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

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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 distinct 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.

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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, Vansteenkoven, Hermans, & Beckers, 2010; Van Gucht, Vansteenkoven, Beckers, & Van Den Bergh, 2008; Van Gucht, Vansteenkoven, 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...
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’ (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 here on 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 totaling 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
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