food, a certain time of the day, the environment or context (Jansen, 1998; Wardle, 1990) and it is also suggested that emotions can become food-signalling CSs (Jansen et al., 2011).

Experimental studies indeed show that eating desires can be conditioned quite easily. Van Gucht and colleagues (Van Gucht, Baeyens, Hermans, & Beckers, 2013; Van Gucht, Baeyens, Vansteenwegen, Hermans, & Beckers, 2010; Van Gucht, Vansteenwegen, Beckers, & Van Den Bergh, 2008; Van Gucht, Vansteenwegen, Van den Bergh, & Beckers, 2008) and Papachristou, Nederkoorn, Beunen, and Jansen (2013) convincingly demonstrated appetitive conditioning to a neutral cue (i.e., a serving tray) in several studies, with participants

☆ *Acknowledgements:* This study is part of an ongoing project that is financed by the Netherlands Organisation for Scientific Research (NWO): Vici Grant 453.10.006, awarded to Anita Jansen.

* Corresponding author.
E-mail address: peggy.bongers@maastrichtuniversity.nl (P. Bongers).

http://dx.doi.org/10.1016/j.appet.2015.02.018
0195-6663/

reporting increased food expectancy, eating desire, and automatic approach tendencies when presented with the cue that predicted the intake of appetizing foods (CS+; a tray in one shape and colour) compared to the cue that did not predict the intake of appetizing foods (CS–; a tray in another shape and colour). Van den Akker, Jansen, Frentz, and Havermans (2013) extended these findings by showing appetitive conditioning in response to contexts (neutral environments in a virtual reality lab), indicating that besides specific cues, specific contexts can also come to elicit food expectancy and eating desire after the context becomes a predictor of intake. In addition to expectancy and desire, Van den Akker et al. (2013) also measured salivation and actual food intake. They found increased saliva production in participants presented with the CS+, but not the CS– context. Thus, after only 6 pairings of a neutral context with the intake of appetizing food, some evidence was found that participants salivated more in the context that predicted the intake compared to a context that did not predict intake. The authors also found that food intake increased in the CS+ compared with the CS– contexts, but only for participants high in impulsivity. This effect of impulsive people showing increased conditioned food intake is interesting, considering the wealth of research showing a positive association between impulsivity on the one hand and food consumption and obesity on the other hand (see Guerrieri, Nederkoorn, & Jansen, 2008 for an overview; Velázquez-Sánchez et al., 2014). Importantly, a role for impulsivity in appetitive conditioning was proposed by Gray (Corr, Pickering, & Gray, 1995) in his BIS/BAS theory, which predicted that high impulsivity (i.e., strong BAS; Behavioural Approach System) is related to increased associative appetitive learning, while high anxiety (i.e., strong BIS; Behavioural Inhibition System) is related to increased aversive learning. Research with regard to the facilitating role of impulsivity in appetitive learning has however yielded mixed results (Corr, 2004; Corr et al., 1995; Paisey & Mangan, 1988; Papachristou et al., 2013; Van den Akker et al., 2013; Zinbarg & Mohlman, 1998; Zinbarg & Revelle, 1989) and studies specifically on food as the appetitive stimulus are scarce (Papachristou et al., 2013; Van den Akker et al., 2013).

If emotional eating is, as we suggest, learned through classical conditioning, two pathways through which this could occur are most obvious. First, it is frequently reported by emotional eaters that they overeat when feeling bad. If a particular emotional state is frequently associated with the intake of appetizing high calorie foods, and the contingency between this emotion and eating is strong (i.e., the probability of the emotion leading to eating approaches one), this association will ultimately lead to the emotion becoming a reliable predictor of food intake, i.e., a CS. After conditioning, confrontation with the CS (emotion) will elicit cue reactivity, i.e., an eating desire or food craving, and ultimately food intake. An alternative pathway is negative mood facilitating the learning of associations between neutral stimuli and food intake. High-calorie foods have strong rewarding properties (see for example Coletta et al., 2009; Macht & Dettmer, 2006; Macht & Mueller, 2007; Small, Zatorre, Dagher, Evans, & Jones-Gotman, 2001), which might be extra rewarding and thus relevant for people who find themselves in a negative emotional state (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Hepworth, Mogg, Brignell, & Bradley, 2010). They would benefit from learning that certain cues predict food intake that might alleviate their bad mood. In this model, a neutral stimulus from the environment, or the environment itself, becomes the CS. The CS predicts food intake and as a consequence of the rewarding foods, a better mood. This pattern might be considered a specific form of state-dependent learning or context learning, in which the negative mood functions as a state or context. Furthermore, research in fear conditioning has brought forward some evidence that negative contexts (i.e., threat) facilitate conditioning (Karos, Meulders, & Vlaeyen, 2014). The latter pathway is the one under investigation in the current study.

In the present study, we tested the hypothesis that participants in a negative mood would show facilitated appetitive conditioning. We expected stronger differential responses to the CSs for the group that was conditioned in a negative mood compared to the group that was conditioned in a neutral mood: those in a negative mood would show a larger difference in expectancies to receive food, desires to eat food, saliva production, and food intake in response to the CS predicting the intake of high-caloric food (CS+) than to the CS not predicting food intake (CS–). Because impulsivity is strongly related to overeating and obesity and earlier research shows that highly impulsive participants in particular eat more after classical conditioning (Van den Akker et al., 2013), we investigated the possibility of a moderating effect of impulsivity on expectancy, desire, salivation and food intake, with higher levels of impulsivity facilitating conditioning.

Methods

Participants

A total of 127 female undergraduate students, aged between 17 and 30 years (M = 19.98, SD = 1.79), took part in the study. The students were told that the study concerned examining the relationship between music and taste. To be included, participants had to like chocolate mousse (the food of choice in the current study; scoring at least 3 on a 5-point Likert scale ranging from 'I do not like chocolate mousse at all' (1) to 'I really like chocolate mousse' (5)), which was assessed with a single question among four filler questions during sign up. They were instructed to eat something small (e.g., a sandwich or an apple) 2 hours before the start of the experiment, and to refrain from food intake (with the exception of water) in the time thereafter. Furthermore, they were asked not to eat any chocolate in the 24 hours before participating. For participation, participants received either one course credit, or € 7.50. The study's procedure was approved by the local ethics committee. At the end of the study, when all testing was completed, participants received a debriefing via email containing an explanation of the aims and measures of the study.

Design

The study used a mixed design. Participants were randomly divided over 2 conditions: negative mood and neutral mood (from hereon called Negative and Neutral, respectively). Within these conditions, participants were divided into two groups for the post-conditioning saliva measurement and taste test. Half of the group in each mood condition received these measurements in presence of the CS+ (from here on called 'Negative CS+' and 'Neutral CS+'), while the other half received them in presence of the CS– (from here on called 'Negative CS–' and 'Neutral CS–'). Mood, expectancy to receive food and desire to eat were within-subject variables, measured 8 times for each participant (4 times in response to CS+, 4 times in response to CS–). Saliva production was an additional within-subject variable, measured at baseline and at the end of the conditioning procedure (for half the participants in presence of the CS+, for the other half in presence of the CS–).

Stimuli

Mood manipulation

After sign-up, the participant was instructed to bring at least three pieces of music (lasting for a minimum of 8 minutes) that made her happy and three pieces of music that made her sad (also totalling at least 8 minutes) with her to the lab. Participants were randomly assigned to either the neutral or negative condition. To induce a negative mood, the participant was asked to think of a sad