LUISS

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DOES PREPAREDNESS PLAY A ROLE?

A STUDY ON THE EFFECT OF THE STIMULI'S SOCIAL RELEVANCE ON HUMANS' CLASSICAL CONDITIONING

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Management Summary

In the efforts to diminish the recent increase in obesity prevalence, public health practitioners investigate beyond the genetic causes beneath such pandemic to shed light in the behavioral and psychological ones. Classical conditioning studies analyzed the ”obesogenic environment” as a main contributor to such pandemic, and explained the extent to which food reactivity is not only acquired from genetics, but can be learned through repeated pairings of stimuli (conditioned stimuli: CS; with unconditioned stimuli: US). Nevertheless, certain associations of stimuli stimuli can be learned faster than others, because of biological and evolutionary predispositions of individuals (i.e., preparedness theory).

Therefore, the purpose of this study is to investigate which types of stimuli can be evolutionarily linked to food intake, hence, become more predictive of it and influence individuals' behavior. An online mixed-subject experiment was conducted among 140 participants to investigate the speed/magnitude of the learning process between socially-relevant stimuli and food, compared to socially-irrelevant stimuli, using repeated-measures ANOVAs. Moreover, the study assesses whether the social identification of the subject with the socially-relevant stimuli used accelerates or not the learning speed/magnitude of the acquisition of the stimuli, along with slowing/ weakening extinction.

The results suggested prepared learning with respect to social cues for US desires, as acquisition appeared to be faster/stronger, and a slower/weaker extinction phase. Similarly, some evidence suggested that US expectancies were also acquired more quickly when social (vs. neutral) stimuli were used as CSs. CS evaluations were not successfully acquired. Social identification was tested as a potential moderator, and it was found that it indeed moderated the speed of the learning process in the *opposite* direction. Specifically, lower levels of social identification appeared to be related to a *stronger* acquisition of desires to eat. Finally, implications for academic researchers who are interested in conducting further preparedness studies in the food domain, along with possibilities for future interventions are discussed. Furthermore, the research provides new insights for marketers with regard to creating new campaigns on the basis of these findings.

Keywords: *Classical conditioning, social relevance, prepared learning, social identification, online experiment*

Preface

This thesis marks the conclusion of my Marketing, Analytics and Metrics *Double Degree* at Luiss Guido Carli and Tilburg School of Economics and Management, and the beginning of a new chapter in my life, full of opportunities and challenges. By studying Marketing, I have always been inspired by the several possibilities that psychology can offer, in order to better understand consumers and their behaviors, to further benefit companies.

Months of hard work, due diligence and research have allowed me to proudly present this thesis. I would like to thank my Supervisor, Professor Simona Romani, who passionately guided me throughout the writing of my dissertation. Her work inspired me and enlightened me towards a deeper understanding of the psychological area of research, showing me that human psychology is the basis for many interventions in various and diverse fields. I feel honored to have had the opportunity to master such topics and contribute to a modest extent to both the public heath domain and marketing practices, to help people in need of guidance to avoid unhealthy practices. I would also like to thank my second reader, Professor Stefania Farace, for her time and involvement. This fundamental research has been decisive to reach the maturity expected from any newly graduate. This paper is the beginning of further research, which will be immensely enlightening and helpful for the public health and its interventions yet to come.

Special thanks go also to all my loved ones, family and friends, who relentlessly supported me throughout my entire academic journey, from beginning to end.

Chapter 1

Introduction

The prevalence of obesity and overweight has reached worrying proportions. Recent estimates consider approximately 2.1 billion individuals worldwide as being overweight, (body mass index [BMI] $>$ 25 kg/m^2), of which 600 million are obese (BMI $>$ 30 kg/m^2)) (NCD Risk Factor Collaboration, 2016 [32]; Ng M et al., 2014 [33]). This global scenario is alarming from a public health perspective as well as from an economic standpoint: obesity is the doorway for numerous medical and psychological problems and societies are facing exploding healthcare costs due to obesity-associated morbidity (Cawley & Meyerhoefer, 2012 [9]).

Research suggests that many obese and overweight individuals try to lose weight, but often unsuccessfully so. The so-called "obesogenic" environment contributes to this difficulty to lose weight, for it promotes a sedentary lifestyle and provides an abundance of easy-to-get high-calorie foods. By signaling the availability of tasty, inexpensive, and easy-to-get high-calorie foods (Hildebrand, Harding & Hadi, 2019 [23]), individuals are almost constantly exposed to environmental food-associated cues, such as sight, smell of food, or food-related contexts. Exposure to these food cues activates a central appetitive state, resulting in both psychological (eating desires) and physiological (i.e., salivation) responses to arise (Jansen, 1998 [24]). Indeed, these increased levels of food cue *reactivity* (i.e., cue-elicited desires to eat) have been associated with overeating, unsuccessful dieting, a higher BMI, and eating psychopathology. Food cue reactivity, is in fact not only the consequence of genetic components, but it can be learned through Pavlovian conditioning. By repeatedly pairing an initially neutral stimulus with the intake of palatable food (unconditioned stimulus or US), so that the stimulus (conditioned stimulus or CS) will become a reliable predictor of intake and elicit conditioned appetitive responses (CRs), such as a higher desire to eat (Jansen, 1998 [24]). To illustrate, consider a person who repeatedly eats popcorn in the evening when watching their favorite TV show: this context (CS; watching their favorite TV show in the evening) may become associated with eating popcorn (US). As a result, the CS by itself will elicit a desire for popcorn and promote its intake, even in the absence of hunger or in excess of calories that are physically needed (van den Akker, Schyns & Jansen, 2018 [55]). Therefore, given its role in the development of eating desires and intake of unhealthy food, it seems paramount for researchers to shed more light on human conditioning learning, and how stimuli can be associated to food intake.

Theoretically, any cue can become associated with high-calorie food intake (e.g. emotions, hunger or satiety), yet certain neutral stimuli may become associated more strongly and quickly with unconditioned stimuli than others. This idea is known as **preparedness** (or **prepared learning**), and has mostly been examined in fear conditioning studies, whereby humans show a predisposition to fear objects and situations that threatened the survival of the species throughout its evolutionary history (Seligman, 1971 [45]). Accordingly, persistent fears and phobias should be more readily acquired to threats of prehistoric origin (i.e., snakes, spiders) than to those of recent origin (i.e., guns). This superior conditioning is usually evidenced by enhanced resistance to extinction of the conditioned response (CR), hence, more difficulty in ”unlearning” these associations. Extinction is a process during which the CS+ is presented in the absence of the UCS, leading the conditioned response (CR) to decline across repeated presentations. In fact, participants conditioned with fear-relevant CSs (i.e., snakes, spiders) usually show reliable conditioned responses to subliminal CSs in extinction, but those conditioned with fear-irrelevant stimuli (i.e., flowers, mushrooms) show immediate extinction of their responses to CSs (Öhman & Mineka, 2001 [36]).

Thus, the nature of the CSs may result in differential learning processes. By gaining deeper knowledge in which stimuli may be more strongly/faster associated to food intake and appetitive responses, and more weakly/slowly extinguished, research on preparedness could be extended and used for future interventions to reduce the obesity ”pandemic”. To this end, it may be hypothesized that social stimuli are deeply intertwined with eating, as food has always used to be eaten in groups throughout history;

therefore, an inherent link might exist between groups of people and food, akin to the link between certain animals and danger (Hastorf, 2016 [22]). Moreover, the rationale for this assumption revolves around the evolution of the concept of food itself; from solely being the primary source of energy for survival, food has come to be the means to bring cultures and people together. From an evolutionary perspective, exchanging and sharing foods with each other secured humans' ancestors' access to the varied diet they needed to survive, and equal acquisition and distribution of food (Kaplan et al., 1985 [26]). As a result, sociological and social anthropological do not consider eating as merely the behavior by which nutrients are delivered to the biological system, but as a social practice, because individuals' eating patterns form in relation to and with others, and mostly occur with others. Even though eating may sometimes involve isolated choices, it is nevertheless conditioned by the context in which it occurs, highlighting the influence that social stimuli may have on food intake (Delormier, Potvin & Frolich, 2009 [16]). In fact, the different social contexts may influence food intake differently. The Social identity theory suggested that social influence emerges primarily, if not solely, from those perceived to be fellow in-group members, as they are the only ones considered to be similar on relevant psychological dimensions (Tajfel, 1974 [49]). Examples of in-groups are peer group, family, community, sports team, political party, gender, religion, or nation (Turner, 1991 [51]). Individuals who would face social contexts that are psychologically relevant to them, should exhibit a faster/stronger acquisition and slower/weaker extinction, compared to those who do not identify with a certain group. In fact, food intake is influenced by the context and by the type of social stimuli present in this context, as close kin and similar others should exhibit similar eating habits, or influence more strongly compared to distant others and non-kin (Feinman, 2016 [18]).

In sum, by definition of prepared learning, one may hypothesize that an historical connection may be present, between social cues and food. When an individual faces social scenarios, they should more readily associate that contextual stimulus to food intake, and having more cravings, because of their innate and evolutionary connection. Extinction should instead be slower/weaker. For purpose of this study, social identification will be considered as having moderating influences on how social stimuli predict food intake, assuming differential effects on US desires (e.g. food cravings) and expectancies (e.g. prepared learning) that occur if associated to either a social group that the participant identify themselves with or not (Cruwys et al., 2012 [13]).

1.1 Problem Statement and Research Questions

The aim of this study can be summarized in the following problem statement:

Are individuals predisposed to more readily/strongly acquire and more slowly/weakly extinguish appetitive responses when the CSs are socially-relevant, and does social identification moderate the speed and/or magnitude of this learning process?

The central problem statement will be answered by building on the following research questions:

- How is preparedness defined in the literature? And why is it relevant in conditioning studies?
- What does social identification entail?
- How do social cues predict food intake?
- Do social cues more strongly and quickly predict food cravings?
- To what extent does social identification moderate the learning process and its rate between social CSs and food as US?
- Is acquisition faster/stronger and/or extinction slower/weaker for the socially-relevant stimuli and food associations?

1.2 Research Method

The problem statement and its research questions will be answered by conducting a review on prior literature on the social influences on food intake, along with the moderating role of social identification. Moreover, to test whether prepared learning for socially-relevant stimuli and food exist or not, empirical quantitative research will be carried out via an online experiment. More specifically, an online conditioning task will be conducted to assess both acquisition and extinction for the socially-relevant and socially-irrelevant CSs by means of repeated-measures ANOVAs.

1.3 Relevance

1.3.1 Academic Relevance

From an academic point of view, this research is relevant for several reasons.

Firstly, in its broadest sense, it contributes to the existing research on the role of classical conditioning in the so-called ”obesity pandemic” to help develop more efficient interventions (Hildebrand, Harding & Hadi, 2019 [23]). To this end, the current research investigates the role of preparedness. While past research has mainly addressed preparedness in fear domains to explain intense fears and phobias (Krane & Wagner, 1975 [28]; Seligman, 1971 [45]), it has rarely been considered that a predisposition to associate stimuli may be present as well between psychological cues and food. Owing to the fact that Seligman (1971) provided the first empirical examination that has found broad consistent support for the notion that certain stimuli associations are learned faster than others, this study will assess the robustness of prepared learning in a different setting. Specifically, social cues are used as conditioned stimuli and assessed for social identification of the subject to the social group, aiming to make another step towards generalizability of this theory.

Secondly, research in the field of preparedness will be extended by gaining deeper insights into the circumstances under which social settings might especially be readily associated with intake (Tajfel, 1974 [49]). It is hypothesized that the type of social context may impact food intake differently, depending on whether the subject identifies with the social group or not. The current research contributes to explain the several facets of social influence into shaping food intake, as a way to leverage such findings to propose more efficient interventions to counteract obesity. To illustrate, public practitioners and lifestyle coaches could expose individuals to socially-irrelevant stimuli in their interventions to slow acquisition of appetitive responses.

1.3.2 Managerial Relevance

From a managerial viewpoint, if humans indeed learn associations between socially-relevant (vs. other) stimuli and food more readily, marketers could use the results at tactical level. Marketing campaigns could show customers social scenarios where eating their product is depicted as a social practice. As a result, social settings might be readily associated with the product, generate increased cravings not only for food in general, but specifically for their brands, making their products some of the first foods consumers think about- and perhaps purchase - when eating together. Policy makers as well can take advantage of these predictions and, if future research confirms these findings, future interventions can leverage the social cues to promote healthy eating, or even prevent unhealthy habits to arise in the first place. Specifically, it could be advise to dieters, when exposed to social cues that elicit the consumption of unhealthy food, to eat by themselves to reduce their desires to eat.

Secondly, by finding possible moderating influences of social identification on the learning process of stimuli, campaigns could more directly target customer segments. Personalized campaigns can depict social groups perceived as in-group in order to increase consumption and desires for their products, because it will be tailored to their personal features and characteristics.

1.4 Structure of the Thesis

The overall structure of this thesis comprises five chapters. Chapter 1 was the introduction, followed by Chapter 2, comprising a discussion on the theoretical framework, elaborating on the prepared learning of social stimuli and food intake, and the moderating effects of social identification. Chapter 3 will set up an experiment to test the hypotheses as developed in Chapter 2, and Chapter 4 will analyze the obtained results. A discussion of the study and an interpretation of the results, will follow in Chapter 5. To conclude, the limitations of the study and future research suggestions will be discussed.

Chapter 2

Theoretical Framework

This chapter will set the theoretical framework for the current study. A comprehensive overview of the role of classical conditioning as a contributor to the ”obesity pandemic” will be provided, along with the evidence in support of the evolutionary connection between social cues and food intake. Based on the literature review, hypotheses will be formulated to then be empirically tested in Chapter 3 and 4.

2.1 Classical conditioning: role in the Obesity Pandemic

Obesity is defined in biological terms: having a body mass index (BMI) above 30kg/m^2. The recent increase in obesity prevalence (Cawley & Meyerhoefer, 2012 [9]) implies that the underlying causes cannot be purely biological in nature, since the gene pool is unlikely to have changed so quickly (Barness, Opitz, & Gilbert-Barness, 2007 [4]). Instead, experts have posited that the main cause of obesity is the changed *”obesogenic”* environment (Dixon & Broom, 2007 [17]). This modern environment includes an abundance of high-calorie, hyperpalatable foods that promotes overeating and makes weight gain almost inevitable (Swinburn, Egger & Raza, 1999 [48]). More specifically, the obesogenic environment includes an abundance of *food cues*, such as the smell of handmade hot chocolate when walking on the street during winter, or the sight of delicious cakes and treats when displayed in the shop windows. Exposure to these food cues elicits *food cue reactivity*, which comprises several responses that can be psychological (e.g. cravings or desire to eat), physiological (e.g., increased salivation and insulin release), and neurocognitive (e.g., brain activation patterns, allocation of attentional resources) in nature (Jansen, 1998 [24]). Food cue reactivity is thought to promote overeating even in the absence of physiological hunger. Thus, through food cue reactivity, the abundant food cues in the obesogenic environment promote (over)eating and weight gain.

According to the Pavlovian (classical) conditioning theory, such food cue reactivity can be learned. To understand how this learning process occurs, one should think of food entering the digestive system as an unconditioned stimulus (US). Once stimuli (conditioned stimuli; CS) become associated with the US after repeated pairings of the conditioned stimulus with the unconditioned stimulus, they can stimulate appetitive responses, i.e., food cue reactivity (conditioned response: CR) (van den Akker, Schyns & Jansen, 2018 [55]; van den Akker, Havermans, & Jansen, 2017 [52]; Jansen, Schyns, Bongers & van den Akker, 2016 [25]). To illustrate, consider a person who repeatedly eats ice-cream in the afternoon when taking a walk in the summer: this context (CS; taking a walk in the afternoon during summer) may become associated with eating ice-cream (US). As a result, the CS (going for an afternoon walk in the summer) by itself will elicit a desire for ice-cream and promote its intake (van den Akker, Schyns & Jansen, 2018 [55]).

Several laboratory studies have examined this Pavlovian learning account of food cue reactivity. In these studies, an initially neutral stimulus (CS+) is repeatedly paired with tasty and high-calorie foods (US; i.e., a piece of chocolate, crisps etc.), and responses to this stimulus are compared with the appetitive responses to another stimulus (CS−), never followed by food intake. The conditioned stimuli used for such studies have been trays, boxes, geometric figures, objects, negative emotions, and (virtual) environments/contexts (van den Akker, Schyns & Jansen, 2017 [54]; van den Akker, Havermans & Jansen, 2017 [52]; van Dis, Hagenaars, Bockting & Engelhard, 2019 [56]). Studies have typically found that already after a few CS-US pairings, the CS+ (vs. CS−) already evokes appetitive responding, such as a heightened desire to eat. Thus, these findings indeed seem to confirm that Pavlovian learning can underlie food cue reactivity – and hence, play a role in promoting overeating and weight gain.

Alongside the relevance of food cue reactivity acquisition in understanding the causes for obesity, public practitioners and researchers are interested in extinction as well, which empowers them to find efficient future interventions to diminish the pandemic (van den Akker, Havermans & Jansen, 2017 [52]). By presenting the CS+ in the absence of the US, the former should not predict the latter anymore, leading the conditioned response (CR) to decline across repeated presentations. Considering the aforementioned ice-cream example, in extinction, one might repeatedly walk in the afternoon during summer without eating ice-cream. Although the walk will elicit cravings and an urge to eat at first, over repeated unreinforced stimulus pairings (trials), these responses will decrease (i.e., extinguish). However, conditioning studies have suggested that a complete extinction of eating desires is difficult to achieve: even after relatively many extinction trials, eating desires to the CS+ often remain higher than to the CS−. In fact, extinction does not eradicate the initial CS+-US association but rather creates new learning, where the CS+ is associated with the absence of the US. For instance, retrieval of extinction, also known as extinction recall, occurs when the extinguished CS+ is re-presented at a later time. Conditioned responses may also reappear spontaneously with passage of time (i.e., spontaneous recovery), following contextual manipulations (i.e., renewal) or presentation of the US even in the absence of the CS+ (i.e., reinstatement) (Bouton, 2002 [7]). This difficulty to completely extinguish eating desires might explain why it is so challenging to stick to one's diet, and lose weight (Boutelle & Bouton, 2015 [6]).

Additional insight into the conditions under which acquisition and extinction is facilitated or slowed might provide new directions for weight loss interventions. For example, knowing the circumstances under which acquisition is facilitated, this knowledge may be directly used in interventions aimed at promoting healthy eating, i.e., quickly associate stimuli with healthy food intake. Conversely, identifying situations under which extinction is slowed will help tailor interventions; for example, in these cases, it might be necessary to apply additional techniques to reduce conditioned responding.

2.2 Preparedness Theory: a conceptualization

Indeed, evidence from the extant literature on classical conditioning shows that some associations are easier to learn than others, both for humans and animals (Krane & Wagner, 1975 [28]). This predisposition to associate certain stimuli more readily with aversive unconditioned stimuli is known as ***preparedness*** or ***prepared learning***, firstly proposed by Seligman (1971) [45].

Studies on preparedness have predominantly been conducted in the fear domain. These studies are based on the observation that prevalent fears often involve animals that are dangerous from an evolutionary perspective (e.g. snakes, spiders) as both humans and animals have a biological predisposition to fear objects and situations that threatened their species' survival throughout history. Fear serves to motivate organisms to escape and avoid sources of danger and threat by a fast activation of defensive behaviors, as was necessary for survival in early evolutionary environments in which disasters could strike fast and without warning.

In the 1970s, Öhman and colleagues published a series of articles that supported some of the basic assertions of preparedness in the fear domain (Seligman & Hager, 1972 [46]; (Öhman & Mineka, 2001 [36]). These studies used classical conditioning paradigms in which participants were shown pictures of fear-relevant stimuli (e.g., snakes or spiders), used as CSs, followed by an aversive outcome (US), such as a shock, and compared to other fear-irrelevant stimuli (i.e., houses, flowers, mushrooms) to observe the different learning processes, measured through skin conductance responses (SCRs) (Öhman, Eriksson, Fredrikson, Hugdahl & Olofsson, 1974 [35]). In the acquisition phase, both types of stimuli were sometimes followed by the US (CS+), and sometimes the CS was never followed by the US (CS−). Fear-relevant stimuli exhibited superior conditioning, that is, faster acquisition firstly, subsequently followed by enhanced resistance to extinction of the conditioned response (CR; i.e., shock). As a matter of fact, only one CS-US pairing appeared sufficient for fear acquisition when fear-relevant stimuli were used for responses to be acquired. These findings regarding superior conditioning to potentially dangerous animal stimuli were extended to another set of fear-relevant stimuli related to social fears (Öhman & Dimberg, 1978 [37]). Specifically, studies investigated conditioned responses to CSs of faces expressing threatening emotions (i.e., anger) paired with aversive outcomes (US; i.e., shock) and compared these to responses to neutral and happy facial expressions (Öhman & Mineka, 2001 [36]). It was found that subjects demonstrated higher resistance to extinction to angry facial emotional expressions, compared to neutral or happy stimuli. The authors explained these findings by arguing that social fears originate from the fear of losing rank in dominance hierarchies, and the desire to minimize aggressive encounters. If a member did not exhibit submissiveness to maintain such order, they would lose their rank, because of negative evaluations of other group members (Öhman & Wiens, 2002 [38]).

Although most studies on prepared learning have been conducted in the fear domain, some appetitive studies have focused on preparedness as well. For instance, a recent study investigated preparedness for olfactory (smell) - gustatory (taste) stimuli associations in evaluative conditioning (EC) [1] (Ruszpel & Gast, 2020 [42]). The idea is that there might be a preparedness of smell and taste pairings because they are usually confused with each other and sometimes they may even sum up to an oral unified sensation which is often described as flavor. Researchers used water-based solutions with one of four smells (grapes, mango, cacao, or blackberry) as olfactory stimuli ($CS_{olfactory}$) and one of two tastes (sugar syrup, polysorbate 20) as gustatory stimuli ($US_{gustatory}$). Visual stimuli (CS_{visual}) were four different bottle labels appearing simultaneously to the drink consumption on the computer screen. In every trial, participants were exposed to a combination of one $CS_{olfactory}$, one CS_{visual}, and one $US_{gustatory}$, which varied between participants. Participants smelled the drinks and looked at the stimuli presented on the screen simultaneously and then drank the content of the cup. In the end, they evaluated the olfactory and visual CSs on pleasantness. It was found that smell-taste combinations show a preparedness effect: olfactory CSs exhibited were evaluated more positively than sounds, even though they had been paired with the exact same US. In fact, smell and taste are intrinsically linked, as they sum up together to a unified sensation (i.e., flavor)

In sum, the studies indicate that organisms show preparedness with combinations of CSs and USs that are somehow intrinsically linked already, resulting in faster acquisition of the conditioned response (CR) and enhanced resistance to extinction of that response, for aversive as well as for appetitive stimuli. However, olfactory stimuli might not be the only ones that result in prepared learning.

2.3 Social Influences on Food intake: an evolutionary perspective

As previous preparedness studies suggest, aversive responses (i.e., fears) may be more readily associated to social stimuli (i.e., angry faces) (Öhman & Mineka, 2001 [36]). It may be hypothesized that analogously, preparedness in appetitive responses occur

[1] Evaluative conditioning is defined as a change in the valence of a conditioned stimulus that is due to the pairing of that stimulus with another positive or negative unconditioned stimulus.

from the exposure to similar stimuli that are social in nature. Indeed, if applied to the area of food, social cues are as well deeply and evolutionarily intertwined with its intake Traditionally, the sharing of food has always been part of the human story, as a social practice that today continues to have an active role in creating, enacting, and sustaining cultural and social processes. In fact, food intake very frequently occurred in groups, and because of this, an intrinsic link might exist between the two – akin to a link between smells and food, or spiders and aversive outcomes (Gergen, 1973 [20]). Food sharing is therefore a nexus for giving, the place where social life is formed and renegotiated. *"To break bread together"*, a phrase that captures the power of a meal to forge relationships, bury anger, provoke laughter (Hastorf, 2016 [22]). Hence, social groups, like olfactory cues, may be associated with intake quicker (e.g. preparedness). To illustrate, an individual may see on TV a marketing commercial depicting a group of friends eating ice-cream together. In this instance, the person watching the commercial may associate the CS (i.e., group of friends; socially-relevant CS) with the US (ice-cream) faster than a potential commercial depicting a single person (socially-irrelevant CS) eating ice-cream alone. This might result in heightened cravings for the US (e.g. US desires) for the individuals exposed to the commercial depicting the socially-relevant stimuli, due to the intrinsic link between food and social stimuli.

Research on the *social facilitation* of eating might already provide some empirical evidence for the extent to which social influences shape food intake (Crawford, 1939 [12]). Social facilitation of behavior has been defined as the increase in the frequency or intensity of responses already learnt by the individual in the past, shown in the presence of others usually engaged in the same behavior. Research found that eating should be facilitated, and it would increase in magnitude in company with others as individuals may have previously easily associated social situations with food intake, promoting learning and CRs, and hence food intake. Hence, social influences on food intake may change according to the context an individual is facing, implying that social stimuli not only influence, yet they can be predictive of eating behaviors.

To conclude, drawing on the evolutionary connection between social contexts and food, and the extent to which their intrinsic link influences appetitive responses, one may hypothesize that prepared learning occurs in case of social stimuli as well, resulting in a stronger/faster acquisition, and a slower/weaker extinction.
Thus, the following hypothesis is formulated:

***H1**: Classical conditioning using socially-relevant (vs. non-socially-relevant) stimuli is easier to establish and harder to extinguish, hence, it can be considered as prepared learning.*

2.4 Social Identity Approach to Social Influence

(Possible) prepared learning with socially-relevant stimuli might depend on the types of social stimuli and contexts (Pliner & Chaiken, 1990 [39]). A social stimulus is in fact any agent, event, or situation with social significance, particularly an individual or group, that elicits a response relevant to interpersonal relationships. However not all individuals are the same, nor they interact in the same contexts or situations, resulting in differential effects that such stimuli may have on the learning process of a single individual.

Social identity theory (Tajfel, 1974 [49]) suggests that individuals categorize themselves as belonging to certain groups (group membership, i.e. nationality, gender). Furthermore, Social identity theory focuses on how this group memberships defines a person's sense of who they are (identity), based on which groups are formed and members' behaviors are subsequently influenced (Tajfel & Turner, 2004 [50]). When a given person self-identifies with a group (i.e their "in-group" [2]), they will behave intrinsically in ways that align with the characteristics that define the group itself, (possibly) empowering even more the influence of social cues on food intake, compared to out-group cues. By extension, these theories imply the expectation that once someone is in the presence of others who are "eating" to whom they identify with (i.e., in-group), one might be more likely to expect to eat with them vs. when an out-group is "eating", to whom they do not identify with. The "eating" is mimicked in the experiment by presentation of a US with the socially-relevant CS+. In addition, Hamilton's rule for natural selection of altruistic behaviors among related individuals (Hamilton, 1964 [21]) suggests that food will be given only when there is a great benefit to the recipient with low cost to the donor. The implications of these kin-selection models is that natural selection will also favor the development of ways of determining kin from non-kin and close kin from distant kin. When Hamilton's rule is applied to food-sharing behavior (Feinman, 2016

[2] in-groups are social groups formed by people who believe they are similar to one another, compared to out-groups.

[18]), a simple expectation of the model is that close kin has always received food shares either more frequently or in larger quantities compared to distant relatives and non-kin. This rule however, is not limited to understanding interactions within family units. Kin selection subsumes classical natural selection, which represents the special case where all interacting individuals are completely unrelated, yet familiar to some extent, as in-group members are.

Findings on social facilitation of eating might already provide some empirical evidence for the moderating influences of this social identity on prepared learning. As familiarity across individuals increases, so does the magnitude of the facilitation effect. Thus, the more a person identifies with a social group, acting as a CS, the more the its influence on food intake will be strong, resulting in an even faster/stronger acquisition and slower/weaker extinction of the CSs-USs associations (Clendenen, Herman & Polivy, 1994 [10]). Therefore, if an individual identifies more with that group, learning might be facilitated.

One important theoretical development that is central to this *social identity approach* is the distinction between a sociological group and a psychological group. That is, social psychologists recognize that objective membership of a social category is not the same as the psychological internalization of that group membership. For instance, a man may be of a height and weight for them to be medically classified as obese (sociological group membership), but it does not necessarily mean that he perceives himself as an obese person (psychological group membership). Therefore, the most important dimension of group membership is not the objective similarity between two individuals on externally defined criteria, but rather the extent to which the shared group membership is *perceived* as psychologically relevant. For this reason, the present study focuses on the psychological (vs. sociological) group membership (Turner, 1991 [51]).

Therefore, the following hypothesis has been formulated:

H2*: When subjects exhibit higher (vs. lower) social identification, prepared learning from social cues-food combinations is stronger.*

2.5 Conceptual Model

Based on the relationships and learning theories described above, the following conceptual model has been developed [3]:

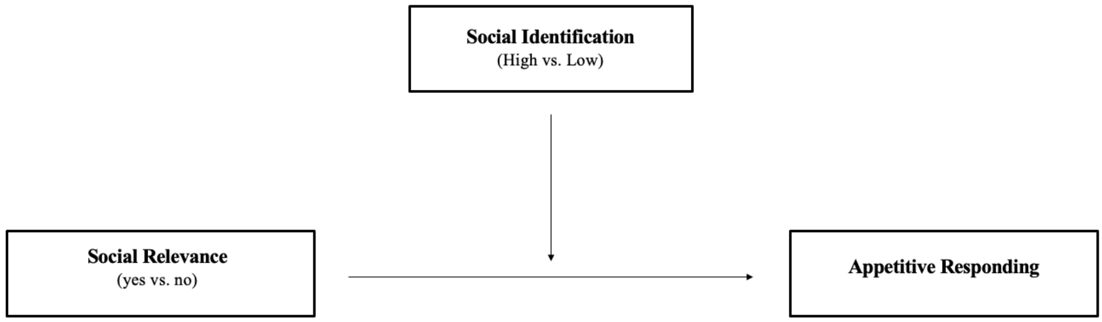


Figure 2.1: Conceptual Model

[3] Social identification is included as moderator because it conceptually moderates acquisition of social cues-food associations, but not statistically examined as such because it could not be measured for one of the IVs.

Chapter 3

Research Methodology

In this chapter, the research method of this study is described. The experimental design will be outlined, followed by the specifications of the stimuli's characteristics and their development through a pretest. In addition, the procedure will be outlined to discuss each independent and dependent variable and their measurements.

3.1 Participants

A total of 143 respondents participated in the study (18+). To determine the required sample size, G*Power (3.1.9.6) was used. Presuming a medium effect size of f = 0.25, an error probability of α = 0.05, and power of 0.80, the aspired sample size would be 98 respondents (Cohen, 1988 [11]). This also satisfied Sawyer and Ball's (1981) [43] rule of thumb, which indicates that at least 30 participants are needed per experimental condition.

Subjects for both the pretest and the main experiment were approached by means of convenience sampling from the researcher's personal network, for the sake of ease, efficiency and lower costs required to gather the required data (Sekeran & Bougie, 2016 [44]). Invitations to take part in the experiment were sent to the participants via Facebook, Whatsapp, LinkedIn, and email. Participants had the option to opt out of the questionnaire, for ethical purposes, if they do not feel comfortable with sharing their answers and personal information (See Appendix E).

3.2 Experimental Design

The aim of the present study was to test the influence of the CSs' social relevance on classical conditioning, its speed and/or magnitude, and the subsequent appetitive responses elicited, such as food cravings. In addition, it was examined whether this classical conditioning process may be moderated by participants' social identification with the social stimuli. Consequently, the most suitable research design was an experimental study. In fact, experiments allow, on the one hand, for causality to be established between the dependent and the independent variable, and, on the other hand, to measure, manipulate, and control variables (Stevens, Loudon, Ruddick, Wrenn & Sherwood, 2005 [47]) (See Appendix A). In other words, it allowed to manipulate the social relevance of the stimuli by allocating the respondents to different experimental conditions, so as to establish the extent to which changes in this variable influence the participant's appetitive responding. More specifically, a standard conditioning paradigm to study preparedness was used, with the only alterations being the dependent variable measured, and the fact that the paradigm was assessed online. The study employed a 2 (Social relevance: yes vs. no) x 2 (Stimulus type: CS+ vs. CS−) x 4/6 (Acquisition Trial/Extinction Trial) mixed-subjects design. Social relevance functioned as between-subject factor, and included a "Social group", where the CSs were socially-relevant (people images), and a "Neutral group", where the CSs were socially-irrelevant (flower images). Stimulus type functioned as within-subjects factor. Each image set was accompanied by some questions regarding US expectancy, in order to assess prepared learning, US desires, to measure food cravings, and CS evaluations. Participants were randomly assigned to either the "social group" or the "Neutral group".

The set-up of the conditioning experiment involved two phases: acquisition and extinction. During acquisition, one of the image sets (CS+) were sometimes followed by a picture of chocolate (US) and the other image set (CS−) was never followed by the US; during extinction, none of the image sets were followed by the US .

3.3 Stimuli

Unconditioned Stimulus (US): To represent the US, an image of chocolate was used, given that the majority of experiments in the classical conditioning has used such type of comfort food and most individuals like it (van den Akker, Havermans, & Jansen, 2017 [52]). To be specific, a generic dark chocolate bar was be displayed (NCA 2019, [31]).

Figure 3.1: Unconditioned stimulus (US)

<u>Conditioned Stimulus (CS)</u>: A pretest was conducted to select the CSs, both socially-relevant and socially-irrelevant. Flower images were selected as socially-irrelevant stimuli [1], and people as socially-relevant stimuli (See Appendix B). Ratings on both valence (the degree of positivity or negativity) and arousal (the intensity of the emotion that the image evokes) of the CS stimuli were collected, in order to select the CSs to be used in the main experimental procedure (See Appendix C). The aim of the pretest was to select the final pictures that would equalize levels of valence and arousal across the stimulus pairs, and hence, exclude the possibility that these aspects were responsible for any effects rather than "true" preparedness. The reason is that the more different two images are perceived, the more classical conditioning may be enhanced, hence, affected in some way.

23 participants participated in the pretest, who were presented with 32 images (sixteen flowers and sixteen images of people having diverse characteristics) in a randomized order: half of the participants first saw images of flowers, whereas the other half first saw images of people (See Appendix B). Each picture was rated on valence and arousal (7-point scales). Based on the results, two sets of images were created, each consisting of four people and four flowers, to act as CS+ and CS−, ensuring that (1) average valence and arousal levels between the stimulus pairs (flowers and people) were similar, (2) characteristics of the pictures themselves (i.e age, gender, facial expressions

[1]Öhman and coworkers used classical conditioning paradigms in which pictures of fear-irrelevant content were typically houses, flowers or mushrooms (Öhman & Mineka, 2001 [36]).

for the people, color for flowers) were averaged across images in order to exhibit similar CS+s and CS−s within each condition (See Appendix D). The findings showed that the mean valence for flowers (vs. people) was 4.93 (vs. 4.78) and the mean arousal rating was 4.45 (vs. 4.61).

Figure 3.2: Socially-relevant stimuli (left: CS+; right: CS−)

Figure 3.3: Socially-irrelevant stimuli (left: CS+; right: CS−)

3.4 Measures

In standard preparedness experiments, skin conductance responses (SCRs) are typically used as outcome measure (McNally, 1986, [30]). However, given the current online set-up, subjective measures may act as valuable substitutes (Boddez, Baeyens, Luyten, Vansteenwegen, Hermans & Beckers, 2013, [5]). Namely, prior research has shown that US expectancies typically change in parallel to SCRs; they are thought to index a similar construct (Davey, 1992 [14]). Other frequently used outcome measures in appetitive conditioning studies are included as well: US desires, as this research aims to test the effects of social relevance on appetitive responding, and CS evaluations (van den Akker, Schyns & Jansen, 2017 [54]). An outline of the scales and the corresponding scale items used will follow below.

US expectancies: 10 point-Visual Analogue Scales (VAS) were used to assess one's expectancy to see the US once the CS was shown (*"To what extent do you expect to see chocolate below this picture at this moment?"*), ranging from 0 (I certainly do not expect it) to 10 (I certainly expect it).

US desires): 10 point-Visual Analogue Scales (VAS) were used to assess the cravings and the subjective desire for chocolate once the CS was shown (*"When looking at this picture, how strong is your desire for chocolate at this moment?"*), ranging from 0 (no desire at all) to 10 (very strong desire).

CS evaluations: 10 point-Visual Analogue Scales (VAS) were used to assess the evaluations of the CS+ and CS− once the CS was shown (*"How pleasant do you find this picture?"*), ranging from 0 (not pleasant at all) to 10 (very pleasant).

Social Identification: the Four Item measure of Social Identification (FISI) (Postmes, Haslam & Jans, 2013 [40]) was used to measure social identification. It is measured on a 7-point Likert scale (1="Strongly Disagree", 7= "Strongly Agree") which has been shown to have good reliability and validity. However, only the first two items were included as they fit the aim of this conditioning study better. The statements are: *"I identify with the group"*, *"I feel committed to the group"*. The other two items *"I am glad to be in the group"*, *"Being in the group is an important part of how I see myself"* were not included as they appeared inadequate as the participant is not actually a member of the depicted social group (See Appendix G). The 2 items measuring Social identification were summed to create two total scores, for both the CS+ and CS− of the Social group, calculated by averaging the items to quantify consumers' overall identification.

Perceptual Discriminability: participants answered read the statement (*"Judge how visually similar/different you find each pair of images below. I am interested in whether you find it easy or difficult to tell the difference between the pictures."*) and answered on a 7 point-Likert scale (1="Extremely similar"; 7="Extremely different"), to assess differences in perceptual discriminability between pairs of stimuli (social CS+ vs. social CS−; non-social CS+ vs. non-social CS−) (Atlas & Phelps, 2018 [2]). Participants saw one image set, depending on the experimental conditioned they were exposed to, and reported perceptual discriminability of each stimulus pair. Previous findings on preparedness in fear conditioning discovered that images perceived as "more" different, may show enhanced learning due to ease of discriminability, and not because of fear-relevance/preparedness. Hence, this measure should be considered to take into account possible alterations in the learning process.

3.4.1 Conditioning task

As previously mentioned, the online experiment consisted of two phases for both conditions (Social and Neutral): acquisition and extinction (See Table 3.1 and Table 3.2 for the stimuli used per phase for each condition).

Acquisition: each CS-US association was learned by repeatedly exposing participants to the CS+ paired with the US. The acquisition phase consisted of four CS+ trials and four CS− trials (8 trails in total). A trial proceeded as follows: Firstly, a CS (CS+ or CS−) was presented in the middle of the computer screen for four seconds. A US expectancy VAS was displayed below the CS. Once this question was completed, the expectancy VAS disappeared while the CS remained visible for other four seconds. Only in case of the CS+, the US was shown as well during these four seconds. Subsequently, the inter-trial interval started (consisting of a white screen), which also lasted four seconds. After this, a new trial started. The order of the CS+ and CS− was random with the restriction that the same stimulus type (CS+ or CS-) was never presented more than twice in a row. Finally, while US expectancies were measured in each trial, US desires and CS evaluations were measured on the first and last acquisition trial only in order to minimize the length of the experiment and avoid attention errors from the participants.

Extinction: immediately after the acquisition phase, participants started the extinction phase. It consisted of six trials for each CS (12 trials in total). For each trial, the trial sequence was the same as for the acquisition trials, with the exception that all CSs shown for four seconds were never reinforced, hence, followed by the US. During this phase, US expectancies were measured on each trial, and US desires and CS evaluations were measured on the first and last trials.

Table 3.1: Stimuli used per phase for the ”Social group” condition; CS: conditioned stimulus

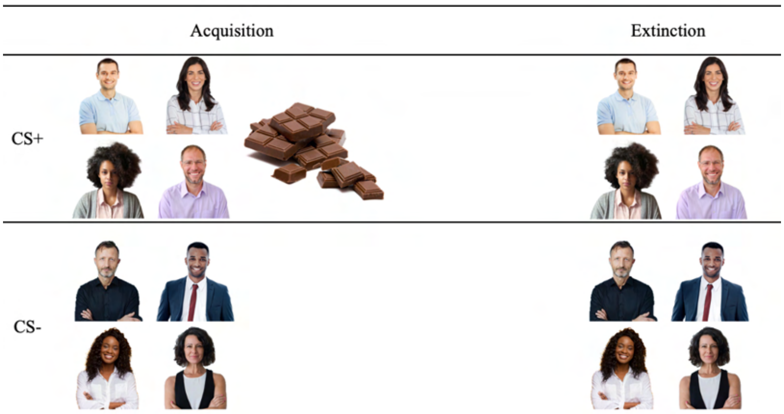
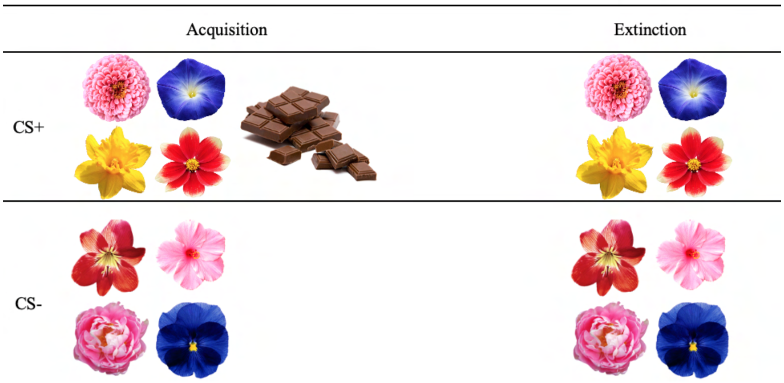


Table 3.2: Stimuli used per phase for the ”Neutral group” condition; CS: conditioned stimulus



3.5 Procedure

The questionnaire was programmed in Qualtrics (See Appendix E). Before participating in the online experiment, each respondent had already been instructed by the researcher that the experiment had to be made on a laptop or desktop (i.e. not on a smartphone) and that they should be in a quite place, with no distractions, in order to concentrate as much as possible. The experiment began with a general introduction. Participants were asked to read and follow all the instructions carefully and they were informed on the length of the questionnaire (8 minutes). Subsequently, participants read instructions on how to engage in mental imagery of the consumption of the food that was going to be displayed. Specifically, they were instructed to vividly imagine eating the food every time they saw a picture of food. Next, participants were instructed that they might be able to predict whenever a picture was going to be followed by a picture of food, by looking at the different images. With mental imagery, that is, the mental simulation of stimuli or situations in the absence of physical stimulation and can involve multiple sensory modalities (Kosslyn, Thompson, & Ganis, 2006 [27]), this study better mimics conditioning studies in laboratories, as the increased desirability of imagined stimuli seems to similarly affect behavior as with direct perception. After this, the conditioning task started. After the task, participants in the Social condition received questions regarding people images along with questions regarding social identification, as for the Neutral condition, flower images were presented to measure US expectancies, US desires and CS evaluations. Finally, demographics questions were asked (i.e age, gender, education), along with perceptual discriminability for the two sets of images presented in the conditioning task. Moreover, other variables were considered such as height and weight in order to calculate the BMI, as it may cause differential learning phases (Boutelle & Bouton, 2015 [6]) (See Appendix G).

3.6 Statistical Analyses

Several 2 (CS-type: CS+ vs. CS−) x 4/6 (Acquisition Trial/Extinction Trial) x 2 (Condition: Social group vs. Neutral group) repeated-measures ANOVAs were performed to test whether any differences in classical conditioning occurred across conditions, in terms of both US expectancy, US desires and CS evaluations. For each measure, differential acquisition and extinction US expectancy, US desires and CS evaluations responses were examined by 2 (CS-type: CS+ vs. CS−) x 2 (Condition: Social group vs. Neutral group) repeated-measures ANOVAs in the fourth acquisition trial and sixth extinction trial, to assess any differences between conditions in these specific trials.

The moderator Social identification was assessed for both the CS+ and CS−, however, the correlation between the two stimuli was found to be somewhat low (r = .29). Therefore, only the CS+ was considered for the moderation analysis [2]. Social Identification was included in the analysis as a covariate, for it cannot be considered a between-subject factor because it was measured only for the participants exposed to the Social

[2]Unlike the CS−, the CS+ is followed first by the US during acquisition, but then it is not during extinction, hence, it was deemed more relevant to detect differences, if any, during the two learning phases.

condition. Chi-square t tests were performed to assess whether any differences in demographics exist across conditions, in order to assess the success of randomization. Lastly, Perceptual discriminability was assessed by means of Independent sample t-test to verify whether respondents did indeed perceive the CS+ statistically different from the CS−, to rule out potential confounding effects on both acquisition and extinction.

Chapter 4

Study Results

This chapter presents the results of the experiment. Once the data were properly cleaned, the assumptions for repeated-measures ANOVAs are checked. Secondly, the key findings of the study on the main effects, as well as the hypothesized moderating effects will be analyzed.

4.1 Data Preparation and randomization check

Initially, 143 respondents participated in the study. However, one participant did not complete the full questionnaire, and two respondents were aged below the required threshold for this study (18+). Hence, they were removed from the sample. The final sample size therefore consisted of 140 participants. Chi-square t tests were performed to assess whether any differences in demographics exist across conditions. Results showed no differences across conditions in gender, age, BMI nor education. Thus, randomization was successful (See Table 4.1).

Table 4.1: Participant characteristics for each condition (Social vs. Neutral groups); frequencies, percentages, means and standard deviations

	Neutral	Social	t or $\chi^2(df)$	p
n	73	67		
Gender (n)				
Females	47 (64.4%)	38 (56.7%)	.95 (1)	.33
Males	26 (35.6%)	28 (41.8%)	.07 (1)	.79
Prefer not to say[d]	0 (0.0%)	1 (1.5%)	-	-
Age (n)[a]				
Youth (18-25)	59 (80.8%)	48 (71.6%)	1.13 (1)	.29
Young adults (26-40)	6 (8.2%)	11 (16.4%)	1.47 (1)	.23
Over > 40 (41-61)	8 (11.0%)	8 (11.9%)	.00 (1)	>.99
Education level (n)[b]				
Lower-medium education	18 (24.7%)	16 (23.9%)	.12 1)	.73
Higher education	55 (75.3%)	51 (76.1%)	.15 (1)	.70
BMI (n)[c]				
Normal (BMI<25 kg/m^2)	51 (92.7%)	44 (93.6%)	-.44	.66
	M (21.34), SD (1.72)	M (21.51), SD (2.03)		
Overweight (BMI>25 kg/m^2)	3 (5.5%)	2 (4.3%)	1.13	.34
	M (26.90), SD (.86)	M (26.17), SD (.18)		
Obese (BMI>30 kg/m^2)	1 (1.8%)	1 (2.1%)	-	-

[a] Age categories were formed in order to perform the Chi-square test; Youth: age 18-25; Young adults: age 26-40; Over 40: age 41-61.
[b] Education categories were formed in order to perform the Chi-square test; Lower-medium education: primary and secondary education; Higher education: Bachelor's degree, Master's degree, Doctorate and others. Low-medium categories were collapsed because of the small n.
[c] BMI categories were formed in order to perform a comparison of the means with the t- test, as the cell sizes are too small for some categories; Normal BMI: (BMI<25 kg/m^2); Overweight: (BMI>25 kg/m^2); Obese: (BMI>30 kg/m^2).
[d] There are not enough valid cases for processing. No statistics are computed.

4.2 Assumptions

Before running the repeated-measures ANOVAs, several assumptions need to be checked: independence of observations, categorical independent variables, normally distributed dependent variables (normality assumption) and equality for the variances of all pairwise differences between variables (sphericity assumption) (Davis, 2002 [15]).

Firstly, the mixed-subjects design of this study satisfied the first assumption, independence of the observations, as each participant was assigned to one condition only.

Secondly, US expectancies, US desires, CS evaluations and Social identification were all measured at the continuous level, whereas Social relevance consists of two categorical, independent groups (i.e. 0 = Neutral, 1 = Social). Therefore, the second assumption requiring categorical independent variables and continuous dependent variables is satisfied as well.

Subsequently, outliers were checked for. Only one potential outlier was found on the variable height, as the participant scored 62. However, it was assumed to be a typo, hence, it was coded as missing value and not removed from the dataset. No other outliers were found as all scales, apart for height and weight, were Likert-scales. Thus, there was not the possibility to score distinctly different from others.

For normality, the significance levels of the Kolmogorov-Smirnov, as well as the Shapiro-Wilk test, showed several violations of normality for all three dependent variables (See Appendix F). However, the sample for this study has more than thirty observations per condition, hence, the analysis is likely to yield accurate and valid results (Norman, 2010 [34]). Lastly, Mauchly's Test of Sphericity indicated violations of this assumption. Therefore, whenever the sphericity assumption was violated, the Greenhouse-Geisser were reported for repeated-measures ANOVAs (Armstrong, 2017 [1]).

4.3 Results

4.3.1 US Expectancy

Overall, differential US expectancies were successfully acquired over the first four acquisition trials, as indicated by a significant CS x T interaction, F (2.63, 362.27) = 22.33, $p < .001$, $\eta^2{}_p$= .14. This indicates that CS+ vs. CS− differentiation increased over the course of acquisition and hence, participants learned to expect to see a US when presented with the CS+. A significant CS+ vs. CS− differentiation on the fourth (last) trial was present, F (1,138)= 36.07, $p < .001$,$\eta^2{}_p$= .21.

Conditions marginally significantly differed in the course of acquisition (CS x T x C), F (2.63, 362.27)= 2.22, p= .09, $\eta^2{}_p$= .02. This marginally significant interaction was followed up by examining differences between conditions on each acquisition trial separately. Analyses showed that on the first, second and fourth (last) trial, group differences were not statistically significant (CS x C), $Fs < 1$. Only the third trial revealed differences across conditions, F (1,138)= 3.74, p= .05, $\eta^2{}_p$= .03. Specifically, the Social (vs. Neutral) condition exhibited a higher differentiation on the third acquisition trial, F (1,138)= 29.87, $p < .001$, $\eta^2{}_p$= .18. These results provide some evidence for an earlier acquisition in the Social group.

US expectancies extinguished over the six extinction trials as indicated by a significant CS x T interaction, F (3.73, 515.17)= 14.10, $p < .001$, $\eta^2{}_p$= .09. This indicates that CS+ vs. CS− differentiation decreased over the course of extinction and hence, participants "unlearned" the expectation to see a US after the CS+.

On the last trial, the differentiation between the CS+ and CS− was not significant anymore, F (1,138)= 1.33, p= .29, $\eta^2{}_p$= .01, meaning that extinction was successful (i.e., the difference between the CS+ and CS− was no longer significant). In fact, differential US expectancies were completely extinguished by the end of the extinction phase, resulting in the "unlearning" of the previously acquired CS-US associations. No significant group differences were found in differential US expectancies in the course of extinction (CS x T x C), nor on the last trial (CS x C), $F < 1$.

In sum, these data provide partial evidence for slightly better contingency learning in the Social (vs. Neutral) condition, reflected by a higher CS+ vs. CS− differentiation on the third acquisition trial: participants in the Social condition reached acquisition faster (See Figure 4.1). Overall, however, these findings do not provide strong evidence regarding consistent group differences in acquisition. No statistical evidence was found for differential extinction across conditions.

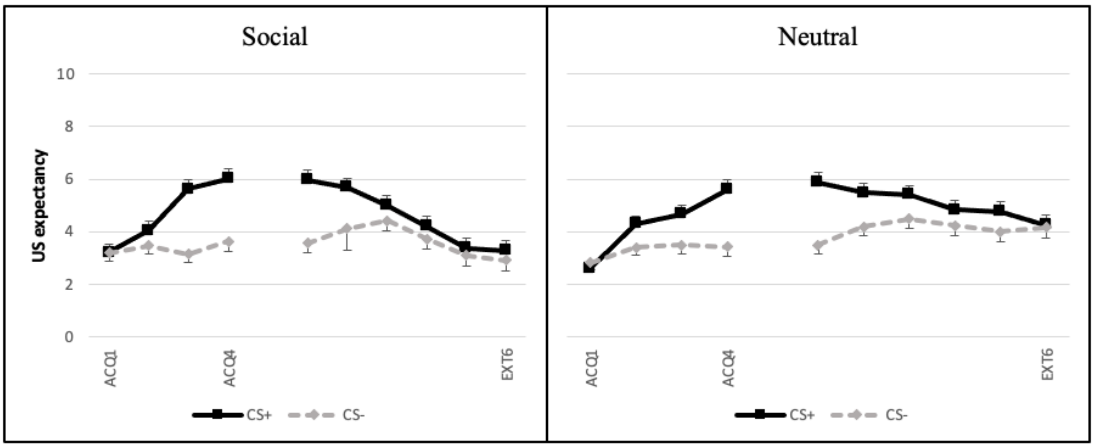


Figure 4.1: Mean US expectancies (± SEM) across groups, phases of the experiment, trials, and CS-types. CS: conditioned stimulus; Social: people CSs; Neutral: flower CSs

4.3.2 US Desires

A differential desire for chocolate was successfully acquired as indicated by a significant CS x T interaction, F (1, 138)= 8.79, p= .004, $\eta^2{}_p$= .06. This resulted in a significant CS+ vs. CS− differentiation on the last trial, F (1, 138)= 5.38, p= .02 $<$ .05, $\eta^2{}_p$= .04. Thus, after repeated CS-US pairings, respondents reported a significantly increased desire for the US when exposed to the CS+ (vs. CS−) (See Figure 4.2).

The CS x T x C interaction was not statistically significant, F (1, 138)= 2.48, p= .12, $\eta^2{}_p$= .02, indicating that the conditions did not significantly differ in the course of acquisition of US desires. Similarly, on the last acquisition trial, no significant difference between conditions was found (CS x C), F (1, 138)= 1.32, p= .25, $\eta^2{}_p$= .01. However, visual inspection of the data suggested that acquisition might have only been successful in the Social group. Exploratory analyses indeed revealed that a CS+ vs. CS− differentiation on the last acquisition trial was significant for the Social condition, F (1, 66)= 6.141, p= .016, $\eta^2{}_p$= .085, but it was not significant for the Neutral condition, $F < 1$. Thus, this provides some evidence for an earlier acquisition in the Social group.

On the first extinction trial the groups did not differ significantly still in differential desires, $F < 1$, however, a significant CS+ vs. CS− differentiation was still present, F (1, 138)= 7.11, p= .01, $\eta^2{}_p$= .49). US desires did not extinguish over the six extinction trials as indicated by a non-significant CS x T interaction, F (1, 138)= 1.36, p= .25, $\eta^2{}_p$=

.01, and they were similar across the conditions (CS x T x C), $F < 1$ (CS x C: F < 1).

However, on the last extinction trial, the Neutral condition showed a smaller and significant differentiation (CS x C) between CS+ and CS−, F (1, 138)= 6.05, p= .02, $\eta^2{}_p$= .04, compared to the Social group. In line with expectations, social cues resulted in a less complete extinction. Indeed, exploratory analyses revealed that a CS+ vs. CS− differentiation on the last extinction trial was significant for the Social condition, F (1, 66)= 4.70, p= .034, $\eta^2{}_p$= .07, but it was not significant for the Neutral condition, F (1, 72)= 1.70, p= .19, $\eta^2{}_p$= .02. Thus, this provides some evidence for a later extinction in the Social group, suggesting that US desires for social cues were in fact less (completely) extinguished.

In sum, in line with expectations, the marginally significant findings and exploratory analyses suggested that acquisition was (more) successful in the Social vs. Neutral group. Moreover, extinction of US desires in the Social vs. Neutral condition was less complete (See Figure 4.2).

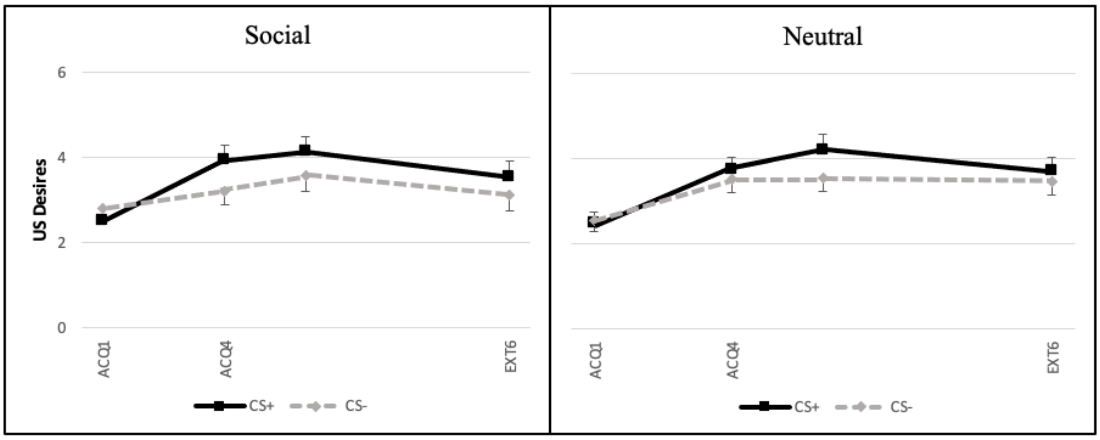


Figure 4.2: Mean US desires (± SEM) across groups, phases of the experiment, trials, and CS-types. CS: conditioned stimulus; Social: people CSs; Neutral: flower CSs

4.3.3 CS Evaluations

Overall, differential CS evaluations were not successfully acquired over the four acquisition trials as indicated by a non-significant CS x T interaction, $F < 1$. Furthermore, group differences in the acquisition of conditioned evaluations were non-significant (CS x T x C), $F < 1$ (overall differentiation: $F < 1$), showing absent and similar likings both for the CS+ vs. CS− and across conditions.

In line with this, on the last acquisition trial, no significant difference between conditions was found (CS x C), $F < 1$, along with no significant CS+ and CS− differentiation. Visual inspection of the data (Figure 4.3) suggested a CS+ and CS− differentiation in the fourth trial for the Social condition only, however, exploratory analysis showed that respondents in the Social group did not report a significantly higher evaluation of the CS+ (vs. CS−) on the fourth acquisition trial, $F < 1$. Overall, these findings did not provide evidence for a successful acquisition of the CS evaluations, nor group differences herein, $F < 1$.

Given that acquisition was not successful, extinction cannot be examined, as associations cannot be extinguished if not previously learned.

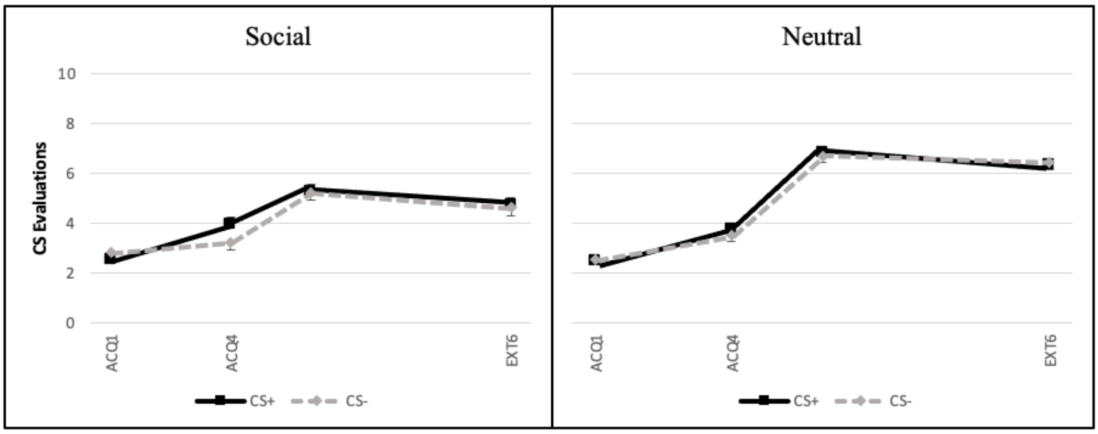


Figure 4.3: Mean CS evaluations (± SEM) across groups, phases of the experiment, trials, and CS-types. CS: conditioned stimulus; Social: people CSs; Neutral: flower CSs

4.3.4 The moderating role of Social Identification in US expectancy

Social identification did not significantly affect the acquisition of US expectancies as indicated by a non-significant significant CS x T x SI interaction, $F < 1$, as well as a non-significant CS x SI interaction on the last acquisition trial, $Fs < 1$. Thus, the extent to which a person identifies with the people depicted in CS+ was not related to a different course (nor final levels) of acquisition.

Similarly, social identification did not affect the extinction of US expectancies, as indicated by a non-significant CS x T x SI interaction, $F < 1$, and a non-significant CS x SI interaction on the last extinction trial, $Fs < 1$.

4.3.5 The moderating role of Social Identification in US Desires

Social identification significantly affected the acquisition of US desires as indicated by a significant CS x T x SI interaction, F (1, 65)= 5.14, p= .03, $\eta^2{}_p$= .07 (See Figure 4.4 and Appendix G). Follow-up analyses showed that unexpectedly, only when social identification was low, the acquisition of US desires was successful; (CS x T), F (1,32)= 8.92, p= .01, $\eta^2{}_p$= .22; however, when social identification was high, no significant acquisition of US desires was found, $F < 1$. Moreover, on the last acquisition trial, a significant CS+ vs. CS− differentiation was present in the LS group (low social identification) only, LS: F (1,32)= 9.51, p= .004, $\eta^2{}_p$= .23; HS:$F < 1$. These results provide some evidence for an earlier acquisition for participants who did not identify with the image depicting the Social group.

Social identification did not statistically affect the extinction of US desires, as indicated by a non-significant CS x T x SI interaction, F (1, 65)= 2.11, p= .15, $\eta^2{}_p$= .03. Similarly, on the last extinction trial, social identification did not significantly affect the differential US desires (CS x SI), $F < 1$.

In sum, opposite to expectations, lower levels of social identification appeared to be related to a *stronger* acquisition of desires to eat. More specifically, only when a person scored low on social identification, a successful acquisition of eating desires was found. Thus, the more a person identifies with a social group, the less their learned desire to eat increases during acquisition.

4.3.6 The moderating role of Social Identification in CS Evaluation

Social identification did not significantly affect the acquisition of CS evaluations (CS x T x SI), $F < 1$, nor it was found a significant CS x SI interaction on the last acquisition trial, $Fs < 1$.

Similarly, social identification did not statistically affect the extinction of CS evaluations, as indicated by a non-significant CS x T x SI interaction, $F < 1$. Also, on the

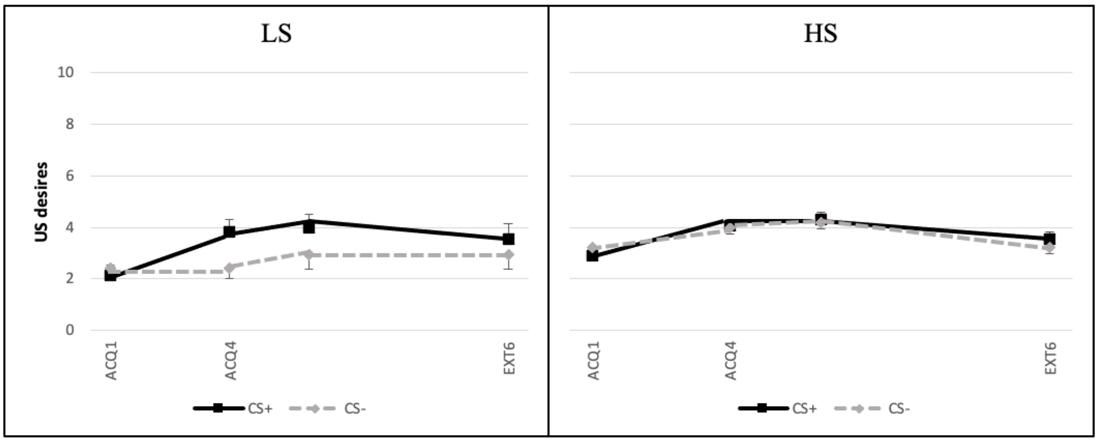


Figure 4.4: Mean US desires (± SEM) across Social identification groups, phases of the experiment, trials and CS-types. CS: conditioned stimulus; HS: High Social identification (value ”1” as ≤ 3.5); LS: Low Social identification (value =”0”)

last extinction trial, social identification did not significantly affect the differential CS evaluations (CS x SI), $F < 1$.

4.3.7 Perceptual Discriminability

If the ”social” image sets would be perceived as ”more” different by participants than the ”neutral” image sets, this may enhance learning due to an increased ease of discriminability, and not because of fear-relevance/preparedness mechanisms (Atlas & Phelps, 2018 [2]). An Independent sample t-test was performed to test whether Perceptual discriminability differed across conditions. The test showed that perceptual discriminability was similar for the Social (vs. Neutral) stimuli (M_{social} = 3.27 (SD = 1.728); $M_{neutral}$ = 3.32 (SD = 1.832); t(138) = .154, p = .878 $>$ 0.05) (See Appendix G). Hence, any group differences in appetitive responding cannot be explained by differences in the perceptual discriminability of the CS+ and CS−.

Chapter 5

Conclusions and Recommendations

This final chapter will start with a summary of the results as reported in Chapter 4. Subsequently, the same results will be discussed, alongside a list of reflected upon limitations to contribute to future research suggestions. Finally, after interpreting the study results, recommendations will be given for both the public health and marketing standpoints.

5.1 Conclusion

This study investigated the impact of social cues on classical conditioning, with the research question: *Are individuals predisposed to associate socially-relevant CS with food as US, and does social identification moderate the speed and/or magnitude of this learning process?* More specifically, the effect of social-cues, compared to non-social-cues, on the acquisition and extinction of US expectancies, US desires and CS evaluations was tested.

It was hypothesized that CS-US associations would be more readily learned and less readily extinguished when using social-cues, as reflected by a faster/stronger acquisition and a slower/weaker extinction (i.e. prepared learning). In addition, the moderating role of Social identification on the effectiveness of such social-cues was assessed. It was expected that a higher social identification, thus, participants who did identify more with the social-cues (only the CS+ was considered), would result in an even faster/stronger acquisition, and a slower/weaker extinction of the previously learned associations.

In line with expectations, (partly exploratory) analyses suggested prepared learning with respect to social cues for US desires, as acquisition appeared to be faster/stronger, and a slower/weaker extinction phase. Similarly, some evidence suggested that US expectancies were also acquired more quickly when social (vs. neutral) stimuli were used as CSs. CS evaluations were not successfully acquired.

Unexpectedly, Social identification of participants with the social stimuli appeared to moderate the speed of the learning process in the *opposite* direction. Specifically, lower levels of social identification appeared to be related to a *stronger* acquisition of desires to eat. In fact, only when a participant scored lower - but not when they scored higher - on social identification, a successful acquisition of eating desires was found.

5.2 Discussion

In line with expectations, the social relevance of the CSs led to differential acquisition and extinction for some of the appetitive responses under study. Specifically, analyses revealed that the acquisition of US expectancies appeared faster in the Social (vs. Neutral) group: on the third acquisition trial, the Cs+ vs. CS− differentiation in US expectancies was larger for the Social group. Visual inspection of the data suggested that acquisition for US desires might have only been successful in the Social group, as a CS+ vs. CS− differentiation on the last acquisition trial was significant for the Social condition only, which provides some evidence that acquisition of US desires was (more) successful in the Social vs. Neutral group. In addition, some evidence was found for extinction to be slower when using social stimuli as CSs: US desires (though not US expectancies) showed a significant CS+ vs. CS− differentiation on the last extinction trial in the Social group only, suggesting that the neutral cues led to an elimination of the differential US desires during extinction. CS evaluations were not successfully acquired, even though, in prior research, acquisition was mostly successful (van den Akker, Schyns & Jansen, 2017 [54]). These results could be due to the greater importance of the number of acquisition trials for evaluative learning, compared to other subjective measures typically assessed in conditioning studies (Baeyens, Eelen, Crombez & Van den Bergh, 1992 [3]).

Hence, these findings suggest that, in line with the hypothesis, social cues seem evolutionarily intertwined with food intake (Gergen, 1973 [20]). Traditionally, just like today, the sharing of food is part of the human history, and individuals expect to engage in the practice of eating more often in the presence of others than in isolation, who also shape the way and desires of eating. Thus, this study leads to the understanding that social stimuli reflect a biological predisposition to be associated to food intake, analogously to the predispositions for individuals to fear objects and situations that threatened the human species throughout its evolutionary history (Seligman, 1971 [45]). Moreover, these findings should not be attributed to differences in perceptual discriminability.

It was also tested whether Social identification moderates the speed and magnitude of acquisition and extinction. Social identification consists of perceiving oneself as part of a social group (Tajfel & Turner, 2004 [50]), and it indeed moderated the effect of socially-relevant (vs. socially-irrelevant) stimuli only on the acquisition of US desires. However, contrary to expectations, it was found that higher levels of social identification were associated with a worse (and even unsuccessful) acquisition of US desires. One explanation for this *opposite* effect could be that the concept of social identification relies on the so-called psychological group membership. To illustrate, a man may be of a height and weight for them to be medically classified as obese (sociological group membership), but it does not necessarily mean that he perceives himself as an obese person (psychological group membership) (Turner, 1991 [51]). However, it is not clear whether participants answered the question on a sociological or psychological level. Thus, this measure exhibited some noise based on possible different interpretations of the respondents, resulting in an unclear interpretation of which aspect is more important for moderating preparedness (if any), and detection of the effects. Thus, the present study is inconclusive in providing a sufficient explanation on why an opposite moderating effect was found, and it remains unclear for now the rationale for these findings.

5.3 Managerial implications

Overall, initial evidence was found for prepared learning between social cues and food intake, indicated by a faster/stronger acquisition and a slower/weaker extinction. In addition, exploratory analyses showed that lower levels of social identification with the social cues led to faster/stronger acquisition of US desires. Thus, if future research confirms these findings, as they were only exploratory in nature, it would be recommended for marketers to advertise based on social cues. To illustrate, a marketing campaign should depict a social context whereby a group of people is eating together, so that when the customer will find themselves in a social situation in the future, thoughts about/desires for the product will be elicited. More specifically, as low levels of social identification resulted in stronger acquisitions of desires to eat, the aforementioned social contexts should depict individuals who are not familiar with others, nor/or with the audience. Indeed, marketers could segment their target audience, and propose to them differentiated advertisements where the customer is not familiar with the social context. However, this suggested approach sounds very counterintuitive and different to current marketing approaches, which highlight social gatherings of families, friends and love partners, to stimulate positive feelings associated with their product, thus increase loyalty towards the brand, and encourage consumers to purchase (Cavanaugh, 2014 [8]). Therefore, it is crucial to replicate the findings first, and then carefully test in a lab or field experiment to what extent these findings actually translate to impacts on product purchases, so that participants would be in their natural in- and out-groups.

Furthermore, policy makers and public practitioners may as well can take advantage of these results for future interventions. It could be advised to dieters, when exposed to socially-relevant cues, to imagine a social situation where eating is done with others to whom they identify with, to reduce their desires to eat. Otherwise, socially-relevant cues could be leveraged to heighten desires to eat for healthy options that would substitute the unhealthy ones. Therefore, depending on the objective, socially-relevant cues can be leveraged bothways.

5.4 Limitations and Further Research

The first limitation is caused by the sampling technique adopted. Due to the convenience sampling method, it was considered only the personal network of the researcher. This resulted in a sample that was not representative of a more generalized population, hence, generalizability of the findings was limited.

Secondly, the study was based on a self-administered online questionnaire (Reips, 2000 [41]), which did not allow the researcher to control for extraneous influences (Sekeran & Bougie, 2016 [44]). In spite of the diligent and carefully structured design of the questionnaire, it was not possible to control if participants paid enough attention to the instructions in the questionnaire, or if they even understood them. This might have caused some inaccuracies in the data. In fact, the questionnaire was completely in English, which was probably hard to understand for those who did not master the English language that well. Moreover, conditioning studies usually involve lab experiments to control for the complexity, length of the task and obtain a better imitated acquisition and extinction process (i.e., the US can be actually consumed). In fact, it is debatable the extent to which participants actually tried to imagine eating the chocolate (US). Nevertheless, the conditioning task led to a successful acquisition of US expectancies and US desires, hence, researchers could use the task as a cost-efficient tool for conditioning studies, using however, a larger sample size and control for exogenous influences.

Lastly, this study was inconclusive in explaining the opposite moderating effect of Social identification found, and the unsuccessful acquisition of CS evaluations. A possible cause could be a lack of power to detect significant differences in these appetitive responses, or the fact that preparedness studies typically use physiological measure to assess learning process, unlike this study. Future research could extend this experimental design by incorporating more trials, extending the time of exposure for each CSs and US, or by replicating these effects in a lab or field experiment. This way, the noise around those variables would be reduced.

In sum, this study had some limitations, which pose insightful opportunities and recommendations for future research. Given that these conclusions are based on preliminary findings, future studies should first replicate the present results, taking into account the aforementioned limitations, and examine the potential consequences of faster appetitive learning for eating behavior and obesity.

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Chapter 6

Appendix

6.1 Appendix A: Advantages and Disadvantages of Experimental design

There are three types of experiments, namely: the laboratory experiment, the field experiment, and the online experiment (Reips, 2000 [41]). A great number of experiments conducted in the field of classical conditioning are laboratory experiments, that is, studies carried out in an artificially-created environment. This type of experiment gives the researcher a strong control over extraneous variables, such as confounding or contaminating influences, in order to assess the actual learning process in all its phases: habituation, acquisition and extinction. By contrast, a field experiment is carried out in a setting as natural and as close to reality as possible (e.g., in a store), generally resulting in an increased difficulty to control for extraneous influences, yet a better generalizability is obtained (Sekeran & Bougie, 2016 [44]). Lastly, online experiments are carried out on the Internet, or other social platforms. This set-up is increasingly enjoying popularity amongst researchers because, despite its low-control process (e.g., subjects might respond multiple times using several devices with different IP addresses), such method allows the gathering of extensive datasets, from a vast number of people, within a relatively short time and much lower costs compared to laboratory or field experiments (Reips, 2000 [41]). Nevertheless, one must not forget that trade-offs concerning the internal and external validity of the study, while choosing the best method to implement. Internal validity refers to the extent to which the manipulated variables in the experiment do indeed cause for changes in the dependent variable, or whether there were other factors present which account for the change. On the other hand, external validity describes the degree to which the results of the respective study are generalizable (e.g., inferences based on sample data can be applied to the whole population, hence, other situations, settings, or geographic areas; Stevens, Loudon, Ruddick, Wrenn & Sherwood, 2005 [47]). In other words, increasing the internal validity of an experiment will automatically decrease its external validity and vice-versa (Sekeran & Bougie, 2016 [44]).

However, factors posing threats to the validity of the experimental designs, especially online, needs to be addressed for the purpose of the current study. As a matter of fact, pre-tests need to be conducted to make sure the experiment is well-designed and that the independent variable is valid in its nature, as well as a random between-subject design, aiming to control for extraneous influences as much as possible. Indeed, random distribution of participants helps accounting for influences beyond the researcher's control by spreading out the risk of these influences confounding the findings over several groups (Reips, 2000 [41]). Lastly, the likelihood of a subject to participate more than once should be reduced to a minimum, given the assumptions that experiments are time consuming, and may not even involve any rewards for participation.

	Advantages	Disadvantages
Online Experiments	***Generalizability***: access to a larger and diversified sample; participants answer the questions in a natural and less controlled environment (e.g., at home, at work) ***Cost and Convenience***: distributing the survey online and through social platforms ensures lower costs, higher convenience, as it is easy to reach a large sample in a relatively short period of time	***Control issues***: participants can participate more than once by using multiple IP addresses; it is impossible for researcher to interact with participants in case of any problem arises, and it is harder to control for extraneous influences, hence, low internal validity.
Laboratory Experiments	***High Internal Validity***: higher control over exogenous factors influencing the dependent variable; higher degree of confidence on the causal effect.	***Low External Validity***: subjects might not act 'naturally' in a lab setting, making it harder to generalize the results.
Field Experiments	***High External Validity***: results tend to be more generalizable to similar settings.	***Limited Internal Validity***: uncertainty about causal effect of IV on DV; difficult to control for extraneous influences

Table 6.1: Table for Validity per Experimental Design (Stevens, Loudon, Ruddick, Wrenn & Sherwood, 2005 [47]; Sekeran & Bougie, 2016; Reips, 2000)

6.2 Appendix B: Stimulus Material for the Pretest

6.2.1 Data from previous research

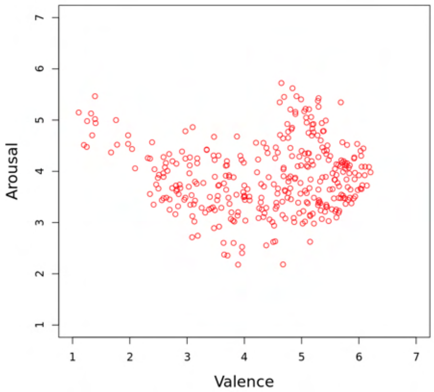

Figure 6.1: Valence and Arousal ratings for socially-relevant stimuli from OASIS

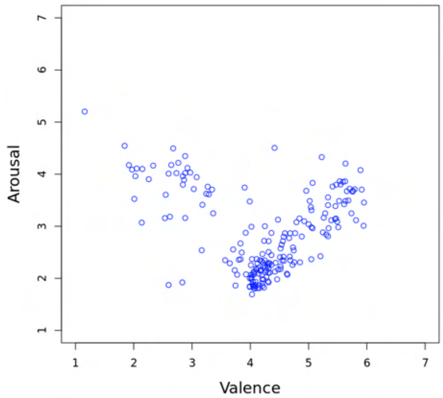

Figure 6.2: Valence and Arousal ratings for socially-relevant stimuli from OASIS

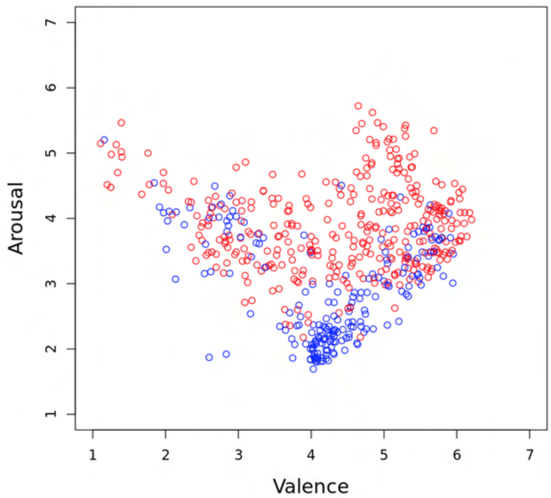

Figure 6.3: A comparison on ratings

6.2.2 Stimuli selected for the Pretest

Figure 6.4: Lily

Figure 6.5: Crocus

Figure 6.6: Lotus

Figure 6.7: Dhalia

Figure 6.8: Iris

Figure 6.9: Rose

Figure 6.10: Daisy

Figure 6.11: Sunflower

Figure 6.12: Edelweiss

Figure 6.13: Hibiscus

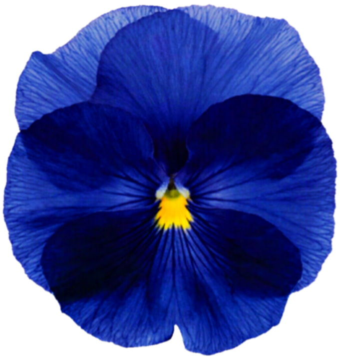

Figure 6.14: Pansy

Figure 6.15: Chrysanthemum

Figure 6.16: Morning glory

Figure 6.17: Peony

Figure 6.18: Marigold

Figure 6.19: Jasmine

Figure 6.20: Cornflower

Figure 6.21: Carnation

Figure 6.22: Daffodil

Figure 6.23: Purple Hyacinth

Figure 6.24: Man 1

Figure 6.25: Woman 1

Figure 6.26: Man 2

Figure 6.27: Woman 2

Figure 6.28: Man 3

Figure 6.29: Woman 3

Figure 6.30: Man 4

Figure 6.31: Woman 4

Figure 6.32: Man 5

Figure 6.33: Woman 5

Figure 6.34: Man 6

Figure 6.35: Woman 6

Figure 6.36: Man 7

Figure 6.37: Woman 7

Figure 6.38: Man 8

Figure 6.39: Woman 8

Figure 6.40: Man 9

Figure 6.41: Woman 9

Figure 6.42: Man 10

Figure 6.43: Woman 10

6.3 Appendix C: Questionnaire pretest

The pretest consisted of 32 pictures (16 flowers and 16 people) that were shown to the participants, for which they have to assessed two scales only (Valence and Arousal). Hereby is the questionnaire displaying the introduction and instruction pages, a sample question for an image of a flower and an image of a person, which were repeated 32 times in total, and lastly, a question about age and gender. The rating scales were placed below each images. For both dimensions, the word **Valence** and **Arousal** were displayed next to a 7-point Likert scale (1= " Very negative/ Very low; 7="Very positive/ Very high), next to the respective questions *"How negative or positive do you find this picture?"* (1="Very negative; 7="Very positive) and *"How arousing do you find this picture?"* (Mattek, Wolford & Whalen, 2017 [29]). Valence and arousal are technical terms, however, they were used simply as labels because their meanings were clearly explained to participants in the instructions. The aim is to reach equality on both dimensions to avoid differential effects in the two experimental conditions for the main study. It is expected that the images depicting people are higher in arousal compared to flowers, given the secondary data provided by the OASIS database [1]. However, the specific images used in this study are not present in the OASIS database, hence, it is relevant to conduct an ad hoc pretest to assess the ratings on both arousal and valence.

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[1] OASIS (Open Affective Standardized Image Set), a database consisting of 900 images that have been rated on valence and arousal by a sample of US-Americans recruited via amazon mechanical Turk.

Dear Participant,

Thank you for agreeing to take part in this study. I am a Marketing Analytics student at Tilburg University, and I am currently working on my Master thesis. For this reason, I am running this pilot study that will help me better design the main experiment for my research project. Your help in the process is fundamental, and it will only take you 5 minutes to complete the survey. The data collected will only be used for the purposes of the present research project, and will be treated **confidentially** and **anonymously**. Please answer as openly and truthfully as you can - there are no **right** or **wrong** answers!

Survey Completion
0% 100%
→

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In the following screens, you will see several pictures. Please look at them carefully, and answer the questions that will be displayed below each picture. In order to answer to the best of your abilities, you need to know the definitions of two important constructs; **Valence** is defined as the positive or negative affectivity and it is measured in terms of how good or bad a certain event/object is to you. On the other hand, **Arousal** measures how calming or exciting the information or event that you see is.

Survey Completion
0% 100%
→

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Please answer the following questions keeping in mind the definitions of two important constructs: **Valence** is defined as positive or negative affectivity and it is measured in terms of how good or bad a certain event/object is to you. On the other hand, **Arousal** measures how calming or exciting the information or event that you see is.

Please click the answer most appropriate to you (1= "Very negative; 7= "Very positive")

	Very negative	Moderately negative	Somewhat negative	Neutral	Somewhat positive	Moderately positive	Very positive
Valence	○	○	○	○	○	○	○

Please click the answer most appropriate to you (1= "Very low; 7= "Very high")

	Very low	Moderately low	Somewhat low	Neutral	Somewhat high	Moderately high	Very high
Arousal	○	○	○	○	○	○	○

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Please answer the following questions keeping in mind the definitions of two important constructs: **Valence** is defined as positive or negative affectivity and it is measured in terms of how good or bad a certain event/object is to you. On the other hand, **Arousal** measures how calming or exciting the information or event that you see is.

Please click the answer most appropriate to you (1= "Very negative; 7= "Very positive")

	Very negative	Moderately negative	Somewhat negative	Neutral	Somewhat positive	Moderately positive	Very positive
Valence	○	○	○	○	○	○	○

Please click the answer most appropriate to you (1= "Very low; 7= "Very high")

	Very low	Moderately low	Somewhat low	Neutral	Somewhat high	Moderately high	Very high
Arousal	○	○	○	○	○	○	○

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Age:

Sex:

- Male
- Female
- Non-binary / third gender
- Prefer not to say

Survey Completion

0% 100%

→

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Thank you for your participation. Now please **press the button below** on your right to submit your answers. If you do not, your answers will not be saved.

Survey Completion

0% 100%

→

6.4 Appendix D: Pretest Results

6.4.1 Data Analysis

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	MeanVAL_flowers	5.1051	22	.60146	.12823
	MeanVAL_people	4.5881	22	.70938	.15124

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	MeanVAL_flowers & MeanVAL_people	22	.262	.240

Paired Samples Test

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	MeanVAL_flowers - MeanVAL_people	.51705	.80113	.17080	.16184	. 87225	3.027	21	.006

Table 6.2: Pairwise t-test to assess whether the mean of Valence measuring images of flowers is the equal to the Valence measuring images of people

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	MeanARO_flowers	4.6005	23	1.00597	.20976
	MeanARO_people	4.4375	23	.70105	.14618

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	MeanARO_flowers & MeanARO_people	23	.317	.140

Paired Samples Test

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	MeanARO_flowers - MeanARO_people	.16304	1.02745	.21424	-.28126	. 60735	.761	22	.455

Table 6.3: Pairwise t-test to assess whether the mean of Arousal measuring images of flowers is the equal to the Valence measuring images of people

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MeanVAL_flowers	23	3.88	6.25	5.0842	.59610
MeanARO_flowers	23	1.38	6.25	4.6005	1.00597
MeanVAL_people	22	2.75	6.06	4.5881	.70938
MeanARO_people	23	2.81	5.88	4.4375	.70105
Valid N (listwise)	22				

Table 6.4: Comparing Means for overall Valence vs. Arousal in both experimental conditions

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Sex:	23	9	10	9.48	.511
Age:	23	20.00	79.00	31.7826	15.85146
Valid N (listwise)	23				

Table 6.5: Description of the means for Age and Gender across participants

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Sex: * MeanVAL_flowers	23	100.0%	0	0.0%	23	100.0%
Sex: * MeanVAL_people	22	95.7%	1	4.3%	23	100.0%

Report

Sex:		MeanVAL_flowers	MeanVAL_people
Male	Mean	4.8594	4.7557
	N	12	11
	Std. Deviation	.37131	.45195
Female	Mean	5.3295	4.4205
	N	11	11
	Std. Deviation	.70936	.88921
Total	Mean	5.0842	4.5881
	N	23	22
	Std. Deviation	.59610	.70938

Table 6.6: Assessment of effects on Valence of Sex

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Sex: * MeanARO_flowers	23	100.0%	0	0.0%	23	100.0%
Sex: * MeanARO_people	23	100.0%	0	0.0%	23	100.0%

Report

Sex:		MeanARO_flowers	MeanARO_people
Male	Mean	4.4167	4.5156
	N	12	12
	Std. Deviation	1.09309	.50714
Female	Mean	4.8011	4.3523
	N	11	11
	Std. Deviation	.90951	.88489
Total	Mean	4.6005	4.4375
	N	23	23
	Std. Deviation	1.00597	.70105

Table 6.7: Assessment of effects on Arousal of Sex

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Age: * MeanVAL_flowers	23	100.0%	0	0.0%	23	100.0%
Age: * MeanVAL_people	22	95.7%	1	4.3%	23	100.0%

Report

Age:		MeanVAL_flowers	MeanVAL_people
20.00	Mean	4.9375	4.0000
	N	1	1
	Std. Deviation	.	.
21.00	Mean	4.9688	5.5000
	N	2	1
	Std. Deviation	.48614	.
22.00	Mean	4.7292	4.9167
	N	3	3
	Std. Deviation	.23662	.54606
23.00	Mean	5.2083	3.9583
	N	3	3
	Std. Deviation	.50518	1.04831
24.00	Mean	5.3375	4.6750
	N	5	5
	Std. Deviation	1.00254	.86309
25.00	Mean	5.0938	4.1563
	N	2	2
	Std. Deviation	.04419	.57452
28.00	Mean	5.3750	4.4375
	N	1	1
	Std. Deviation	.	.
46.00	Mean	4.9375	4.8125
	N	1	1
	Std. Deviation	.	.
50.00	Mean	4.0000	4.0000
	N	1	1
	Std. Deviation	.	.
51.00	Mean	5.6875	4.9375
	N	1	1
	Std. Deviation	.	.
52.00	Mean	4.7500	5.1250
	N	1	1
	Std. Deviation	.	.
58.00	Mean	4.9375	4.5000
	N	1	1
	Std. Deviation	.	.
79.00	Mean	5.6875	5.3125
	N	1	1
	Std. Deviation	.	.
Total	Mean	5.0842	4.5881
	N	23	22
	Std. Deviation	.59610	.70938

Table 6.8: Assessment of effects on Valence of Age

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Age: * MeanARO_flowers	23	100.0%	0	0.0%	23	100.0%
Age: * MeanARO_people	23	100.0%	0	0.0%	23	100.0%

Report

Age:		MeanARO_flowers	MeanARO_people
20.00	Mean	3.7500	4.0000
	N	1	1
	Std. Deviation	.	.
21.00	Mean	4.7813	5.1250
	N	2	2
	Std. Deviation	.13258	.35355
22.00	Mean	3.2917	4.1042
	N	3	3
	Std. Deviation	1.68904	.56711
23.00	Mean	5.1667	3.7708
	N	3	3
	Std. Deviation	1.16145	.88682
24.00	Mean	4.8500	4.5125
	N	5	5
	Std. Deviation	.91494	.95750
25.00	Mean	4.5938	4.1563
	N	2	2
	Std. Deviation	1.37002	.22097
28.00	Mean	4.8125	4.3750
	N	1	1
	Std. Deviation	.	.
46.00	Mean	5.0000	4.3125
	N	1	1
	Std. Deviation	.	.
50.00	Mean	4.3125	4.3750
	N	1	1
	Std. Deviation	.	.
51.00	Mean	5.5625	4.9375
	N	1	1
	Std. Deviation	.	.
52.00	Mean	4.3125	5.1250
	N	1	1
	Std. Deviation	.	.
58.00	Mean	4.8750	4.8125
	N	1	1
	Std. Deviation	.	.
79.00	Mean	4.8125	5.3750
	N	1	1
	Std. Deviation	.	.
Total	Mean	4.6005	4.4375
	N	23	23
	Std. Deviation	1.00597	.70105

Table 6.9: Assessment of effects on Arousal of Age

Descriptive Statistics

Flower Images		N	Minimum	Maximum	Mean	Std. Deviation
Image 1	Valence	23	3	7	5.04	1.224
	Arousal	23	1	7	4.35	1.402
Image 2	Valence	23	3	7	5.39	1.305
	Arousal	23	1	7	4.65	1.849
Image 3	Valence	23	2	7	5.26	1.484
	Arousal	23	1	7	4.30	2.055
Image 4	Valence	23	3	7	4.91	1.164
	Arousal	23	1	7	4.52	1.563
Image 5	Valence	23	3	7	5.13	1.392
	Arousal	23	2	7	4.57	1.701
Image 6	Valence	23	4	7	5.91	.996
	Arousal	23	1	7	5.87	1.486
Image 7	Valence	23	2	7	5.09	1.125
	Arousal	23	1	7	4.48	1.974
Image 8	Valence	23	3	7	5.22	1.242
	Arousal	23	1	7	5.04	1.492
Image 9	Valence	23	2	7	4.96	1.224
	Arousal	23	2	7	4.48	1.442
Image 10	Valence	23	3	7	5.39	1.373
	Arousal	23	1	7	4.74	1.711
Image 11	Valence	23	2	7	4.83	1.527
	Arousal	23	1	7	4.17	1.875
Image 12	Valence	23	2	7	4.87	1.058
	Arousal	23	1	7	4.26	1.764
Image 13	Valence	23	2	7	4.61	1.270
	Arousal	23	2	7	4.43	1.199
Image 14	Valence	23	1	7	4.74	1.573
	Arousal	23	1	7	4.43	1.903
Image 15	Valence	23	2	7	5.17	1.302
	Arousal	23	1	7	4.65	1.873
Image 16	Valence	23	3	7	4.83	.887
	Arousal	23	1	7	4.65	1.496
	Valid N (listwise)	23				

Table 6.10: Description of the individual means for Valence and Arousal for each image of flowers across participants

Descriptive Statistics

People images		N	Minimum	Maximum	Mean	Std. Deviation
Image 1	Valence	23	4	7	5.17	.887
	Arousal	23	1	7	4.61	1.438
Image 2	Valence	23	2	6	3.57	1.237
	Arousal	23	2	7	3.78	1.347
Image 3	Valence	23	1	7	4.70	1.363
	Arousal	23	1	6	4.30	1.521
Image 4	Valence	23	1	7	5.09	1.621
	Arousal	23	1	7	4.70	1.893
Image 5	Valence	23	3	7	5.39	1.158
	Arousal	23	3	7	5.09	1.125
Image 6	Valence	23	3	7	5.04	1.022
	Arousal	23	2	7	4.91	1.311
Image 7	Valence	23	1	6	3.52	1.473
	Arousal	23	1	6	3.61	1.699
Image 8	Valence	23	1	7	4.52	1.442
	Arousal	23	1	6	4.13	1.424
Image 9	Valence	23	1	7	4.83	1.267
	Arousal	23	1	7	4.78	1.506
Image 10	Valence	23	1	7	3.83	1.557
	Arousal	23	1	7	3.91	1.474
Image 11	Valence	23	2	7	4.78	1.085
	Arousal	23	2	7	4.83	1.029
Image 12	Valence	23	1	7	4.00	1.382
	Arousal	23	1	7	4.09	1.379
Image 13	Valence	23	1	7	3.96	1.609
	Arousal	23	1	7	3.96	1.551
Image 14	Valence	23	2	7	4.87	1.392
	Arousal	23	1	7	4.61	1.699
Image 15	Valence	23	1	7	4.43	1.727
	Arousal	23	1	7	4.09	1.730
Image 16	Valence	23	3	7	5.57	.843
	Arousal	23	3	7	5.61	1.158
	Valid N (listwise)	23				

Table 6.11: Description of the individual means for Valence and Arousal for each image of people across participants

6.4.2 Images selected

Figure 6.44: Chosen image for Socially-relevant stimulus (CS+)

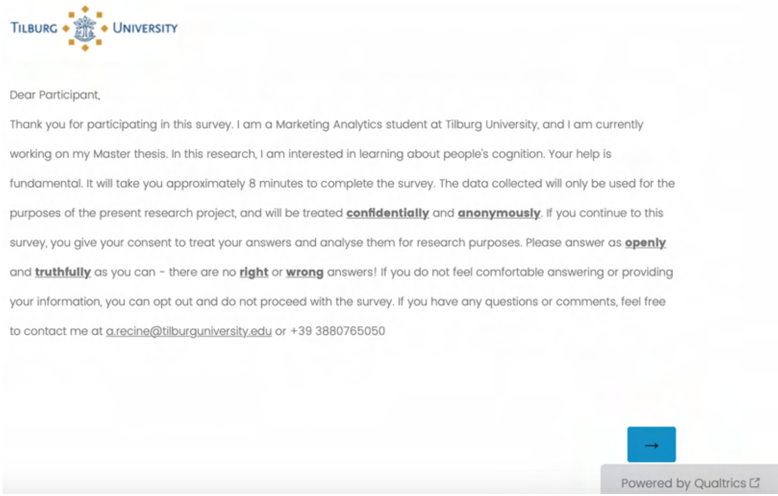
Figure 6.45: Chosen image for Socially-relevant stimulus (CS-)

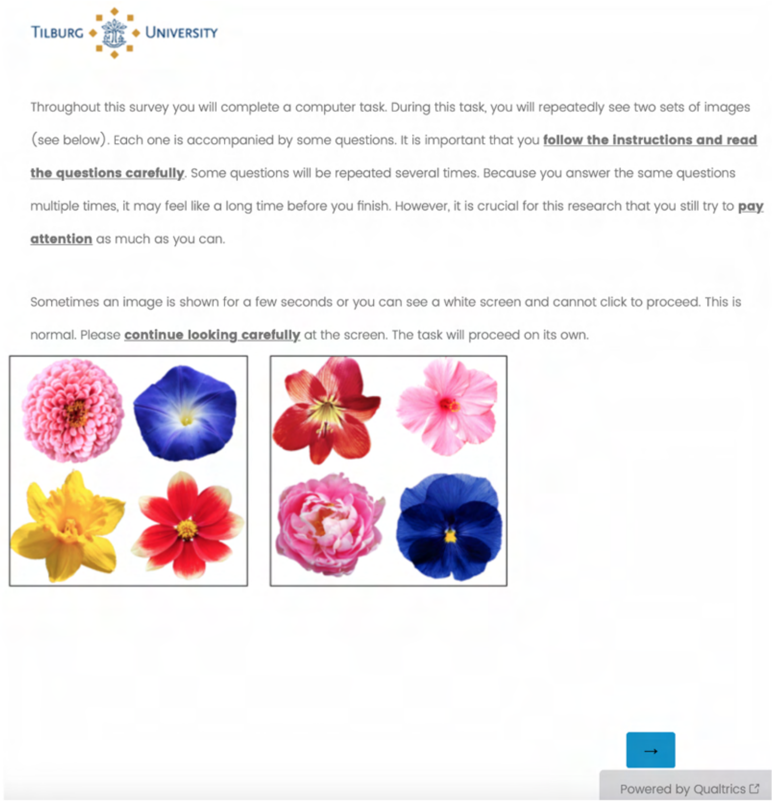
Figure 6.46: Chosen image for Socially-relevant stimulus (CS+)

Figure 6.47: Chosen image for Socially-relevant stimulus (CS-)

6.5 Appendix E: Questionnaire conditioning task

6.5.1 Overview of the Neutral group condition: flowers




Tilburg University
Throughout this survey you will complete a computer task. During this task, you will repeatedly see two sets of images (see below). Each one is accompanied by some questions. It is important that you **follow the instructions and read the questions carefully**. Some questions will be repeated several times. Because you answer the same questions multiple times, it may feel like a long time before you finish. However, it is crucial for this research that you still try to **pay attention** as much as you can.
Sometimes an image is shown for a few seconds or you can see a white screen and cannot click to proceed. This is normal. Please **continue looking carefully** at the screen. The task will proceed on its own.
→
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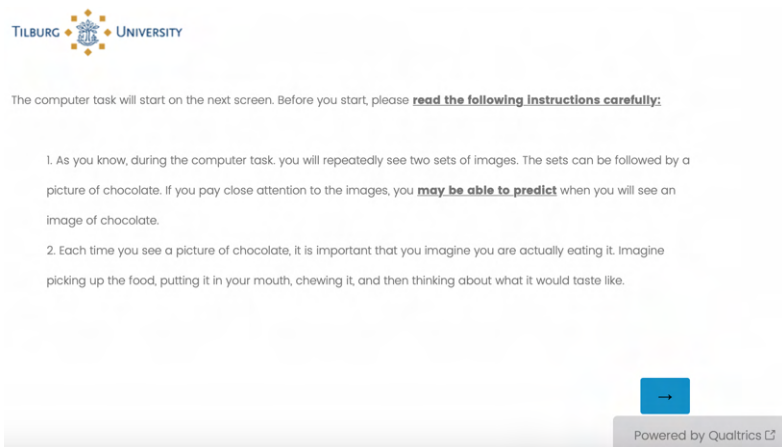

Tilburg University
The computer task will start on the next screen. Before you start, please **read the following instructions carefully:**
1. As you know, during the computer task. you will repeatedly see two sets of images. The sets can be followed by a picture of chocolate. If you pay close attention to the images, you **may be able to predict** when you will see an image of chocolate.
2. Each time you see a picture of chocolate, it is important that you imagine you are actually eating it. Imagine picking up the food, putting it in your mouth, chewing it, and then thinking about what it would taste like.
→
Powered by Qualtrics

At this point, the computer task begins with the acquisition phase, which consists of four trials. US expectancies are measured at each trial, whereas US desired and CS evaluations are measured only on the first and fourth trial. The CS+ and CS− are randomized in the order in which they are presented. The CS+ is always followed by an image of chocolate, which will be displayed for 4s. To illustrate, find below the questionnaire layout for the first trial.

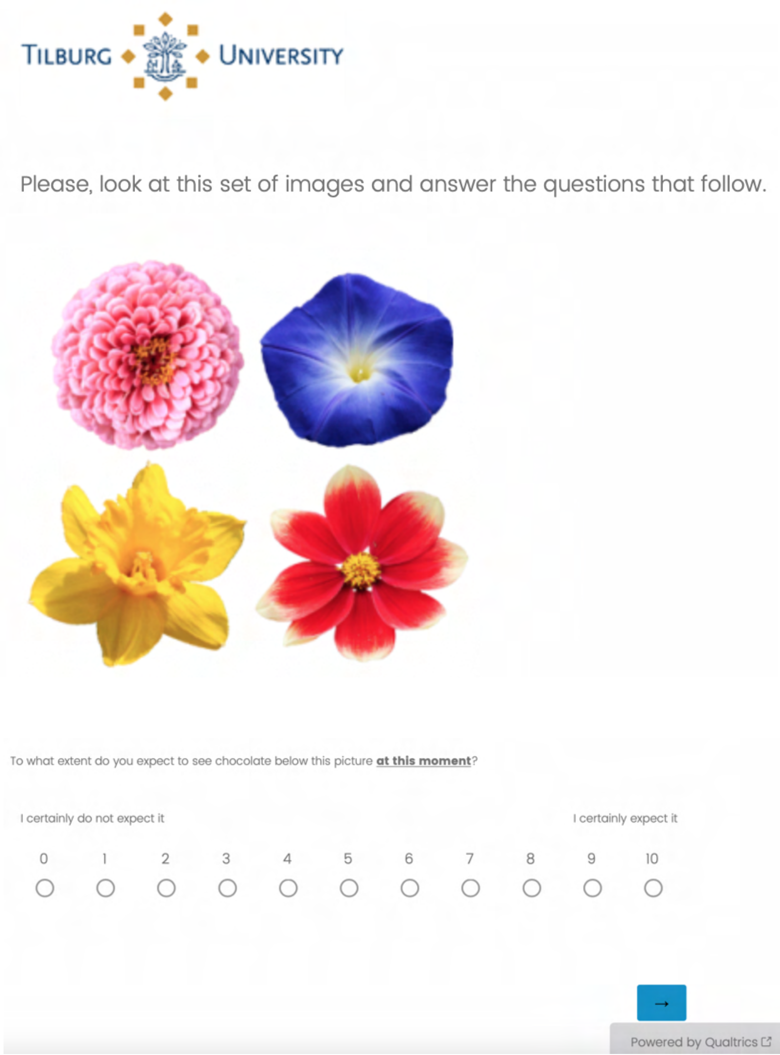


Figure 6.48: US expectancy

Figure 6.49: US desires

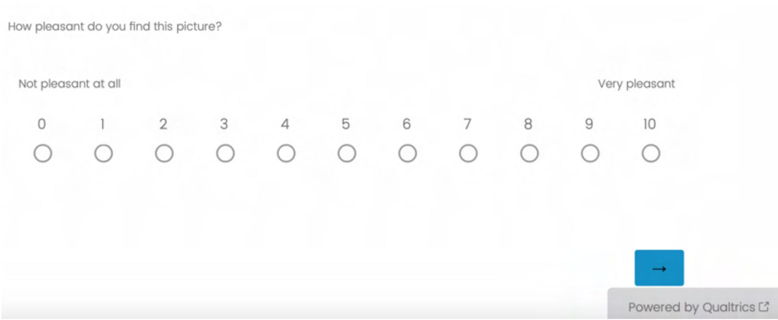


Figure 6.50: CS evaluations

Figure 6.51: CS+ paired with the US

Figure 6.52: US expectancy

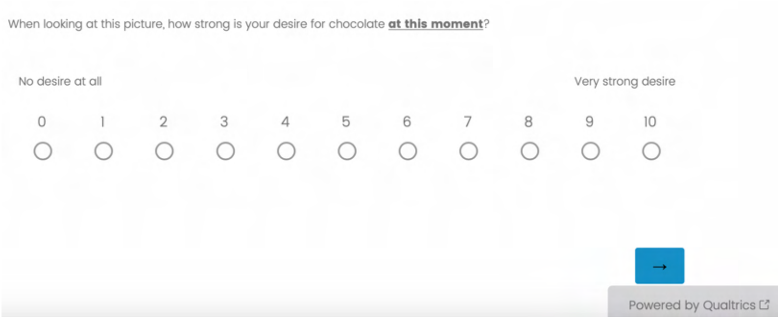


Figure 6.53: US desires

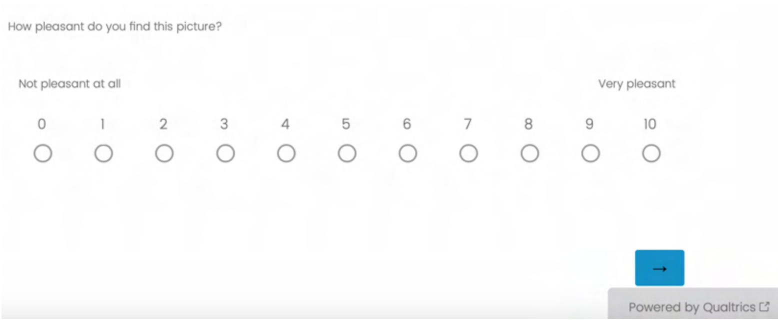
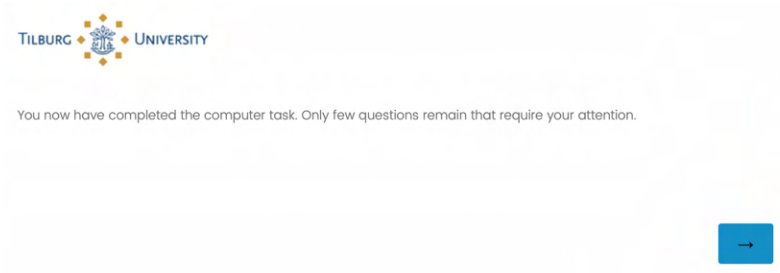
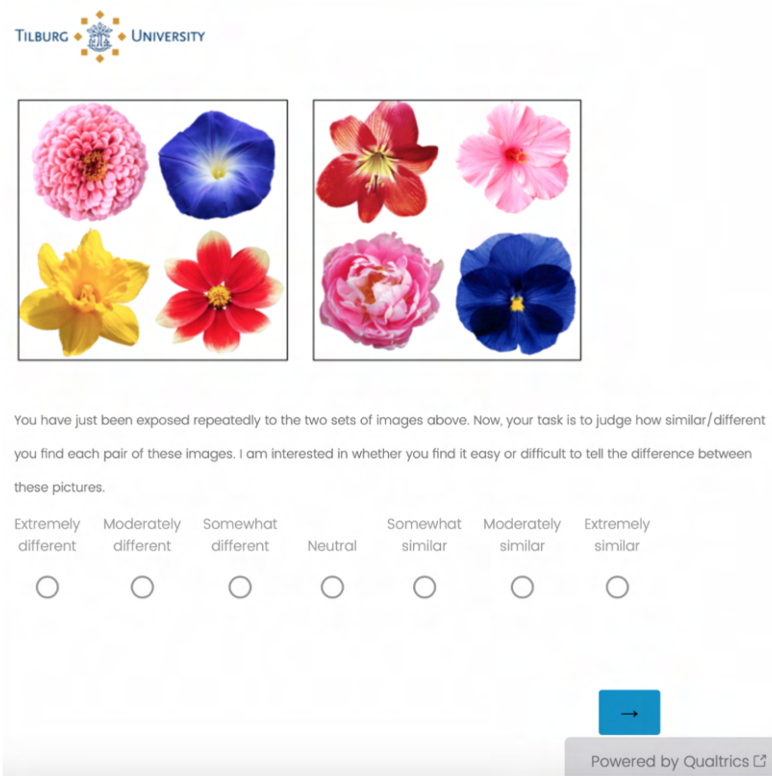


Figure 6.54: CS evaluations

Figure 6.55: CS−

At this point, the computer task continues with the extinction phase, which consists of six trials. US expectancies are measured at each trial, whereas US desired and CS evaluations are measured only on the first and sixth trial. The CS+ and CS− are randomized in the order in which they are presented. The questionnaire layout is the same as for the acquisition phase, however, the CS+ is never followed by the image of chocolate in this case. Once the extinction phase is also completed, few questions remain, including the measures for the perceptual discriminability, and the demographics.

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You have just been exposed repeatedly to the two sets of images above. Now, your task is to judge how similar/different you find each pair of these images. I am interested in whether you find it easy or difficult to tell the difference between these pictures.

Extremely different	Moderately different	Somewhat different	Neutral	Somewhat similar	Moderately similar	Extremely similar
○	○	○	○	○	○	○

→

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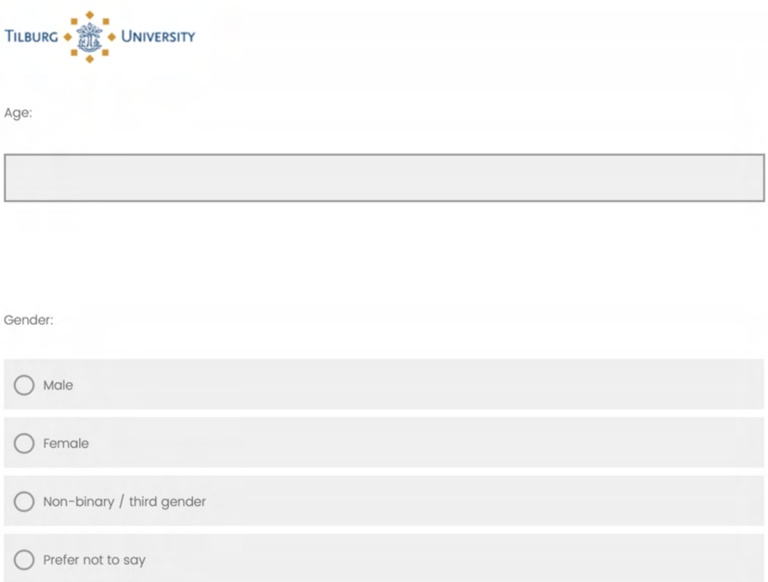
Figure 6.56: Perceptual discriminability


TILBURG UNIVERSITY

Age:

Gender:

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Prefer not to say

Please indicate your height (expressed in cm). If you are not comfortable answering this question, you can simply decide to skip it.

Please indicate your weight (expressed in kg). If you are not comfortable answering this question, you can simply move on to the next page.

What is your highest level of education?

- Primary education
- Secondary education (High school diploma or equivalent)
- Bachelor's degree
- Master's degree
- Doctorate
- Other (please specify)

Tilburg University

You have now finished the study. Thank you for your participation. Now please **press** the **button below on your right** to submit your answers. If you do not, your answers will not be saved.

→

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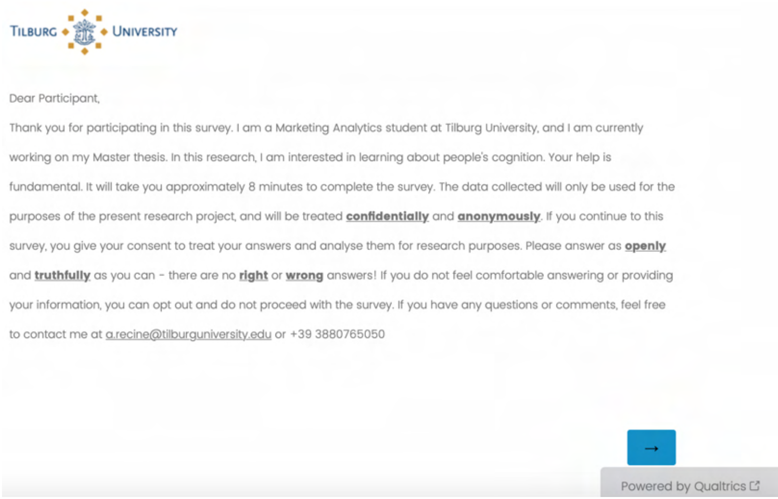
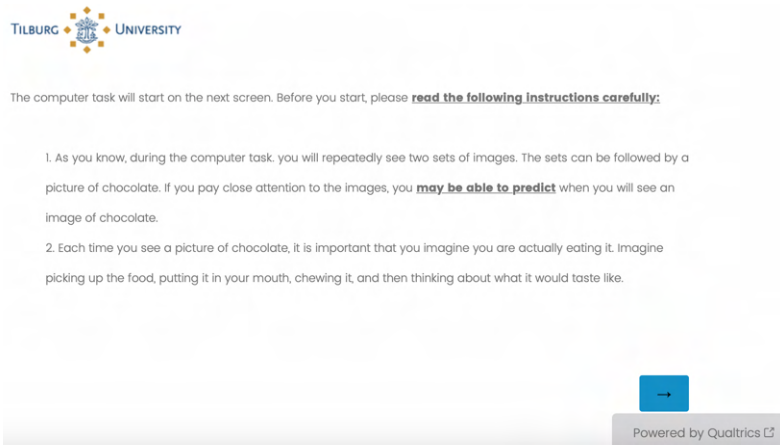
6.5.2 Overview of the Social group condition: people




Tilburg University
The computer task will start on the next screen. Before you start, please read the following instructions carefully:
1. As you know, during the computer task. you will repeatedly see two sets of images. The sets can be followed by a picture of chocolate. If you pay close attention to the images, you may be able to predict when you will see an image of chocolate.
2. Each time you see a picture of chocolate, it is important that you imagine you are actually eating it. Imagine picking up the food, putting it in your mouth, chewing it, and then thinking about what it would taste like.
→
Powered by Qualtrics

At this point, the computer task begins with the acquisition phase, which consists of four trials. US expectancies are measured at each trial, whereas US desired and CS evaluations are measured only on the first and fourth trial. The CS+ and CS− are randomized in the order in which they are presented. The CS+ is always followed by an image of chocolate, which will be displayed for 4s. To illustrate, find below the questionnaire layout for the first trial.

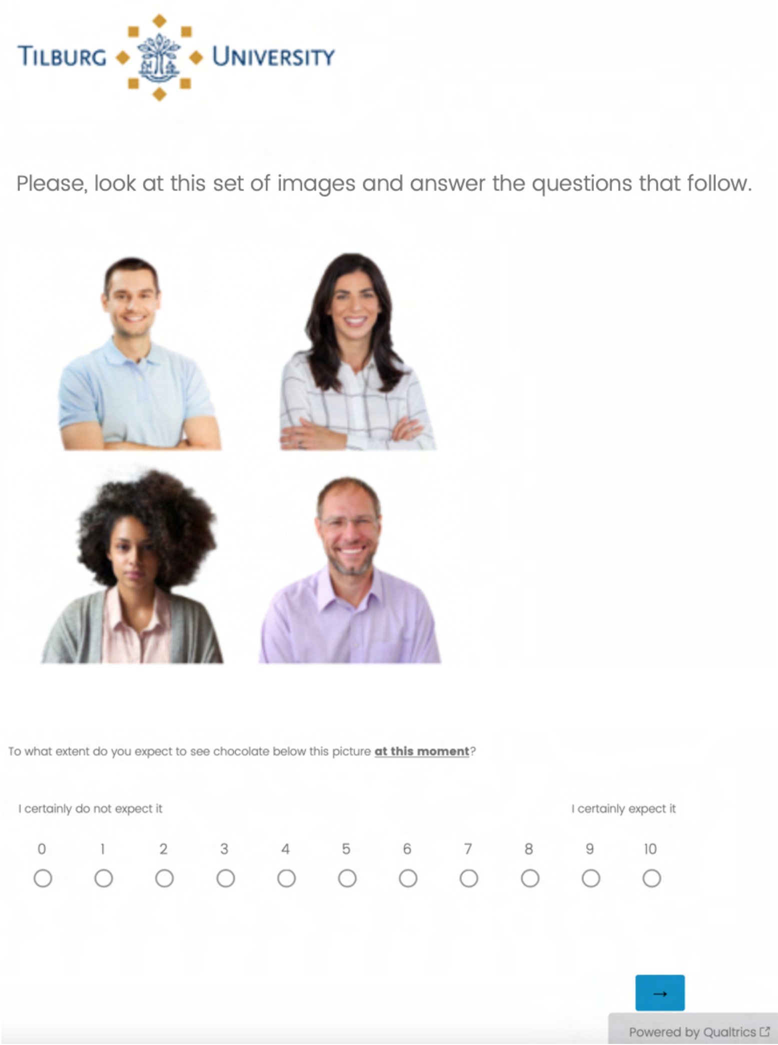


Figure 6.57: US expectancy

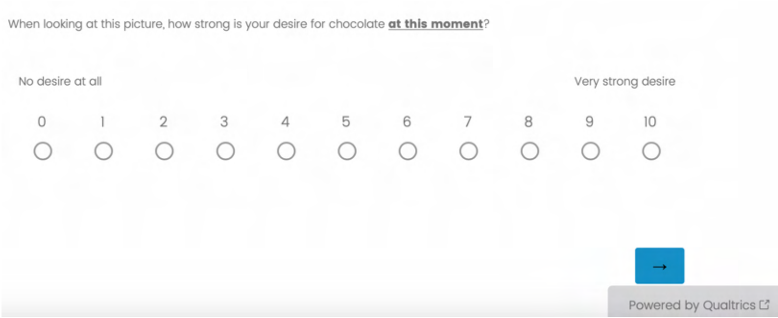


Figure 6.58: US desires

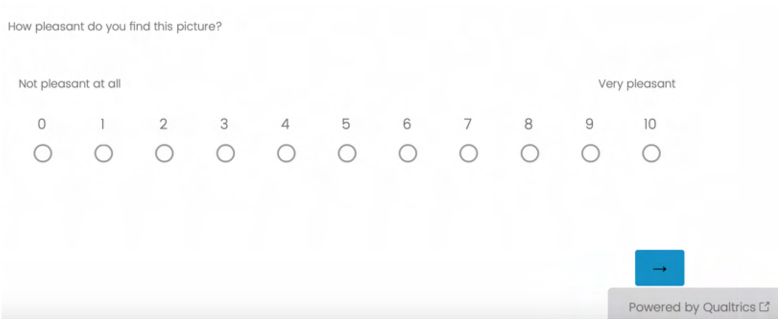


Figure 6.59: CS evaluations

Figure 6.60: CS+ paired with the US

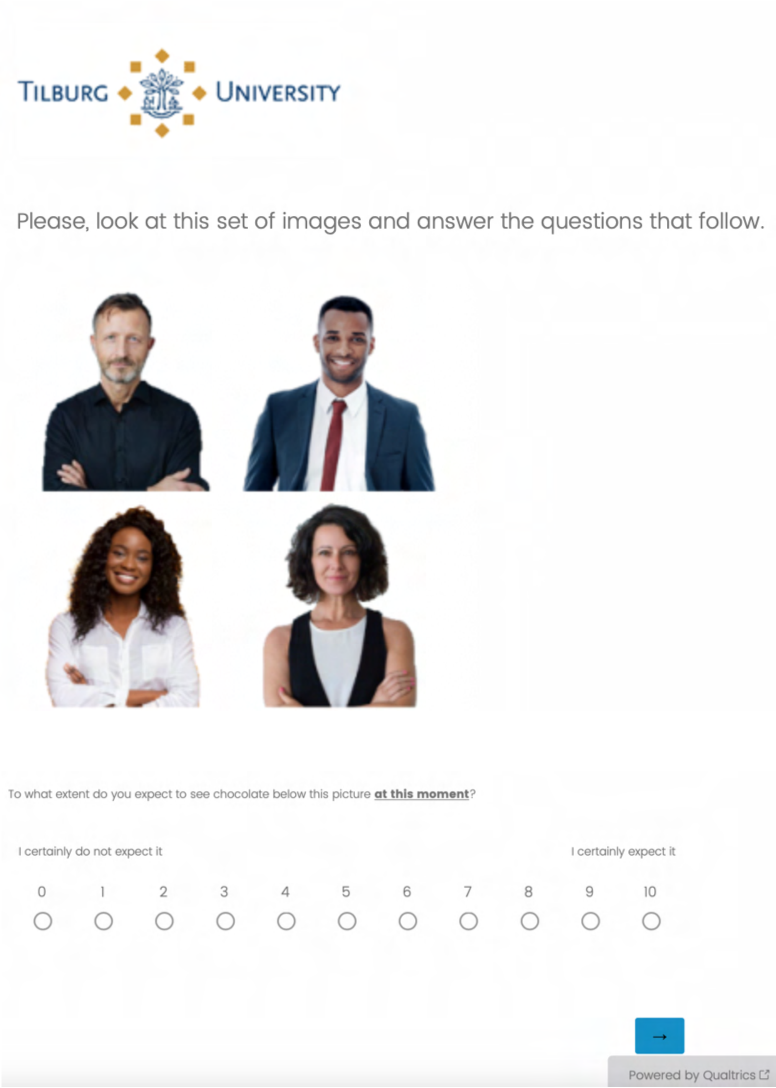


Figure 6.61: US expectancy

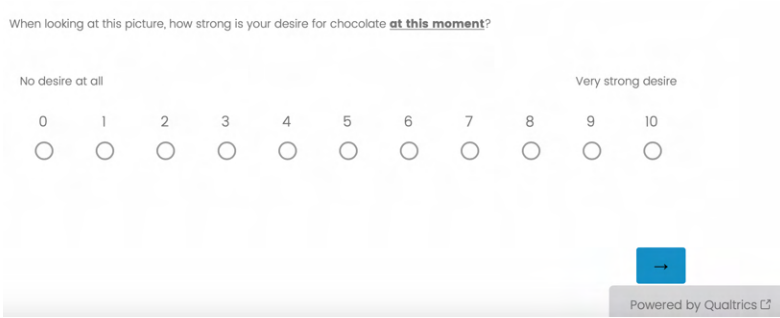


Figure 6.62: US desires

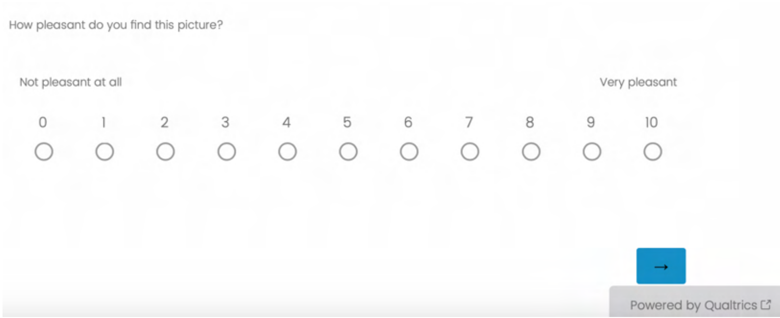


Figure 6.63: CS evaluations

Figure 6.64: CS−

At this point, the computer task continues with the extinction phase, which consists of six trials. US expectancies are measured at each trial, whereas US desired and CS evaluations are measured only on the first and sixth trial. The CS+ and CS− are randomized in the order in which they are presented. The questionnaire layout is the same as for the acquisition phase, however, the CS+ is never followed by the image of chocolate in this case. Once the extinction phase is also completed, few questions remain, including the measures for the perceptual discriminability, social identification, and the demographics.

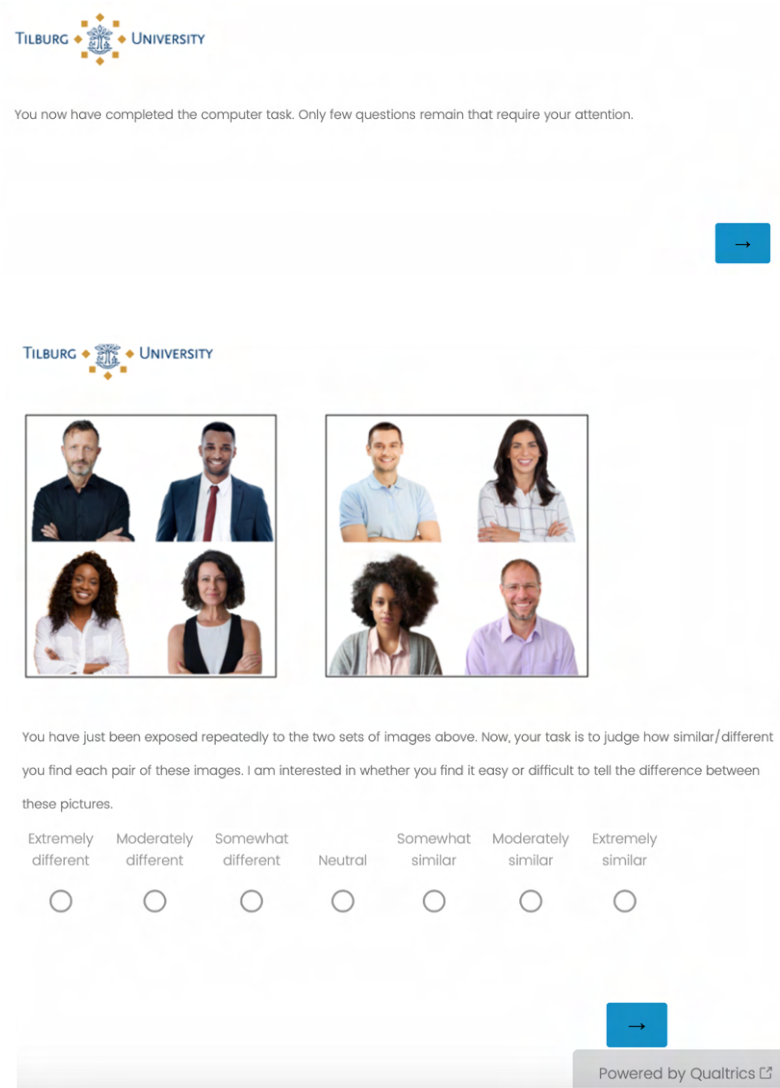


Figure 6.65: Perceptual discriminability

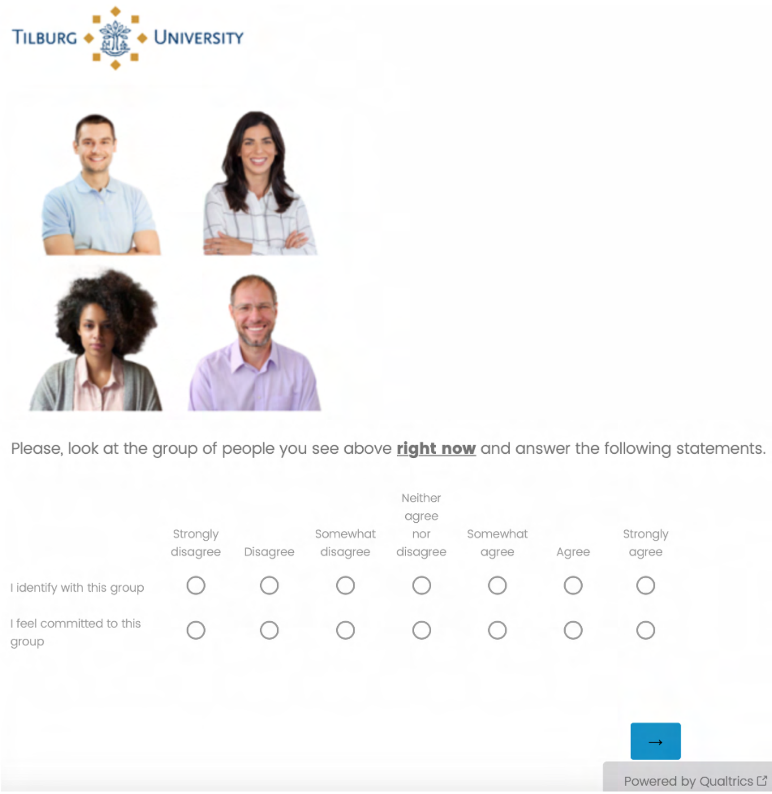
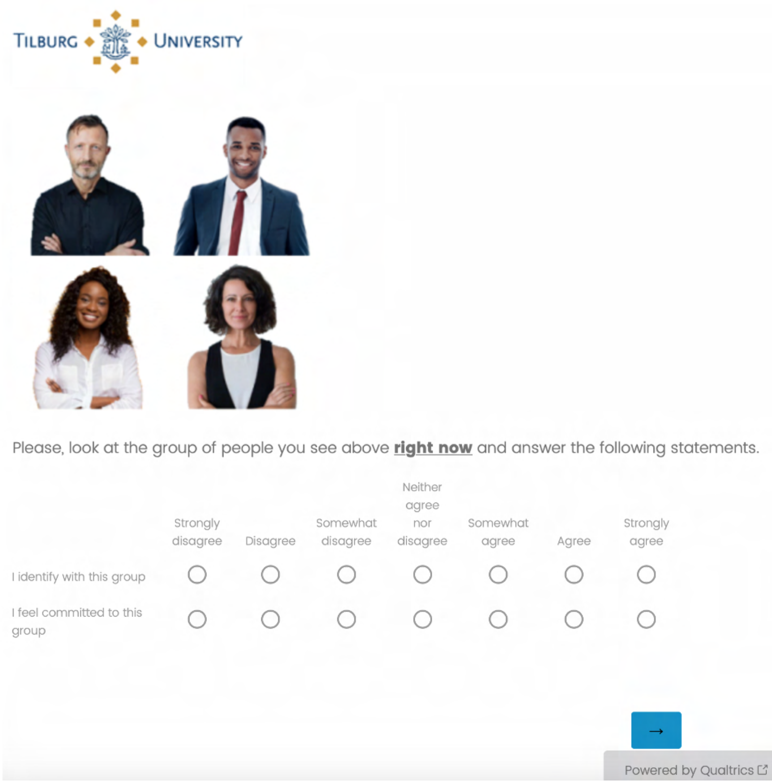


Figure 6.66: Social identification CS+



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Please, look at the group of people you see above **right now** and answer the following statements.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I identify with this group	○	○	○	○	○	○	○
I feel committed to this group	○	○	○	○	○	○	○

→

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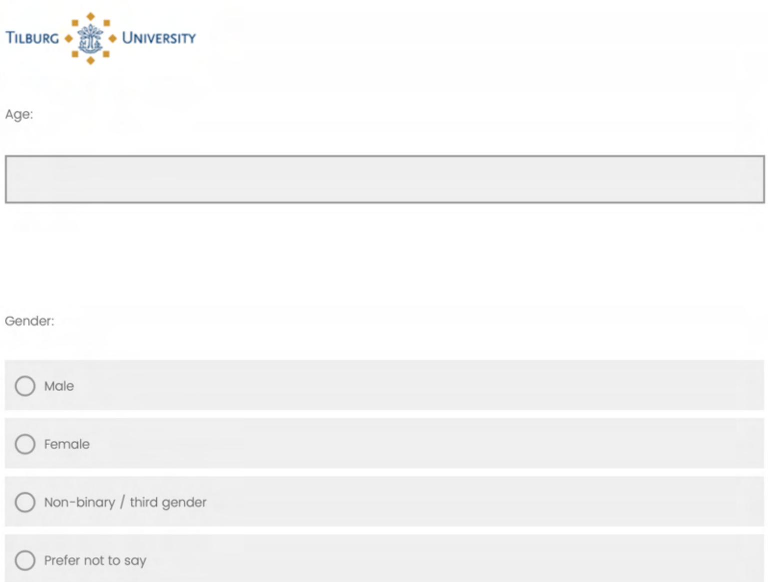
Figure 6.67: Social identification CS−



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Age:

Gender:

○ Male

○ Female

○ Non-binary / third gender

○ Prefer not to say

Please indicate your height (expressed in cm). If you are not comfortable answering this question, you can simply decide to skip it.

Please indicate your weight (expressed in kg). If you are not comfortable answering this question, you can simply move on to the next page.

What is your highest level of education?

- Primary education
- Secondary education (High school diploma or equivalent)
- Bachelor's degree
- Master's degree
- Doctorate
- Other (please specify)

TILBURG UNIVERSITY

You have now finished the study. Thank you for your participation. Now please **press** the **button below on your right** to submit your answers. If you do not, your answers will not be saved.

→

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6.6 Appendix F: Results repeated-measures ANOVAs assumptions

6.6.1 Normality tests per condition

Test of Normality

	Neutral		Social	
	Kolmogorov-Smirnov[a]	Shapiro-Wilk	Kolmogorov-Smirnov[a]	Shapiro-Wilk
	Sig.	Sig.	Sig.	Sig.
Acquisition EXP T1 CS+	.000	.000	.003	.001
Acquisition EXP T1 CS-	.001	.000	.000	.000
Acquisition DES T1 CS+	.000	.000	.000	.000
Acquisition DES T1 CS-	.000	.000	.000	.000
Acquisition EVAL T1 CS+	.001	.001	.000	.001
Acquisition EVAL T1 CS-	.003	.003	.000	.001
Acquisition EXP T2 CS+	.045	.025	.001	.002
Acquisition EXP T2 CS-	.023	.003	.001	.001
Acquisition EXP T3 CS+	.001	.003	.001	.002
Acquisition EXP T3 CS-	.001	.000	.005	.000
Acquisition EXP T4 CS+	.018	.000	.000	.000
Acquisition EXP T4 CS-	.012	.000	.007	.000
Acquisition DES T4 CS+	.000	.002	.059	.009
Acquisition DES T4 CS-	.006	.000	.000	.000
Acquisition EVAL T4 CS+	.002	.012	.001	.063
Acquisition EVAL T4 CS-	.000	.001	.003	.007
Extinction EXP T1 CS+	.000	.000	.002	.000
Extinction EXP T1 CS-	.000	.000	.006	.000
Extinction DES T1 CS+	.000	.000	.005	.006

Extinction DES T1 CS-	.001	.001	.000	.000
Extinction EVAL T1 CS+	.002	.003	.068	.080
Extinction EVAL T1 CS-	.000	.014	.052	.064
Extinction EXP T2 CS+	.002	.005	.069	.011
Extinction EXP T2 CS-	.050	.002	.003	.000
Extinction EXP T3 CS+	.200*	.012	.188	.014
Extinction EXP T3 CS-	.015	.001	.038	.001
Extinction EXP T4 CS+	.012	.002	.001	.002
Extinction EXP T4 CS-	.006	.000	.009	.000
Extinction EXP T5 CS+	.009	.001	.000	.000
Extinction EXP T5 CS-	.001	.000	.000	.000
Extinction EXP T6 CS+	.000	.000	.000	.000
Extinction EXP T6 CS-	.004	.000	.000	.000
Extinction DES T6 CS+	.006	.004	.000	.000
Extinction DES T6 CS-	.000	.000	.000	.000
Extinction EVAL T6 CS+	.000	.008	.092	.064
Extinction EVAL T6 CS-	.000	.001	.001	.016

Table 6.12: Normality test per condition; EXP: US Expectancy; DES: US Desires; EVAL: CS Evaluations; T: Trial

6.6.2 Sphericity tests

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CStype	1.000	.000	0	.	1.000	1.000	1.000
Trials	.678	53.044	5	.000	.809	.830	.333
CStype * Trials	.820	27.201	5	.000	.875	.900	.333

Table 6.13: Mauchly's Test of Sphericity; Measure: Acquisition US Expectancy; CStype: CS+ and CS−

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CStype	1.000	.000	0	.	1.000	1.000	1.000
Trials	1.000	.000	0	.	1.000	1.000	1.000
CStype * Trials	1.000	.000	0	.	1.000	1.000	1.000

Table 6.14: Mauchly's Test of Sphericity; Measure: Acquisition US Desires; CStype: CS+ and CS−

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CStype	1.000	.000	0	.	1.000	1.000	1.000
Trials	1.000	.000	0	.	1.000	1.000	1.000
CStype * Trials	1.000	.000	0	.	1.000	1.000	1.000

Table 6.15: Mauchly's Test of Sphericity; Measure: Acquisition CS Evaluations; CStype: CS+ and CS−

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CStype	1.000	.000	0	.	1.000	1.000	1.000
Trials	.182	232.040	14	.000	.583	.602	.200
CStype * Trials	.458	106.278	14	.000	.747	.776	.200

Table 6.16: Mauchly's Test of Sphericity; Measure: Extinction US Expectancy; CStype: CS+ and CS−

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CStype	1.000	.000	0	.	1.000	1.000	1.000
Trials	1.000	.000	0	.	1.000	1.000	1.000
CStype * Trials	1.000	.000	0	.	1.000	1.000	1.000

Table 6.17: Mauchly's Test of Sphericity; Measure: Extinction US Desires; CStype: CS+ and CS−

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CStype	1.000	.000	0	.	1.000	1.000	1.000
Trials	1.000	.000	0	.	1.000	1.000	1.000
CStype * Trials	1.000	.000	0	.	1.000	1.000	1.000

Table 6.18: Mauchly's Test of Sphericity; Measure: Extinction CS Evaluations; CStype: CS+ and CS−

6.7 Appendix G: Results repeated-measures ANOVAs

Group Statistics

	Condition	N	Mean	Std. Deviation	Std. Error Mean
SIMILARITY	.00	73	3.3151	1.83240	.21447
	1.00	67	3.2687	1.72839	.21116

Independent Samples Test

		Levene's Test for Equality of Variance		t-test for Equality of Means						
									95%Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Differences	Std. Error Differences	Lower	Upper
SIMILARITY	Equal variances assumed	.249	.619	.154	138	.878	.04641	.30173	-.55020	.64302
	Equal variances not assumed		.154	.154	137.892	.878	.04641	.30097	-.54870	.64152

Table 6.19: Independent Samples Test; Measure: Perceptual discriminability; Condition: Neutral (0), Social (1)

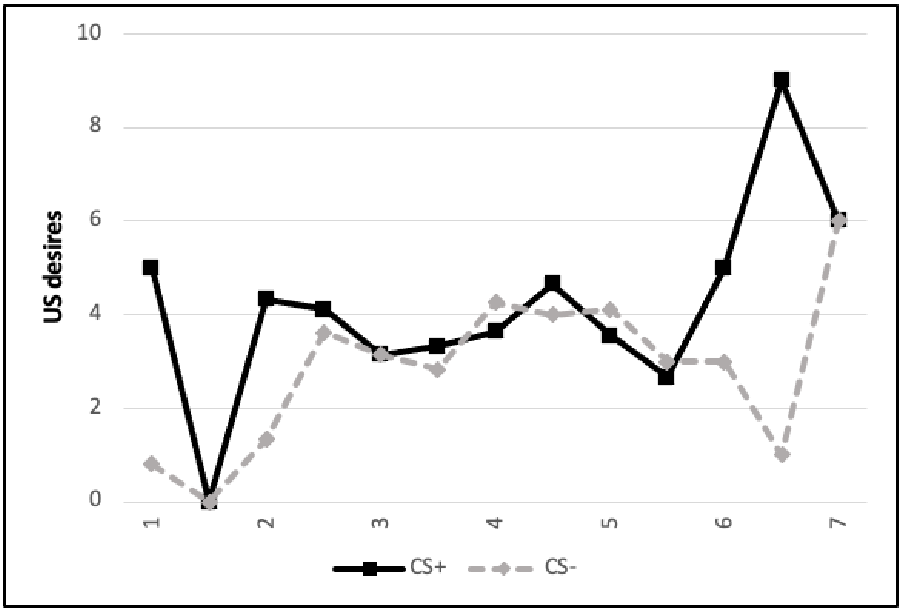

Figure 6.68: Mean US desires across Social identification ratings (1-7) and CS-types. CS: conditioned stimulus

6.7.1 Reliability of Measurement Scales

Before conducting the data analysis, the reliability of the multi-item measurement scale for Social identification was assessed to check whether it would be appropriate to summarize the different scale items into one variable with a mean score, and most importantly, to see whether two items are enough instead of four. To this end, Cronbach's alpha for each of the two multi-item measurement scale used in the questionnaire was evaluated (Social identification CS+: $\alpha = 0.80$; Social identification CS−: $\alpha = 0.82$). Moreover, both items are moderately correlated for the CS+ (.67) and CS− (.70). When looking at the scores, it becomes evident that the scale for both CSs provides good internal consistency (i.e., 0.9 ¿ 0.8) (George & Mallery, 2003 [19]). This enabled the analysis to continue with the mean scores of the scale items, and with only two items of the original scale.

6.7.2 Control Variables

Participants' BMI may cause differences in the learning process (Boutelle & Bouton, 2015 [6]). Specifically, a dummy variable for BMI was created, having value \0" if the value is below 25 for normal individuals, \1" for the overweight, and \2" for the obese. During the course of acquisition, such variable did not affect changes in US expectancies (CS x T x BMI), $F < 1$, however, their acquisition was affected by the BMI of participants as indicated by a significant CS x T interaction, F (2.60, 256.78)= 15.62, $p<$ .001, $\eta^2{}_p$= .14. In fact, it seems like participants that are obese, tend to have a faster acquisition of US expectancies. The same significant results were found during extinction as indicated by a significant CS x T interaction, F (3.72, 372.16)= 16.34, $p<$ .001, $\eta^2{}_p$= .14, indicating a slower extinction.

As for US desires and CS evaluations, no significant evidence was found as well, as indicated by non-significant CS x T and CS x T x BMI interactions, $F < 1$, both during acquisition and extinction. Hence, BMI does not appear to influence the classical conditioning of the participants.

Chapter 7

Summary

In the efforts to diminish the recent increase in obesity prevalence, public health practitioners investigate beyond the genetic causes beneath such pandemic to shed light in the behavioral and psychological ones. Classical conditioning studies analyzed the ”obesogenic environment” as a main contributor to such pandemic, and explained the extent to which food reactivity is not only acquired from genetics, but can be learned through repeated pairings of stimuli (conditioned stimuli: CS; with unconditioned stimuli: US). Nevertheless, certain associations of stimuli stimuli can be learned faster than others, because of biological and evolutionary predispositions of individuals (i.e., preparedness theory).

Therefore, the purpose of this study is to investigate which types of stimuli can be evolutionarily linked to food intake, hence, become more predictive of it and influence individuals' behavior.

7.1 Theoretical Framework and Models

The prevalence of obesity and overweight has reached worrying proportions. Recent estimates consider approximately 2.1 billion individuals worldwide as being overweight, (body mass index [BMI] $>$ 25 kg/m^2), of which 600 million are obese (BMI $>$ 30 kg/m^2)) (NCD Risk Factor Collaboration, 2016 [32]; Ng M et al., 2014 [33]). This global scenario is alarming from a public health perspective as well as from an economic standpoint: obesity is the doorway for numerous medical and psychological problems and societies are facing exploding healthcare costs due to obesity-associated morbidity (Cawley & Meyerhoefer, 2012 [9]).

Research suggests that many obese and overweight individuals try to lose weight, but often unsuccessfully so. The so-called "obesogenic" environment contributes to this difficulty to lose weight, for it promotes a sedentary lifestyle and provides an abundance of easy-to-get high-calorie foods. By signaling the availability of tasty, inexpensive, and easy-to-get high-calorie foods (Hildebrand, Harding & Hadi, 2019 [23]), individuals are almost constantly exposed to environmental food-associated cues, such as sight, smell of food, or food-related contexts. Exposure to these food cues activates a central appetitive state, resulting in both psychological (eating desires) and physiological (i.e., salivation) responses to arise (Jansen, 1998 [24]). Indeed, these increased levels of food cue *reactivity* (i.e., cue-elicited desires to eat) have been associated with overeating, unsuccessful dieting, a higher BMI, and eating psychopathology. Food cue reactivity, is in fact not only the consequence of genetic components, but it can be learned through Pavlovian conditioning. By repeatedly pairing an initially neutral stimulus with the intake of palatable food (unconditioned stimulus or US), so that the stimulus (conditioned stimulus or CS) will become a reliable predictor of intake and elicit conditioned appetitive responses (CRs), such as a higher desire to eat (Jansen, 1998 [24]). To illustrate, consider a person who repeatedly eats popcorn in the evening when watching their favorite TV show: this context (CS; watching their favorite TV show in the evening) may become associated with eating popcorn (US). As a result, the CS by itself will elicit a desire for popcorn and promote its intake, even in the absence of hunger or in excess of calories that are physically needed (van den Akker, Schyns & Jansen, 2018 [55]). Therefore, given its role in the development of eating desires and intake of unhealthy food, it seems paramount for researchers to shed more light on human conditioning learning, and how stimuli can be associated to food intake.

Theoretically, any cue can become associated with high-calorie food intake (e.g. emotions, hunger or satiety), yet certain neutral stimuli may become associated more strongly and quickly with unconditioned stimuli than others. This idea is known as **preparedness** (or **prepared learning**), and has mostly been examined in fear conditioning studies, whereby humans show a predisposition to fear objects and situations that threatened the survival of the species throughout its evolutionary history (Seligman, 1971 [45]). Accordingly, persistent fears and phobias should be more readily acquired to threats of prehistoric origin (i.e., snakes, spiders) than to those of recent origin (i.e., guns). This superior conditioning is usually evidenced by enhanced resistance to extinction of the conditioned response (CR), hence, more difficulty in ”unlearning” these associations. Extinction is a process during which the CS+ is presented in the absence of the UCS, leading the conditioned response (CR) to decline across repeated presentations. In fact, participants conditioned with fear-relevant CSs (i.e., snakes, spiders) usually show reliable conditioned responses to subliminal CSs in extinction, but those conditioned with fear-irrelevant stimuli (i.e., flowers, mushrooms) show immediate extinction of their responses to CSs (Öhman & Mineka, 2001 [36]).

Thus, the nature of the CSs may result in differential learning processes. By gaining deeper knowledge in which stimuli may be more strongly/faster associated to food intake and appetitive responses, and more weakly/slowly extinguished, research on preparedness could be extended and used for future interventions to reduce the obesity ”pandemic”. To this end, it may be hypothesized that social stimuli are deeply intertwined with eating, as food has always used to be eaten in groups throughout history; therefore, an inherent link might exist between groups of people and food, akin to the link between certain animals and danger (Hastorf, 2016 [22]). Moreover, the rationale for this assumption revolves around the evolution of the concept of food itself; from solely being the primary source of energy for survival, food has come to be the means to bring cultures and people together. From an evolutionary perspective, exchanging and sharing foods with each other secured humans’ ancestors’ access to the varied diet they needed to survive, and equal acquisition and distribution of food (Kaplan et al., 1985 [26]). As a result, sociological and social anthropological do not consider eating as merely the behavior by which nutrients are delivered to the biological system, but as a social practice, because individuals’ eating patterns form in relation to and with others, and mostly occur with others. Even though eating may sometimes involve isolated choices, it is nevertheless conditioned by the context in which it occurs, highlighting the influence that social stimuli may have on food intake (Delormier, Potvin & Frolich, 2009 [16]). In fact, the different social contexts may influence food intake differently. The Social identity theory suggested that social influence emerges primarily, if not solely, from those perceived to be fellow in-group members, as they are the only ones considered to be similar on relevant psychological dimensions (Tajfel, 1974 [49]). Examples of in-groups are peer group, family, community, sports team, political party, gender, religion, or nation (Turner, 1991 [51]). Individuals who would face social contexts that are psychologically relevant to them, should exhibit a faster/stronger acquisition and slower/weaker extinction, compared to those who do not identify with a certain group. In fact, food intake is influenced by the context and by the type of social stimuli present in this context, as close kin and similar others should exhibit similar eating habits, or influence more strongly compared to distant others and non-kin (Feinman, 2016 [18]).

In sum, by definition of prepared learning, one may hypothesize that an historical connection may be present, between social cues and food. When an individual faces social scenarios, they should more readily associate that contextual stimulus to food intake, and having more cravings, because of their innate and evolutionary connection. Extinction should instead be slower/weaker. For purpose of this study, social identification was considered as having moderating influences on how social stimuli predict food intake, assuming differential effects on US desires (e.g. food cravings) and expectancies (e.g. prepared learning) that occur if associated to either a social group that the participant identify themselves with or not (Cruwys et al., 2012 [13]).

The aim of this study can be summarized in the following problem statement:

Are individuals predisposed to more readily/strongly acquire and more slowly/weakly extinguish appetitive responses when the CSs are socially-relevant, and does social identification moderate the speed and/or magnitude of this learning process?

The central problem statement will be answered by building on the following research questions:

- How is preparedness defined in the literature? And why is it relevant in conditioning studies?
- What does social identification entail?
- How do social cues predict food intake?
- Do social cues more strongly and quickly predict food cravings?
- To what extent does social identification moderate the learning process and its rate between social CSs and food as US?
- Is acquisition faster/stronger and/or extinction slower/weaker for the socially-relevant stimuli and food associations?

Therefore, the following hypotheses have been formulated:

***H1**: Classical conditioning using socially-relevant (vs. non-socially-relevant) stimuli is easier to establish and harder to extinguish, hence, it can be considered as prepared learning.*

***H2**: When subjects exhibit higher (vs. lower) social identification, prepared learning from social cues-food combinations is stronger.*

Based on the relationships and learning theories described above, the following conceptual model has been developed [1]:

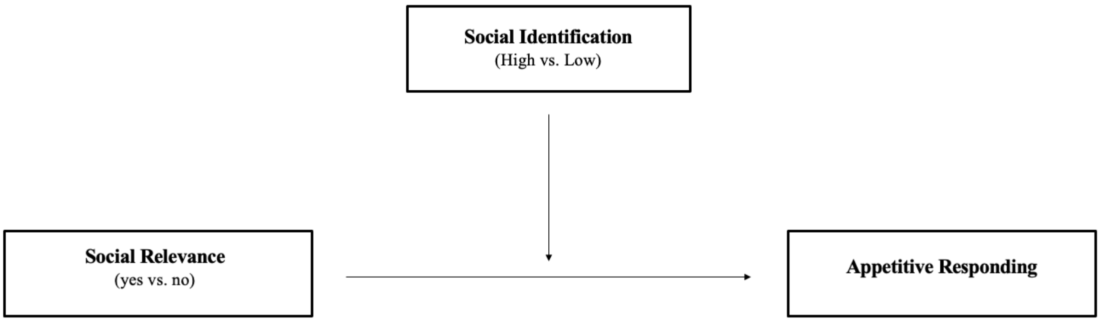

Figure 7.1: Conceptual Model

7.2 Experimental design

An online mixed-subject experiment was conducted among 140 participants to investigate the speed/magnitude of the learning process between socially-relevant stimuli and food, compared to socially-irrelevant stimuli, using repeated-measures ANOVAs. Moreover, the study assesses whether the social identification of the subject with the socially-relevant stimuli used accelerates or not the learning speed/magnitude of the acquisition of the stimuli, along with slowing/ weakening extinction.

The online experiment consisted of two phases for both conditions (Social and Neutral): acquisition and extinction. Participants were randomly assigned to each condition, and the image sets chosen for the main experiment (flowers vs. people images) were

[1] Social identification is included as moderator as it conceptually moderates acquisition of social cues-food associations, but not statistically examined as such for it could not be measured for one of the IVs.

pretested, in order to obtain images that were similar in terms of valence and arousal, so to avoid any confounding effects of such constructs on the final results.

Acquisition: each CS-US association was learned by repeatedly exposing participants to the CS+ paired with the US. The acquisition phase consisted of four CS+ trials and four CS− trials (8 trails in total). A trial proceeded as follows: Firstly, a CS (CS+ or CS−) was presented in the middle of the computer screen for four seconds. A US expectancy VAS was displayed below the CS. Once this question was completed, the expectancy VAS disappeared while the CS remained visible for other four seconds. Only in case of the CS+, the US was shown as well during these four seconds. Subsequently, the inter-trial interval started (consisting of a white screen), which also lasted four seconds. After this, a new trial started. The order of the CS+ and CS− was random with the restriction that the same stimulus type (CS+ or CS-) was never presented more than twice in a row. Finally, while US expectancies were measured in each trial, US desires and CS evaluations were measured on the first and last acquisition trial only in order to minimize the length of the experiment and avoid attention errors from the participants.

Extinction: immediately after the acquisition phase, participants started the extinction phase. It consisted of six trials for each CS (12 trials in total). For each trial, the trial sequence was the same as for the acquisition trials, with the exception that all CSs shown for four seconds were never reinforced, hence, followed by the US. During this phase, US expectancies were measured on each trial, and US desires and CS evaluations were measured on the first and last trials.

7.3 Results

Several 2 (CS-type: CS+ vs. CS−) x 4/6 (Acquisition Trial/Extinction Trial) x 2 (Condition: Social group vs. Neutral group) repeated-measures ANOVAs were performed to test whether any differences in classical conditioning occurred across conditions, in terms of both US expectancy, US desires and CS evaluations. For each measure, differential acquisition and extinction US expectancy, US desires and CS evaluations responses were examined by 2 (CS-type: CS+ vs. CS−) x 2 (Condition: Social group vs. Neutral group) repeated-measures ANOVAs in the fourth acquisition trial and sixth extinction trial, to assess any differences between conditions in these specific trials.

The moderator Social identification was assessed for both the CS+ and CS−, however, the correlation between the two stimuli was found to be somewhat low (r = .29). Therefore, only the CS+ was considered for the moderation analysis [2]. Social Identification was included in the analysis as a covariate, for it cannot be considered a between-subject factor because it was measured only for the participants exposed to the Social condition.

Chi-square tests and independent sample t tests were performed to assess the differences, if any, in demographics across conditions, to assess the success of randomization.

Lastly, Perceptual discriminability was assessed by means of Independent sample t-test to verify whether respondents did indeed perceive the CS+ statistically different from the CS−, to rule out potential confounding effects on both acquisition and extinction.

The results suggested prepared learning with respect to social cues for US desires, as acquisition appeared to be faster/stronger, and a slower/weaker extinction phase.

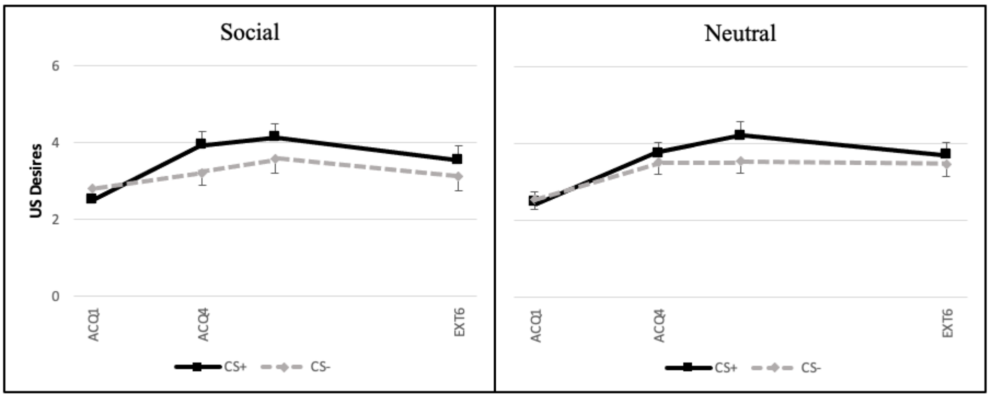

Figure 7.2: Mean US desires (± SEM) across groups, phases of the experiment, trials, and CS-types. CS: conditioned stimulus; Social: people CSs; Neutral: flower CSs

In sum, these data provide partial evidence for slightly better contingency learning in the Social (vs. Neutral) condition, reflected by a higher CS+ vs. CS− differentiation on the third acquisition trial: participants in the Social condition reached acquisition faster (See Figure 7.2). Overall, however, these findings do not provide strong evidence

[2]Unlike the CS−, the CS+ is followed first by the US during acquisition, but then it is not during extinction, hence, it was deemed more relevant to detect differences, if any, during the two learning phases.

regarding consistent group differences in acquisition. No statistical evidence was found for differential extinction across conditions.

Similarly, some evidence suggested that US expectancies were also acquired more quickly when social (vs. neutral) stimuli were used as CSs. In sum, in line with expectations, the marginally significant findings and exploratory analyses suggested that acquisition was (more) successful in the Social vs. Neutral group. Moreover, extinction of US desires in the Social vs. Neutral condition was less complete (See Figure 7.3).

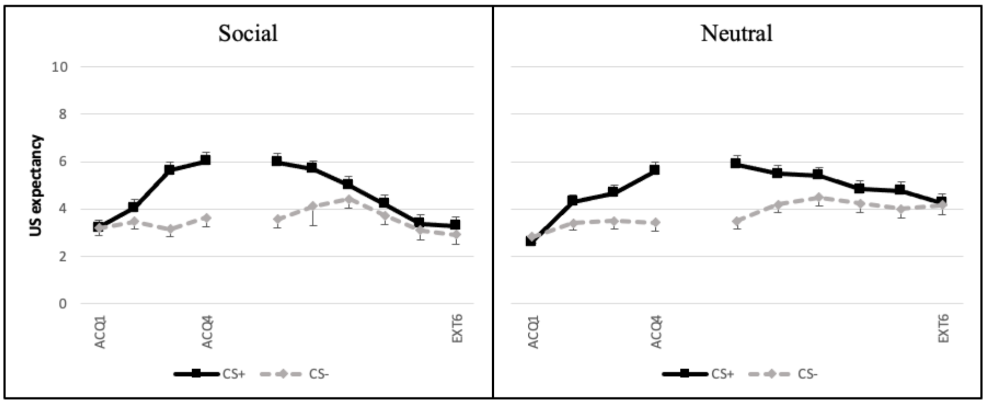

Figure 7.3: Mean US expectancies (± SEM) across groups, phases of the experiment, trials, and CS-types. CS: conditioned stimulus; Social: people CSs; Neutral: flower CSs

CS evaluations were not successfully acquired.

Social identification was tested as a potential moderator, and it was found that it indeed moderated the speed of the learning process in the *opposite* direction. Specifically, lower levels of social identification appeared to be related to a *stronger* acquisition of desires to eat.

In sum, opposite to expectations, lower levels of social identification appeared to be related to a *stronger* acquisition of desires to eat. More specifically, only when a person scored low on social identification, a successful acquisition of eating desires was found. Thus, the more a person identifies with a social group, the less their learned desire to eat increases during acquisition (See Figure 7.4).

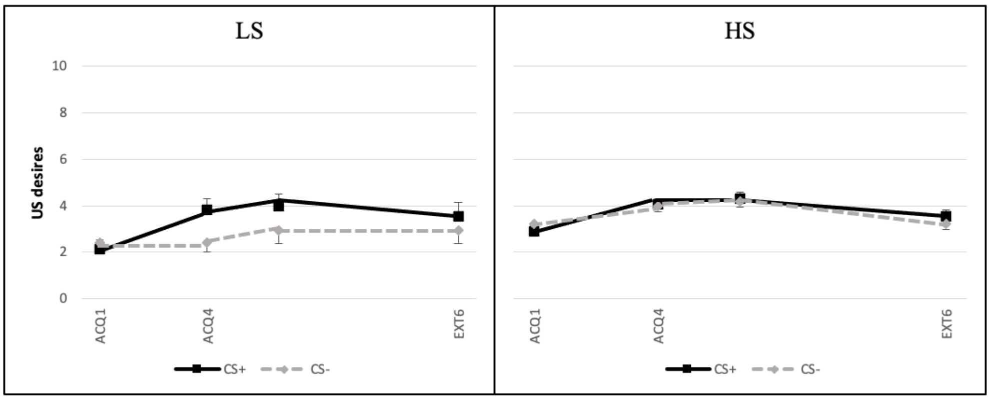

Figure 7.4: Mean US desires (± SEM) across Social identification groups, phases of the experiment, trials and CS-types. CS: conditioned stimulus; HS: High Social identification (value "1" as ≤ 3.5); LS: Low Social identification (value ="0")

7.4 Relevance and Future Research

Overall, initial evidence was found for prepared learning between social cues and food intake, indicated by a faster/stronger acquisition and a slower/weaker extinction. In addition, exploratory analyses showed that lower levels of social identification with the social cues led to faster/stronger acquisition of US desires. Thus, if future research confirms these findings, as they were only exploratory in nature, it would be recommended for marketers to advertise based on social cues. To illustrate, a marketing campaign should depict a social context whereby a group of people is eating together, so that when the customer will find themselves in a social situation in the future, thoughts about/desires for the product will be elicited. More specifically, as low levels of social identification resulted in stronger acquisitions of desires to eat, the aforementioned social contexts should depict individuals who are not familiar with others, nor/or with the audience. Indeed, marketers could segment their target audience, and propose to them differentiated advertisements where the customer is not familiar with the social context. However, this suggested approach sounds very counterintuitive and different to current marketing approaches, which highlight social gatherings of families, friends and love partners, to stimulate positive feelings associated with their product, thus increase loyalty towards the brand, and encourage consumers to purchase (Cavanaugh, 2014 [8]). Therefore, it is crucial to replicate the findings first, and then carefully test in a lab or field experiment to what extent these findings actually translate to impacts on product purchases, so that participants would be in their natural in- and out-groups.

Furthermore, policy makers and public practitioners may as well can take advantage of these results for future interventions. It could be advised to dieters, when exposed to socially-relevant cues, to imagine a social situation where eating is done with others to whom they identify with, to reduce their desires to eat. Otherwise, socially-relevant cues could be leveraged to heighten desires to eat for healthy options that would substitute the unhealthy ones. Therefore, depending on the objective, socially-relevant cues can be leveraged both ways.

In sum, this study had some limitations, such as the fact that this study was inconclusive in explaining the opposite moderating effect of Social identification found, and the unsuccessful acquisition of CS evaluations, or the fact that conditioning studies usually involve lab experiments to control for the complexity, length of the task and obtain a better imitated acquisition and extinction process (i.e., the US can be actually consumed). In fact, it is debatable the extent to which participants actually tried to imagine eating the chocolate (US). Nevertheless, such limitations pose insightful opportunities and recommendations for future research. Given that these conclusions are based on preliminary findings, future studies should first replicate the present results, taking into account the aforementioned limitations, and examine the potential consequences of faster appetitive learning for eating behavior and obesity.