Cheering versus giggling: two happy stimuli can be used in appetitive conditioning paradigms

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CHEERING VERSUS GIGGLING: TWO HAPPY STIMULI CAN BE USED IN APPETITIVE CONDITIONING PARADIGMS*

In appetitive conditioning, a neutral stimulus (CS) is conditioned to elicit a positive emotional response by pairing it with a positive/appetitive unconditioned stimulus (US). This method is useful for studying emotional disorders and emotion in general. Studying appetitive conditioning in humans has been hampered by the lack of adequate positive unconditioned stimuli. This study investigated multimodal social stimuli as potential unconditioned stimuli in an appetitive conditioning paradigm. Neutral faces (CS+'giggle' and CS+'woohoo') were paired with two multimodal unconditioned stimuli consisting of the same smiling face and two different sound stimuli (US'giggle' and US'woohoo'). The dependent variable was participant skin conductance response (SCR) alongside participant emotional ratings of the stimuli, that together indexes the conditioned response. CS+'giggle' was hypothesized to be rated as happier, and less fearful than CS+'woohoo'. Successful conditioning was evidenced by higher happiness ratings for both stimuli after acquisition compared to habituation. However, no effect of acquisition was found on SCR. US'woohoo' was also rated as more fearful and arousing and less happy and pleasant than the US'giggle'. In sum, this thesis presents a paradigm that can be used in future studies on appetitive conditioning.

The study of emotion plays a key role in understanding motivated behaviour. When we navigate ourselves through the world, we encounter countless forms of different stimuli that elicit many different types of emotional responses. These responses can significantly affect our behaviour in a number of ways. Studying these reactions can increase our knowledge about human behaviour and help us gain insight into vital behavioural structures and decision making (Clark, Hollon & Phillips, 2012; Everitt, Cardinal, Hall, Parkinson & Robbins, 2000; Kerr, 1996). This is particularly salient regarding motivational and goal-directed behaviours. Any goal-directed behaviour is to some extent the result of an emotional reaction and therefore contains an inherent emotional component. This component generally manifests in two ways: *appetitive* and *aversive* emotional reactions to things we encounter in the world (Andreatta & Pauli, 2015). In other words, our emotional reactions can result in goal-directed behaviour where one either seeks to attain something, known as approach behaviour, or behaviour where one seeks to avoid something, known as avoidance behaviour (Balconi, Falbo, & Conte, 2012; Martin-Soelch, Linthicum, & Ernst, 2007). The development of both types of behaviour are a result of evolution and consequently important for survival (Martin-Soelch et al, 2007). However, much of the literature on avoidance and approach behaviours has focussed upon aversive reactions and, more specifically, *aversive conditioning,* a type of conditioning where an association is formed

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between a neutral stimulus and an aversive stimulus to elicit negative emotions. Much less focus has been devoted to *appetitive conditioning*, which refers to conditioning where a neutral stimulus is associated with a positive stimulus to elicit positive emotions (see below for a detailed description of conditioning). This entails a major shortcoming in the literature as understanding of appetitive conditioning is particularly important not only for expanding knowledge about motivational and learning processes, but also for understanding of emotions as a whole (Martin-Soelch et al, 2007). So, despite having the same evolutionary significance as the conditioning of aversive stimuli, appetitive conditioning has received significantly less attention in the research literature compared to aversive conditioning. This gap in research between appetitive and aversive conditioning can be explained by the difficulty to find suitable appetitive stimuli that elicit physiological reactions similar enough to allow for comparison to stimuli used in aversive conditioning (Martin-Soelch et al, 2007). Understanding aversive and appetitive conditioning and explaining avoidance and approach behaviours is vital for explaining several types of psychiatric disorders related to emotion and motivation. These include disorders such as addiction, where motivation plays a key role (Kalivas & Volkow, 2005), and other disorders, such as borderline personality disorder, where the individual's emotional response is incongruent with the typical and/or expected reaction to stimuli encountered in the world (Lieb, Zanarini, Schmahl, Linehan, & Bohus, 2004). Theorists have argued that a shift in focus is needed, from the negative emotions individuals experience in these disorders, to positive emotions (Seligman & Csikszentmihalyi, 2000), which would benefit from the use of appetitive conditioning.

Positive emotions

Often, the distinction between positive emotions and other closely related affective states, such as positive mood and sensory pleasure, has been blurry, and it has been suggested that emotions in general best be conceptualized as "multicomponent response tendencies – incorporating muscle tension, hormone release, cardiovascular changes, facial expression, attention and cognition, among other changes – that unfold over a relatively short time span" (Fredrickson & Cohn, 2016, p. 778). This evolved into the even more recent *appraisal theory*, which makes the distinction between sensory pleasure and emotional states in that, whereas sensory pleasure may share a subjective pleasant feel and physiological changes may be included, an emotion also requires an *appraisal* of the situation/some stimulus, or alternatively, an assessment of its meaning (Scherer, 1999). As suggested by Berridge and colleagues (Berridge & Robinson, 2003; Pecina; Smith, & Berridge, 2006), on a neurological level, positive affect, i.e. a positive emotional state, includes a "passive liking component" mediated by opioid receptors and a "motivational wanting component" mediated by dopamine. Along these lines, researchers have suggested that the function of all positive emotions can be conceptualized as facilitating approach behaviour (Cacioppo, Priester, & Berntson, 1993; Davidson, 1993), or continued action (Carver & Scheier, 1990; Clore, 1994). Experiences of positive emotions, from this perspective, is evolutionary adaptive for individuals, their species, or both, as it prompts individuals to engage and interact with their environments and take part in beneficial activities (Fredrickson & Cohn, 2016). In this way, the tendency for individuals to experience mild affect frequently, even in neutral contexts (Diener & Diener, 1996), can be explained through the link between positive affect and activity engagement (Lyubomirsky, King, & Diener, 2005; Mageau & Vallerand, 2007). Theorists have disagreed on the modelling of emotion: various models of emotion include points on a two-dimensional plane, points in a higher dimensional space, and separately evolved modules, see Scherer (2000) and Sloman (2000) for other examples.

However, a general consensus has been reached "that a primary characteristic of every emotion is valence on a bipolar continuum from highly unpleasant to highly pleasant" (Fredrickson & Cohn, 2016, p. 779). In addition to the valence dimension, each emotion can also be rated on arousal, from low-arousing to high-arousing. This results in a two-dimensional circumplex model of emotions (Russell, 1980).

Appraisal or quantification of pleasantness can occur when an emotion, for instance, remedies a noxious or goal-inconsistent state, contributes to a personal goal, or when it fulfils a biological need (Ellsworth & Scherer, 2003). Arousal, on the other hand, is a more biological reaction and can be quantified by measuring eye blinking, the skin conductance response, and heart rate, to name a few. A shortcoming of previous investigations into positive emotions has been to conflate pleasantness with either high arousal or high personal control, despite that pleasant emotions are known to span the range of these phenomena, i.e. pleasant emotions span across both high and low arousal and across high and low control. Fredrickson and Cohn (2016) suggest this is important as low-arousal emotions are likely to differ from high-arousal ones in their thought-action tendencies. One way of quantifying and to predict an individual's psychological and social outcomes is to look at the ratio between positive to negative emotions (Fredrickson & Losada, 2005; Gottman, 1994). Therefore, it is highly relevant to be able to quantify what type of stimuli can cause these reactions in order to improve human wellbeing. Interestingly, experiences of various positive emotions are more likely to covary than negative emotions (Barrett, Gross, Christensen, & Benvenuto, 2001). In other words, one is more likely to experience a range of positive emotions when one is in a positive state, compared to negative emotions, where one is more likely to only feel one negative emotion at a time. Positive emotions prompt a broader range of actions and thoughts than negative ones because negative emotions are evolutionary adapted for specific, survival-critic situations, and therefore it is plausible that only one emotion – or a closely related cluster – would be evoked in negative situations (Fredrickson & Cohn, 2016). Positive emotions initiate a broader range of actions and thoughts, and therefore it is more likely that, for instance, a feeling of joy and pride upon accomplishment of a task would create even more positive emotions, causing one to engage in even greater challenges. Negative emotions have received a great deal more of research attention, for a number of reasons, such as the fact that psychology as a whole has emphasized solving problems in people's lives over looking at positive aspects of the individual's life (Seligman & Csikszentmihalyi, 2000). In other words, negative emotions are pathologically more present both in disorders of the mind and in the research literature. However, positive emotions manifest in many types of disorders, such as mania or addiction, and neglecting positive emotions – which play a critical role in both the disorder and in developing compensatory strengths to overcome adversity – results in an incomplete picture which overlooks possible means of individual recovery from these disorders.

Hence, it is important to study positive emotions and how they may be elicited from conditioned stimuli, as it may provide us with tools not only to understand and study the underlying processes behind pathological behaviour manifested in mental illness but may also aid in increasing overall happiness for people suffering from different emotional disorders. In a research setting, classical conditioning has been the favoured and most robust method for examining this phenomenon.

Classical conditioning

Classical conditioning entails the repeated pairing of a neutral stimulus (NS) with an unconditioned stimulus (US). By continual association, the NS will come to trigger the same reaction as the US. Hence, the unconditioned response (UR) produced by the US is now elicited by the NS. The NS is then referred to as the conditioned stimulus (CS) and the reaction to the CS is known as the conditioned reaction (CR). 'Unconditioned' means that the response to the stimulus is not learned but naturally connected. Some important main prerequisites exist for classical conditioning. One of these is that the unconditioned reaction elicited by the US is innate, and that the unconditioned reaction occurs at a physiological level (Pavlov, 1927). In the original classic experiments by Pavlov, dog saliva levels were used as the innate physiological response (UR) to the presentation of food (US). He used repeated pairing of the sound of a bell or a flashing light (NS) with the delivery of food, while also ensuring close temporal proximity between the NS and US and showed that the flashing lights alone or the sounding bell could result in salivation (CR) (Pavlov, 1927). However, conditioning is not produced solely by pairing US and CS: contemporary theories of learning emphasize the predictive relationship between the CS and the US. Another important condition for classical conditioning is a close temporal proximity between the presentation of the US and CS. This allows the CS to predict the occurrence of the US and the subject learns that the stimuli are connected (Martin-Soelch et al, 2007). Moreover, it has been shown that the information value of CSs can be degraded through CS-alone and US-alone trials, resulting in offset of the pairings. (Martin-Soelch et al, 2007; Rescorla, 1966; Rescorla & Wagner, 1972). When learning has been accomplished and the CR is elicited by the CS, the CS can then be paired with a new neutral stimulus to produce the same response (CR). This process is known as second-order conditioning, a core aspect of acquisition of new rewards, along with being a critical process involved in adaptive motivated behaviour (Martin-Soelch et al, 2007). In sum, classical conditioning is the process through which neutral stimuli acquire new motivational significance through their association with e.g. a reward as in appetitive conditioning. At current, research on appetitive conditioning in humans has received limited attention, but there is a substantial animal literature on appetitive conditioning, and several different types of stimuli has been used in many different studies.

From crabs to humans – appetitive conditioning across species and different appetitive stimuli

Appetitive conditioning is evolutionary conserved across species (Olsson and Phelps, 2007) and much research has been conducted on animals, such as crabs, frogs, mice, mussels, and snails (Andrew & Savage, 2000; Bouton & Peck, 1989; Cole, Hobin, & Petrovich, 2015; Cybulska-Klosowicz, Zakrzewska, & Kossut, 2009; Klappenbach, Nally, & Locatelli, 2017). It is clear that animals can learn to condition to appetitive stimuli and adapt its behaviour. Why, then, has so little research focused on appetitive conditioning in humans? The fundamental answer is probably that it has been considerably and consistently more difficult to find stimuli that can elicit appetitive responses in humans. The most frequently used appetitive stimuli for conditioning animals and humans is food, perhaps the most basic unconditioned stimulus. As it is a type of unconditioned stimuli, one can assume that the effect of using food as the main appetitive stimuli will produce similar effects across species. Food as an appetitive stimulus has been found to be useful in many different studies, such as temporal map learning (Taylor, Joseph, Shao, & Balsam, 2013), but also in studies on brain networks (Britton, Lissek, Grillon, Norcross, & Pine, 2011; Martin-Soelch et al, 2007). Hence, food is a useful type of stimuli that can be used to elicit appetitive responses in both humans and other animals. However, the effectiveness of using food as an unconditioned stimulus is dependent on several factors, the most apparent being the general appetite of the individual or organism being put through the conditioning procedure. In some cases, participants have been asked to not eat, or to eat very little before being exposed to the conditioning process (Andreatta & Pauli, 2015). This carries with it certain disadvantages and may in certain cases not be ethically viable. For instance, some individuals require special diets and may not react well to not eating for even a short period, such as diabetics or the elderly. It is also unclear what effect low blood sugar can have on test results and the ability to being conditioned. Therefore, these individuals may not be able to partake in these types of testing, elucidating a shortcoming in using food as a main stimulus.

Another frequently used unconditioned stimuli is money. The use of monetary unconditioned stimuli is problematic because money is a secondary reinforcer, and different neural networks underlie the processing of primary and secondary reinforcers (Delgado, as cited by Andreatta & Pauli, 2015). Previous studies have also made use of appetitive stimuli in the form of pornographic images (Bradley, Greenwald, Petry, & Lang, 1992) or texts (Cahill & McGaugh, 1995), another problematic form of stimuli entailing ethical issues such as that it cannot be used on children, conflates arousal with pleasantness, and furthermore its effectiveness is dependent on many factors such as sexual orientation. Hence, food, money, and sexually arousing content are three of the most widely used flawed stimuli in appetitive conditioning. The current investigation seeks to remedy the shortcomings of other studies, by using social stimuli in the form of smiling faces and human cheering and giggling sounds as unconditioned stimuli. Social stimuli are biologically relevant and easily delivered to participants, without the need for special preparation (e.g. fasting as in the case of food). Furthermore, as facial expressions and human vocal sounds are the two most important ways for humans to communicate emotions to one another, they are possibly more likely to elicit any type of human emotion than other ‘dead’ stimuli, such as food or money. A sound such as a human giggle or a laugh is not only a way of communicating emotion, but it is also the natural response to a humorous event. Therefore, it is likely one of the most natural sounds one can use to elicit a positive emotion. Despite the advantages of using positive social stimuli as unconditioned stimuli in appetitive conditioning paradigms, few studies have tested appetitive conditioning using social stimuli in humans.

Current investigation

This thesis investigates the effect of the unconditioned stimulus on appetitive conditioning in humans by creating and testing a novel appetitive conditioning paradigm with two multimodal appetitive unconditioned social stimuli. Hence, the aim will be to test whether two social stimuli can be used as unconditioned stimuli in appetitive conditioning, and if the conditioned response differs between the stimuli. Emotional responses to the conditioned stimuli will be examined using *skin conductance response* (SCR; a physiological index of arousal) and subjective happiness/fear ratings of the stimuli, to allow for a comparison between their experience of the stimuli, and their SCR readings as a measure of general arousal.

The current investigation makes use of appetitive conditioning in a trial where participants encounter either appetitive conditioning in two types: the first stimulus consisting of a smiling face paired with a giggling sound, and the second stimulus consisting of a smiling face paired with a cheering *woohoo* sound. A comparison will be made between habituation to the conditioned stimuli (baseline) and acquisition to determine whether there is any change in participant ratings and/or arousal during or between habituation and acquisition (see below for detailed description of habituation/acquisition phases). It is hypothesized that the giggle will be rated as significantly happier than the 'woohoo', and that the 'woohoo' will be rated as significantly more fearful. This hypothesis assumes that the sound of a giggle is a fundamentally happier sound in comparison to the sound of a 'wohoo' as the giggle is conceivably more evolutionary significant, more natural and easier to comprehend than the sound of a 'wohoo'. Therefore, it seems plausible that the more familiar giggle sound will result in greater happiness ratings than the less familiar sound as the connotations it carries may be clearer compared to the more ambiguous 'woohoo'. Furthermore, it is hypothesized that the 'woohoo' will elicit significantly greater arousal as a 'woohoo' sound is perhaps more likely to be used in conjunction with an arousing event such as a competition than a giggle. Furthermore, as the sound of a 'woohoo' is a less natural and perhaps more ambiguous sound it may cause increased arousal due to its novelty in comparison to the more familiar sound of a giggle.

Method

The current study is part of a larger project studying emotions, memory, and recognition at the Department of Psychology at Stockholm University. The complete test battery included questionnaires and tests not used in the current study, including a questionnaire on caffeine habits, Situational Test of Emotional Understanding (STEU), Emotion Recognition Assessment in multiple Modalities (ERAM), one aversive and one appetitive conditioning paradigm, State-Trait Anxiety Inventory – Trait (STAI-T), Adult Temperament Questionnaire (ATQ), and the Emotion Regulation Questionnaire (ERQ). The current study concerns the appetitive conditioning paradigm only.

Design

The experiment was a within-subjects repeated measures comparison. The outcome variables were SCR and subjective emotional ratings and included two main conditions: the 'woohoo' condition, and the 'giggle' condition. All data was collected during a single session.

Participants

Participants consisted of 43 individuals recruited chiefly through poster advertising in different Stockholm universities and mailing lists. Due to time limitations, only 27 of these individuals participated in the final ratings(see below for detailed description of ratings). The majority of participants consisted of students attending Stockholm University. All participants were awarded with either 2 hours of course credit hours (EE), or 2 cinema vouchers. The only inclusion requirement for participation was basic knowledge of Swedish, to ensure understanding of the material. 15 men, 27 women, and 1 individual who did not report gender were included. 15 participants were educated at the university level (34.9%), 27 participants were educated at the high school level (62.8%), and 1 participant was educated at the elementary school level (2.3%). The mean age of participants was 24.93, with a minimum age of 19 years old, a maximum age of 43 years old, and a standard deviation of 5.853 years.

Appetitive conditioning task

Stimuli

Faces used in the procedure were collected from the FACES database (Ebner, Riediger, & Lindenberger, 2010). The following faces were used: 006, 069, 134. All faces were converted to grayscale and presented to the participants (Figure 1.).

Figure 1. The faces used in the study were taken from the FACES database. The numbers correspond to the numbers in the FACES database.

Sounds

The 'woohoo' sound was acquired from the AudioMicro stock audio library via https://www.audiomicro.com/woohoo-sound-effects-820363 (track no. 820363). The giggling sound was acquired from Laukka et al. (2013) (clip HapFUS2.wav).

Conditioning paradigm

The conditioning made use of black-and-white photos of three different women with neutral facial expressions as conditioned stimuli (CS), and photos of the same women with happy facial expressions combined with a sound of a giggle or a 'woohoo' as the multimodal unconditioned stimulus (US). During the entire experiment, electrodes attached to participants' left hand registered their skin conductance. All participants were presented with the same stimuli in a pseudorandom order according to paradigm, i.e. some individuals would have been presented with face 006 as the CS-, whereas other would have been presented with face 069 as the CS-, and some with face 134 as the CS-, and so forth. This was to control for any effects of specific CS.

The conditioning process involved three main parts: 1) habituation, 2) acquisition and 3) extinction. Habituation ensures that any initial individual differences in response to any of the three neutral faces do not affect learning. This is achieved by presenting each CS (neutral faces) 4 times each during 8 s, without being paired with any other stimulus. Between face presentations, a grey background was presented for a variable time (10-14 s). During acquisition, the CS was shown 12 times each. One of the CS (CS+'woohoo') was paired with pleasure through appetitive conditioning, i.e. the neutral face (CS+'woohoo') was presented for 6.5 s, after which it simultaneously changed expression to a happy face and a 'woohoo' (US'woohoo') sound played in the headphones for 1.5 s. Another CS (CS+'giggle') was instead paired with a smiling face and a giggle sound (US'giggle'), and the third CS (CS-) was shown for 8 seconds and never paired with another stimulus. Reinforcement rate was 75%, i.e. in 75%

(9/12) of CS+'woohoo' and CS+'giggle' presentations US'woohoo' and US'giggle' were presented respectively. During extinction each CS was presented 10 times each without the US.

Measures

Skin conductance response

Participants' skin conductance responses were recorded using the BIOPAC system (BIOPAC Systems, Goleta, CA) with two Disposable Ag/AgCl SCR electrodes attached to the palmar surface of their left hand. Scoring of SCRs were done using the Ledalab software package (Benedek & Kaernbach, 2010) implemented in Matlab (Mathworks Inc., Natick, MA). Analyses of SCR was done using the maximum phasic driver amplitude (Max.SCR) 1-4 s after presentation for each participant. Values lower than 0.01 were scored as zero (non-response). SCRs were square root transformed and range-corrected by dividing all SCRs for each participant with each participants' maximum SCR (Lykken, 1972). Therefore, SCRs range from 0 to 1, and used here as a measure of learning.

Ratings

Participants were asked to rate their happiness and their fear when looking at the faces for all three CS before habituation, after acquisition, and after extinction on a scale from 1 to 10, where 1 is the lowest rating and 10 the highest rating, i.e. a rating of 10 would indicate participants found the stimuli to be very happy or fearful, and a rating of 1 would indicate participants did not think the stimuli was happy or fearful at all. After extinction and rating of the CS, participants also rated fear, happiness, arousal, and pleasantness of the unconditioned stimuli on the same scale.

Procedure

The experiment took place in a Stockholm University lab. They filled out the informed consent form and were told that there would be a connection between what neutral face they would see and what emotion would be presented but were otherwise uninformed of the contents of the experiment. Two electrodes were placed on the participants' palm and they were told to remain still and focus on the screen. The participants received the audio stimuli through headphones while looking at a computer monitor presenting the visual stimuli. Ratings were recorded using the number buttons on a computer keyboard. The experimenter was present in the room throughout the entire experiment and managed the conditioning paradigm using a separate computer beside the participant. Participants were ensured privacy from the experimenter by using a screen divider.

Results

SCR

Habituation

A paired samples t-test was conducted to determine whether mean SCR during habituation was significantly different for the CS+'giggle' condition (M = .114, SEM = .017) compared to the neutral condition CS- (M = .120, SEM = .019). No significant difference was found; $t(42) = -.386$, $p = .702$. A further paired samples t-test was conducted to determine whether the CS+'woohoo' condition (M = .092, SEM = .017) was significantly different than the CS- condition (M = .120, SEM = .019). No significant difference was found; $t(42) = -1.722$, $p = .095$. In a paired samples t-test between the CS+'giggle' and the CS+'woohoo' conditions during habituation, no significant difference between the CS+'giggle' (*M* = .114, *SEM* = .017) and CS+'woohoo' (*M* = .091, *SEM* = .018) was found, *t*(42) = 1.287, *p* = .205.

Acquisition

A paired samples t-test between CS+'giggle' (*M* = .119, *SEM* = .013) and CS- (*M* = .104, *SEM* = .012) during acquisition revealed no significant difference: *t*(42) = 1.362, *p* = .180. Upon comparing the CS+'woohoo' condition (*M* = .117, *SEM* = .013) with the unreinforced CS- condition (*M* = .104, *SEM* = .012) it was found that SCR readings were not significantly different for the CS- compared to the CS+'woohoo', *t*(42) = 1.134, *p* = .263. In a paired samples t-test between the CS+'giggle' (*M* = .119, *SEM* = .013) and the CS+'woohoo' (*M* = .117, *SEM* = .013) conditions, no significant difference was found: *t*(42) = .199, *p* = .843.

Testing was conducted to determine whether participants' skin conductance response to the stimuli changed as a function of acquisition. A paired samples t-test revealed no significant difference in SCR readings for the CS+'giggle' stimulus during habituation (*M* = .114, *SEM* = .017) compared to during acquisition (*M* = .119, *SEM* = .013); *t*(42) = -.291, *p* = .773. Furthermore, no significant difference was found when comparing the CS+'woohoo' stimulus during habituation (*M* = .092, *SEM* = .017) and during acquisition (*M* = .117, *SEM* = .013); *t*(42) = -1.591, *p* = .119.

Ratings

Habituation

Fear ratings during habituation was not significantly different between the CS- (*M* = 1.79, *SEM* = .313) and the CS+'woohoo' stimulus (*M* = 2.05, *SEM* = .305); *t*(42) = -.992, *p* = .327, nor was there a significant difference in fear rating between the CS- and the CS+giggle stimulus (*M* = 1.60, *SEM* = .300); *t*(42) = .881, *p* = .229. Furthermore, happiness ratings for the CS- (*M* = 2.37, *SEM* = .278), and the CS+'woohoo' stimulus (*M* = 2.60, *SEM* = .288) did not statistically differ; *t*(42) = -1.220, k = .229, and there was no significant difference in happiness rating between the CS- and the CS+'giggle' stimulus (*M* = 2.42, *SEM* = .289); *t*(42) = -.321, *p* = .750. Initial fear ratings during habituation did not differ between the CS+'woohoo' stimulus (*M* = 2.05, *SEM* = .305) and the CS+'giggle' stimulus (*M* = 1.60, *SEM* = .300); *t*(42) = 1.607, *p* = .116. Furthermore, no significant difference was found in initial happiness ratings between the CS+'giggle' stimulus (*M* = 2.60, *SEM* = .288), and the CS+'woohoo' stimulus (*M* = 2.42, *SEM* = .289); *t*(42) = .984, *p* = .331.

Acquisition

Fear ratings for the CS- (*M* = 2.14, *SEM* = .356) and the CS+'woohoo' (*M* = 2.19, *SEM* = .362) did not statistically differ during acquisition; t(42) = -.128, p = .899, nor did fear ratings between the CS- and the CS+'giggle' (1.70, SEM = .311); *t*(42) = 1.237, *p* = .223. However, happiness ratings for the CS- (*M* = 1.95, *SEM* = .274) and the CS+'woohoo' (*M* = 2.91, *SEM* = .329) were significantly different; *t*(42) = -3.355, *p* = .002. Participants also rated the CS+'giggle' stimulus (*M* = 3.79, *SEM* = .353) significantly higher on the happiness scale than the neutral stimulus during acquisition; *t*(42) = -5.608, *p* < .001. No significant difference was found between the fear ratings of the CS+'woohoo' stimulus (*M* = 2.19, *SEM* = .362), and the CS+'giggle' stimulus (*M* = 1.70, *SEM* = .311); *t*(42) = 1.561, *p* = .126, however happiness ratings differed significantly between the CS+'woohoo' (*M* = 2.91, *SEM* = .329) and the CS+'giggle' (*M* = 3.79, *SEM* = .353) stimuli; *t*(42) = -3.239, *p* =.002. The face paired with a giggle was thus rated as significantly happier during acquisition than the face paired with the 'woohoo'.

Testing was conducted to determine whether participants' rating of the stimuli changed as a function of acquisition. No significant difference was found in participant fear rating of the CS+'woohoo' stimulus during habituation (*M* = 2.05, *SEM* = .305) compared to during acquisition (M = 2.19, SEM = .362); $t(42)$ = -.397, p = .693, nor was there any difference in happiness rating of the CS+'woohoo' stimulus during habituation (M = 2.60, SEM = .288) compared to during acquisition (M = 2.91, SEM = .329); $t(42)$ = -.994, p = .326. Upon comparing participant fear rating of the CS+'giggle' stimulus during habituation (M = 1.60, SEM = .300) and during acquisition (M = 1.70, SEM = .311), no significant difference was found; $t(42)$ = -342, p = .734. A significant difference was however found when comparing participant happiness rating of the CS+'giggle' stimulus during habituation (M = 2.42, SEM = .289) to during acquisition (M = 3.79, SEM = .353); $t(42)$ = -4.082, p < .001, showing that participants rated the CS+'giggle' stimulus as happier after acquisition.

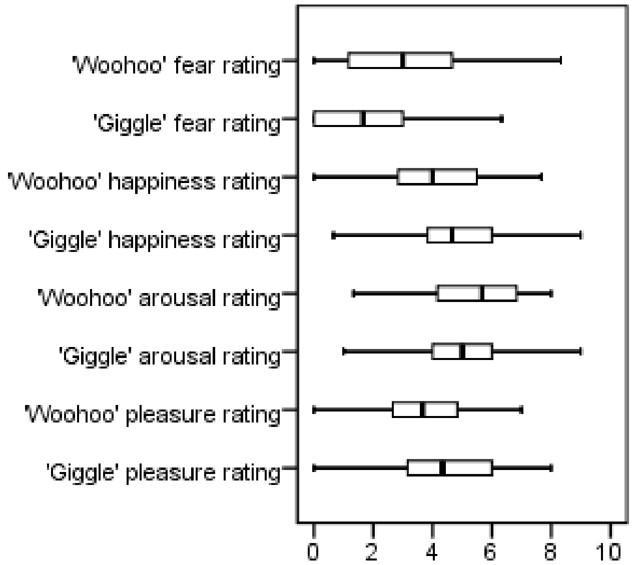

Figure 2. The final ratings of the unconditioned stimuli. Participants responded to the statement "Rate your fear", etc.

Final ratings of unconditioned stimuli

Paired samples t-tests were conducted to determine whether participants rated the stimuli significantly different in the final rating interval. The US'woohoo' stimulus received significantly higher fear ratings (M = 3.03, SEM = .437) than the US'giggle' stimulus (M = 1.778, SEM = .355); t(26) = 4.624, p < .01. The US'giggle' stimulus received significantly higher happiness ratings (M = 4.691, SEM = .381) than the US'woohoo' stimulus (M = 3.901, SEM = .396); $t(26)$ = -3.007, p = .006. The arousal rating of the US'woohoo' stimulus (M = 5.444, SEM = .347) were higher than the arousal rating of the US'giggle' stimulus (M = 4.938, SEM = .368); $t(26)$ = 2.541, p = .017. The US'giggle' stimulus was rated as more pleasant (M = 4.494, SEM = .417) than the US'woohoo' stimulus (M = 3.531 , SEM = .363); $t(26)$ = -2.828, p = .009.

Discussion

The aim of this study was to investigate whether two multimodal social stimuli can be used as unconditioned stimuli in an appetitive conditioning paradigm, and if the conditioned response differs between the stimuli. Subjective measures in the form of participants' ratings of the conditioned stimuli showed that both CS+ (CS+'woohoo' and CS+'giggle') were rated significantly happier than CS- during acquisition, but not during habituation, evidencing successful conditioning to the multimodal social stimuli. However, there was no effect of acquisition on SCR. Furthermore, CS+'woohoo' was rated as more fearful and less happy than the CS+'giggle'. This was in line with the US'woohoo' being rated as more fearful, more arousing, less happy, and less pleasant than US'giggle'. Hence, the evidence supported the hypothesis that the giggle was a significantly happier, less fearful, and less arousing stimulus than the 'woohoo'. The results indicate that this paradigm and the multimodal social stimuli can be used for appetitive conditioning to elicit positive emotional responses in participants, albeit only subjective emotional responses.

In relation to earlier appetitive conditioning paradigms, the present paradigm builds – among others – on the work of Andreatta and Pauli (2015), who confirmed animal findings in humans regarding both appetitive and aversive conditioning. The present study perpetuates these findings and manages to accomplish appetitive conditioning with multimodal social stimuli as the sole reinforcer. However, due to the lack of significant differences between the two stimuli on SCR readings, it is not possible to conclude whether the stimuli were sufficiently different to produce different levels of arousal on a biological level. However, several key differences were found between participant experience regarding the conditioned and unconditioned responses to 'giggle' and 'woohoo'; a finding that may have many explanations. For instance, a giggle is a natural response to a humorous event – an evolutionary significant response unconditioned by culture – whereas a 'woohoo' is less natural, and perhaps even fundamentally conditioned by culture; it is unclear whether the 'woohoo' sound can be translated into different cultures, and it is therefore credible that it is not as much a product of evolution as the 'giggle' sound. A 'giggle' is a conceivably more familiar sound than a 'woohoo', and this may in part explain why participants rated it as happier. Furthermore, a 'giggle' is a type of sound that carries with it certain pronounced connotations and is a form of emotional communication where its intent is obvious: it expresses joy to a distinct degree. The meaning of a 'woohoo' sound may be more ambiguous: it can express not only joy but can be interpreted differently in many different settings. For instance, in a competitive setting, 'woohoo' can be used to express both the joy experienced upon completing a task or achieving victory but can also be used as a form of cheering-on sound. This could explain why participants rated the 'woohoo' as distinctively less happy than the 'giggle'. Pitch and structure of the sounds likely play a part in this as well, in that the 'woohoo' may lie closer in pitch, volume, and structure to negative sounds such as booing. So, despite the lack of significant biological arousal data, it is evident that this paradigm managed to change participant experience of the stimuli.

Limitations

One limitation of the current investigation is that not all participants went through the rating of the US due to time limitations. Furthermore, using only images of females may have affected the results. Therefore, future studies should make use of stimuli consisting of both female and male faces to control for any gender effects. Another further limitation of the study is the use of smiling pictures both for the giggle and the 'woohoo' sounds. It seems likely that by using a different picture for the 'woohoo' condition different results could be achieved. A 'woohoo' sound is not naturally connected to a smiling face the same way a smiling face is naturally connected to a giggle, and it is likely this could have affected the outcome. It seems plausible that participants may have been confused by the smiling lady paired with the 'woohoo' sound. Future studies should make use of a face that better expresses the emotional components and visual properties of a 'woohoo' sound. Importantly, the facial muscles around the mouth which expresses a smile combined with the sound which expresses something slightly different, is likely enough to have caused this confusion. In other words, using a face where the person is making a rounded mouth in contrast to a smiling mouth could be the key for avoiding any confusion regarding what the images are meant to express.

Advantages and future directions

This study had several advantages compared to earlier studies on appetitive conditioning where non-social stimuli was used. The main advantage of this experiment was that it managed to accomplish appetitive conditioning without the use of food or money as unconditioned stimuli. The key advantage encompasses the ease of delivering the stimuli/paradigm to participants compared to the use of stimuli such as food; participants are solely required to sit at a screen for 30 minutes with the conditioning materiel presented continuously and automatically. If this study had used for instance, food instead, several complications would have arisen, such as how to best prepare so that individuals receive the food at the correct time, and other logistical issues related to having fresh food prepared for the participants. Money is another type of stimuli that would not have been appropriate in this context due to similar logistical reasons, and also that it is not a primary reinforcer.

This paradigm can be useful in many contexts. For instance, this paradigm could be used to study human emotional learning in general, but also be used to study ailments such as addiction, mania, and individual differences in social processing present in e.g. autism or social anxiety disorder. Post-traumatic stress disorder, bipolar disorder and other affective disorders could also be investigated by using this non-invasive technique. In other words, this paradigm has a myriad of different uses within the study of emotion. It would be interesting to, for instance, make use of this paradigm in a study on autism to determine whether processing of this type of stimuli is also affected by social problems related to being on the autistic spectrum. Another interesting study would be to compare addicts to non-addicts. Furthermore, different measures such as eye blinking as a measure of emotional valence could potentially give interesting results by using the same paradigm. Future studies could also make use of this paradigm in a fMRI trial or other techniques that examines brain patterns to determine what networks may be involved in this type of information processing.

In studies on appetitive conditioning where other stimuli such as money is used as a reinforcer, participants are often more aware of the contents of the experiment and may therefore be more prepared for conditioning. For instance, Dixon, Maclaren, Jarick, Fugelsang & Harrigan (2013) made use of a simulated slot machine where participants could win real money and found that near-misses on the slot machine received higher SCR readings than regular losses. Hence, participants in the experiment by Dixon and colleagues (2013) were more aware of the content of the experiment and knew that a reward was waiting for them at the end. Perhaps the current investigation could have been improved by making use of an interactive component as well, or maybe an explicit reward at the end of the paradigm could have made participants more pervious to conditioning through reward system activation. In this way the current study may have failed to activate participants' motivational wanting component, resulting in nonsignificant SCR readings. However, it may be problematic to compare passive experience of stimuli in the current experiment to an interactive experience where a reward is certain; perhaps studying appetitive reactions requires more engaging stimuli than aversive conditioning. Positive emotions are more likely to be experienced in clusters than negative emotions and studies on appetitive stimuli need to address this and make use of stimuli that not only elicits one but several different positive emotions at a time.

Likely, the degree at which these emotions are elicited are not only affected by type or number of emotions, but also dependent on context: studies using only images and sounds, such as Hillman, Cuthbert, Bradley, & Lang (2004), have found that participant SCR response to pictures depicting sporting events can be affected by belonging to a sports team, in that there were differences between rival sport fans in response to the same stimuli. In other words, watching a rival team win is not likely to cause an appetitive reaction or positive emotions, whereas watching one's own team win is very likely to cause positive emotions. Hence, elicitation of positive emotions is dependent not only on the stimuli itself but also on individual differences including attitudes, tastes, and a wide array of other factors. The present investigation brings clarity on whether a ‘woohoo’ sound can be used as a positive stimulus, and perhaps this can be utilized further in a different context. A ‘woohoo’ sound is very likely to be used in an athletic context and perhaps combining this sound with athletic images instead of simply using smiling faces can shine even more light on the processing of appetitive stimuli. To sum up, the current study adds some new tools that can be used in future studies on appetitive conditioning, but – in light of the nonsignificant SCR readings – the most important aspect when eliciting arousal may not be the sounds or pictures themselves, but rather the involvement of the participant being exposed to them.

Conclusion

The current investigation explored two multimodal social stimuli as potential unconditioned stimuli for appetitive conditioning paradigms. Participant conditioning was evidenced through increased participant happiness ratings during acquisition compared to habituation, among others. In relation to earlier literature using different stimuli, such as money, food, or erotic images/texts, this study elucidates possible uses of new types of stimuli in the form of smiling human faces paired with sounds expressing positive emotions. Positive emotions are harder to study than negative emotions, and future studies are suggested to make use of a different stimuli combination, retaining the sounds, and changing one of the images to a more fitting one, as well as using different measures of arousal.

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