MASTERARBEIT / MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

„Effects of Motivational States on Approach Behavior Towards Reward Cues"

verfasst von / submitted by

Christina Spitzhofer, BSc

angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien, 2021 / Vienna 2021

Studienkennzahl lt. Studienblatt / degree programme code as it appears on the student record sheet:	UA 066 840
Studienrichtung lt. Studienblatt / degree programme as it appears on the student record sheet:	Masterstudium Psychologie UG2002
Betreut von / Supervisor:	Assoz. Prof. Giorgia Silani, Privatdoz. PhD

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Acknowledgements

Thanks to my supervisor Dr. Giorgia Silani and Ana Stijovic, MSc for helping and supporting me in my process of writing this thesis and also for letting me be a part of this important research project on motivational states.

It may be important to mention that there could be similarities in the theses written by colleagues because this thesis was part of a bigger research project and is based on the same experimental study we conducted together. The colleagues specialized on stress and cortisol measures as well as effects on mood states and personality traits, however the focus of my thesis was the effects of motivational states on the approach behavior and 'liking' of rewards. Therefore, some of the experimental measures were only described and results not fully outlined in order to explain the experiment's procedure accurately but to prevent overlaps of the theses.

Thanks to my study colleagues Fiona and Mascha for helping and supporting each other during the process of collecting data, statistical analysis and writing this thesis.

I like to especially thank my boyfriend Clemens for being there for me and giving me all the support that I needed for writing this thesis. I appreciate him for giving me time and patience with all technical difficulties.

Additionally, I would also like to thank my family for always being there for me and showing me support when I needed it. Thanks to all of my friends for supporting me during the process of writing this thesis.

Introduction

How are people affected by acute periods of forced hunger and mandated social isolation? Food consumption and social contact as well as social interactions are basic human needs and are therefore very important for the mental and physical well-being and health of humans (Baumeister & Leary, 1995; J. T. Cacioppo et al., 2014; Tomova et al., 2019, 2020). If these essential needs are not met, it can lead to serious disruptions to the organism and the homeostatic balance, which can further lead to pathological conditions like eating disorders, addictions, loneliness as well as affective mood disorders (J. T. Cacioppo & Cacioppo, 2018; Livneh et al., 2017; Tomova et al., 2019, 2020). The deprivation of these needs may create a 'wanting' and desire for what is lacking, in other words, motivates behaviors towards rewarding stimuli that are missing (J. T. Cacioppo et al., 2014). Research on unmet (social and non-social) human needs and their consequences, specifically on motivational behaviors, however, is scarce and that is way we are proposing the following study (Tomova et al., 2019, 2020).

Theoretical Background

Survival Circuits

When an organism is faced with a threat or stressor, an opportunity or challenge, a combination of *survival circuits* consisting of sensory-motor integrative devices are activated. According to LeDoux (2012), these "include, at a minimum, circuits involved in defense, maintenance of energy and nutritional supplies, fluid balance, thermoregulation, and reproduction" (p. 655). These circuits and their adaptive functions are found within mammalian species, such as most animals but also in humans. Survival circuits of the body help organisms to survive and thrive, and are used to control behavioral responses and internal physiological adjustment (LeDoux, 2012). Activation of the motivational system by activated survival circuits also plays a key role in understanding human behavior. Otherwise, an organism gets out of balance and remains stressed.

Therefore, every organism wants to maintain *homeostasis*, keeping an organism in balance and body parameters within an optimal range, meaning all organs and the system are working properly and one's needs are fulfilled (Bear et al., 2016; Fletcher, 1942; Schultz, 2015). When disruptions to the system occur, for example due to hunger or social isolation, the body will be trying to regulate itself back to balance by activating survival circuits (Bear et al., 2016; Matthews & Tye, 2019). When these disruptions maintain and are not easily

corrected, thus motivational drive states cannot be pursued, it can lead to homeostatic imbalance and further bring about pathological conditions, such as obesity, addiction or eating disorders (Livneh et al., 2017).

Hunger

An organism is faced with a disruption in its state of homeostasis, when the system for maintenance of energy and nutritional supplies is activated and recognizes changes in interoceptive sensory neurons that monitor metabolic signals showing hunger (Atasoy et al., 2012). These sensory neurons in the hypothalamic arcuate nucleus (ARC) are activated by hormonal signals of energy deficits, such as ghrelin and express AGRP (Agouti-related peptide) neurons among others (Atasoy et al., 2012; Ferrario et al., 2016). "AGRP neuron output represent an orexigenic, appetite-stimulating signal, as these neurons are activated by fasting" (Rossi & Stuber, 2018, p. 4). These activated AGRP neurons further lead to the motivational drive state of hunger due to these homeostatic imbalances and motivate individuals to behaviors in order to reduce upcoming aversive feelings and stress (Atasoy et al., 2012; Betley et al., 2015; Matthews & Tye, 2019). Such behaviors include food consumption and food-seeking behavior to relieve feelings of hunger. In addition, monoaminergic neurons, specifically mesolimbic dopamine, can also play a key role in motivational behavior and can influence food intake because of its role in reward processing (Rossi & Stuber, 2018). Hunger also increases neural responses while processing food cues (especially high caloric food pictures). These cues activate similar brain areas (of the ventral reward pathway) that are activated during actual food consumption (Chen et al., 2016). The attentional processing of rewards such as pictures or words of highly palatable food can be different in a physiological state of hunger or stress (Pool, Delplanque, et al., 2015).

Furthermore, learning processes are involved in feeding behavior as well, e.g. learning preference in mice (Betley et al., 2015). According to Ferrario et al. (2016), these "AGRP neurons motivate behavior by a negative valence signal of homeostatic need" and reinforce learned eating behavior and approach to food-related cues in order to reduce negative feelings (p. 11475; Rossi & Stuber, 2018).

To summarize, humans eat and consume food because the body sends signals of imbalance, e.g. hunger, and the survival system for nutritional regulation influences behavior that leads to consuming food, because the body needs nutrients to survive (Betley et al., 2015; Livneh et al., 2017). As soon as the primary need is fulfilled, motivational behaviors are normally being inhibited by the system (Bear et al., 2016). Signals of these homeostatic

(im)balances are sometimes also overridden, meaning a mismatch between the motivation to eat and energy demand. This is shown, for example, when someone choses to consume a dessert even though they just had a satiating meal, or they react to food-associated stimuli despite being satiated (Ferrario et al., 2016). Specifically, under stressful conditions, the consumed amount of food can overstep the homeostatic need (Pool, Delplanque, et al., 2015).

Food Rewards

Humans consume food for reasons of homeostatic needs. By contrast, humans also consume food due to its good taste, release of negative feelings, offer of the possibility of reducing stress and experience of pleasure. The impact of *food rewards* on eating behavior is therefore also an important aspect to consider (Berridge, 2009; Ziauddeen et al., 2014).

Hedonic aspects associated with pleasure of food rewards consist essentially of '*liking'* and due to pleasurable consumption can reduce negative feelings (Pool, Delplanque, et al., 2015). On the other hand, according to Berridge (2009), '*wanting*' as also being a component of reward, can be regarded as the psychological process of incentive salience and explains the motivation to obtain a reward (Berridge et al., 2009; Berridge & Robinson, 1998; Korb et al., 2020; Pool, Brosch, et al., 2015). This sensation of 'wanting' or "craving" is linked to the brain reward circuit depending mostly on subcortical mesolimbic dopamine neurotransmission (Kelley & Berridge, 2002). The midbrain dopamine system as well as the striatum is therefore involved in the motivational processing of rewards (Berridge, 2012; Berridge & Robinson, 2003; Tomova et al., 2019).

Incentive salience is ordinarily connected with hedonic activation and associative learning, however can also be triggered independently (Berridge et al., 2009; Berridge & Robinson, 1998). This incentive salience 'wanting' can also happen without conscious awareness. It can be easily triggered by cues or just the imagination of taste, smell, or sight of (palatable) foods (Berridge, 2009). As stated before, another component of reward is '*learning'*– associative and cognitive – which also plays an important part in motivational reward processing and comprises predictions about the reward (Berridge et al., 2009; Berridge & Robinson, 2003; Schultz, 2015; Ziauddeen et al., 2014). These consist of cognitive forms of learning due to the relationships among stimuli and consequences of actions and associative learning referring to Pavlovian and instrumental conditioning (Berridge & Robinson, 2003).

Recently, animal affective neuroscience studies have identified a connected network of hedonic hotspots in the limbic forebrain such as the nucleus accumbens and ventral

pallidum, “that use opioid neurotransmission to causally increase taste ‘liking’ and ‘wanting’ together to enhance food reward“ (Berridge, 2009, p. 540). Taken together, these findings imply that ‘liking’ and ‘wanting’, as well as ‘learning’, are three different but similarly important concepts of reward processing and are usually connected in healthy individuals but can also happen independently (Berridge, 2009; Berridge et al., 2009; Berridge & Robinson, 2003).

Consistent with the incentive salience theory, stress resulting from homeostatic imbalances might directly amplify cue-triggered ‘wanting’, suggesting that under stress ‘wanting’ can also be independent of ‘liking’ (Pool, Delplanque, et al., 2015). Pool et al. (2015) found out that “stress selectively increases cue-triggered wanting, independently of the hedonic properties of the reward“ in humans (p. 128; Peciña et al., 2003). As predicted by Pool et al. (2015), results showed that participants spent more energy to smell chocolate odor in stress conditions, however, they did not report it as more pleasurable. These results are consistent with the concept of the incentive salience theory, as ‘wanting’ and ‘liking’ can be activated independently of each other and also represent different reward processing components (Berridge & Robinson, 1998, 2003; Pool, Brosch, et al., 2015).

Furthermore, most people have different eating behaviors during stressful periods and situations that are either decreasing their food intake or considerably increasing it (Adam & Epel, 2007). Not only can the amount of consumed food be different, but changes can additionally be seen in the kind of food that is overeaten. Previous literature has shown that participants in stressful conditions prefer to eat highly palatable food, in particular highly caloric food because of the associated rewarding hedonic pleasure which can have stress-reducing effects (Adam & Epel, 2007; Pool, Delplanque, et al., 2015). According to the aversive state reduction hypothesis formulated by Robbins and Fray (1980), these highly palatable foods offer comfort to stressed people and help them cope with and reduce emotional discomfort and aversive feelings associated with stress.

Taken together, these findings show that motivated behaviors regulating food intake should be distinguished as a) homeostatic, because food is essential for survival and maintenance of energy balance and b) hedonic, that is driven by pleasure or sensory perception (Matthews & Tye, 2019; Rossi & Stuber, 2018). In other words, there are motivational drive states of different valence, negative feelings of hunger, and positive hedonic value of palatable food (Matthews & Tye, 2019).

Social Isolation

All mammalian species, including humans, have the fundamental basic need to socially connect with one another and form relationships or organizations with each other (J. T. Cacioppo et al., 2011, 2014; J. T. Cacioppo & Cacioppo, 2014; Matthews & Tye, 2019). Especially in the animal world, it is necessary to form groups and pairs in order to ensure survival and provision of mutual protection and support (J. T. Cacioppo et al., 2011, 2014; Matthews & Tye, 2019). Among humans, social connections are essential to enhance and protect one's health and well-being.

Cacioppo et al. (2011) and other colleagues have shown that *social isolation* on the contrary is a significant risk factor for morbidity and mortality of humans and animals (J. T. Cacioppo & Cacioppo, 2014; Grant et al., 2009; Hawkley et al., 2006; Holt-Lunstad et al., 2015). The definition of social isolation includes a lack of social connections (e.g. no close friends or family), social rejection, exclusion, neglect and social loss (Hawkley et al., 2006; Matthews & Tye, 2019). In the animal world, researchers have already shown that social isolation can decrease the lifespan of certain social species, e.g. of honeybees or rats (Matthews & Tye, 2019; Yee et al., 2008). Current research have shown similar consequences for the lifespan of humans (Bzdok & Dunbar, 2020; Holt-Lunstad et al., 2015). Negative effects of social isolation in humans presumably include changes in physiological stress responses similar to the effects of experimental manipulations of isolation in social animal species (Bzdok & Dunbar, 2020). Effects of perceived social isolation (loneliness), as indicated by poor sleep quality, due to an increased number of microawakenings and feeling less rested, as well as an association with elevated systolic blood pressure, additionally consist of "increased tonic sympathetic tonus and HPA activation, glucocorticoid resistance, decreased inflammatory control, immunity, sleep salubrity, and expression of genes regulating glucocorticoid response" (Bzdok & Dunbar, 2020; J. T. Cacioppo et al., 2011, p. 5; Doane & Adam, 2010; Grant et al., 2009; Hawkley et al., 2006, 2010; Holt-Lunstad et al., 2015). Furthermore, negative effects of experimentally induced social isolation also include an increased depressive symptomatology and anxiety, as well as a decreased self-esteem and negative mood besides the biological effects on one's health (J. T. Cacioppo et al., 2006, 2014; Hawkley et al., 2006).

Moreover, not only is objective low quantity and quality of social relationships important to consider, but perceived social isolation can have serious consequences for physical and mental health (Bzdok & Dunbar, 2020; Hawkley & Cacioppo, 2010; Holt-

Lunstad et al., 2015; Matthews & Tye, 2019b; Tomova et al., 2019). In the twenty-first century, due to technological advancements and communication possibilities, the human species became more connected than ever before. However, there is an increase in perceived social isolation within society, resulting in a growing number of people experiencing *loneliness*, them either being dissatisfied with social relationships or having a feeling of being alone (J. T. Cacioppo et al., 2014; Matthews & Tye, 2019; Tomova et al., 2019, 2020).

According to Matthews and Tye (2019), humans experiencing social isolation and feelings of loneliness receive physiological and psychological signals that there is a deficiency to the organism (J. T. Cacioppo & Cacioppo, 2014). Hence, these feelings of loneliness and social deprivation are evolving to an aversive motivational state promoting changes in behavior to increase seeking of social contact to fulfill unmet social needs, similar to the biological feeling of hunger that promotes seeking of food (J. T. Cacioppo et al., 2014; Hawkley & Cacioppo, 2010; Tomova et al., 2019). Feelings of loneliness and social deprivation additionally promote humans to repair broken relationships and strengthen social connections to ensure the survival of our genes and promote health (S. Cacioppo et al., 2016; Hawkley & Cacioppo, 2010). Adaptive responses to reduce aversive feelings of social deprivation by recovering *social homeostasis* - maintenance of stable internal states concerning social systems - react similarly to experienced challenges in the physiological imbalances, such as thermoregulation and energy balance (Matthews & Tye, 2019). As Matthews and Tye (2019) argue, these changes in social connections may not have immediate effects on the internal stability but can have serious long-term consequences on vulnerability, health and behavior of humans and other social species.

First, feeling lonely leads to an increase of attentive observational mechanisms and hypervigilance for negative social stimuli such as cues signaling social threats (J. T. Cacioppo et al., 2014; J. T. Cacioppo & Cacioppo, 2012; S. Cacioppo et al., 2016; Hawkley & Cacioppo, 2010; Matthews & Tye, 2019). Additionally, arousal and anxiety levels of individuals tend to rise (Matthews & Tye, 2019; Stednitz & Epkins, 2006). Consequently, loneliness can lead to increased motivation to avoid bad social situations and may lead to lower prosocial behavior, social withdrawal and avoidance (Hawkley & Cacioppo, 2010; Tomova et al., 2019).

Second, increased activation of social motivation due to feelings of loneliness leads to heightened hypervigilance for desirable social cues like smiling faces (Bhanji & Delgado, 2015; Matthews & Tye, 2019; Tomova et al., 2020). In addition, detected deficits of social

connections also lead to enhanced sensitivity and increased social motivation (J. T. Cacioppo & Cacioppo, 2012; Matthews & Tye, 2019b; Tomova et al., 2019).

Social Rewards

Social rewards such as social interactions, evaluations and connections in humans are equally important to primary rewards and activate similar brain structures as monetary rewards or food rewards do (Bhanji & Delgado, 2015; Korb et al., 2020; Matthews & Tye, 2019; Tomova et al., 2019). Interestingly, similar to food deprivation, dopaminergic systems as well as the striatum are involved in the motivation to seek social contact and are involved in the social reward processing (Bhanji & Delgado, 2015; Tomova et al., 2019). Additionally, similar to food rewards of high valence, participants exert more effort and prefer to view social stimuli that have a high valence, such as attractive and trustworthy faces (Aharon et al., 2001; Bhanji & Delgado, 2015; Morrison et al., 2017).

Taken together these findings, motivational drive states for social contact and connection work in a similar manner as motivated behavior regulating food. On the one hand, there is the aversive state of social isolation and on the other hand, the hedonic value of social reward (Matthews & Tye, 2019; Tomova et al., 2020). As expected, social behaviors are driven by both positive and negative motivational processes in order to create homeostatic balance (Matthews & Tye, 2019).

Moreover, research in social animals has shown that social isolation can also impact other motivational behaviors, such as an increased food intake and seeking for other rewards, e.g. drugs (Schipper et al., 2018; Tomova et al., 2019).

So far, there has not been much research and experimental approaches to induced acute social isolation in human participants (Tomova et al., 2019, 2020). Therefore, it is still very difficult to compare loneliness research in humans with social isolation research in rodents (Tomova et al., 2019, 2020).

Approach Behavior Towards Specific and Non-Specific Reward Cues

Overall, humans are motivated either by the pursuit of rewards involving approach behavior towards desired outcomes or the avoidance of aversive states and undesired outcomes (LeDoux, 2012; Salamone & Correa, 2012; Tomova et al., 2019). Homeostatic imbalance due to stressors leads to aversive motivation, resulting in increased seeking of (nutritional and social) rewards that bring the system back to balance and relieve negative feelings (Matthews & Tye, 2019; Pool, Delplanque, et al., 2015).

Specific reward cues consist of stimuli relevant to the deprived motivational state. For instance, hunger can increase responsiveness to visual food stimuli and an increased desire for social contact can increase responsiveness to social stimuli (S. Cacioppo et al., 2016; Chen et al., 2016; Livneh et al., 2017). Consequently, approach behaviors towards stimuli specific to the state will be increased. Non-specific reward cues consist of stimuli that are not immediately relevant to the deprived system, however may still be very pleasurable for humans and therefore can be pursued as well (Schipper et al., 2018; Tomova et al., 2020).

Aim of the Study

The study was based on a bigger research project and focused on the experimental induction of comparable social and non-social motivational states. This thesis specifically focused on how these motivational states such as hunger and social isolation affect approach behavior towards specific reward cues of high and low valence and non-specific reward cues. When answering this question, the influence of these specific and non-specific reward cues on approach behavior (‘wanting’) and pleasantness rating (‘liking’) has been investigated. Furthermore, a manipulation check was conducted to measure whether the experimental induction did work, in other words, if there was a heightened subjective desire for food and social contact. It is important to mention that research on the experience of induced fasting periods and acute social isolation is still scarce, which is why further research is necessary (Tomova et al., 2019, 2020).

Hypotheses

Aversive motivational states compared to neutral conditions are expected to induce an increased approach behavior towards specific reward cues of both valence levels. These specific reward cues meet the need, for example food stimuli for hunger or smiling faces for social isolation. The valence of stimuli differs between high and low. As one example, food stimuli consisting of highly palatable and highly caloric food pictures have a higher valence compared to pictures of healthy food.

Approach Behavior

The first hypotheses suggested that, first, participants in the hunger condition would experience more craving for non-social (food) stimuli compared to the neutral and social isolation condition. Second, participants' approach behavior towards social stimuli in the social isolation condition is expected to be increased compared to the neutral and hunger condition. During the approach behavior task, the salience of stimuli relevant to the homeostatic system is expected to be higher in a non-homeostatic (e.g. hunger, social isolation) than in a balanced state, so is the motivated behaviour towards these stimuli (S. Cacioppo et al., 2016; Chen et al., 2016; Livneh et al., 2017).

Hypothesis 1.1: The aversive motivational state hunger compared to a neutral and social isolation state leads to an increase in approach behavior towards specific reward cues of both valence levels (high & low).
Hypothesis 1.2: The aversive motivational state social isolation compared to a neutral and hunger state leads to an increase in approach behavior towards specific reward cues of both valence levels (high & low).

The second hypotheses proposed that approach behavior towards non-specific reward cues is expected to increase in the non-homeostatic condition (hunger, social isolation) compared to a balanced state. These non-specific reward cues do not meet the need but are very pleasant, for example food stimuli for socially isolated participants.

Hypothesis 2.1: The aversive motivational state hunger compared to a neutral and social isolation condition leads to an increase in approach behavior towards highly pleasurable, non-specific reward cues.

Hypothesis 2.2: The aversive motivational state social isolation compared to a neutral and hunger condition leads to an increase in approach behavior towards highly pleasurable, non-specific reward cues.

Pleasantness Rating

The third hypotheses proposed that 'liking' of specific reward cues does not increase during the non-homeostatic conditions compared to the neutral condition, notwithstanding the increase of approach behavior towards specific reward cues. As expected from the incentive salience theory, 'liking' can be independent of 'wanting' in stressful situations (Peciña et al., 2003; Pool, Brosch, et al., 2015; Pool, Delplanque, et al., 2015).

Hypothesis 3.1: The aversive motivational state hunger does not lead to an increase in 'liking' of specific reward cues.

Hypothesis 3.2: The aversive motivational state social isolation does not lead to an increase in 'liking' of specific reward cues.

Methodology

Participants

Participants in the study were 30 healthy adult female participants, between 18 to 35 years old (M = 22.57; SD = 3.10) and fluent in German, as the experiment was conducted in German. All participants were within a healthy weight range, with a body mass index between 18 and 25 (M = 21.81; SD = 1.57). We recruited only female participants using hormonal contraceptives, for example the birth control pill, because salivary levels of stress hormones, such as cortisol and alpha-amylase vary across genders. Therefore, the need to control for gender differences within the sample was not obligatory. Furthermore, participants were not tested during their withdrawal bleeding to control for hormonal fluctuations, because of the influence on stress and cortisol levels. In addition, to further avoid interferences on the stress level, participants with the use of medication, current or previous drug or alcohol abuse, current or previous neurological or psychiatric disorders, smokers, and pregnant or nursing women were excluded from the study.

Recruitment of participants happened through an electronic subject recruitment system of the Faculty of Psychology (https://labs-univie.sona-systems.com) and via advertisement posts on different web pages and social media platforms as well as advertisement flyers distributed in universities and different Cafes in Vienna.

Completing all three sessions successfully, participants received 180€ compensation for their participation. Additionally, they received 5€ for bringing each of the three follow-up saliva samples and questionnaires they did at home the morning after the session. If participants showed up for the first appointment but did not complete one session, they received 10€ as compensation. If participants decided to withdraw from the study after completing at least one whole session, they received 40€ for participation.

Procedure

Data collection took place in two separate phases and was collected in German. The first phase consisted of an online questionnaire which participants had to complete after reading the informed consent of the study. The second phase was the laboratory experiment composed of three different sessions. The research was conducted in the laboratories at the Faculty of Psychology of the University of Vienna.

Online Questionnaire

Participants were required to complete an online questionnaire to measure sociodemographic data, questions about health status, current medication, alcohol and drug use, BMI, and menstrual cycle. Moreover, the Eating Disorder Examination Questionnaire (EDE-Q) (Hilbert et al., 2007) was applied to exclude participants with a high probability of an eating disorder. The UCLA Loneliness Scale (Lamm & Stephan, 1986; Russell et al., 1980) was used to measure the degree of loneliness since people with a moderately or severely high degree of loneliness have altered daily cortisol rhythms (Kusaslan Avci, 2018). In addition, due to the influence of frequency of social contact on the reaction to acute social isolation, it was measured with the Social Isolation Index (Grant et al., 2009); and the Extroversion/introversion scale (Satow, 2012) was used, since this personal trait may affect the effects of social isolation on one's motivational and emotional state. After fulfilling all criteria measured in the online questionnaire, the recruitment team called eligible participants to check inclusion criteria once more, explained the procedure of the experimental study again and arranged appointments for each of the three sessions in the laboratory experiment.

Participants recruited after March 2020 needed to fill out an additional questionnaire regarding changed inclusion criteria due to the global pandemic caused by the SARS-CoV-2.

Measures

All of the following measures were included in the online questionnaire. Participants were asked to provide sociodemographic data on the variables age, gender, education, and relationship status.

The **Eating Disorder Examination Questionnaire** (EDE-Q) (Hilbert et al., 2007) was used in order to measure the probability of an eating disorder. The scale has 22 items and represents the four factors: "Restraint", "Eating concern", "Weight concern" and "Shape concern". These items use a 7-point scale (0 – "*not one day*", 1 – "*1-5 days*", 2 – "*6-12 days*", 3 – "*13-15 days*", 4 – "*16-22 days*", 5 – "*23-27 days*", and 6 – "*every day*") and participants had to respond how many days of the last 28 days they experienced certain symptoms.

The **UCLA Loneliness Scale** (Lamm & Stephan, 1986; Russell et al., 1980) was used to measure the degree of loneliness, since people with a moderately or severely high degree of loneliness have altered daily cortisol rhythms (Kusaslan Avci, 2018). The scale contains 20 items and participants rated how often they experience a statement from 1 "*I never feel this way*" to 4 "*I often feel this way*" on a 4-point Likert scale (Russell et al., 1980). All ratings were then summed to a total loneliness score.

An example item is: "I feel that no one knows me really well." (Russell et al., 1980)

The **Social Isolation Index** (Grant et al., 2009) includes three binary questions assessing the frequency of social contacts because it influences the reaction to acute social isolation. Participant's responses were then summed to a total isolation score, and a score of three or four was considered socially isolated.

An example question is: "Did you see relatives less than once a month and/or never had any contact with relatives?" (Grant et al., 2009)

For measuring the personality trait of extraversion, the **Big-Five-Personality Test** (B5T) (Satow, 2012) was used, since this personal trait may affect the effects of social isolation on one's motivational and emotional state. It contains five subscales, and only the Big-Five-Scale Extraversion was used. Participants rated the ten statements on a 4-point Likert scale ranging from 1 "*does not apply to me at all*" to 4 "*applies to me completely*".

An example item is: "I am really sociable" (Satow, 2012)

Another example item is: "I am a talkative and communicative person" (Satow, 2012)

Experimental Study

This study was conducted as a within-subject factorial design with one factor: motivational state (neutral, social aversive, non-social aversive).

Each participant had to complete three sessions consisting of similar procedures, except for the specific motivational state that changed. The breaks between sessions must not be of a very different length, it was between a minimum of one week and a maximum of three weeks. One of the sessions was the neutral condition: a session with food and social contact; the social aversive condition included food but no social contact, and the aversive non-social condition - also called hunger condition - consisted of social contact but without food.

Before the participants started their experimental sessions in the lab, they had to send information about items they wanted to bring with them for the sessions three days in advance for the recruitment team to check their suitability. They had the possibility to bring between three and five items that do not contain social contents, such as non-fiction books and knitting material. They were specifically reminded not to bring novels, magazines with faces, or other electronic devices, e. g. phones, laptops, or sports equipment. Certain items were already prepared for participants free to use during the sessions, like non-fiction and coloring books, crossword puzzles, a Rubic's Cube, and other riddles. Depending on the sessions, participants were also asked to fill in a list of conversation times with contact name

and number and to send it in advance. The list contained four time slots during which participants should use the opportunity to call their social contacts to have as much social contact as possible. They were given the choice of calling either with a phone or having a skype talk on a laptop. They needed to inform their social contacts beforehand that they were ready to talk during the conversation time slot.

Participants were also informed to arrive for sessions after an overnight fast to ensure measurements to be accurate. After arriving in the morning at the lab at the Faculty of Psychology, they received a breakfast first and were then trained for about one or one and a half hours by an experimenter about the procedure of the sessions. The training consisted of applying rules and rooms as well as training on how to use experimental equipment to independently perform physiological saliva measures and answer self-report questionnaires during the experiment. They were introduced to the equipment consisting of nine labeled SaliCaps (IBL International, Hamburg, Germany) for collecting saliva samples, an ecological momentary assessment (EMA) tool, which was an iPod with an in-built application used for collecting self-report measures, and the heart rate monitor belt for measuring heart rate variability. Additionally, they received a plan for the day as a reminder as well as a short manual with descriptions on how to use measurement equipment properly. They were also informed that there was a security camera in the test room to secure the safety of participants during the whole experiment but reassured that nothing was recorded.

After the training, they had a few more minutes to relax, read through the manual, and get used to the situation in the test room. Moreover, all personal belongings including the participant's phone were then locked in the preparation room and they also had the possibility to ask all their remaining questions before starting the experimental session at approximately 10:50 a.m. The experimental phase started afterwards, so they spent the following eight hours in the test room. The procedure of the experimental session is shown in the following figure.

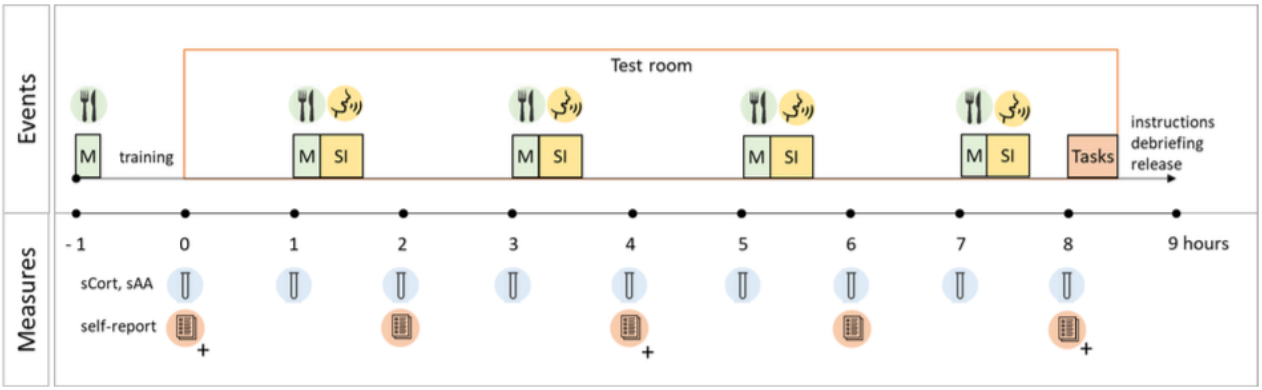

Figure 1. Timeline of the procedure for the neutral condition

Every hour, participants received a signal from the EMA iPod to collect a saliva sample (sCort = salivary cortisol; sAA = salivary alpha-amylase) and, additionally, every second hour, they needed to fill in short questionnaires (self-report). The length and duration of these questionnaires to complete differed at every measurement point. Participants were asked to consume prepared meals (M = meals) in the neutral and social-aversive condition every two hours. In the neutral and non-social aversive condition, participants had 30 minutes time slots for conversations with their family and friends (SI = social interaction) once every two hours.

After these eight hours in the test room, participants needed to move to another room to complete certain tasks on a computer: the *approach behavior task* and other *executive function tasks* measuring motor coordination, response inhibition, and working memory (e. g. finger tapping test). When participants completed all these tasks, an experimenter came and explained the follow-up phase with saliva measures and questionnaires for the next morning.

Experimental Measures

Physiological stress markers measured in this study were salivary cortisol and salivary alpha-amylase as well as the heart rate. Cortisol is a hormone of the hypothalamic pituitary adrenal (HPA) axis and is often used as a biomarker of psychological stress (Hellhammer et al., 2009). Alpha-amylase is an enzyme in saliva representing stress-induced changes of the autonomic nervous system (ANS) (Linnemann et al., 2015; Nater & Rohleder, 2009).

Participants were asked to collect saliva samples using the SaliCap system (IBL International, Hamburg, Germany) and to store them in a coolbox during the sessions. Saliva vials needed to be collected nine times during one experimental session. Once an hour they needed to transfer all collected saliva into a labeled vial after not swallowing for two minutes.

They were instructed to type the number printed on the vial into the iPod in order to control for the right measurement points after every assessment. Afterwards, these tubes were stored at -20° in freezers in the Department of Psychology, University of Vienna until the biochemical analyses. In addition, participants were instructed to conduct another two saliva samples in the follow-up phase the morning after each session. They had to collect saliva once directly after waking up and another one half an hour later.

During each experimental session, the heart rate of each participant was recorded in order to assess ANS activity. The heart rate is known to change during experienced stress and arousal (Lovallo et al., 1990). The heart rate monitor chest strap Polar H10 (Polar Electro, Finland) was used to assess heart rate availability to measure sympathetic (high frequency-range) and parasympathetic (low frequency-range) systems (Shaffer & Ginsberg, 2017).

Self-Report Measurements. Every hour, every second hour and every fourth hour during the experimental session each participant had to answer certain questionnaires measuring their mood, stress level and motivational states. The following was asked every hour.

Single item ratings concerning stress, anxiety, avoidance (desire to avoid the situation) and controllability (ability to control the situation) level of participant were assessed on a visual analogue scale ranging from 1 "*not at all*" to 100 "*very strong*".
An example question is: "How much do you have the situation under control?"

Following questionnaires were asked five times every second hour (0, +2, +4, +6, +8).

The **Multidimensional Mood Questionnaire** (MDBF) (Steyer et al., 2004) is a scale with two different short forms A and B, each containing 12 adjectives measuring the following three dimensions: good – bad mood, alertness – tiredness, calmness – restlessness. Participants were asked to rate these adjectives on a 5-point Likert scale ranging from 1 "*not at all*" to 5 "*very much*". This questionnaire was used to measure the general affective and mood state of participants.
An example item is: "At the moment, I feel content" (Steyer et al., 2004)
Another example item is: "At the moment, I feel tired" (Steyer et al., 2004)

The **Multidimensional Fatigue Inventory** (MFI) (Lin et al., 2009) contains 20 items in total measuring the following five subscales: *general fatigue (GF), physical fatigue (PF), mental fatigue (MF), reduced motivation (RM), reduced activity (RA)*. In favor of faster measures, it was decided to take only one of the items of each of the five subscales.

Participants needed to rate these items on a 5-point Likert scale ranging from 1 "*not at all*" to 5 "*very*".

An example item is: "At the moment, I feel unmotivated" (RM) (Lin et al., 2009)

Another example item is: "I can concentrate well" (MF) (Lin et al., 2009)

Single item ratings concerning hunger, loneliness and boredom level of participant were assessed on a visual analogue scale ranging from 1 "*not at all*" to 100 "*very strong*".

An example question is: "How hungry do you feel at the moment?"

Desire for food (DF) is a custom questionnaire with four items adapted from the questionnaire measuring the urge for cigarettes (Cox et al., 2001). Participants were asked to indicate the degree to which these items apply to them on a visual analogue scale ranging from "*not at all*" to "*extremely*".

An example item is: "I have a desire for food right now"

Another example item is: "I have an urge to eat"

Desire for social contact (DSC) is also a custom questionnaire similar to the desire for food questionnaire with four items and the same visual analogue scale ranging from "*not at all*" to "*extremely*". Furthermore, participants were given a short definition of social contact at the beginning of the questionnaire, explaining that this definition of social contact includes seeing, hearing, touching someone or speaking to someone.

An example item is: "I have a desire for social contact right now"

Another example item is: "Nothing would be better than social contact right now"

These last two measurements DF and DSC were expected to measure an increased desire for food and social contact and were necessary to check if experimental manipulation was successful.

Following questionnaires were asked three times every fourth hour (0, +4, +8).

The **Profile of Mood States** (POMS) (Dalbert, 1992) is a mood level scale that has five subscales: *sadness, hopelessness, tiredness, positive mood, anger*. This scale instructs participants to rate their own current mood state using a seven-point Likert response format ranging from 1 "*not at all*" to 7 "*very strongly*" and it was measured with 19 words representing feelings and mood states.

Example items are: "angry" and "exhausted"

Desire for phone/internet (DPI) is also a custom questionnaire similar to the desire for food/social contact questionnaire with four items and the same visual analogue scale ranging from "*not at all*" to "*extremely*". This scale was used to check whether the effects of

the experimental condition on the affective state could be modulated by the desire for their phone and internet.

An example item is: "I have an urge to use my phone or internet right now"

Experimental Task – Approach Behavior Task

Measuring 'Wanting'. Approach towards social and non-social visual stimuli that represent higher and lower level rewards is measured by an adapted task developed by Ziauddeen and associates (Ziauddeen et al., 2014). This task includes visual stimuli of different types (food or human faces) and different valence (positive/high or neutral/low). Social stimuli such as human faces are chosen from the FACES database and food stimuli are chosen from the Food Research Image database (Ebner et al., 2010; Foroni et al., 2013). Positive and neutral visual stimuli differ on the dimension of valence but are matched on caloric value for food stimuli and on dimensions of attractiveness for social stimuli. To mention one example, smiling faces compared to angry faces are considered to be of positive and high valence.

First, participants needed to press the hand dynamometer three times prior to the actual task in order to have the percentage from their maximum force. Then the actual task was starting, so they observed stimuli on the screen in eight short blocks, each consisting of five either social or non-social stimuli. In total, there were 45 visual stimuli presented. Each stimulus was presented 6 s, in the first 4 s, participants had the chance to manipulate the size by pressing a hand dynamometer, while in the last 2 s, they observed the picture in the final size (see Figure 2).

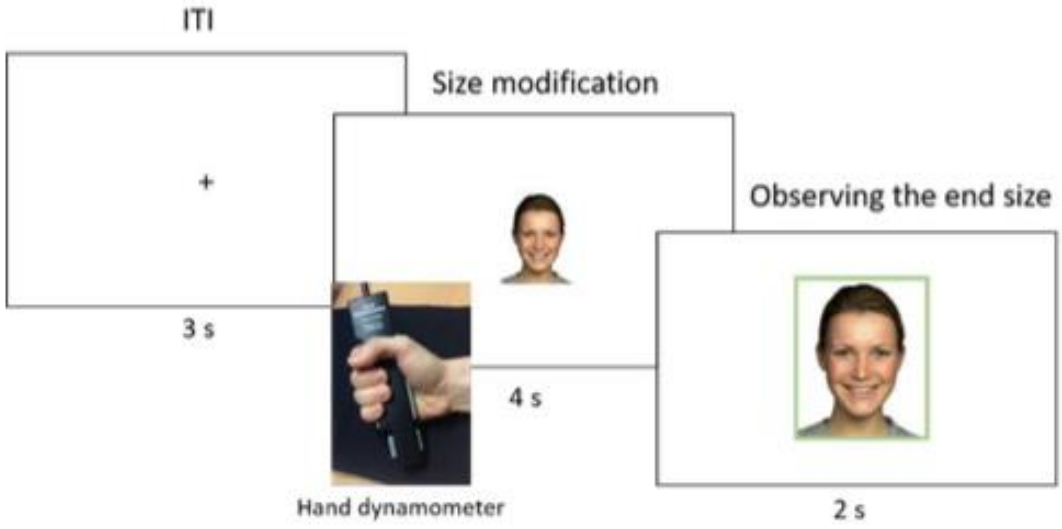

Figure 2. Size modification of the approach behavior task and hand dynamometer

The size of the picture was modified based on the percentage of the participant's maximum force employed at a given moment. The main measures of the approach behavior task were average maximum percentage force employed across trials belonging to the same stimulus category and additionally, the energy exerted in trials belonging to the same stimulus category (area under the force curve averaged for all stimuli of the same category). There was a 20 s break between every two blocks in order to reduce the effects of hand exhaustion.

Measuring ‚Liking'. In addition to measuring ‚wanting' by the size modification by pressing the hand dynamometer, participants also needed to do a pleasantness rating of each stimulus on a visual analogue scale afterwards. Thus, in order to measure ‚liking', they needed to rate how much they ‚liked' a certain reward on the scale ranging from "*very unpleasant*" to "*very pleasant*" with the midpoint representing "*neutral*".

In total, participants completed this task in approximately 20 minutes.

Ethics

All participants received and read the informed consent form and signed it for participation in the study. Moreover, they were informed of their right to withdraw from the study at any given moment. Privacy of the participants was guaranteed, each participant was given an assigned code, thereby personal data was stored separately. All information collected during the study remained absolutely confidential. This study was conducted in accordance with the Declaration of Helsinki (World Medical Association, 2013).

Analysis

The program IBM SPSS 27 for Mac was used for all of the statistical analyses. The significance level was defined in advance as $\alpha < .05$. For the manipulation check a *two-way repeated measures Analysis of Variance* with two factors (time and condition) was conducted. A *repeated measures Analysis of Variance* and a *simple effects analysis* using Bonferroni alpha-correction was conducted for the specific hypotheses with three factors of condition (Neutral, Hunger, Social Isolation), two factors of type of reward (non-social stimuli, social stimuli) and two factors of level of reward (high valence, low valence).

Assumptions of the *Analysis of Variance* have been examined. Some of the variables did not meet the requirements for the Analysis of Variance, for example the criteria of outliers, but all outliers were in an acceptable range, so it was assumed that it did not affect

the procedure of the analyses. Additionally, the sample had no normal distribution due to the small sample size. However, it was assumed that the Analysis of Variance offers a robust procedure regarding the violation of some of the requirements (Glass et al., 1972; Harwell et al., 1992).

Results

Manipulation Check

The Manipulation Check was conducted in order to measure the effectiveness of the experimental study. A *two-way repeated measures Analysis of Variance* was conducted for the dependent variables *desire for food* and *desire for social contact*, with condition (neutral, hunger, social isolation) and time (five time-measurement points) as within subject factors.

Desire for Food

Mauchly's test indicated that the assumption of sphericity had been violated for the main effects of condition and interaction of time and condition. Therefore, the Greenhouse-Geisser adjustment was used to correct for violations of sphericity.

Desire for food was highest in the hunger condition (M = 51.72, SE = 3.22) and, decreased in the social isolation condition (M = 19.30, SE = 4.24) and lowest in the neutral condition (M = 16.94, SE = 4.12).

For the main effect of condition, the Greenhouse-Geisser estimate of the departure from sphericity was $\varepsilon = .73$, $p < .005$. This main effect was a significant one, $F(1.45, 42.06) = 66.51$, $p < .001$. Contrasts revealed that desire for food was significantly higher in the hunger condition in comparison to the neutral condition, $F(1, 29) = 78.54$, $p < .001$. Additionally, contrasts revealed that in the neutral condition compared to the social isolation condition, desire for food was not statistically significant different $F(1, 29) = 1.27$, $p = .270$.

The main effect of time was statistically significant, $F(4, 116) = 36.92$, $p < .001$, which means that all other variables ignored, desire for food differs between measurement time points. Contrasts revealed that the difference between each measurement time point was statistically significant, first compared to second measurement point $F(1, 29) = 39.14$, $p < .001$, first compared to third $F(1, 29) = 96.06$, $p < .001$, first compared to fourth $F(1, 29) = 83.29$, $p < .001$ and first compared to last $F(1, 29) = 105.46$, $p < .001$.

For the interaction, the Greenhouse-Geisser estimate of the departure from sphericity was $\varepsilon = .66$, $p < .005$. There was a significant interaction effect between condition and time, $F(5.25, 152.23) = 46.90$, $p < .001$, which means that desire for food is different in the three conditions depending on measurement time points, as shown in Figure 3.

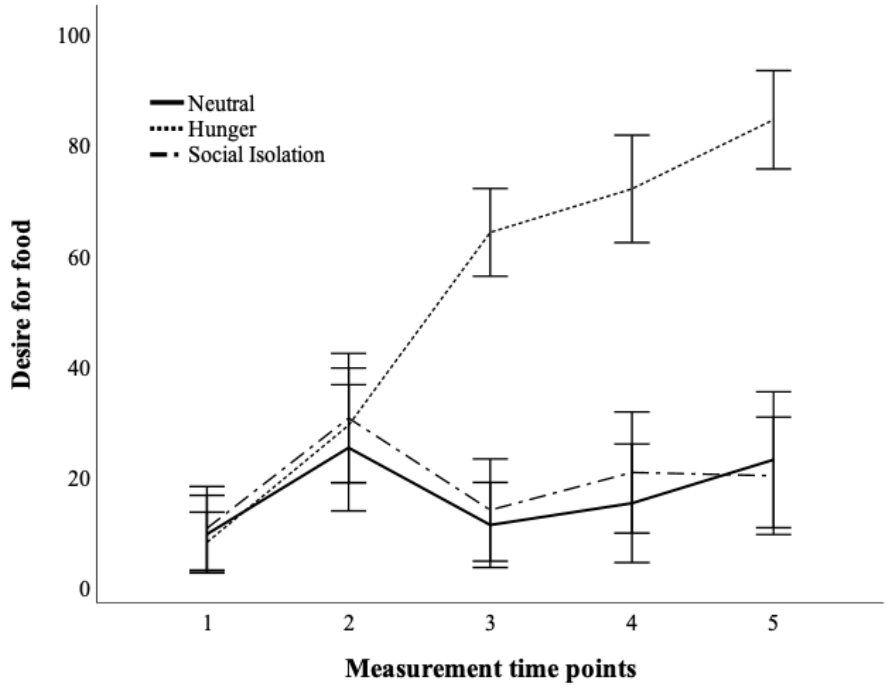

Figure 3. Significant interaction effect between condition and time for desire for food. Error bars representing 95% confidence intervals.

Desire for Social Contact

Mauchly's test indicated that the assumption of sphericity had been violated for the main effects of time and interaction of time and condition. Therefore, the Greenhouse–Geisser adjustment was used to correct for violations of sphericity.

Desire for social contact was highest in the social isolation condition (M = 38.50, SE = 4.78), and decreased in the hunger condition (M = 28.36, SE = 4.29) and lowest in the neutral condition (M = 24.31, SE = 4.21).

There was a significant main effect of the condition $F(2, 58) = 6.72$, $p < .005$. Contrasts revealed that desire for social contact was significantly higher in the social isolation condition in comparison to the neutral condition, $F(1, 29) = 13.98$, $p < .005$. Additionally, contrasts revealed that the difference for desire for social contact in the neutral condition compared to the hunger condition was not statistically significant $F(1, 29) = 1.38$, $p = .250$.

For the main effect of time, the Greenhouse-Geisser estimate of the departure from sphericity was $\varepsilon = .61$, $p < .001$. This main effect was a statistically significant one, $F(2.44, 70.77) = 20.70$, $p < .001$, which means that all other variables ignored, desire for social contact differed between measurement time points. Contrasts revealed that the difference between each measurement time point was statistically significant, first compared to second measurement point $F(1, 29) = 17.43$, $p < .001$, first compared to third $F(1, 29) = 9.63$, $p <$

.005, first compared to fourth $F(1, 29) = 17.70$, $p < .001$ and first compared to last $F(1, 29) = 44.24$, $p < .001$.

For the interaction the Greenhouse-Geisser estimate of the departure from sphericity was $\varepsilon = .66$, $p < .001$. Concerning the interaction between condition and time, it was significant, $F(5.26, 152.65) = 2.76$, $p = .018$, which means that desire for social contact was significantly different in the three conditions depending on measurement time points (see Figure 4).

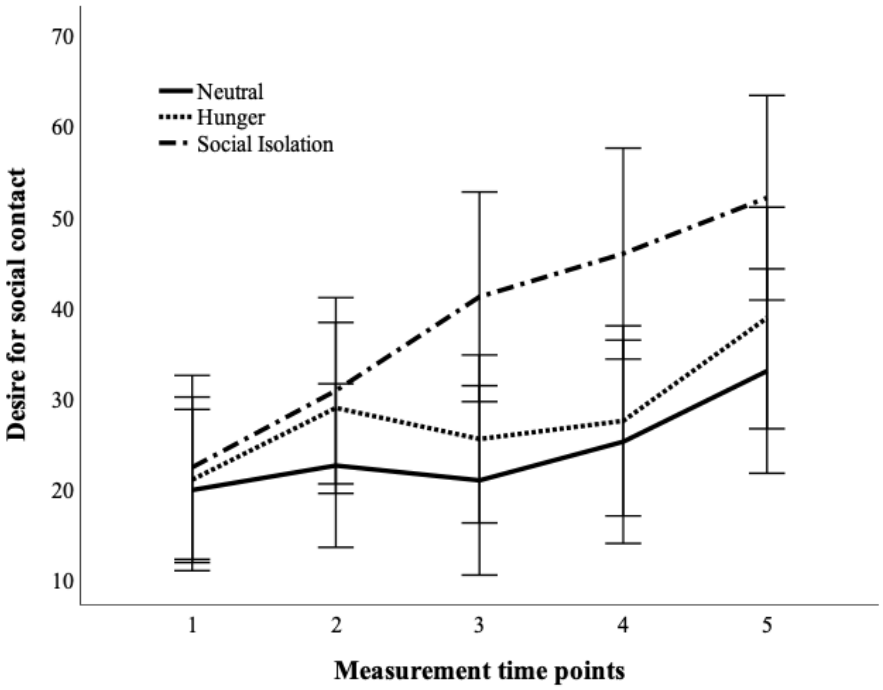

Figure 4. Significant interaction effect between condition and time for desire for social contact. Error bars representing 95% confidence intervals.

In sum, we considered the manipulation as effective because the desire for food and the desire for social contact each was highest in the specific deprived experimental condition. Additionally, both desires increased over time, the longer participants were deprived of food or social contact, the greater the desire for food and social contact, which confirms the findings of Cacioppo et al. (2016), Chen et al. (2016) and Livneh et al. (2017).

Approach Behavior

The first hypothesis 1.1 was supported: The motivational state of hunger significantly increased approach behavior towards specific (non-social) reward cues. Valence level of rewards did not significantly make a difference for approach behavior.

However, hypothesis 1.2 was not supported: The motivational state of social isolation did not significantly increase approach behavior towards specific (social) reward cues. Valence level of rewards also did not significantly make a difference for approach behavior.

Mauchly‘s test of sphericity was not necessary because there are always only two factors, so sphericity is assumed except for the three factors of condition. Mauchly’s test indicated that the assumption of sphericity had been violated for condition and the interaction between condition and type of reward. Therefore, the Huynh-Feldt adjustment was used to correct for violations of sphericity.

For the main effect of condition, the Huynh-Feldt estimate of the departure from sphericity was $\varepsilon = .86$, $p = .029$. There was no statistically significant difference for the different conditions, $F(1.72, 49.87) = 2.77$, $p = .080$, partial $\eta^2 = .09$. Contrasts revealed that the approach behavior was significantly higher in the hunger condition in comparison to the neutral condition, $F(1, 29) = 9.71$, $p = .004$, partial $\eta^2 = .25$. Contrasts revealed no significant difference for approach behavior between the neutral condition and the social isolation condition, $F(1, 29) = 1.16$, $p = .289$, partial $\eta^2 = .04$. Bonferroni-adjusted post-hoc analysis revealed a significant difference ($p = .012$) in the neutral condition and the hunger condition (-9067.88, 95%-CI[-16460.68, -1675.07]).

There was a significant main effect of the type of reward ($F(1, 29) = 54.48$, $p < .001$, partial $\eta^2 = .65$), which means on average, participants pressed more for non-social stimuli ($M = 80708.28$, $SE = 6162.18$) than for social stimuli ($M = 49281.11$, $SE = 5947.99$). Contrasts revealed that the difference for approach behavior between type of rewards was statistically significant, $F(1, 29) = 54.48$, $p < .001$, partial $\eta^2 = .65$. Bonferroni-adjusted post-hoc analysis revealed a significant difference ($p < .001$) between the non-social stimuli and the social stimuli (31427.18, 95%-CI[22718.69, 40135.66]).

There was a significant main effect of the level of reward $F(1, 29) = 25.89$, $p < .001$, partial $\eta^2 = .47$, which means participants pressed more for high valence stimuli ($M = 73098.47$, $SE = 6078.09$) than for low valence stimuli ($M = 56890.92$, $SE = 5693.48$). Contrasts revealed that the difference for approach behavior between level of rewards was

statistically significant, $F(1, 29) = 25.89$, $p < .001$, partial $\eta^2 = .47$. Bonferroni-adjusted post-hoc analysis revealed a significant difference ($p < .001$) in the high valence and the low valence of level of reward (16207.56, 95%-CI[9693.07, 22722.04]).

For the interaction effect of condition and type of reward, the Huynh-Feldt estimate of the departure from sphericity was $\varepsilon = .88$, $p = .043$. **There was a statistically significant interaction between condition and type of reward ($F(1.75, 50.85) = 3.96$, $p = .030$, partial $\eta^2 = .12$), which means that approach behavior is significantly different in the three conditions depending on the type of reward.** Figure 5 shows approach behavior for non-social and social reward stimuli in the three conditions.

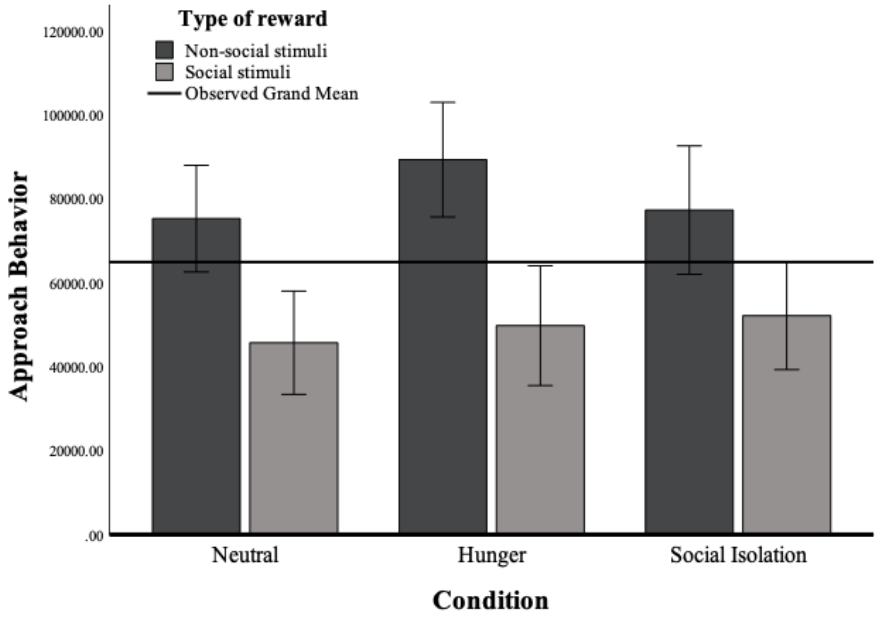

Figure 5. Approach behavior for non-social and social reward stimuli in the three conditions (Neutral, Hunger, Social Isolation). Error bars representing 95% confidence intervals.

Pairwise post-hoc comparisons with Bonferroni correction showed a significant difference between the types of reward (non-social and social stimuli) within the neutral condition ($p < .001$), within the hunger condition ($p < .001$) as well as within the social isolation condition ($p < .001$).

Pairwise post-hoc comparisons with Bonferroni correction showed a significant difference of non-social stimuli as a type of reward between the neutral condition and the hunger condition ($p = .023$), but there was neither a significant difference between the hunger

and the social isolation condition (p = .131) nor between neutral and social isolation condition (p = 1.000). Pairwise post-hoc comparisons with Bonferroni correction showed neither a significant difference of social stimuli as type of reward between the neutral condition and the hunger condition (p = .338), nor between the hunger and the social isolation condition (p = 1.000) nor between neutral and social isolation condition (p = .494).

Table 1

Means and standard errors for approach behavior

Type of reward		Neutral condition	Hunger condition	Social Isolation Condition
Non-social stimuli	*M*	75345.12	89403.61	77376.12
	SE	6212.19	6672.47	7486.69
Social stimuli	*M*	45764.36	49841.62	52237.34
	SE	6015.70	6973.00	6289.25

Note. *M* and *SE* represent mean and standard error, respectively.

Table 1 presents means and standard errors for both types of reward for each of the conditions. The means in table 1 show that approach behavior in the neutral condition is higher for non-social stimuli (M = 75345.12, SE = 6212.19) than for social stimuli (M = 45764.36, SE = 6015.70) as well as in the hunger condition, where the 'wanting' for the deprived stimuli (non-social stimuli) was highest (M = 89403.61, SE = 6672.47). There was a similar pattern in the social isolation condition, that is, a higher approach behavior for non-social stimuli (M = 77376.12, SE = 7486.69), which was not the deprived cue. In the social isolation condition, the approach behavior for social stimuli (deprived stimuli) was highest compared to the other conditions (M = 52237.34, SE = 6289.25).

The second hypotheses (2.1, 2.2) proposing that aversive motivational states lead to an increase in approach behavior of high valence non-specific reward cues were both not supported.

In contrast, the interaction between condition and level of reward (F(2, 58) = .83, p = .442, partial η^2 = .03) was not statistically significant, which means that the approach behavior was not different in the conditions when the level of reward was high compared to when it was low.

The interaction between condition, type, and level of reward was also not significant (*F*(2, 58) = .33, *p* = .723, partial η² = .01). This means that the interaction between the conditions and type of reward was not different when the level of reward was high compared to when it was low.

Pleasantness Rating

The third hypothesis (3.1) proposing that the aversive motivational state hunger does not lead to an increase in 'liking' of specific reward cues was not supported because the motivational state of hunger showed an increase in 'liking' of specific reward cues.

The third hypothesis 3.2 was supported: The motivational state of social isolation did not significantly increase 'liking' of specific (social) reward cues. However, 'liking' of non-specific (non-social) reward cues did increase.

Mauchly's test of sphericity is not necessary because there are only two factors, so sphericity is assumed except for condition. Mauchly's test indicated that the assumption of sphericity had been violated for the condition and other interaction effects. Therefore, the Huynh-Feldt adjustment was used to correct for violations of sphericity.

For the main effect of condition, the Huynh-Feldt estimate of the departure from sphericity was ε = .79, *p* = .004. There was a statistically significant difference for the different conditions, *F*(1.58, 45.83) = 5.55, *p* = .011, partial η² = .16. Contrasts revealed that the pleasantness rating was significantly higher in the hunger condition in comparison to the neutral condition, *F*(1, 29) = 14.38, *p* = .001, partial η² = .33. Contrasts revealed no significant difference for pleasantness rating between the neutral condition and the social isolation condition, *F*(1, 29) = 0.10, *p* = .752, partial η² = .00. Bonferroni-adjusted post-hoc analysis revealed a significant difference (*p* = .002) in the neutral condition and the hunger condition (0.805, 95%-CI[0.27, 1.35]).

There was a significant main effect of the type of reward (*F*(1, 29) = 32.91, *p* < .001, partial η² = .53), which means participants liked non-social stimuli more (*M* = 3.03, *SE* = 0.36) than social stimuli (*M* = -0.01, *SE* = 0.51). Contrasts revealed that the difference for pleasantness rating between type of rewards was statistically significant, *F*(1, 29) = 32.90, *p* < .001, partial η² = .53. Bonferroni-adjusted post-hoc analysis revealed a significant difference (*p* < .001) between the non-social stimuli and the social stimuli (3.04, 95%-CI[1.95, 4.12]).

There was a significant main effect of the level of reward $F(1, 29) = 91.54$, $p < .001$, partial $\eta^2 = .76$, which means participants liked high valence stimuli more ($M = 3.51$, $SE = 0.42$) than low valence stimuli ($M = -0.49$, $SE = 0.40$). Contrasts revealed that the difference for pleasantness rating between level of rewards was statistically significant, $F(1, 29) = 91.54$, $p < .001$, partial $\eta^2 = .76$. Bonferroni-adjusted post-hoc analysis revealed a significant difference ($p < .001$) in the high valence and the low valence of level of reward (4.00, 95%-CI[3.15, 4.86]).

For the interaction effect of condition and type of reward, the Huynh-Feldt estimate of the departure from sphericity was $\varepsilon = .71$, $p < .001$. **There was a statistically significant interaction between condition and type of reward ($F(1.42, 41.27) = 8.41$, $p = .003$, partial $\eta^2 = .23$), which means that pleasantness rating is significantly different in the three conditions depending on the type of reward.** Figure 6 shows pleasantness rating for non-social and social reward stimuli in the three conditions.

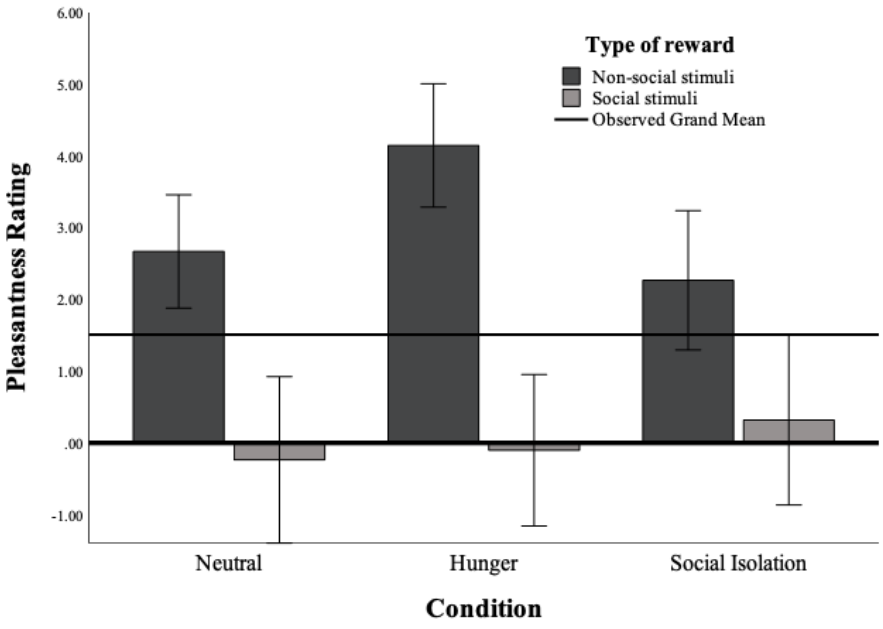

Figure 6. Pleasantness rating for non-social and social reward stimuli in the three conditions (Neutral, Hunger, Social Isolation). Error bars representing 95% confidence intervals.

Pairwise post-hoc comparisons with Bonferroni correction showed a significant difference between the types of reward (non-social and social stimuli) within the neutral condition ($p < .001$), within the hunger condition ($p < .001$) as well as within the social isolation condition ($p = .009$).

Pairwise post-hoc comparisons with Bonferroni correction showed a significant difference of non-social stimuli as type of reward between the neutral condition and the hunger condition ($p = .002$), but there was neither a significant difference between the hunger and the social isolation condition ($p = .507$) nor between neutral and social isolation condition ($p = .438$). Pairwise post-hoc comparisons with Bonferroni correction showed neither a significant difference of social stimuli as the type of reward between the neutral condition and the hunger condition ($p = 1.000$), nor between the hunger and the social isolation condition ($p = 1.000$) nor between neutral and social isolation condition ($p = .416$).

Table 2

Means and standard errors for pleasantness rating

Type of reward		Neutral condition	Hunger condition	Social Isolation Condition
Non-social stimuli	*M*	2.67	4.15	2.27
	SE	0.39	0.42	0.48
Social stimuli	*M*	-0.24	-0.10	0.32
	SE	0.57	0.52	0.58

Note. M and *SE* represent mean and standard error, respectively.

Table 2 presents means and standard errors for both types of reward for each of the conditions. The means in table 2 show that participants 'liked' non-social stimuli the most in the hunger condition ($M = 4.15$, $SE = 0.42$), but also 'liked' them in the neutral condition ($M = 2.67$, $SE = 0.39$) and in the social isolation condition ($M = 2.27$, $SE = 0.48$). In comparison to the non-social stimuli, participants only 'liked' social stimuli in the deprived condition – the social isolation condition ($M = 0.32$, $SE = 0.58$). In the neutral condition ($M = -0.24$, $SE = 0.57$) and in the hunger condition ($M = -0.10$, $SE = 0.52$), participants did not 'like' social stimuli.

There was neither a statistically significant interaction between condition and level of reward ($F(2, 58) = .41$, $p = .666$, partial $\eta^2 = .01$) nor between type and level of reward ($F(1, 29) = .29$, $p = .593$, partial $\eta^2 = .01$).

For the interaction effect of condition and type of reward, the Huynh-Feldt estimate of the departure from sphericity was $\varepsilon = .84$, $p = .018$. Results also showed no significant interaction between condition, type and level of reward ($F(1.68, 48.71) = 1.86$, $p = .171$).

Discussion

Interpretation of Results

The aim of this research paper was to gain a better understanding of the influences of motivational states on approach behavior ('wanting') and pleasantness rating ('liking'). In this study, short-time hunger and social isolation were experimentally induced and compared to a neutral condition. For this purpose, a sample consisting of 30 healthy female participants was tested. Approach behavior or 'wanting' was operationalized by the average force pressing a hand dynamometer for getting certain reward stimuli consisting of social and non-social stimuli of different valence levels. Pleasantness rating or 'liking' was measured by a subjective rating scale.

First, induced short-term fasting and social isolation evoked attention towards the deprived need and led to a heightened desire for food and desire for social contact, respectively. Effects for deprived food specifically started to show after the second measurement point, which was around noon. It seems logical that desire for food started being significantly different at lunchtime when people normally consume food. However, desire for social contact also started to be significantly different at the third measurement time point but this effect was considerably less remarkable. In general, both desires increased over time. Thus, at the end of the experimental conditions of hunger and social isolation compared to the neutral condition, participants were subjectively deprived more of these specific needs, food and social contact and experienced a heightened desire for them, which also confirms the findings of Cacioppo et al. (2016), Tomova et al. (2020), Chen et al. (2016) and Livneh et al. (2017).

The results of the present study support the hypothesis that people who are forced to fasting crave specific non-social reward cues the most. This effect of 'wanting' for non-social stimuli was highest in the hunger condition. Examples of these non-social reward cues were pictures of different food stimuli. As expected, the deprived state of hunger in comparison to the neutral state and the social isolation condition led to a motivational approach towards cues such as food stimuli that help release negative feelings or stress associated with hunger. This pattern of results is consistent with the previous findings of Tomova et al. (2020), that is, deprivation of one need leads to a specific focus on and craving for this deprived need. Further they showed that areas in the brain associated with reward processing (e.g. the ventral tegmental area) represented aversive motivation and these responses were selective to the deprived cue, in this case, more responsive to food cues after fasting (Tomova et al., 2020).

Whereas past researchers have found that induced acute social isolation causes craving of social interactions and elicits neural responses towards social cues similar to hungry people craving food (Tomova et al., 2019, 2020), the present study has shown that nevertheless, people were motivated more to approach social cues than in the other two conditions, this effect was not significantly different. Thus, participants' 'wanting' for social stimuli was highest in the social isolation condition, however, they still wanted non-social stimuli more even though this was not the deprived reward cue in this case. This finding may be explained by the idea that deprivation of one need can also lead to increased approach behavior or craving for other rewards (LeDoux, 2012). Specifically, research in previous animal models has shown that social isolation has led to other changes in behavior and motivation, such as increased food consumption and addictive behavior (Schipper et al., 2018; Tomova et al., 2019). So, the increased generalized reward-seeking behavior may function as a compensation of the deprived need and as a balance to the lack of social contact (Tomova et al., 2019).

Another possible explanation for the higher approach behavior or 'wanting' for non-social reward stimuli overall in all three conditions could be the measurement of approach behavior. Thus, in order to see food stimuli in an optimal size, participants needed to press more to get a bigger picture that it resembles the actual size and that one can see pictures of food more specifically. Conversely, participants reached the preferred size for social stimuli (faces) quicker, so the pressing of the hand dynamometer stopped earlier. Additionally, an argument could be that faces look disturbing or irritating if they are displayed too big on participants' screen.

In general, participants pressed more for high valence stimuli than for low valence stimuli, however, valence levels did not make a significant difference for approach behavior. It is surprising that the approach behavior neither significantly increased for high valence specific reward cues nor for non-specific reward cues. So this pattern of results concerning non-specific reward cues of high valence is not consistent with previous literature because past researchers have shown that participants in stressful conditions prefer to eat highly palatable and/or caloric food due to the associated rewarding hedonic pleasure (Adam & Epel, 2007; Pool, Delplanque, et al., 2015). Furthermore, as stated by the aversive state reduction hypothesis formulated by Robbins and Fray (1980), these highly palatable foods often provide comfort and help reduce aversive feelings associated with stress. Similarly to food rewards of high valence, researchers have shown that participants also preferred social

stimuli with a high valence like attractive or smiling faces (Aharon et al., 2001; Bhanji & Delgado, 2015; Matthews & Tye, 2019; Morrison et al., 2017; Tomova et al., 2020).

Finally, we obtained evidence that on the one hand, in the aversive motivational state condition of hunger, specific (non-social) reward cues were 'liked' the most in contrast to the concept of the incentive salience theory, which states that 'wanting' and 'liking' can be activated independently of each other and previous findings concluded that under stress 'wanting' is often independent of 'liking' (Berridge & Robinson, 1998, 2003; Pool, Brosch, et al., 2015; Pool, Delplanque, et al., 2015). In previous studies of Pool et al. (2015) participants spent more energy to smell preferable odors in stressful situations but did not report it as more pleasurable. It could be argued that participants in our study were not stressed enough to experience this differentiation of 'wanting' and 'liking'. The results of the present study rather support the view of the connectedness of these two concepts in the reward processing as Berridge (2009) found out in recent animal affective neuroscience studies (Berridge & Robinson, 2003).

On the other hand, the motivational state of social isolation did not increase 'liking' of specific social reward cues. However, participants 'liked' non-specific (non-social) reward cues in the social isolation condition, even though this was not the specific deprived need, but was not significantly different to the neutral condition. These findings could again be explained by the type of stimuli, maybe the non-social stimuli (food) were just more appealing to participants than the social stimuli (faces). Another important aspect to consider is that this pattern of results is consistent with previous research of social animals mentioned before, in particular, that social isolation can also impact other motivational compensatory behaviors (Schipper et al., 2018; Tomova et al., 2019). It seems reasonable, however, that people deprived of social contact seek anything pleasurable that can help reduce experienced aversive feelings.

Concerning the valence level of reward, in general, participants 'liked' both kinds of stimuli of high valence more than of low valence, which seems logical and in accordance with previous literature (Adam & Epel, 2007; Aharon et al., 2001; Bhanji & Delgado, 2015; Morrison et al., 2017; Pool, Brosch, et al., 2015). However, the valence of rewards did not significantly influence the interaction between condition and type of rewards.

Conclusion

In conclusion, the findings of this study highlight the evoked approach behavior towards the deprived need and the experienced heightened desire for food and desire for social contact in the experimental conditions of hunger and social isolation compared to the neutral condition (S. Cacioppo et al., 2016; Chen et al., 2016; Livneh et al., 2017; Tomova et al., 2020).

Results have further shown a significant increase of approach behavior towards or 'wanting' of specific non-social reward cues in the hunger condition in order to release and mitigate negative feelings (Tomova et al., 2020). For the social isolation condition, participants have shown a slightly increased approach for or 'wanting' of social stimuli as well, however, they preferred non-social reward cues that may be explained as a compensatory reward-seeking behavior to balance out the deprived need for social contact (Schipper et al., 2018; Tomova et al., 2019).

Finally, the findings of pleasantness rating show that the motivational state of hunger led to an increase in 'liking' of specific reward cues even though the hypothesis stated independence of 'wanting' and 'liking' in stressful conditions. This result supports the connection of these two concepts in reward processing (Berridge, 2009; Berridge & Robinson, 2003). Contrary to the results of the hunger condition, the motivational state of social isolation did not increase 'liking' of social reward stimuli, which is in accordance with previous research differentiating these two concepts (Berridge & Robinson, 1998, 2003; Pool, Brosch, et al., 2015; Pool, Delplanque, et al., 2015).

In my view, the most compelling explanation for the present set of findings for 'wanting' and 'liking' is that non-social stimuli - pictures of food, especially those of high valence - were more appealing than social stimuli consisting of faces. Additionally, for approach behavior, participants reached their preferred size of social stimuli earlier and therefore, stopped pressing the hand dynamometer earlier. Another critical point to keep in mind is that participants may not have experienced "enough" stress and therefore, results did not show expected distinct differences of these two reward processing concepts. In terms of future research, it would be useful to extend the current findings further by additionally examining specific brain areas involved in the reward processing of 'wanting' and 'liking' (Tomova et al., 2020).

Limitations and Future Research Recommendation

There are at least two potential limitations concerning the results of this study. A first limitation concerns the small sample of 30 healthy female adults, mostly students, all living in one cultural context. The average age of our sample was 23 years, so it could have been possible that the effect of the deprived need for social contact did not have as much influence on them due to their young age. It seems reasonable that elderly people are on average more affected by chronic loneliness than younger individuals (Bzdok & Dunbar, 2020; Hawkley & Cacioppo, 2010; Tomova et al., 2020). Further research should therefore keep age in mind and also focus on the effects of deprivation on older individuals as well as children and young adults. Another important factor to consider is that our sample consisted only of women using hormonal contraceptives due to better controllability of hormonal fluctuations. Critical in this study was also that it did not matter which kind of hormonal birth control method participants were using but, however, the dose of hormones can vary between these. Therefore, generalizations for the whole population cannot be made because gender and hormones could have had considerable effects on the outcomes of the study. Additionally, one's period of life and the cultural context may also make a difference concerning both motivational states – hunger and social isolation. It can also be important to measure differences and changes in people's behavior for short-term (hours) and long-term (weeks, months) deprivation of one's important needs. However, it is questionable if it is even ethically possible to test fasting and social isolation in humans for much longer time periods than one or two days.

A second potential limitation of the study was the global pandemic due to the occurrence of the SARS-CoV-2 in early 2020. Millions of people had to isolate themselves from others in order to prevent the virus from spreading as public health and government mandated. This sudden change of people's social practices may have had an influence on the outcomes of the second half of the study. Specifically, the social isolation condition might have been experienced differently by the participants, because they were more used to being alone and on their own for longer time periods than before the pandemic. Furthermore, it may have made a difference for the experienced feelings of social connectedness because people had to start and were more used to communicate by video chats, such as Zoom or Skype, to stay in touch with each other virtually.

Another important issue that the global pandemic demonstrated is the importance of objective social connections and especially also the subjective feeling of being socially

connected and the psychological consequences that the absence of these social needs may have (Bzdok & Dunbar, 2020). Future research should also focus on technical advances that offer virtual social interactions and possibilities to stay in touch online to fulfill social needs because these became particularly valuable during the required self-isolation and quarantine during the global crisis. However, the important question remains, whether the opportunities to be virtually connected with others are enough to fulfill these social needs of humans (Bzdok & Dunbar, 2020; Tomova et al., 2020).

Next to the rather obvious influences of the consequences of the pandemic on perceived social isolation, perceived stress and mood of people may be influenced too, possibly resulting in a change of amount and kind of food that was consumed. As shown in previous research, people in stressful situations tend to consume more and preferable highly caloric and palatable food (Adam & Epel, 2007; Pool, Brosch, et al., 2015).

Another limitation of this study is that all measures only used pictures of reward stimuli instead of actual food and social rewards (Ziauddeen et al., 2014). While this limitation is important to mention, there have been other previous studies investigating anticipatory behavior towards representations of reward stimuli with results showing that approach behavior is often just guided by representations or imagination of the reward stimulus (Berridge, 2009; Ziauddeen et al., 2014).

The effects of homeostatic imbalances due to depriving conditions can have serious and devastating consequences on the physical and mental health of human beings (Tomova et al., 2020). Consequently, public health should also pay more attention because illnesses such as obesity, eating disorders, addiction and affective disorders may be influenced and attributed to these imbalances and dysregulations (Livneh et al., 2017). In terms of future research, it would be useful to further investigate effects of stressors and homeostatic imbalances as well as effects of motivational states on human reward processing and the differences and similarities of ‘wanting’ and ‘liking’.

Despite these limitations, the present study has enhanced the understanding of the similarities and differences between the motivational states of hunger and social isolation and their consequences on reward processing in humans. I hope that the current research will stimulate further investigation of this important area. Additionally, further research may also shed light on specific brain areas involved in reward processing of ‘wanting’ and ‘liking’.

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Appendix

English Abstract

Food consumption and social interactions are human needs, and a lack of these essential needs may lead to a homeostatic imbalance, which can further lead to pathological and psychological disorders. Homeostatic imbalance also leads to aversive motivation, resulting in increased seeking of (nutritional and social) rewards that bring the system back to balance and relieve negative feelings and stress. The motivation to seek rewards involves approach behavior towards desired outcomes, including the motivation to obtain a reward ('wanting') and the hedonic pleasure associated with the reward consumption ('liking'). These two concepts, however, can be triggered independently especially when participants experience stress. This study addressed the question of how these motivational states of hunger and social isolation affect approach behavior towards and pleasantness rating of specific reward cues of high and low valence and non-specific reward cues. During the experiment, participants (n = 30) had to undergo deprivation sessions (8h) of mandated fasting and social isolation. Results showed that desires for deprived cues increased gradually over time. After the fasting period, the participant's approach behavior increased for the deprived target. However, after social isolation, this effect did not occur, but results rather showed an increased approach towards non-social reward stimuli that may be explained as a compensatory reward-seeking behavior. Findings of pleasantness rating show that the motivational state of hunger led to an increase in 'liking' of specific reward cues and on the contrary, social isolation did not increase 'liking' of social reward cues. The effects of homeostatic imbalances due to depriving conditions can have devastating consequences for the physical and mental health of humans and should therefore be addressed in future research.

Keywords: Hunger; Social Isolation; Motivation; Reward; Wanting; Liking

German Abstract

Nahrungsaufnahme und soziale Interaktionen sind menschliche Bedürfnisse, und ein Mangel an diesen essenziellen Bedürfnissen kann zu einem homöostatischen Ungleichgewicht führen, das wiederum zu pathologischen und psychologischen Störungen führen kann. Ein homöostatisches Ungleichgewicht führt auch zu einer aversiven Motivation, was zu einer verstärkten Suche nach (Ernährungs- und sozialen) Belohnungen führt, die das System wieder ins Gleichgewicht bringen und negative Gefühle und Stress lindern können. Die Motivation nach Belohnungen zu suchen, umfasst das Annäherungsverhalten gewünschte Belohnungen zu erhalten ("Wollen") und das hedonistische Vergnügen, das mit dem Konsum der Belohnung verbunden ist ("Mögen"). Diese beiden Konzepte können jedoch unabhängig voneinander ausgelöst werden, insbesondere in Stresssituationen. Diese Studie befasste sich mit der Frage, wie diese motivationalen Zustände von Hunger und sozialer Isolation das Annäherungsverhalten an und die Angenehmheitsbewertung von spezifischen Belohnungsreizen hoher und niedriger Valenz und unspezifischen Belohnungsreizen beeinflussen. Während des Experiments mussten sich die Teilnehmerinnen (N = 30) Deprivationssitzungen (8h) mit Fasten und sozialer Isolation unterziehen. Die Ergebnisse zeigten, dass das Verlangen nach deprivierten Belohnungen im Laufe der Zeit allmählich anstieg. In der Fastenbedingung stieg das Annäherungsverhalten der Teilnehmerinnen für die deprivierte Belohnung, nach der sozialen Isolation trat dieser Effekt jedoch nicht auf, sondern die Ergebnisse zeigten eine erhöhte Annäherung an nicht-soziale Belohnungsreize, die als kompensatorisches Belohnungsaufsuchen erklärt werden kann. Die Ergebnisse der Angenehmheitsbewertung zeigten, dass der motivationale Zustand des Hungers zu einem Anstieg des "Mögens" spezifischer Belohnungsreize führte und im Gegensatz dazu erhöhte die soziale Isolation nicht das "Mögen" sozialer Belohnungsreize. Die Auswirkungen des homöostatischen Ungleichgewichts aufgrund der Deprivationsbedingungen können schwerwiegende Folgen für die physische und psychische Gesundheit des Menschen haben und sollten daher in der zukünftigen Forschung berücksichtigt werden.

Schlüsselbegriffe: Hunger; Soziale Isolation; Motivation; Belohnung; Wollen; Mögen

Experiment Informed Consent

TeilnehmerInneninformation und Einwilligungserklärung zur Teilnahme an der Studie:

Der Einfluss von sozialen und nicht sozialen Bedürfnissen auf den körperlichen Zustand

Sehr geehrte(r) Teilnehmer(in),

Wir laden Sie ein, an der oben genannten Studie teilzunehmen.

Ihre Teilnahme an dieser Studie erfolgt freiwillig. Sie können jederzeit ohne Angabe von Gründen aus der Studie ausscheiden. Die Ablehnung der Teilnahme oder ein vorzeitiges Ausscheiden aus dieser Studie hat keine nachteiligen Folgen für Sie.

Diese Art von Studien ist notwendig, um verlässliche neue wissenschaftliche Forschungsergebnisse zu gewinnen. Unverzichtbare Voraussetzung für die Durchführung von Studien ist jedoch, dass Sie Ihr Einverständnis zur Teilnahme an dieser Studie schriftlich erklären.

Bitte lesen Sie den folgenden Text als Ergänzung zum Informationsgespräch mit dem/der StudienleiterIn sorgfältig durch und zögern Sie nicht, Fragen zu stellen.

Bitte unterschreiben Sie die Einwilligungserklärung nur
- wenn Sie Art und Ablauf der Studie vollständig verstanden haben,
- wenn Sie bereit sind, der Teilnahme zuzustimmen,
- wenn Sie sich über Ihre Rechte als TeilnehmerIn an dieser Studie im Klaren sind.

1. Was ist der Zweck der Studie?

Das Ziel der Studie ist die Untersuchung der Schwankungen der Stresshormone Cortisol und Alpha Amylase im Tagesverlauf. Diese werden während drei motivationalen Zuständen gemessen: (1) im Laufe eines normalen Tages, (2) im Laufe eines Tages mit verringerter Kalorienaufnahme und (3) im Laufe eines Tages mit verringertem sozialem Kontakt. Wir sind interessiert daran, wie die hormonellen Veränderungen mit Ihren persönlichen Erfahrungen in Beziehung stehen.

Bitte lesen Sie dieses Dokument aufmerksam durch und fragen Sie bei Unklarheiten nach, bevor Sie Ihr Einverständnis zur Studienteilnahme erteilen.

2. Wie läuft die Studie ab?

Die Studie findet in der Fakultät für Psychologie, Universität Wien, Liebiggasse 5, 1010 Wien, statt. Es werden insgesamt 30 Personen (Alter 18 bis 35 Jahre) daran teilnehmen.

Vor der Teilnahme an der Studie werden potentielle TeilnehmerInnen gebeten einen Online-Fragebogen auszufüllen. Dabei werden diese auf das Zutreffen aller Einschlusskriterien und das Fehlen aller Ausschlusskriterien hin überprüft. Der Online-Fragebogen wird weiter einige vorbereitende psychologische Fragebögen beinhalten. Anschließend bekommen alle

Teilnehmenden die Möglichkeit, allgemeine Fragen zur Studie und zum Design zu stellen. Wenn Sie als TeilnehmerIn für die Studie zulässig sind, werden drei Termine mit Ihnen im Labor der Fakultät für Psychologie vereinbart.

Die Studie besteht aus drei Sitzungen. Jede Sitzung dauert 10 Stunden (insgesamt 30 Stunden). In einer von drei Sitzungen werden Sie nur in der Vorbereitungsphase Essen erhalten, nicht aber während der Testphase (Bedingung der verringerten Kalorienaufnahme). In einer anderen Sitzung werden Sie während der Testphase keinen sozialen Kontakt haben (Bedingung des verringerten sozialen Kontakts). In der dritten Sitzung werden Sie in der Vorbereitungsphase und in der Testphase sowohl Essen als auch sozialen Kontakt haben (Neutrale Bedingung). Die Reihenfolge der Bedingungen wird per Zufall zugeteilt. Am Folgetag jeder Sitzung werden sie gebeten zwei weitere kurze Messungen zu Hause durchzuführen und diese bei der nächsten Sitzung oder an einem anderen vereinbarten Termin abzugeben.

Ablauf einer Sitzung

Die erste Sitzung startet mit einer Vorbereitungsphase von ca. 1 ½ Stunden. In der zweiten und dritten Sitzung wird die Vorbereitungsphase etwas kürzer sein. Am Anfang werden Sie ein Frühstück erhalten und einen psychologischen Fragebogen ausfüllen. Anschließend werden Sie vom/von der VersuchsleiterIn geschult die Messinstrumente selbstständig zu benutzen. Die Messinstrumente beinhalten: Die Salicaps zum Sammeln der Speichelproben, das Ecological Momentary Assessment Device (EMA), über welches die Fragebögen beantwortet werden, und den Gürtel, welcher Ihre Herzfrequenz misst. Am Ende der 1 ½-stündigen Vorbereitungsphase werden wir Sie um die erste selbstständige Messung (bestehend aus Speichelprobe und Fragebögen) bitten.

Auf die Vorbereitungsphase folgt die Testphase. Diese wird 8 Stunden dauern. Sie werden gebeten, Ihre persönlichen Gegenstände im Vorbereitungsraum zu lassen. Das ist notwendig, um die Bedingungen für alle Teilnehmenden so ähnlich und vergleichbar wie möglich zu halten. Außerdem können Sie drei bis fünf Gegenstände von zu Hause als Beschäftigungsmöglichkeit mitbringen. Dabei darf es sich nicht um elektronische Geräte (z.B. Handy, Laptop, I-Pod) oder soziale Inhalte handeln (z.B. Bilder von Gesichtern, Romane). Nähere Informationen zu den Gegenständen werden Sie von uns vor der Sitzung erhalten. Während der Testphase können Sie die Zeit so verbringen, wie Sie es möchten. Zusätzlich zu Ihren eigenen mitgebrachten Gegenständen stehen im Raum verschiedene Beschäftigungsmöglichkeiten (z.B. Bücher, Puzzles, Zeichenmaterial) zu Ihrer freien Verfügung. Ungefähr einmal in der Stunde wird das EMA Gerät Ihnen ein Signal geben (in Form eines Piepens) und Sie auffordern einen kurzen Fragebogen auszufüllen und eine Speichelprobe abzugeben. In den Sitzungen, bei denen Sie während der Testphase Mahlzeiten erhalten, wird Ihnen das Essen zu vorgegebenen Zeiten bereitgestellt. Für die Messung des Hormonspiegels ist es wichtig nur dann zu essen, wenn Sie dazu instruiert werden. In den Sitzungen, bei welchen Sie während der Testphase sozialen Kontakt haben, werden Sie den von Ihnen ausgewählten Gesprächspartnern via Skype und/oder Handy kommunizieren. Sie werden zu bestimmten Zeiten dafür mit einem Laptop und einem Handy ausgestattet (Wichtig: Es handelt sich dabei um Geräte der Universität, nicht Ihre eigenen). Sie werden vor der Sitzung noch nähere Informationen zur Absprache mit Ihren gewählten Kontakten erhalten. Während der Testphase ist die Kommunikation mit dem/der TestleiterIn nicht möglich, außer bei Notfällen oder der Entscheidung, die Studie abzubrechen. Aus diesem Grund wird der Raum mit einer Überwachungskamera ausgestattet, damit der/die TestleiterIn Ihr Wohlbefinden sicherstellen kann. Diese Kamera nimmt nicht auf und überträgt keinen Ton. Ihr Verhalten im Raum wird nicht analysiert.
Am Ende der Testphase werden Sie am Computer noch ein paar Tests durchführen, die aus zwei Teilen bestehen. Im ersten Teil wird Ihnen eine Reihe von Bildern präsentiert. Ihre Aufgabe ist es zu entscheiden, wie groß die Bilder auf dem Bildschirm sein sollen. Danach sollen Sie bewerten, wie sehr Ihnen die Bilder gefallen haben. Im zweiten Teil werden Sie eine Aufgabe zur

Bewegungskoordination, eine Aufgabe zum Arbeitsgedächtnis und eine Aufgabe zur Aufmerksamkeitskontrolle durchführen.

Nach Vollendung der Testphase erhalten sie Instruktionen für die Nachfolgephase (den Morgen nach der Testung)**.** Diese Phase besteht aus zwei weiteren Messungen, die Sie selbstständig zu Hause durchführen. Sie werden gebeten, jeweils direkt nach dem Aufwachen und 30 Minuten nach dem Aufwachen einen kurzen Fragebogen auszufüllen und eine Speichelprobe abzugeben. Letztlich werden Sie gebeten, diese zu Ihrer nächsten Sitzung oder zu einem anderen vereinbarten Zeitpunkt in die Fakultät für Psychologie, Universität Wien, Liebiggasse 5, 1010 Wien, zu bringen.

3. Worin liegt der Nutzen einer Teilnahme an der Studie?

Die Teilnahme an dieser Studie hat für Sie persönlich keinen unmittelbaren Nutzen. Wir hoffen jedoch, dass die Ergebnisse dieser Studie uns weitere Einblicke in körperliche und emotionale Reaktionen auf Veränderungen in der Menge von Kalorienaufnahme und sozialem Kontakt auf täglicher Ebene liefern.

4. Gibt es Risiken, Beschwerden und Begleiterscheinungen?

Nein, die Teilnahme an der Studie ist nach menschlichem Ermessen mit keinen oder vernachlässigbaren Risiken assoziiert. Die Untersuchungen werden ohne Ausnahme von trainierten VersuchsleiterInnen durchgeführt. Es werden keine medikamentöse oder therapeutische Methoden zu Zwecken der Studie verwendet. Die oben beschriebenen Untersuchungen sind nicht-invasiv und wurden bereits ohne negative Konsequenzen durchgeführt.

5. Hat die Teilnahme an der Studie sonstige Auswirkungen auf die Lebensführung und welche Verpflichtungen ergeben sich daraus?

Wir bitten Sie:

- am Tag der Sitzung bevor Sie ins Labor kommen keinerlei Nahrung zu sich zu nehmen
- 24 Stunden vor Beginn der Sitzungen keinen Kaugummi zu kauen,
- eine Stunde vor Beginn der Sitzungen Ihre Zähne nicht zu putzen,
- in den 18 Stunden vor den Sitzungen nicht zu rauchen oder koffeinhaltige Getränke (Kaffee, Cola, Tee), Säfte oder Alkohol zu konsumieren,
- und 24 Stunden vor Beginn den Sitzungen keinen Sport mehr zu betreiben,

da all diese Aktivitäten Einfluss auf die physiologischen Messungen haben könnten.

Dieselben Einschränkungen gelten auch für den Abend nach der Sitzung, bis zum Zeitpunkt der Nachfolgephase am nächsten Morgen.

6. Was ist zu tun beim Auftreten von Beschwerdesymptomen, unerwünschten Begleiterscheinungen und/oder Verletzungen?

Sollten im Verlauf der Studie unerwünschte Symptome, Begleiterscheinungen, Krankheiten oder Verletzungen auftreten, müssen Sie diese der Studienleitung und/oder den Mitarbeitenden umgehend mitteilen.

7. Wann wird die Studie vorzeitig beendet?

Sie können jederzeit, auch ohne Angabe von Gründen, Ihre Teilnahmebereitschaft widerrufen und aus der Studie ausscheiden, ohne dass Ihnen dadurch irgendwelche Nachteile entstehen.

Ihr/e StudienleiterIn wird Sie über alle neuen Erkenntnisse, die in Bezug auf diese Studie bekannt werden und für Sie wesentlich sein könnten, umgehend informieren. Auf dieser Basis können Sie dann Ihre Entscheidung zur weiteren Teilnahme an dieser Studie neu überdenken.

Es ist aber auch möglich, dass Ihr/e StudienleiterIn Ihre Teilnahme an der Studie vorzeitig beendet, ohne vorher Ihr Einverständnis einzuholen.

Die Gründe hierfür können sein:

a) Sie können den Erfordernissen der Studie nicht entsprechen;
b) Der/die StudienleiterIn hat den Eindruck, dass eine weitere Teilnahme an der Studie nicht in Ihrem Interesse ist.

Sollte Ihre Teilnahme an der Studie vorzeitig beendet werden (von Ihnen oder von der Studienleitung), werden Sie 10€ als Kompensation erhalten, falls keine der Sitzungen vollendet wurde. Sie erhalten 40€, falls bis zu diesem Zeitpunkt zumindest eine Sitzung vollendet wurde.

8. In welcher Weise werden die im Rahmen dieser Studie gesammelten Daten verwendet?

Ihre Daten werden pseudonymisiert (d.h. ohne Verweis auf Ihren Namen gespeichert), indem Ihnen eine ID Nummer zugeordnet wird. Für Personen ohne Zugang zu diesen persönlichen Informationen, wird es daher nicht möglich sein, Rückschlüsse auf Ihre Person zu ziehen. Vorbehaltlich anderslautender gesetzlicher Bestimmungen werden nur Mitglieder der Forschungsgruppe Zugang zu vertraulichen Daten mit persönlichen Informationen erhalten (Name, Vorname, Alter, Email). Diese werden in einem, von den anderen erhobenen Daten separaten Dokument auf einem sicheren, passwort-geschützten Computer gespeichert. Die Forschungsgruppenmitglieder unterliegen der Schweigepflicht.

Die komplette statistische Auswertung wird auf Basis der pseudonymisierten Daten erfolgen. In wissenschaftlichen Publikationen und Präsentationen werden nur die Gruppenergebnisse präsentiert und Sie werden niemals namentlich genannt. Das Dokument in welchem Ihre persönlichen Daten gesammelt werden, wird sobald alle Auswertungen abschlossen sind, zerstört. Alle anderen Daten werden in Übereinkunft mit den gesetzlichen Vorschriften gespeichert.

9. Entstehen für die TeilnehmerInnen Kosten? Gibt es einen Kostenersatz oder eine Vergütung?

Durch Ihre Teilnahme an dieser Studie entstehen für Sie keine Kosten. Als Vergütung für Ihren Zeitaufwand erhalten Sie nach erfolgter Teilnahme **180€**.

Falls Sie für die Studie geeignet sind und für die erste Sitzung erscheinen, diese aber nicht beenden, erhalten Sie ein „Erscheinungsentgelt“ von **10€**. Falls Sie mindestens eine, aber weniger als drei Sitzungen vollenden, erhalten Sie ein „Teilentgelt“ von **40€**. Wenn Sie alle drei Sitzungen vollenden erhalten Sie das gesamte Entgelt von **180€.**

Für jede vollendete *Nachfolgephase am nächsten Morgen* erhalten Sie zusätzliches Entgelt von jeweils **5€**. Dieses zusätzliche Geld kommt zu Ihrem Hauptentgelt am Ende Ihrer Teilnahme hinzu.

10. Möglichkeit zur Diskussion weiterer Fragen

Für weitere Fragen im Zusammenhang mit dieser Studie stehen Ihnen Ihre Studienleiterin und ihre MitarbeiterInnen gerne zur Verfügung. Auch Fragen, die Ihre Rechte als ProbandIn in dieser Studie betreffen, werden Ihnen gerne beantwortet.

Name	Rolle	Telefon	Email
Dr. Giorgia Silani	Studienleiterin	+43 01 4277 47223	giorgia.silani@univie.ac.at
Ana Stijovic, MSc	Verantwortlicher Datenaufnahme	+43 01 4277 47235	ana.stijovic@univie.ac.at

Einwilligungserklärung

Name der teilnehmenden Person in Druckbuchstaben: .....
Geb. Datum: .....

Ich erkläre mich bereit, an der Studie „Der Einfluss von sozialen und nicht sozialen Bedürfnissen auf den körperlichen Zustand“ teilzunehmen.

Ich bin von „……“ (Name der aufklärenden Person) ausführlich und verständlich über Zielsetzung, Bedeutung und Tragweite der Studie und die sich für mich daraus ergebenden Anforderungen aufgeklärt worden. Ich habe darüber hinaus den Text dieser TeilnehmerInneninformation und Einwilligungserklärung gelesen, insbesondere den 4. Abschnitt (Gibt es Risiken, Beschwerden und Begleiterscheinungen?). Aufgetretene Fragen wurden mir von der Studienleitung verständlich und ausreichend beantwortet. Ich hatte genügend Zeit, mich zu entscheiden, ob ich an der Studie teilnehmen möchte. Ich habe zurzeit keine weiteren Fragen mehr.

Ich werde die Hinweise, die für die Durchführung der Studie erforderlich sind, befolgen, behalte mir jedoch das Recht vor, meine freiwillige Mitwirkung jederzeit zu beenden, ohne dass mir daraus Nachteile entstehen. Sollte ich aus der Studie ausscheiden wollen, so kann ich dies jederzeit schriftlich oder mündlich bei Dr. Giorgia Silani oder Ana Stijović veranlassen.

Ich bin zugleich damit einverstanden, dass meine im Rahmen dieser Studie erhobenen Daten aufgezeichnet und ausgewertet werden.

Ich stimme zu, dass meine Daten dauerhaft in pseudonymisierter Form elektronisch gespeichert werden. Die Daten werden in einer nur der Projektleitung zugänglichen Form gespeichert, die gemäß aktueller Standards gesichert ist.

Sollte ich zu einem späteren Zeitpunkt, die Löschung meiner Daten wünschen, so kann ich dies innerhalb der nächsten sechs Monate schriftlich oder telefonisch ohne Angabe von Gründen bei Dr. Giorgia Silani (E-Mail: giorgia.silani@univie.ac.at, Tel.: +43-1-4277-47223) oder Ana Stijović (E-Mail: ana.stijovic@univie.ac.at, Tel.: +43-1-4277-47235) veranlassen.

Den Aufklärungsteil habe ich gelesen und verstanden. Ich konnte im Aufklärungsgespräch alle mich interessierenden Fragen stellen. Sie wurden vollständig und verständlich beantwortet.

Eine Kopie dieser TeilnehmerInneninformation und Einwilligungserklärung habe ich erhalten. Das Original verbleibt bei der Studienleitung.

(Datum und Unterschrift der TeilnehmerIn)

.....

(Datum, Name und Unterschrift der Studienleitung)

…….

Experiment Fee Note

Timepoint (TO/T1): , Sosci: , ID:

Fakultät für Psychologie

Institut für Klinische und Gesundheitspsychologie

Privatdoz. Dr. Giorgia Silani
Liebiggasse 5
A- 1010 Wien

T +43-1-4277-47223

Aufwandsentschädigung

Hiermit bestätige ich, im Rahmen der Studie „Der Einfluss von sozialen und nicht sozialen Bedürfnissen auf den körperlichen Zustand" (Studienleiterin Prof. Giorgia Silani) des Instituts für Klinische und Gesundheitspsychologie als freiwillige Versuchsperson an der Labortestung teilgenommen zu haben und ersuche um Überweisung von € _____ als Dankeschön für die Teilnahme.

Für die etwaige Versteuerung dieser Aufwandsentschädigung erkläre ich mich selbst verantwortlich.

IBAN: _____

BIC: _____
(nur bei ausländischen Konten)

Name: _____

Adresse: _____

_____ _____

Datum: _____ _____
Unterschrift der Versuchsperson

Conversation Times

Während Ihrer Sitzung werden Sie 4 Gesprächszeiten haben, die jeweils 30 Minuten dauern. Sie werden Handy und Laptop der Universität für die Gespräche verwenden.

Sie werden Zugang zu den Kontakten haben, die Sie in die untenstehende Tabelle eintragen. Alle Nummern die Sie unten eintragen, werden für kurze Zeit an dem Handy der Universität gespeichert und nach Ende Ihrer Sitzung sofort wieder gelöscht.

Falls Sie möchten, werden Sie ebenfalls Ihren eigenen Skype-Account verwenden können und zu all Ihren Skype-Kontakten Zugang haben. Bitte vergewissern Sie sich vor der Sitzung, dass Sie ihren Skype-Username und Ihr Passwort für Skype parat haben.

Notieren Sie die Namen Ihrer Gesprächspartner in der Tabelle so, dass Sie sie später wiedererkennen (Spitznamen), daneben die Telefonnummer und den Skype-Namen (falls erforderlich). Notieren Sie zusätzlich einige Ersatzkontakte, die Sie anrufen können falls ein Gespräch frühzeitig beendet wird oder das geplante Gespräch nicht zustande kommt.

Bitte erinnern Sie Ihre Gesprächspartner noch vor der Sitzung an den Termin. Informieren Sie Ihre Gesprächspartner, dass diese nicht mit Ihrem eigenen Handy angerufen werden. Das Handy der Universität hat eine anonyme Nummer. Daher wird bei einem eingehenden Anruf “Private number” auf dem Display Ihrer Gesprächspartner aufscheinen.

Die Struktur der Studie erlaubt keine Abweichungen der Gesprächstermine. Die von Ihnen gewählten Gesprächspartner müssen innerhalb der folgenden Gesprächszeiten verfügbar sein:

12:17-12:47

14:22-14:52

16:17-16:47

18:17-18:47

Sie können auch mit der gleichen Person zu verschiedenen Gesprächszeiten kommunizieren oder mit ein paar Personen innerhalb einer Gesprächszeit.

Bitte senden Sie uns den Gesprächszeitenplan spätestens 3 Tage vor der Sitzung zu. Falls es zu Veränderungen bezüglich der Termine kommen sollte, informieren Sie uns bitte so schnell wie möglich!

Dieser Plan dient Ihnen auch als Erinnerung während der Sitzung.

List of Activities

Zeitvertreib im Testraum

Bitte **NICHT** mitbringen:

- Handy, Tablet, Laptop, andere elektronische Geräte
- Lesestoff mit vorwiegend sozialen Inhalten
- Magazine und Zeitungen mit Fotos von Gesichtern und Romane
- Laute Instrumente z.B. Trompete, Saxophon
- Material zur sportlichen Betätigung z.B. Gewichte, Yogamatte, ...

Mitbringen **ERLAUBT**:

- Lesestoff ohne soziale Inhalte (ohne Bilder von Gesichtern): Lernbücher, Magazine über Natur, Sachbücher,...
- Puzzles, Rätsel, ...
- Leise Instrumente z.B. akkustische Gitarre, Ukulele
- Handarbeitmaterial z.B. Strickzeug
- Material zum Basteln/Zeichnen