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1	INTRODUCTION	- 1 -
1.1	Desire and food cravings	- 2 -
2	THEORETICAL BACKGROUND	- 6 -
2.1	The Elaborated Intrusion (EI) Theory of Desire.....	- 6 -
2.1.1	Introducing the EI Theory of Desire	- 6 -
2.2	Grounded Theory of Desire and Motivated Behavior	- 10 -
2.2.1	Situated conceptualization.....	- 10 -
2.2.2	Pattern completion interference.....	- 11 -
2.2.3	Simulations	- 12 -
2.3	Comparison of EI Theory and Grounded Theory of Desire and Motivated Behavior ..	- 14 -
2.4	Determinants of food intake.....	- 15 -
2.4.1	General influences on food choice	- 15 -
2.4.2	Other influences on food choice	- 18 -
2.5	Food cravings in vulnerable groups	- 23 -
2.5.1	Bulimia nervosa	- 23 -
2.5.2	Chocolate cravers.....	- 25 -
3	THE PRESENT STUDY.....	- 28 -
3.1	Introduction.....	- 28 -
3.2	Materials and Methods.....	- 30 -
3.2.1	Research question	- 30 -
3.2.2	Participants	- 30 -
3.2.3	Design.....	- 30 -
3.2.4	Hypothesis	- 31 -
3.2.5	Experimental tasks	- 33 -
3.2.6	Procedure	- 34 -
3.2.7	Measures	- 35 -
4	RESULTS	- 37 -

4.1 Descriptive Statistics	- 37 -
4.1.1 Sample size	- 37 -
4.1.2 Age and Body Mass Index.....	- 39 -
4.1.3 DEBQ and PSRS values	- 41 -
4.1.4 Hunger, satiety and appetite.....	- 44 -
4.1.5 Time for intervention	- 45 -
4.1.6 Sub-Hypothesis	- 47 -
4.2 Main Analysis.....	- 48 -
4.2.1 Consumed amount of chips.....	- 48 -
5 DISCUSSION	- 51 -
5.1 Sub-Hypothesis	- 51 -
5.2 Main-Hypothesis.....	- 51 -
5.3 Limitation of the study	- 53 -
5.3.1 Application	- 54 -
5.4 Conclusion	- 55 -
6 APPENDIX	- 56 -
6.1 Abstract	- 56 -
6.2 Abstract (deutsch).....	- 56 -
6.3 References	- 58 -
7 ATTACHMENTS	- 72 -
7.1 Questionnaires	- 72 -
7.1.1 Demographic data	- 72 -
7.1.2 DEBQ-RE (Restriktives Essverhalten)	- 73 -
7.1.3 Perceived Self-Regulatory Success in Dieting Scale (PSRS).....	- 75 -
7.1.4 Assessment of hunger, satiety, appetite and preference via visual analogue scale (VAS) ..	- 75 -
7.1.5 Taste Test.....	- 77 -
7.1.6 Manipulation Check	- 81 -
7.1.7 Mental Imagery Task	- 82 -

7.2 Procedure.....	- 86 -
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Tables

Table 1 Distribution of courses among participants	- 38 -
Table 2 Group characteristics	- 38 -
Table 3 Restraint-value among participants.....	- 41 -
Table 4 PSRS value among participants	- 43 -
Table 5 Possible influential factors on chips consumption	- 47 -
Table 6 Amount of chips consumed.....	- 48 -
Table 7 Consumed potato chips in intervention and control groups in kcal .	- 49 -

Figures

Figure 1 Elaborated Theory of Desire [Kavanagh, 2005]	- 7 -
Figure 2. Influences on desire [Mela, 2006]	- 16 -
Figure 3 Distribution of courses among participants	- 37 -
Figure 4 Distribution of age among all participants	- 39 -
Figure 5 Distribution of BMI among all participants.....	- 40 -
Figure 6 Restraint-value among the four study groups	- 42 -
Figure 7 Boxplots of the PSRS values among the four study groups.....	- 43 -
Figure 8 Hunger, satiety and appetite pre and post ad libitum consumption	- 44 -
Figure 9 Duration of mental imagery task among the four groups	- 46 -
Figure 10 Chips consumption in the four study groups	- 49 -
Figure 11 Boxplots of the amount of consumed chips	- 50 -
Figure 12 Chips consumption among intervention and control group	- 50 -

1 Introduction

Obesity and its related health disorders are one of the major public health problems [Roberto et al., 2014]. Over the last decades, overweight and obesity have been at the rise, resulting in a high percentage of overweight and obese individuals, especially in the UK and the US [Lawrence et al., 2015, Wang and Beydoun, 2007]. However, obesity is no longer just a problem of most developed countries, but a significant and increasing health problem in developing countries as well [Mela and Boland, 2014].

Especially food-rich environments in combination with the tendency of selecting high energy foods are being held responsible for increasing numbers of overweight and obese individuals [Papies and Veling, 2013]. Efforts to obtain changes in policy, which are targeting our food-rich environment, may involve complex and time-consuming decisions [Swinburn et al., 2011]. Therefore, the development of applicable interventions to reduce energy dense food choices within our environmental setting is an important research issue [Hill et al., 2003].

One strategy of scientific efforts is about evoking satiation via imagined food consumption, referred to as mental imagery [e.g. Morewedge et al., 2010]. The experimental part of this work will focus on this paradigm, with the attempt to replicate former findings and give more insights into the topic.

The theoretical part of the present work will address underlying and related mechanisms which are connected to food consumption. A closer look will be taken at the drivers for food intake and cognitive processes which are assumed to underlie determinants for food intake. In particular, the terms desire and craving in relation to food consumption will be of crucial importance in this context.

The practical part of this work will focus on the mental imagery paradigm, and its impact of food consumption, with the attempt to replicate former findings.

1.1 Desire and food cravings

Craving for food is seen as an important driver for overconsumption [May et al., 2012]. Therefore, food craving seems to be strongly involved in the development of obesity [Schlundt et al., 1993], and is also seen as a reason for binge eating and early dropout from weight-loss programs [Gendall et al., 1998] [Sitton, 1991].

Food craving per definition is the “strong desire or intense longing” to consume a specific food [Kozlowski and Wilkinson, 1987; Weingarten and Elston, 1990]. Driving forces for food cravings seem to be cognitive and emotional processes, which consequently motivate behavior. [May et al., 2012]

Papies et al. (2015) define desire as “a psychological state of motivation for a specific stimulus or experience that is anticipated to be rewarding.” Especially in an eating behavior context it is important to understand desire and its impact on food intake. Desire for food as well as food craving can arise in the absence of hunger or thirst, as a result of purely cognitive processes. These processes are often triggered by an environmental cue like the exposure to attractive food [Papies and Barsalou, 2015]. Outside of the eating behavior context smokers who attempt to quit smoking experience cravings for a cigarette even while wearing a nicotine patch. [Tiffany et al., 2000] This underlines that desire as well as cravings occur even without being in a state of deprivation and may not be in line with physiological deficits [Papies and Barsalou, 2015].

A widespread theory links cravings for foods to homeostatic imbalances, which appear as a consequence of a nutrient or caloric deficit [Keys et al., 1950]. Another hypothesis is that neurochemicals take an important part in cravings, especially levels of endogenous opiates or brain serotonin [Drewnowski, 1991]. Furthermore, science and laymen link hormonal responses to craving episodes. A matter of common knowledge is craving for specific foods in times of pregnancy and within the menstrual circle. Especially cravings for chocolate and other sweets seem to be strongly connected to the menstrual circle [Dickens and Trethowan, 1971; Cohen et al., 1987]. Nevertheless, a specific mechanism

to link cravings to the reproductive state was not yet identified [Pelchat, 1997]. Moreover, expectations and anticipation of reward from food seem to have a stronger impact on eating behavior than neurophysiological responses [May et al., 2012].

Another assumption is focusing on the environmental setting of an eating experience, which may serve as a conditioned response for food cravings later on [Weingarten, 1983]. Also, sensory factors are thought to influence food cravings. “Cue reactivity”, a term well known from drug literature, describes the observation of food cravings being triggered by the exposure to sensory properties of foods [Cornell et al., 1989; Bauer, 1992]. The frequency of food cravings is correlated with scores on the externality scale of the Dutch Eating Behavior Questionnaire [Hetherington and Macdiarmid, 1993]. Additionally, it is hypothesized that cravings may occur due to being deprived of certain sensory characteristics or cognitive categories of food [Dickens and Trethowan, 1971].

It is emphasized that craving is a multidimensional experience and that the term comprises much more than desire itself [Cepeda-Benito et al., 2000; Nederkoorn et al., 2000]. There is also a complexity to the phenomenon of cravings, which makes it hard to rule out theories. As there are several kinds of cravings there are also different underlying drivers for it. Comparing individuals craving for the same kind of food, craving may not be caused by the same mechanisms. For instance, the craving for pizza could be either evoked by a sodium deficiency or by the perception of pizza as a forbidden food [Pelchat, 1997]. Furthermore, it may be important to differentiate between factors causing craving and such satisfying it [Michener and Rozin, 1994].

In our society craving for foods seems to be a common phenomenon, which is affecting the daily life of many [Hill and Heaton-Brown, 1994]. Craving for foods is suggested to increase snacking behavior and interfere with dietary restrictions [Hetherington and Macdiarmid, 1993]. Another negative association to cravings is binge eating [Drewnowski, 1991]. But there may also be positive effects of cravings. As cravings occur during monotonous diets they could help

to prevent nutrient deficits and affect nutrient status [Kamen and Peryam, 1961; Krebs-Smith et al., 1987].

In connection to this, sensory imagery is reported as a consistent feature of food craving [Harvey et al., 2005], and also cravings for tobacco, alcohol and even sports [Kavanagh et al., 2009; Statham et al.; 2011, May et al., 2008]. The elaboration of sensory images leads to the extension of craving episodes and makes cravings more intense, due to improvement of articulation and vividness of the images [May et al., 2012]. Alcohol addicts who are trying to abstain from alcohol report sensory imagery while experiencing strongest episodes of craving [Kavanagh et al., 2009]. Furthermore, the intensity of a craving experience is associated with visual, gustatory and olfactory imagery [Tiggemann and Kemp, 2005]. Research of May et al. (2008) suggests that vividness of imagery is the only variable predicting strength of craving [May et al., 2008].

Tiggemann's and Kemp's experimental study on food cravings illustrated that only two out of 130 students were not able to recall a craving experience. The study requested participants, who were able to recall a craving experience to write a paragraph about the experience. Food cravings were most often described as overwhelming. 61,5% of the students described craving with phrases like they "could not stop to think about it"; it "really played on their mind" and they "could not concentrate on anything else". Moreover the craving was named as an "obsession", "overpowering" and "really intense". 30% of the participants explicitly depicted imagery processes. Chocolate was clearly the most common individual food mentioned as a target for cravings. Further foods were other sweet treats like ice cream and savory treats like nuts and chips. Also, 22% of the participants declared to experience cravings for take-away foods and 21% for a whole meal. There was a clear distinction between men and women. Women tend to crave for chocolate more frequently than men, whereas more men craved for a whole meal than women [Tiggemann and Kemp, 2005].

This data is consistent with other findings, which describe that craving mostly occurs for foods which are exceedingly palatable and energy dense, or in other words high in sugar and/or fat [Rodríguez-Martín and Meule, 2015].

Additionally, to the “Food Craving Survey” Tiggemann and Kemps conducted a questionnaire called “Favourite Food” to induce a food craving experience including mental imagery in laboratory. Results proved the involvement of sensory domains in mental imagery. Moreover the study concluded that the vividness of the imagery can be seen as a predictor of the craving intensity. Thereby, the influence of the vividness on craving intensity is attached to a greater importance than hunger. A correlation was found between the vividness of imagery and imagery ability in general. Particularly, people who show high ability in the visual domain have more vivid food images [Tiggemann and Kemp, 2005].

Taken together the study of Tiggemann and Kemp (2005) underlines the effectiveness of mental imagery in the phenomenology of food craving and points out the primacy of visual features within modalities [Tiggemann and Kemp, 2005].

2 Theoretical Background

2.1 The Elaborated Intrusion (EI) Theory of Desire

2.1.1 Introducing the EI Theory of Desire

In their paper on the Elaborated Intrusion Theory of Desire, Kavanagh et al. (2005) give insights in their research on the formation of desire in the brain and focus thereby on cognitive processes. Whereas a lot of literature describes the phenomenon of desire as epiphenomenal Kavanagh et al. (2005) are convinced that desire holds a strong motivating force.

Kavanagh et al. (2005) describe desire as the wish or urge to experience pleasure, relief, ease discomfort, satisfy a want or engage in behavior which is leading towards these goals. [Kavanagh et al., 2005] Desire is not just an emotion, but better referred to as a preference for something [Zajonc, 1980]. Although behavioral responses may be underpinned by unconscious or implicit processes, desire itself is assumed to be conscious [Robinson and Berridge, 2003, Tiffany, 1990]. Moreover desire is seen as a direct experience, like pain or fear, and not as metacognition. However, it is important to note that reports or ratings of desire are clearly metacognitive. Therefore brain activation patterns of people who are rating their desire and of those who are just experiencing it might be quite different.

An important attempt of the authors of this work is the differentiation of desires from their antecedents like associated cognition, physiological deficits or any environment. Although the appearance of these events may contribute to a higher incidence of desire, they do not offer an explanation for the phenomenon itself.

The Elaborated Intrusion Theory of Desire highlights elaborative processes, which occur at a higher level as the basic associative processes. Associative processes are linked to spontaneous intrusive thoughts, which can occur when attention is drawn to another task. Elaborative processes, on contrast, are

occupied with the search of target-related information and its retention in working memory. Figure 1 describes the distinction between the conscious experience of desire, displayed in the central box and underlying triggers or sources of information around the box.

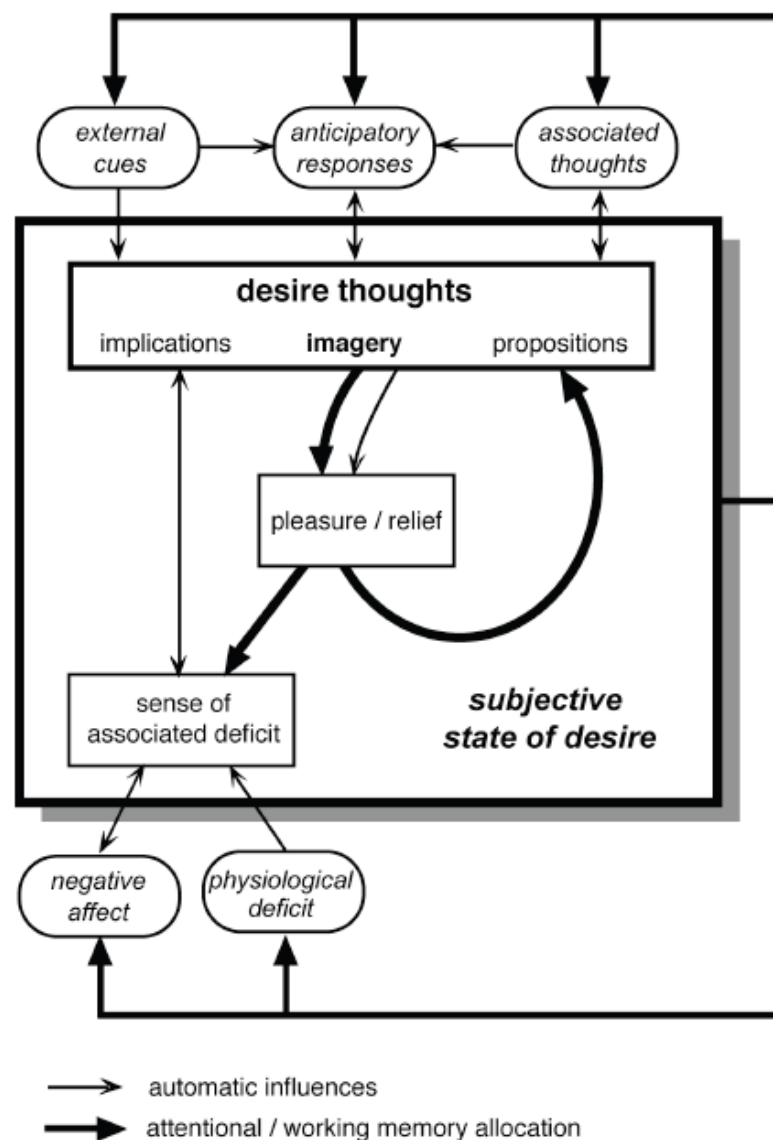


Figure 1 Elaborated Theory of Desire [Kavanagh, 2005]

Initiating events of intrusive thoughts have low demands for controlled processing or working memory, which makes it easier to enter into concurrent cognitive processes. Associative connections have the tendency to reactivate

instigating factors, whereas intrusive thoughts themselves are temporary events. Thoughts about the targets can be easily distracted by salient stimuli or cognitive associates, which are not related to the target.

The Elaborated Intrusion Theory suggests that appearance of strong target related affective reactions or keen senses of deficits, evoked by the intrusive thoughts, may lead to elaboration. Elaboration describes the search for relevant information, and their processing in working memory. The search includes internal states like physiological states, episodic memories and target-related cognitions as well as external states like relevant situational cues.

Elaboration does not occur only when associated processes are emerged, but can be triggered by instruction also. Either way, elaboration has the potential to capture processing resources as it competes for priority in working memory. Sensory images are assumed to lie at the core of desire. It is suggested that extended episodes of rumination about a target typically includes the construction of very vivid and strong images, which contribute to the emotional impact of the process and makes desire even stronger [Kavanagh et al., 2005]. To generate, maintain and manipulate vivid images several high level cognitive processes are required [Baddeley and Andrade, 2000].

Craving episode can not be seen as self-sustaining. Both processes, associative and elaborative ones, bear the possibility of either termination or further development of the craving experience. This gives the reason for fluctuation of desires in salience and affective intensity over time.

Important to mention is that affect plays a focal role in desire. Elaborated and intrusive thoughts are both neglected to reward processes, which are leading towards a hedonic goal and are having a strong impact on attention. However, the most commonly emotional reaction involved in desire is a negative one. Negative emotions can be seen as both, a precursor and also a consequence of desire. As a precursor, negative emotions can prime actions which are thought to return a person to a positive hedonic state. By the attempt of controlling intrusive and elaborated thoughts, guilt and anxiety are arising, which also

contribute to the negative mood. So even though the imagery of the desired target may be sweet, connected experiences like deprivation, anxiety and guilt leave someone tortured [Kavanagh et al., 2005].

Authors of the EI theory underline the importance of enhancement of motivational interventions. In their opinion best effects would be induced by focusing on benefits of functional behavioral changes rather than on potential negative outcomes [Kavanagh et al., 2014]. This new approach is named Functional Imagery Training and operates with sessions of imagery training, but also with reminders during routine activities, such as calendar reminders and SMSs to remind participants to exercise imagery in natural environment. Trials to test this new approach are in progress [May et al., 2015].

2.2 Grounded Theory of Desire and Motivated Behavior

A more generally speaking theory describes the arising of desire by using three key words; situated conceptualization, pattern completion interference and simulation.

2.2.1 Situated conceptualization

Situated conceptualization is suggested to play a key role in desire. But more than that, it is assumed to be fundamentally for all cognitive activity.

A situated conceptualization can be seen as the memory of a situation. Thereby all of its elements are captured and stored as a distributed memory pattern in the brain. Later on, when relevant information is needed the situated conceptualization can be retrieved as a simulation and helps to understand and behave in the current situation.

Situated conceptualization can be divided into two forms: local and global conceptualization. Local conceptualization is referred to the processing and evaluation of one given element of the situation, like the visual analysis of a physical object. Linkage between single elements of the situation and interpretation at a higher conceptual level is seen as global conceptualization. Global conceptualization offers an explanation for goal-setting and acting towards achieving it [Papies and Barsalou, 2015]

A situation is referred to much more than just the environmental setting. It includes internal states like cognition, bodily states like taste and actions like motor actions [Papies and Barsalou, 2015]. An important aspect is that situated conceptualization results from the situated architecture of the brain [Barsalou, 2003, 2011]. Perceived elements of an experience are processed simultaneously in the brain. This can be illustrated by the example of spending an evening with good friends watching a movie and having some chips. All perceived elements of this situation are captured and conceptual interpreted. This interpretation serves to understand the situation and helps in regulating behavior. Perception and processing may include cues of the environment,

bodily state and emotions, the taste and somatosensory experience of eating chips, the pleasure resulting from it as well as self-relevance, along with many others. These elements are processed via perceptual, interoceptive and motor systems of the brain. Afterwards, all the elements are stored together as a comprehensive representation of the situation. Once stored in memory a situated conceptualization can be re-activated by any of its elements later on and consequential re-instate itself. In this sense a situated conceptualization supplies the brain with relevant information and motivates our actions. To find the situated conceptualization best fitting the current situation a Bayesian retrieval process may be triggered [Papies and Barsalou, 2015]. The Bayesian process complies with the quality of the situated conceptualization and the frequency of the pattern retrieval in the past [Barsalou, 2011].

2.2.2 Pattern completion interference

Retrieval of a situated conceptualization can happen due any of its elements and uses pattern completion interferences. In this way, parts of the pattern can re-activate a larger pattern, containing elements which are not activated by the current situation itself. Therefore, stimuli like the sight, smell or taste of a tasty food can bring to memory experiences of previous food consumption.

Accordingly, just seeing a pack of potato chips in a grocery store can retrieve all other elements of the situated conceptualization. Going back to the movie night example, this would include experiences like the mouth-feel of chips, the hedonic pleasure of the consumption, the feeling of being connected to friends and the desire to watch another movie.

The outcome of pattern completion interference may often be desire, which is able to motivate subsequent behavior, regardless of someone's physiological state. Familiar with each of us, desire for a certain food can motivate us towards eating without being in any state of need. As such, desire is highly prevalent in our daily lives, triggered by a multitude of cues, which are very hard to control [Papies and Barsalou, 2015].

2.2.3 Simulations

Elements of the situated conceptualization which are activated via pattern completion interferences are much more than a symbolic description, instead they are perceived as multimodal simulations [Papies and Barsalou, 2015]. According to Barsalou a simulation is assumed to provide a core form of computation in the brain and includes two basic processes: capture and reenactment. During an experience the brain captures different modal states of a category (e.g. a chair) and stores them as a multimodal representation in the brain. On occasion when knowledge of a category is needed perceptual, motor, and introspective states are reenacted and create a simulation of instances associated with the category [Barsalou 1999; 2008]. In this sense, the brain reproduces the kind of state, which is active during the experience itself. This includes gustatory, reward and motor systems [Papies and Barsalou, 2015].

It is assumed that simulations do not reenact the previous experience exactly, but more likely just parts of it. Furthermore simulations seem to be biased and distorted in different ways. Another important assumption is that simulations occur independently of the intentional executive process and are acting unconsciously and implicitly. As soon as simulations enter the conscious state, they are perceived as mental imagery. Mental imagery in its various forms is indicated to play an important role in desire [Papies and Barsalou, 2015, Kavanagh, 2005]. Diverse forms of cognitive processes are linked to simulations, such as high-level perception, categorization, attention, working memory, long-term memory, language, thought, emotion and social cognition [Barsalou, 2008].

Research indicates different forms of stimulations. When people are asked to represent a characteristic of a category in its absence, they are able to use simulations across all modalities [Papies and Barsalou, 2015]. When asked for the visual features of a physical object, people often represent them with visual simulations [Goldberg et al. 2006]. Similar results were observed when people were asked to represent the auditory properties of an object. In this case they used auditory simulations for the task [Kiefer et al., 2008]. Also representation

with motor simulations was found in people who were asked for description of the function of an object and actions performed on it [Pulvermann et al., 2013]. Recent research indicates that simulations may also affect more abstract concepts [Papies and Barsalou, 2015]. Also emotions, like anger and connected affective stimuli are stored as situated conceptualizations in the brain and can be later retrieved as simulations [Barrett, 2013; Papies and Barsalou, 2015]. Observations indicate that emotions often arise in the light of a confrontation with food stimuli, like a tasty dessert. This findings support the assumption that cross-modal cues elicit situational conceptualizations of former eating experiences. Associated tastes are experienced as simulations and able to influence the actual taste experience.

It is assumed that situation conceptualization can be activated in various ways, thereby having an impact on behavior, either impulsively or reflectively and may result in successful or unsuccessful behavior [Papies and Barsalou, 2015].

2.3 Comparison of EI Theory and Grounded Theory of Desire and Motivated Behavior

The Grounded Theory of Desire and Motivated Behavior differs from the Elaborated Intrusion Theory in regards to some important aspects. The Grounded Theory of Desire and Motivated Behavior is focusing on situated conceptualization, which originates during consumption. Later on, situated conceptualization is extended by pattern completion inferences and simulations. In contrast to that the Elaborated Intrusion Theory of Desire focuses not just on mechanisms underlying desire but also on those producing motivated behavior and the learning of behavioral patterns.

Whereas the Elaborated Theory of Desire of Kavanagh et al. (2005) talks a lot about sensory imagery, the theory of Papies and Barselou describes simulations as more broadly, including bodily states, motor behavior, settings and internal states. Moreover, the Grounded Theory of Desire and Motivated Behavior does not speak about conscious imagery only, but includes unconscious reenactment of perception, action and various internal states in their definition of simulations. It further assumes that desire can also result from automatic simulations, which are not elaborated in working memory. Contrary to that the authors of the Elaborated Theory of Desire primarily think of desire as a result of conscious elaboration of associative intrusions. In addition neural mechanisms are not taken into account whereas Papies and Barselou (2015) mention them as central.

In spite of these differences both theories assume that representations of consumptions can lead to development of desire [Papies and Barsalou, 2015].

2.4 Determinants of food intake

Desires and liking of food are the outcome of food experiences and attitudes, developed during life. In this sense the decision for food intake and food choices are strongly individual and also situational. Not just stimulations from foods and hunger drive someone towards eating, but also many other cues. These include interactions between internal and external cues and also more stable individual physiological and psychological characteristics [Mela, 2001].

It is often believed that obesity, to a large extent, is resulting from increased hedonic response to specific foods or a higher pleasure from food consumption. Seemingly important, while talking about this topic, is to make a distinction between “liking” and “wanting”. Liking describes the pleasure, which is derived from oro-sensory stimulation of food, while wanting is more about the incentive salience or motivation for eating [Mela, 2006]. People who are overweight or obese appear to like and also select foods which are energy-dense. Although liking of food seems to be an important driver for food intake, it is just one of many aspects which influences eating behavior. Problems associated with weight control are more about cues and motivation to eat than about the pleasure achieved from eating. Interestingly, people who are concerned about their eating behavior are more prone for thoughts, emotions and situational cues which can lead to overeating and consequently restrained eating behavior. Behavior like repeated dieting, high day-to-day fluctuations regarding intakes and strict restrained eating appear to be counterproductive to weight control efforts. Beneficial for the success of long-term weight management programs is the effort to structure a personal food environment with the opportunity for some flexibility in food choices [Mela, 2001].

2.4.1 General influences on food choice

As mentioned before food intake is influenced by many different factors, with even perhaps availability as the most important one [Mela, 1999]. Figure 2 demonstrates the three main factors influencing the desire to eat a specific food; current internal states, liking and perceived appropriateness [Mela, 2001].

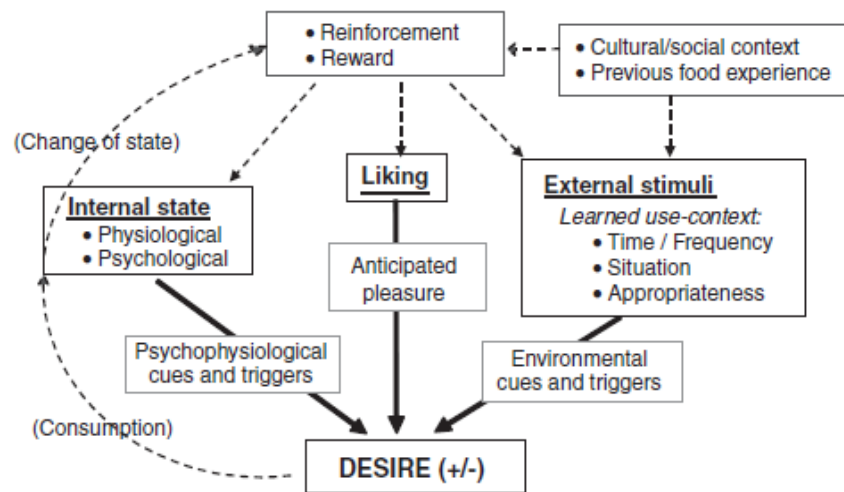


Figure 2. Influences on desire [Mela, 2006]

Liking

Liking as a reflection of “the immediate experience or anticipation of pleasure from the orosensory stimulation of eating a food can be associated with the terms hedonic value or “palatability” [Mela, 2006]. Most likes of humans are learned ones. Unlearned likes are only those who are biologically predestined and are appearing without any previous exposure [Mennella and Beauchamp, 1996, Mela, 1997]. Most evidently in regard to unlearned liking is the occurrence of liking for sweetness. Very soon after birth infants already orient towards odors presented within their respective diet. In the course of growing up inborn hedonic responses can be overridden by experience [Mela, 2001]. Reasonable for sensory experiences of an individual is a particular socioeconomic and cultural environment. This experiences shape not just the kind of food choice, but also frequency and conditions of consumption [Mela, 1999]. Thereby, environmental influential experiences contain both individual differences and broad commonalities within cultures. Growing evidence indicates that our liking of specific combinations of sensory odors in foods is

predominantly acquired via associative conditioning, pairing the food experience repeatedly with positive or negative stimuli [Mela, 2008].

Appropriateness and situational cues

Hedonic responses, as liking, are obviously not enough to explain the variations in terms of the motivation for food consumption [Mela, 2001]. There is a clear difference between the desire for a food or the motivation to eat and the actual liking of the food choice in a given situation [Berridge, 2001]. Actually, perceived appropriateness may have a high impact on desire. In this way, food choices depend strongly on the consideration if the food matches the situation and context [Cardello et al., 2000].

Very often people make food choices for less desired foods alternatives. This is when liking is exceeded by positive drivers for the alternatives, like cognitive considerations as health concerns. This commonly known phenomenon is obviously quite useful for public health campaigns. The attempt is to shift people's food choices towards foods which are initially defined as less liked. In this sense it could be possible to guide food likes and consequently change eating behavior. This very important challenge is currently faced by academic and industrial nutritionists as well as consumer researchers [Mela, 2006].

Current internal states

Also the immediate psycho-physiological state may elicit desire for a specific food. An example for that would be thirst, or the desire for chocolate evoked by current mood state or hunger [Mela, 2001, Gibson and Desmond, 1999]. In this case, eating the desired food could lead to an alteration of the "need state" and therefore support the development of liking [Mela, 2000 (2)].

2.4.2 Other influences on food choice

Taste hedonics

Many studies present orosensory responses as the central influence on food choice, with a certain sequence of events:

taste preference → food liking → food purchase and consumption

Therefore they conclude that there may be an association between the hedonic responses to certain foods and the predisposition to overeat. Early studies preoccupied themselves with the perception of sweetness [Mela, 2001]. The assumption was that obese individuals show a greater liking of sweet foods and consequently consume more of it. More recently, studies on sensory perception and food choices are discussing a predisposition of fat perception as a possible feature for obesity [Mela and Rogers, 1998; Mela, 2001]. However, there is not a lot of data from obese and non-obese population which is supporting these findings. This is quite comprehensible since liking might be just one factor of influence on food choice [Mela, 2001].

The question remains if there is a link between obesity and a higher consumption of single foods or food groups. Epidemiological data indicates a relationship between weight status and fat intake. Other findings in this area are difficult to interpret because of the subjective classification schemes for food groups. The arrangements are often based on nutrient profiles, sensory characteristics or others which are hard to define and often far from everyday life.

Better statistical methods made it possible to interpret consumer data more precisely. Thereby, the body mass index (BMI) is combined with a certain food choice pattern [Mela, 2001]. Results show a positive relation between BMI and higher intakes of meats, eggs, fats and oils [Maskarinec et al., 2000]. Also, there is a link between a lower BMI and diets higher in vegetables, beans, or fruits and grains. These findings are consistent with other experimental data suggesting that obesity stems from higher intake of energy-dense, savory foods

[Cox et al., 1999]. Also frequent consumption of fast food, even though poorly defined, is associated with obesity. Nevertheless it is important to note that fast food may be just a slice of the cake promoting sedentary lifestyles, which is in general associated with weight gain [Binkley et al., 2000].

Boredom and monotony

A consumer may become bored of eating a specific food, when its consumption is described as common, routinely and unexciting, or appears at an undesirable or inappropriate high frequency. In this sense boredom may be strongly influenced by norms. Once a pattern and frequency of “normal” and “appropriate” food consumption is defined, deviations towards higher intake may be perceived as boring. Therefore, boredom seems to have a strong cognitive component [Mela, 2000].

Stubenitsky et al (1999) observed ratings of liking and boredom in a study population, which was given chocolate bars and sausages over a period of ten weeks. Whereas participants received three chocolate bars per week, sausages were provided for once-per-week consumption. There were no changes in the hedonic responses or liking, but boredom increased relatively consistent over the period of time [Stubenitsky et al., 1999].

Findings of Schutz and Pilgrim (1958) support the assumption of a strong culinary or cultural assignment of boredom. They proved that foods which are commonly associated with daily consumption like cereals and bread are most resistant to decreases in acceptability [Schutz and Pilgrim, 1958].

Apparently it is questionable how good consumers are in predicting their declines in liking in case of repeated consumption [Mela, 2000]. In a study of Kahneman and Snell (1992) participants were told to eat the same flavor of ice cream every day for 8 weeks. Their estimation before starting the experiment predicted a greater decline in liking of the ice cream than actually experienced [Kahneman and Snell, 1992]. These findings underline the assumption that the idea of repeated consumption is affected by repetition rather than the actual experience of the sensory characteristics [Mela, 2000].

Externality

Over the last decades, research in food choice, weight control and obesity were influenced by the externality theory, which was defined by Schachter and Rodin (1974) [Schachter, 1971; Schachter and Rodin, 1974]. They observed that obese rats and also humans were more susceptible for external cues, like time, situational effects and others than to internal hunger and satiety signals. This leads to the conclusion that obesity may be caused and sustained by the vulnerability to an environment of easily accessible and enjoyable food [Mela, 2001].

Further research on externality and obesity was quite controversial and came to the conclusion that the relationship was more complex than originally assumed [Rodin, 1981]. Although some thoughts have to be added to the externality theory it still remains applicable [Mela, 2001].

Interestingly, infants and small children are generally capable to regulate their energy intakes very well. However, over time they become more and more prone to external cues [Mela, 2001]. Heavy children and those, whose mothers are frequently on diets and show impulsive eating behavior, have deficits to adequately lower energy intake in response to a meal [Johnson, 2000]. Further research indicates that mothers, who are constantly worrying about their diet and are having difficulties to remain in control of their diet, transfer these habits to their children [Cutting et al., 1999]. Consequently, these children may be predisposed to greater fat gain during childhood [Hood et al., 2000]. Pretest differences in external responsiveness to food and non-food stimuli were found to be able to predict weight gain and losses in children attending a summer camp. [Rodin and Slochower, 1976] According to that, externality has to be considered as a contributing factor for obesity [Mela, 2001].

Restrained eating and disinhibition

Disinhibition is found to take place when restraint eaters are confronted with a situation which enables them to remain in control of their self-imposed inhibition of eating. In further consequence, an oppressed desire of eating is released,

which often leads to overeating [Herman, 1978; Herman and Mack, 1975]. An alternative for the root of this behavior may be increased externality, which could arise due to repeated dieting and increased responsiveness to situational cues [Lowe, 1993].

Fundamental research in the field of restrained eating was done by Herman (1978). He did a series of studies and used a Restraint Scale to measure concerns about weight and short-term weight fluctuations. [Herman, 1978; Herman and Mack, 1975]

Herman's well-known experiment about restrained eating gives insights into the reaction and eating behavior of restraint eaters. For his study he recruited 45 female students, who were divided into two intervention groups, receiving either one or two milkshakes as a preload, and a control group, receiving no preload. Following the preload was another taste test to rate the flavor of ice cream. After the taste test the participants were allowed to eat as much of the remaining ice cream as they wanted. As predicted, results showed that participants with a high restraint score consumed more ice cream after a preload than those with no preload. Low restraint participants decreased their amount of consumed ice cream in adaption to the size of the preload. Nevertheless, it has to be mentioned that even in unrestrained eaters caloric regulation was not as good as it could have been. Also noteworthy is that obese women appeared to show slightly more overall restraint than those of normal weight, even though these findings showed no significance [Herman and Mack, 1975].

The paradox that restraint eaters tend to exhibit disinhibited eating has been underpinned by further research. A study, which is underlining the cognitive rather than the physiological basis of the paradox, found that restraint eaters also ate more when they were simply brought to believe that the preload they consumed was high-caloric. The same effect was shown when restraint eaters were told that they would be eating a food high in calorie or "forbidden foods", later on [Mela and Rodgers, 1998].

Therefore the question is, if difficulties with weight management can be seen as the consequence of dieting and weight concerns or rather as a reflection of the constant struggle against biologically originated drivers to gain weight. [Mela, 2001]

2.5 Food cravings in vulnerable groups

2.5.1 Bulimia nervosa

Although food cravings are a quite common phenomenon, there is a particular high interest in the insights of cravings due to the association to binge eating [Moreno et al., 2009]. People who are suffering from a binge eating disorder consume large amounts of food in a discrete period of time, often combined with a feeling of being out of control [American Psychiatric Association, 2016]. During binge eating episodes very large amounts of food are consumed, approximately over 3000 kcal. Thereby, favored foods are mostly palatable, energy dense, high in fat and/or high in carbohydrate [Hetherington et al., 1994]. In bulimic patients binge eating episodes are typically followed by purging like self-induced vomiting, abuse of laxatives or excessive exercise to counteract gain weight. Prone to bulimia are mainly young women and most of them are of normal weight [American Psychiatric Association, 1995]. Especially times of personal stress are crucial for the beginning of bulimia [Rogers and Smit, 2000]. Actual binge eating episodes are often preceded by dysphoric mood [Hetherington et al., 1994].

A theory for the emergence of a binge eating episode offers the dietary restraint model, which was proposed in the late 1970s. Assumingly, the attempt of maintaining dietary control is prone for disinhibition, which consequently leads towards cravings and overeating [Polivy and Herman, 1985]. Individuals, who are struggling with eating disorders, are quite familiar with the cycle of temporary caloric restriction and homeostatic imbalances, which causes cravings for food. These food cravings, in turn, can lead someone to episodes of binge eating [Cepeda-Benito and Gleaves, 2001].

Reasons for binge eating episodes, besides disinhibition of dietary restraint and eating forbidden foods [Mela and Rodgers, 1998], are a lot of free time and being alone [Johnson, 1985], watching commercials and advertisements related to diet [Warren et al., 2005] and also strong emotional states [Wilson, 1999].

Alpers and Tuschen-Caffier (2001) did some research on emotions and the desire to eat in patients with bulimia nervosa. Especially negative feelings are associated with the perpetuation of bulimia nervosa (BN). [Alpers and Tuschen-Caffier, 2001] An assumption is that binge eating is a strategy to handle stressful situations and negative mood states. Overeating, therefore, may serve as a distractor from negative experiences. [Elmore and de Castro, 1990] According to this, it is hypothesized that binge eating is to be provoked by low mood states and that mood is improving during a binge eating episode. [Alpers and Tuschen-Caffier, 2001]

Retrospective reported data from BN patients name negative emotions like tension, anxiety and sadness as being typical for preceding binge eating [Abraham and Beumont, 1982; Mitchell et al., 1985]. A study of Johnson and Larson assessed the mood state of BN patients every 2 hours. Compared to the control group BN patients reported themselves to be more lonely, sad, weak, irritable, passive and pressured. Their mood was more negative before, and worsened during binge eating, but improved afterwards [Johnson and Larson, 1982].

In the study of Alpers and Tuschen-Caffier (2001) mood states of BN patients were compared with those of patients with panic disorder (PN patients) and a control group. The results showed that BN and also PN patients reported more negative feelings than healthy women. Negative feelings measured were tension, anxiety, sadness and insecurity. There was no significant difference found between the two patients groups. On contrast, healthy women proved to have higher scores for feeling of well-being and emotional balance. Importantly, the study supports the assumption that not the mood state itself but rather the connection between emotions and the desire to eat is specific for the bulimia nervosa [Alpers and Tuschen-Caffier, 2001].

2.5.2 Chocolate cravers

Food cravings and its association to food “addiction” is often discussed in social media and also debated in scientific literature. Hebebrand et al. (2014) critically discuss the term “food addiction”, which implies both concepts, substance-based and behavioral addiction. Because there is not a lot evidence-based data on substance-based food addiction available, Hedebrand et al. (2014) vote for the concept of addictive eating behavior. This concept is based on the assumption that eating, like other behaviors, can become addictive in a specific environment. [Hedebrand et al., 2014]

Chocolate is the food most often reported in connection to food craving and also food “addiction” [Rogers and Smit, 1999]. Even though other energy dense foods like cakes, biscuits and several salty and savory snacks are mentioned quite commonly in this context [Weingarten and Elston, 1991]. The question is, if chocolate or food in general can be referred to as addictive. Addictions are highly associated with drug abuse [Rogers and Smit, 1999]. A review’s definition puts it this way: “Addiction is restricted to the extreme or psychopathological state where control over drug use is lost” [Altman et al., 1996]. However, statements like “I am a chocoholic”, concepts like “chocolate addiction” or more generally spoken “food addiction” need to be further examined [Rogers and Smit, 1999]. One hypothesis is that chocolate craving might be a “subjective manifestation of an addiction to a psychoactive chemical contained in cocoa” [Gibson and Desmond; 1999, di Tomaso et al., 1996]. However, this drug addiction model is not readily applicable [Gibson and Desmond, 1999]. Several potentially psychoactive chemicals in cocoa originating from chocolate come into question for being addictive, like the two biogenic amines, tyramine and phenylethylamine, and also methylxanthines as theobromine and caffeine [Hurst and Tommey, 1981]. To be referred to as addictive, mechanisms initiated by substances of a food need to meet certain conditions. First, psychoactive substances have to act stimulant, euphoric or at least reinforcing. Second, effects should be observed by intake of every food containing sufficient amounts of these chemicals. And third, craving should also

occur, when substances are ingested alone and not as ingredient of the craved food [Gibson and Desmond, 1999].

Another assumption is that craving is connected to effects of the biogenic amines of chocolate [Gibson and Desmond, 1999]. Against this hypothesis speaks the fact that metabolizations of biogenic amines by enzymes like the monoamine oxidase (MAO) are taking place in the liver and the gut and therefore, probably may not even reach the brain [Karoum et al., 1979]. Moreover, biogenic amines are not found in chocolate only, but in a wide range of different foods [Gibson and Desmond, 1999].

By contrast, methylxanthines absorbed from food or drinks are able to pass the blood-brain barrier in a psychoactive amount [Tarka, 1982]. Moreover, withstanding from caffeine has shown to cause withdrawal symptoms in chronic caffeine users [Rogers et al., 1995]. However, it is not possible to link liking or “addiction” for beverages containing caffeine and craving or liking for chocolate [Rozin et al., 1991]. In addition, amounts of caffeine in chocolate are negligible. Although theobromine is found in chocolate in more considerable amounts, it is not clear if it has some stimulant or reinforcing effects [Max, 1989; Gibson and Desmond, 1999].

Michener and Rozin (1994) found out that cocoa powder alone did not lower cravings more than cacao powder capsules or nothing. On contrast, white chocolate in combination with or without cocoa powder capsules reduced cravings to some extents. However this white chocolate did not reduce cravings to the same extent as milk chocolate (sweetness and cacao butter). Taken together, cocoa ingredients did not prove to have an impact on cravings for chocolate, while sensory similarities did [Michener and Rozin, 1994].

Another assumption is that chocolate craving is provoked by stimulation of endogenous opioid receptors, similar to opiate drug addiction [Drewnowski et al., 1992]. However, a multitude of sweet and fatty foods with little evidence for cravings have shown opioid mediation [Blass et al., 1989].

Results of Michener and Rozin (1994) indicate that a pharmacological model of food craving is not reasonable, but that orosensory properties might play an important role. Moreover, they assume that the consumption of calories might also have a relevant impact [Michener and Rozin, 1994].

Important to note is that craving for chocolate can be increased through eating chocolate repeatedly when being hungry. The observation of increased craving for a specific food was also made with other foods, if consumed repeatedly when being hungry. Gibson and Desmond (1999) come to the conclusion that cravings for food can be identified as a strong urge to consume a specific food. But they do not consider pharmacological models of reinforcement as reasonable explanation for food cravings [Gibson and Desmond, 1999]. Nevertheless, it is very likely that food cravings share neurochemical and psychological mechanisms with drug cravings [Wise, 1997].

3 The present study

3.1 Introduction

The present study is based on the two studies; “Thought for Food: Imagined consumption reduces actual consumption” from Morewedge et al. (2010) and “Mental imagery interventions reduce subsequent food intake only when self-regulatory resources are available” from Missbach et al. (2014) [Morewedge et al., 2010; Missbach et al., 2014]. Morewedge’s research indicates that repeated imagination of consumption of a certain food item leads to a reduced consumption of that food item, subsequently. For the testing of the paradigm two different foods, M&M’s and cheese cubes, were chosen. When participants performed the imagery task of 30 repetitions of food consumption they ate significant fewer than those in the 3-repetition condition. This effect was shown for both, the M&M’s and the cheese cubes group [Morewedge et al., 2010]. Important to note is that imagined consumption had to follow clear instructions to create a simulation of an actual eating experience. These instructions concluded the imagination of picking up each M&M or cheese cube, putting it into the mouth, chewing and swallowing it [Larson et al., 2014]. In the study of Missbach et al. (2014) a replication of these findings was aimed using a high (36) and medium (18) number of repetitions for the imagery task. Gummy bears were chosen as food item. Like in the study of Morewedge et al. (2010) participants of the control group imagined putting a coin into a laundry machine. Results showed that participants who imagined gummy bear consumption ate significant fewer gummy bears, subsequently than those in the control group. Contrary to expectations, the interaction between the number of repetition and habituation effect was not significant. However, findings suggested that 18 repetitions of the imagery task are enough to evoke a habituation effect [Missbach et al., 2010].

The aim of the present study was to replicate the findings of Missbach et al. (2014) and to further decrease the number of repetitions of the imagery tasks.

We hypothesized that a further reduction could also lead to the same habituation effect.

3.2 Materials and Methods

3.2.1 Research question

The attempt of the present study was to replicate the findings of Missbach et al. (2014), who were able to show a habituation effect to a food item using 18 repetitions of an imagery task [Missbach et al., 2014]. Additional to the replication of these findings we wanted to reduce the number of repetitions to 9 repetitions and introduce a novel food into the paradigm.

In addition to the amount of consumed potato chips, we evaluated several other parameters which are thought to have an influence on the amount of the food consumed. Next to socio-demographic data, questionnaires regarding eating behavior (DEBQ-RE), weight management (PSRS), hunger, satiety and appetite (before and after the imagery task; VAS I and II), liking of chips and foodstuff testing were requested.

3.2.2 Participants

184 participants were recruited to participate in either of our two studies. To guarantee reproducibility we decided to use the same inclusion criteria as Missbach et al. (2014) for their study [Missbach et al., 2014]. Therefore, participants were all-female, of normal weight and were aged between 18 and 30. Recruitment was realized through online forums, social media platforms, message boards of the University of Vienna as well as word of mouth. There was the possibility to register for a date and time by using the online scheduling tool doodle. Blinding was imposed by promoting the experiment as a sensory evaluation of salty snacks. In the end of the procedure each participant received an expense allowance of 5 €.

3.2.3 Design

Together with this study (study 1), which is referred to in this thesis, we conducted another study (study 2), testing the variety effect in the context of habituation. For the execution of both studies we recruited 184 female

participants, mostly from the University of Vienna. Through the drawing of numbers they were allocated in one of the four subgroups of study 1, using a 2 (number of repetitions: 18 vs. 9) x 2 (target: food vs. coins) between subject design or one of the 4 subgroups of study 2, using a 2 (variety item: similar food vs. dissimilar food) x 2 (imagery item: food vs. coins) between subject design.

This means that study 1 concluded 93 participants which were divided into two intervention and two control groups. Participants of the intervention groups were engaged with the mental imagery task of food consumption, whereas participants of the control groups had to deal with the imagination of putting a coin into the laundry machine. The numbers of repetitions were set to 18 vs. 9 times, in both, the habituation and the control group.

Groups

- Intervention group 1: mental imagery task of food consumption 18 times
- Control group 1: mental imagery task of putting a coin into a laundry machine 18 times
- Intervention group 2: mental imagery task of food consumption 9 times
- Control group 2: mental imagery task of putting a coin into a laundry machine 9 times

The amount of consumed potato chips in the subsequent taste test served as independent variable. Furthermore we evaluated possible disturbance variables, which may influence the amount of potato chips consumed, as restrained eating behavior (DEBQ-RE), body mass index, hunger, satiety appetite and preference for potato chips. Referring to previous studies these parameters are discussed to influence food consumption directly as well as indirectly.

3.2.4 Hypothesis

Main-Hypothesis:

H0: The mental imagery paradigm does not work when reducing the number of repetitions from 18 to 9, which is reflected in subsequent food consumption.

H1: The mental imagery paradigm also works when reducing the number of repetitions from 18 to 9, which is reflected in subsequent food consumption.

H2: The actual food consumption of the control group is not higher due to exchanging the imagery task of food intake with an imagery task of putting a coin into a laundry machine.

H3: The actual food consumption of the control group is higher due to exchanging the imagery task of food intake with an imagery task of putting a coin into a laundry machine.

Sub-Hypothesis:

Regardless from mental imagery the amount of consumed potato chips might be influenced by other parameters, like restrained eating (DEBQ-RE), body mass index (BMI), ability to maintain weight (PSRS), hunger, satiety, appetite (VAS) and liking of potato chips.

H0: The amount of consumed potato chips is not influenced by restrained eating (DEBQ-RE), body mass index (BMI), ability to maintain weight (PSRS), hunger, satiety, appetite (VAS) and liking of potato chips.

H1: The amount of consumed potato chips is influenced by restrained eating (DEBQ-RE), body mass index (BMI), ability to maintain weight (PSRS), hunger, satiety, appetite (VAS) and liking of potato chips.

3.2.5 Experimental tasks

Mental imagery task: It is assumed that a mental imagery task leads to an internal representation of a situation. In our study participants were instructed to create mental images of the repeated consumption of potato chips. Intervention group and control group were divided into two subgroups each; one had to do 18 the other one 9 repetitions of the imagery task. For each repetition participants were instructed to use a time frame of about 15 seconds.

The imagery task of the intervention group instructed the participants not to think about the food consumption randomly, but to follow certain instruction. Firstly, they had to close their eyes and think about a bowl filled with potato chips. Secondly, they had to imagine taking the food product out of the bowl, looking at it closely and smelling it. Thirdly, they had to imagine putting it into the mouth, chewing and swallowing the food item.

The imagery task of the control group, on the other hand, contained instructions as follows. Firstly, the participants had to close their eyes and imagine standing in front of a laundry machine, a bowl of 50 cent coins standing next to them. Secondly, they had to imagine taking a 50 cent coin out of the bowl, taking a look at it and thirdly, putting it into the laundry machine.

3.2.6 Procedure

Because testing was taking place one by one, participants were asked to pick time and date on the scheduling-platform doodle. We offered appointments between 9 am and 5 pm from May, 4th until June, 3rd 2015.

Upon arrival participants were greeted by the experimenter and had to draw an ID-number out of a box to be allocated into one of the groups. The experimenter introduced the study briefly and answered upcoming questions. At next the participant was asked to take a seat in the hall in front of a PC to answer the first part of the online questionnaire. This questionnaire included demographic data, questions about restrained eating behavior (DEBQ-RE) and weight maintenance (PSRS). After accomplishment the participant was taken into the lab and instructed about the imagery task. Then left by herself the partaking woman had to do the VAS I-questionnaire which included questions about hunger, satiety, appetite and liking of the food. At next the mental imagery task took place, followed by the VAS II-questionnaire, which contained the same questions as VAS I. After that the participant rang a bell, as a sign for the experimenter to enter the lab and bring a bowl of potato chips. The participant was left by herself again to eat from the bowl of chips ad libitum. Being done with that, the taste test and finally the manipulation check followed. After leaving the lab, the participants were handed 5 Euros and were dismissed.

3.2.7 Measures

Questionnaires used for the evaluation of our data are described as follows.

Demographic data

Demographic data, which was measured at first, served as an assurance that all participants were exclusively female and aged between 18-30 years.

Information about the height and weight served us as variables to calculate the body mass index of the women. A body mass index less than $18,5 \text{ kg/m}^2$ is referred to as underweight, more than $24,99 \text{ kg/m}^2$ as overweight. Our exclusion regarding the BMI was mean value $\pm 2,5$.

Amount of potato chips consumed

To evaluate the amount of potato chips consumed, the bowl of chips was weighed before and after the foodstuff testing. The consumed amount of potato chips served as independent variable of this study.

Restraint eating

The german translation of the Dutch Eating Behavior Questionnaire-Restrictive Eating behavior (DEBQ-RE) was used to differ between restrained and non-restrained eaters. The used parameter therefore was the restraint-value. For evaluation participants completed a questionnaire of 10 questions, using a 5-point-scala from “never” (1) to “very often” (5).

There is evidence that restrained eaters eat more than unrestrained eaters when having consumed a high caloric preload, beforehand. This phenomenon is reducible to the loosing of self-control, which is experienced by restrained eaters, when eating a high caloric food. [Herman, 1978]

Weight maintenance

For evaluation of the capability to maintain weight participants were asked to answer three questions (PSRS) regarding their weight management. The

questions had to be answered on a 7-point-scale, ranging from “not at all”(1) to “very good”(7).

Hunger, satiety, appetite and liking

Hunger, satiety as well as appetite were retrieved via visual analogue scale, before and after the taste test (VAS I, VAS II). Therefore visual analogue scales were used for the measurement of these subjective conditions. To rate the sensation of hunger participants were asked to mark a point on the 4-point-scale anywhere between “not hungry”, “slightly hungry”, “very hungry” or “extremely hungry”. The question about satiety and also appetite had to be answered on a 3-point-scale ranging from “not at all full/no appetite” to “very satisfied/big appetite”.

Partaking women were also asked if they liked potato chips in general. For that a 3-point-scale with the endpoints “not at all” and “very much” was used.

Taste test and manipulation check

Because participants were invited under the pretext of a sensory testing of salty snacks, we asked all in all 14 questions about the food consumed. This included next to others color, appearance, taste, texture of potato chips. 10 questions could be answered by choosing one of six terms (“excellent”, “very good”, “okay”, “neutral”, “not good”, “not good at all”). 3 questions were “yes”/“no” questions and one was an open one.

At last, participants were asked if they had followed the instructions as requested.

The survey of the data took place via online-questionnaires, the program used was Unipark.

Study participants were informed about the study procedure upon arrival and a written informed consent was obtained from every participant.

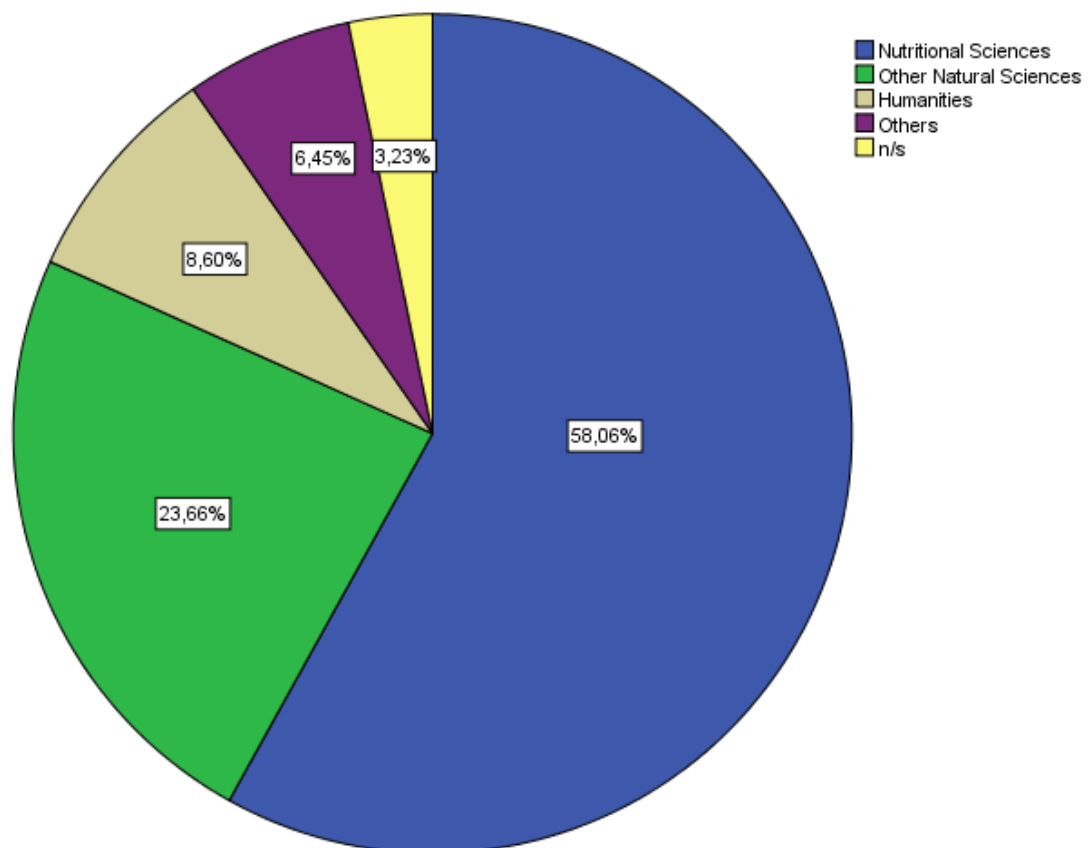
4 Results

4.1 Descriptive Statistics

4.1.1 Sample size

In total, 95 females were recruited and completed the experiment. As exclusion criteria for the BMI, mean BMI $\pm$ 2,5 SD was applied. The majority of the study participants, 58,1%, were female students of nutritional sciences. 23,7% were students of other natural sciences, 8,6% of humanities. The rest of 9,7% was shared by other courses or professions (6,5%) and those without making a specification about their occupation (3,2%).

Figure 3 Distribution of courses among participants



course	frequencies	percentage in %
Nutritional Sciences	54	58,1

Other Natural Sciences	22	23,7
Humanities	8	8,6
Others	6	6,5
n/s	3	3,2
in total	93	100

Table 1 Distribution of courses among participants

Following Table gives an overview of some of the characteristics of the four study groups. As shown by the p-value no significant difference was found between the groups regarding any of these variables.

	9x MI chips	18x MI chips	9x MI coins	18x MI coins	p-value
age ($\pm$SD)	22,6 $\pm$ 2,2	23,2 $\pm$ 2,8	22,8 $\pm$ 2,7	23,0 $\pm$ 2,6	0,46
BMI in kg/m² ($\pm$SD)	21,9 $\pm$ 2,5	21,2 $\pm$ 1,9	20,9 $\pm$ 2,1	21,3 $\pm$ 2	0,91
DEBQ ($\pm$SD)	33,0 $\pm$ 6,3	31,5 $\pm$ 8,4	33,4 $\pm$ 7,3	33,9 $\pm$ 6,6	0,69
PSRS mean ($\pm$SD)	13,1 $\pm$ 3,8	15,7 $\pm$ 2,6	14,5 $\pm$ 3,3	14,6 $\pm$ 3,7	0,18

Table 2 Group characteristics

4.1.2 Age and Body Mass Index

Average age, which was between 18 and 30 years of age, with a mean age of $22,9 \pm 2,61$ years of age. The youngest participant was at the age of 18, while the oldest was 29 years old.

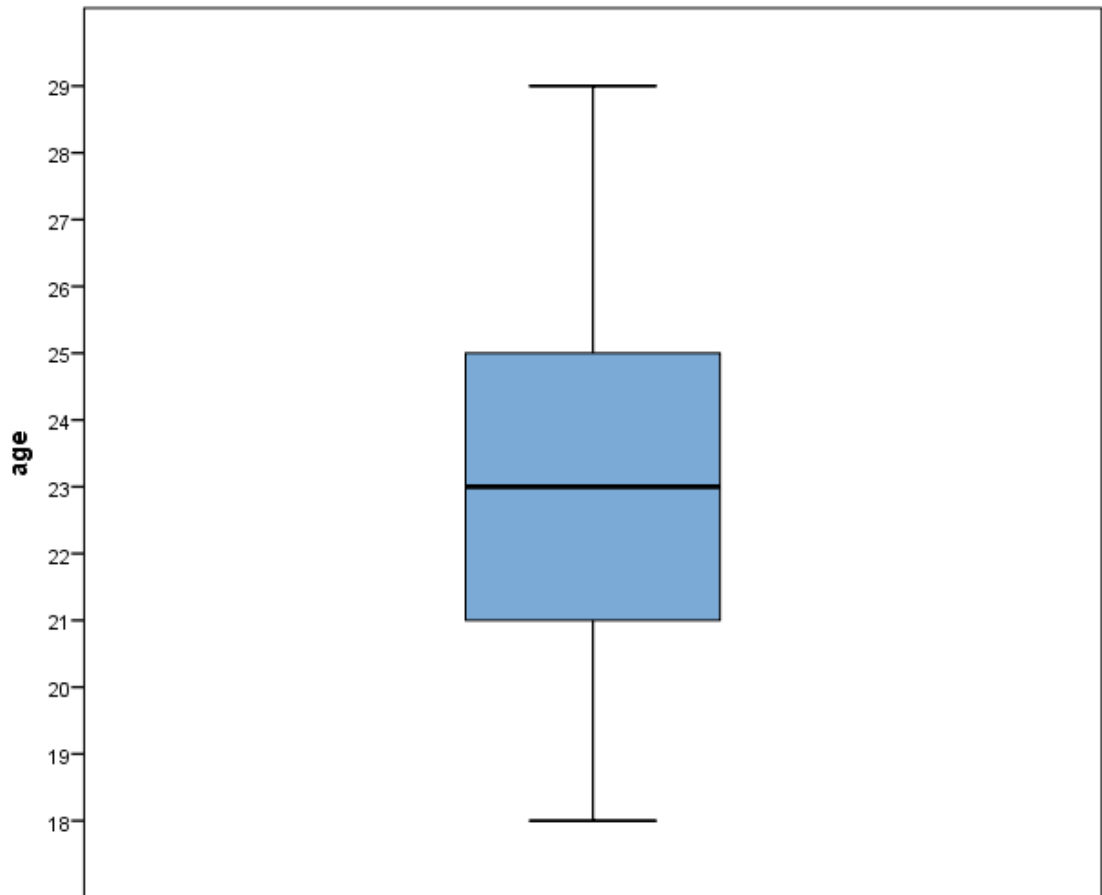


Figure 4 Distribution of age among all participants

The Boxplot shows that 50% of all participants were between the age of 21 and 25 with a median of 23 years of age.

For evaluation of the BMI participants were asked for weight and height. BMI was calculated via following formula [Elmadfa and Leitzmann, 2004]:

$$BMI = \frac{bodyweight (kg)}{(height (m))^2}$$

The average BMI among all participants was $21,3 \pm 2,15 \text{ kg/m}^2$. The Boxplot shows the distribution of BMI among all participants. 50% of the participants had an BMI between 19,8 and 22,5 kg/m^2 . The median proved to be 21,0 kg/m^2 .

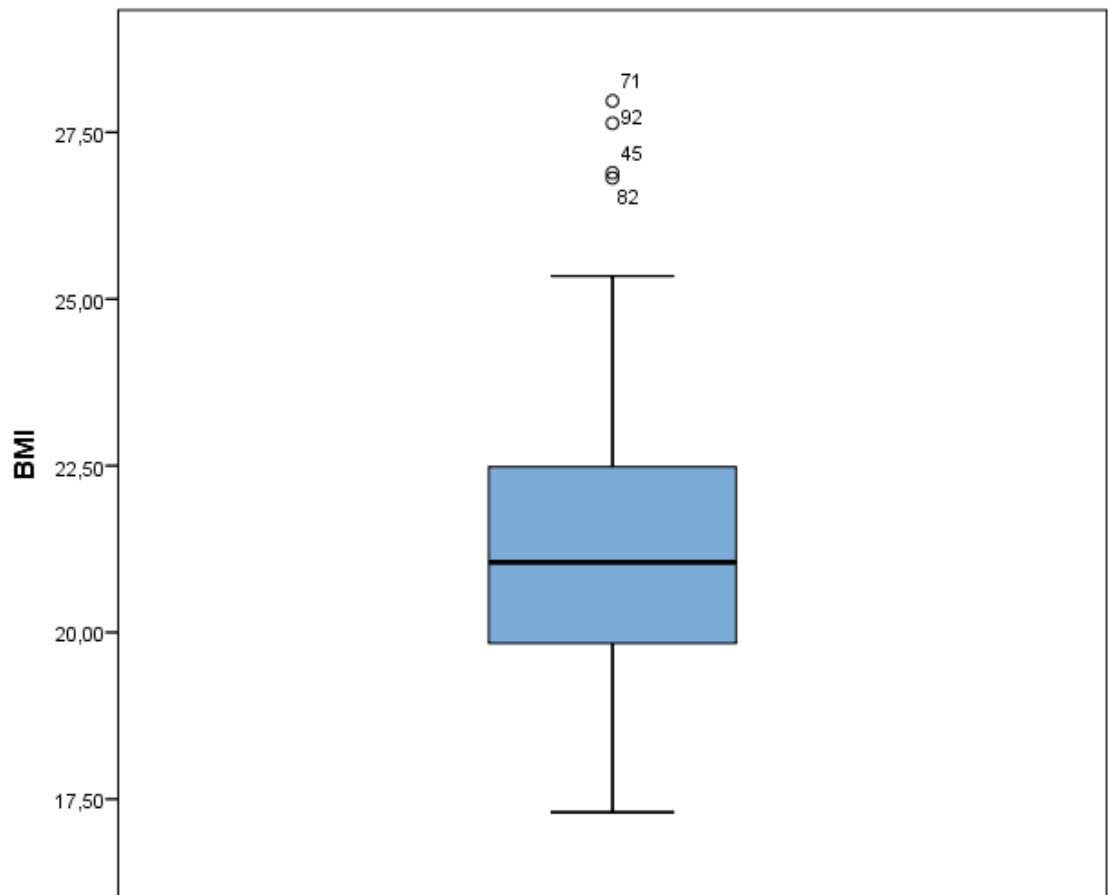


Figure 5 Distribution of BMI among all participants

4.1.3 DEBQ and PSRS values

Since restrained and non-restrained eaters may differ in their eating behavior in our taste test we used the restraint-value, evaluated via the Dutch Eating Behavior Questionnaire. This german translation of the Questionnaire contains 10 questions with a 5-point-scale. The higher the score, the more restrained the eating behavior. The mean value of all groups together was 33,0 (SD=7,12), the minimum value was 17,0 and the maximum value 46,. There was no significant difference found between the four condition groups ($F(1,92)=2,47$, $p=0,12$). The Boxplot shows the distribution of the restraint-value among the intervention and control groups. The mean median of the restraint-value among all groups was 33. For more details see Table 3.

condition	N	mean value (M)	standard deviation (SD)	median
9x MI chips	23	33,0	6,32	35,0
18x MI chips	22	31,5	8,39	32,0
9x MI coins	24	33,42	7,34	33,0
18x MI coins	23	33,0	6,56	34,0
in total	92	33,0	7,12	33,0

Table 3 Restraint-value among participants

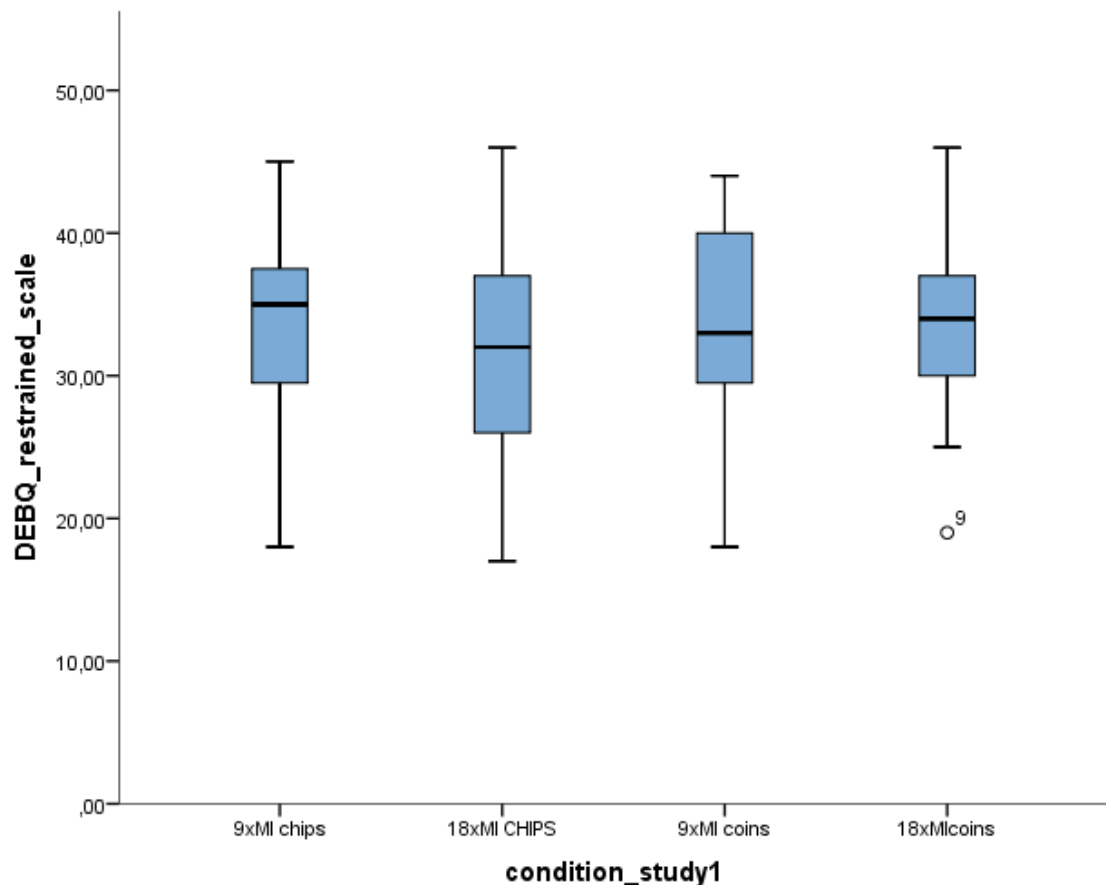


Figure 6 Restraint-value among the four study groups

Another parameter, the PSRS value, was evaluated. The PSRS questionnaire contains three questions regarding the capability to maintain weight. For all three questions a three-point-scale was used, resulting in a highest score of 21 all in all. The higher the score, the easier is it for someone to maintain and manage weight. The mean value of the questionnaire among all participants was 14,5 (SD=3,34), the lowest score was 3 and the highest 21. There was no significant difference found between the four study groups ($F(1,92)=0,64$, $p=0,43$) The mean median among all groups was 15,0. More details are shown in the graphical illustration in from of a Boxplot and the Table below.

condition	N	mean value (M)	standard deviation (SD)	median
9x MI chips	23	13,1	3,76	13,0
18x MI chips	23	15,7	2,60	16,0

9x MI coins	24	14,5	2,84	15,0
18x MI coins	23	14,65	3,71	16,0
in total	93	14,5	3,34	15,0

Table 4 PSRS value among participants

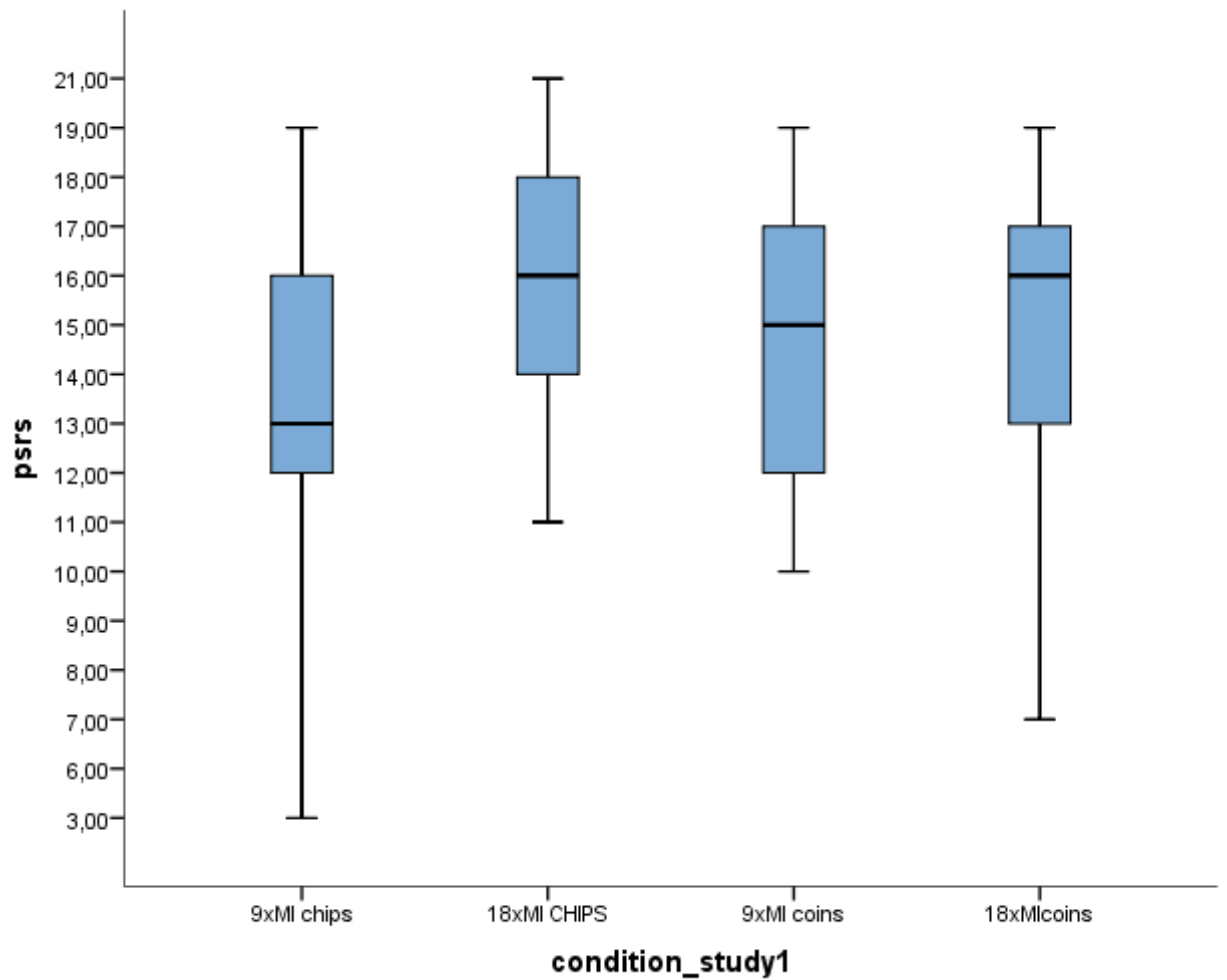


Figure 7 Boxplots of the PSRS values among the four study groups

4.1.4 Hunger, satiety and appetite

Due to the camouflage of our experimental testing as a taste test liking of the consumed food, hunger, satiety and appetite was evaluated via an analogue scale (VAS I, VAS II). As shown in the illustration below there was no difference in terms of hunger, satiety and appetite before and after the tasting of the chips.

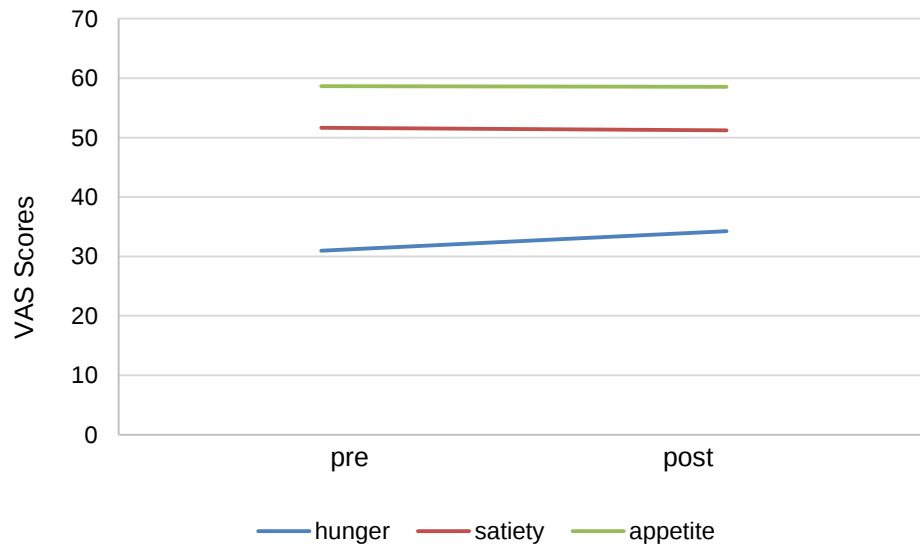


Figure 8 Hunger, satiety and appetite pre and post ad libitum consumption

4.1.5 Time for intervention

We suggested that by comparing the times of the lower and higher repetition groups we might get an idea if the mental imagery task was done properly or not. We assumed that participants who were in the lower repetition groups took less time to complete the imagery task than those in the higher repetition groups. For comparison of the four study groups regarding study duration an ANOVA was conducted. Results showed that there was no significant difference between times to complete the mental imagery task, when comparing all groups ($F(3,88)=3,05$, $p=0,033$), but between times to complete the whole procedure ($F(3,89)=4,98$, $p=0,003$). Further analysis points out the significant difference between the 9 and the 18 repetition groups regarding the study duration ($F(1,90)=11,4$, $p=0,001$). Intervention and control group in the 9 repetition condition show a mean value of $14,1 \text{ min} \pm 3,83 \text{ min}$, whereas the mean value of the 18 repetition condition groups was $17,2 \text{ min} \pm 4,92 \text{ min}$. The difference of the duration of the mental imagery task between the 9 and 18 repetition groups were significant ($F(1,89)=8,37$, $p=0,005$). Times of the 9x MI intervention and 9x MI control group were 206 sec ($N=21$, $SD=120$) and 234 sec ($N=24$, $SD=122$) respectively. Those of the 18x MI intervention and 18x MI control group were 302 sec ($N=22$, $SD=189$) and 339 sec ($N=22$, $SD=205$) respectively. Data is normally distributed, for both, the time to complete the mental imagery task and the time of the whole study procedure (Levene's test: $p > 0,05$).

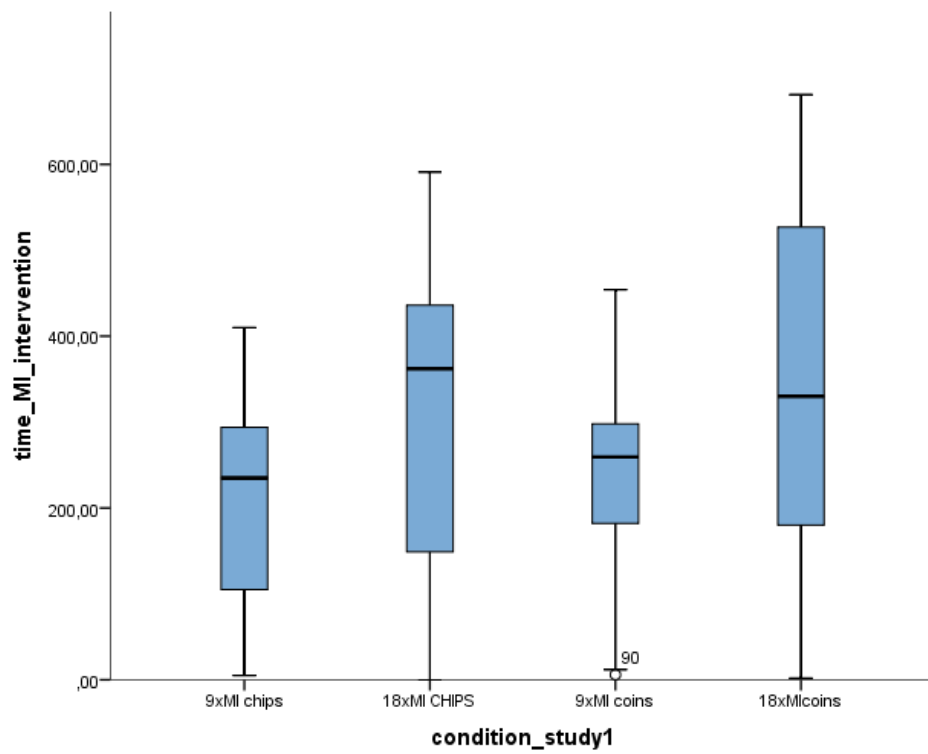


Figure 9 Duration of mental imagery task among the four groups

4.1.6 Sub-Hypothesis

The purpose of the sub-hypothesis of our study was to observe any possible influence of other parameters rather than the mental imagery task on the amount of consumed chips. These parameters were body mass index (BMI), restrained eating (DEBQ-RE), ability to maintain weight (PSRS), hunger, satiety, appetite (VAS) and liking of potato chips. According to our results, none of these parameters had a significant influence on the amount of consumed chips.

	df	F	p
BMI	1	1,04	0,31
DEBQ-RE	1	2,81	0,10
PSRS	1	0,21	0,65
VAS			
hunger1	1	0,67	0,45
satiety1	1	0,18	0,67
appetite1	1	0,14	0,71
liking	1	0,28	0,60
total	92		

Table 5 Possible influential factors on chips consumption

4.2 Main Analysis

4.2.1 Consumed amount of chips

The average amount of consumed potato chips was 18,6 g (SD=13,8 g) and 100,8 kcal (SD=74,4 kcal) among all participants. Average amounts of consumed potato chips in the four groups are demonstrated in Table 6. Data is normally distributed (Levene's test: $p > 0,05$). There is no significant difference between the groups, neither between control and intervention groups, nor

	9x MI chips	18x MI chips	9x MI coins	18x coins	in total $\pm$ SD
consumed chips in g	16,2	19,3	18,0	21,1	18,6 $\pm$ 13,8
consumed chips in kcal	87,3	104,5	97,4	114,1	100,8 $\pm$ 74,4
number of participants (N)	23	23	24	23	93

Table 6 Amount of chips consumed

between 9 and 18 repetition groups.

As depicted in Table 6 which shows the means of potato chips consumption in kcal, higher number of repetitions is associated to a greater amount of consumed potato chips. This is observed for both, intervention and control group. Nevertheless, the results do not reach significance. The intervention group with the imagery task using 9 repetitions consumed on average 87,3 kcal of potato chips ($M=87,3$, $SD=73,9$), whereas the intervention group, which had to do the 18 repetitions of the imagery task consumed 104,5 kcal of potato chips ($M=104,5$, $SD=53,8$). It can also be seen that participants of the control groups consumed slightly more potato chips than the intervention group. The control group, which had to do 9 repetitions of the imagery task, consumed on average 97,4 kcal of potato chips ($M=97,4$, $SD=81,4$), whereas those doing 18 repetitions ate 114,1 kcal of potato chips on average ($M=114,1$, $SD=86,5$). Also these results are not significant.

study condition	Consumed food in	N	SD
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	kcal		
9xMI chips	87,3	23	73,9
18xMI chips	104,5	23	53,8
9xMI coins	97,4	24	81,4
18xMI coins	114,1	23	74,4
in total	100,8	93	74,4

Table 7 Consumed potato chips in intervention and control groups in kcal

A one-way ANOVA was conducted to compare the means of consumed potato chips in kcal between the intervention and control group ($F(1,91)=0,39$, $p=0,53$). Therefore there is no statistical difference between the participants who imagined chips consumption and those who imagined putting a coin into the laundry machine.

Also the one-way ANOVA comparing the means of consumed potato chips in view of repetitions does not provide a significant result ($F(1,91)=1,02$, $p=0,32$).

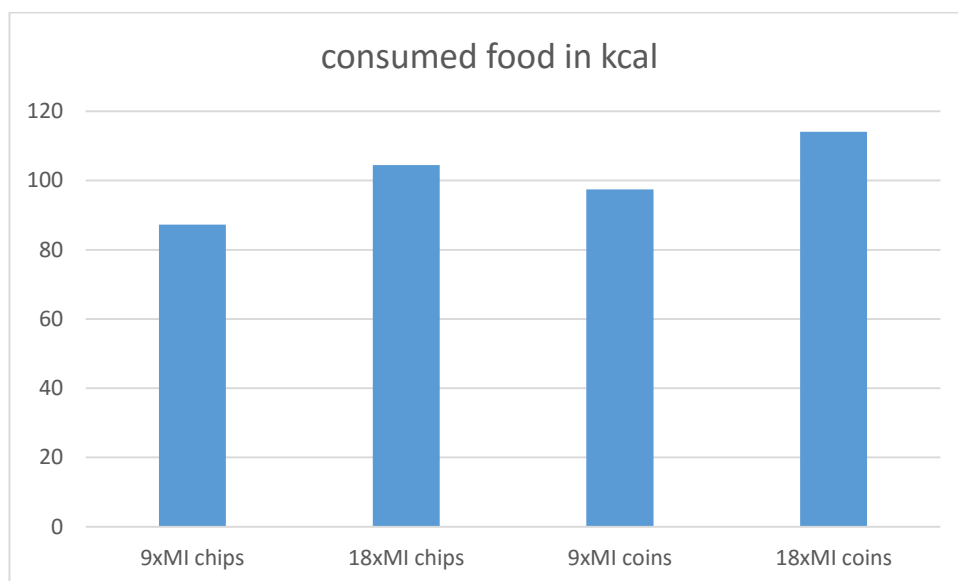


Figure 10 Chips consumption in the four study groups

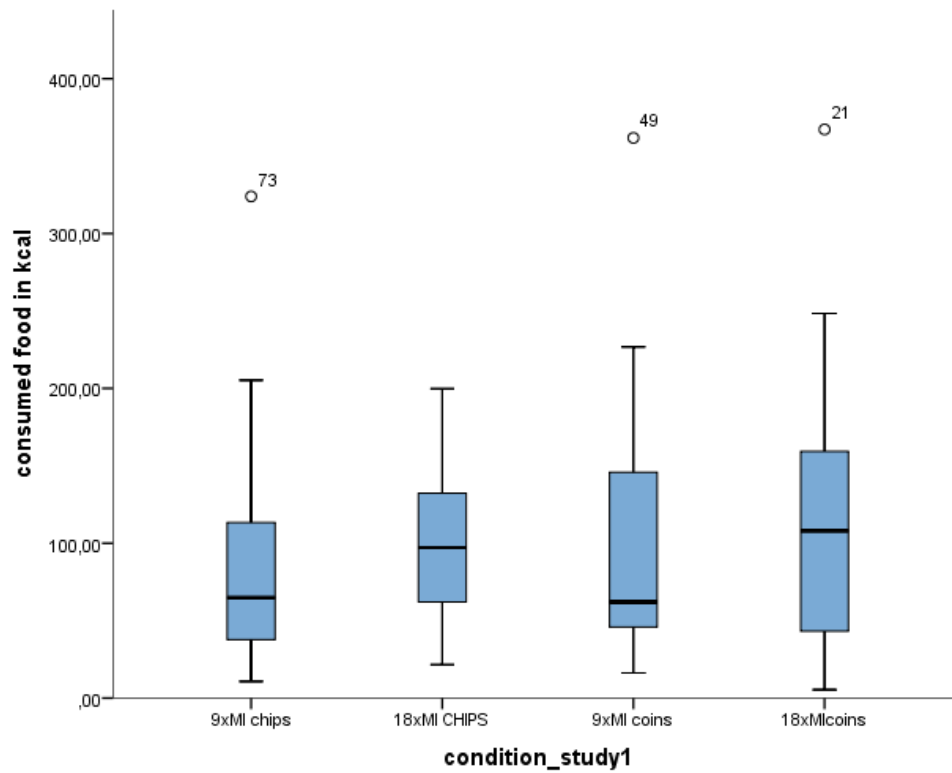


Figure 11 Boxplots of the amount of consumed chips

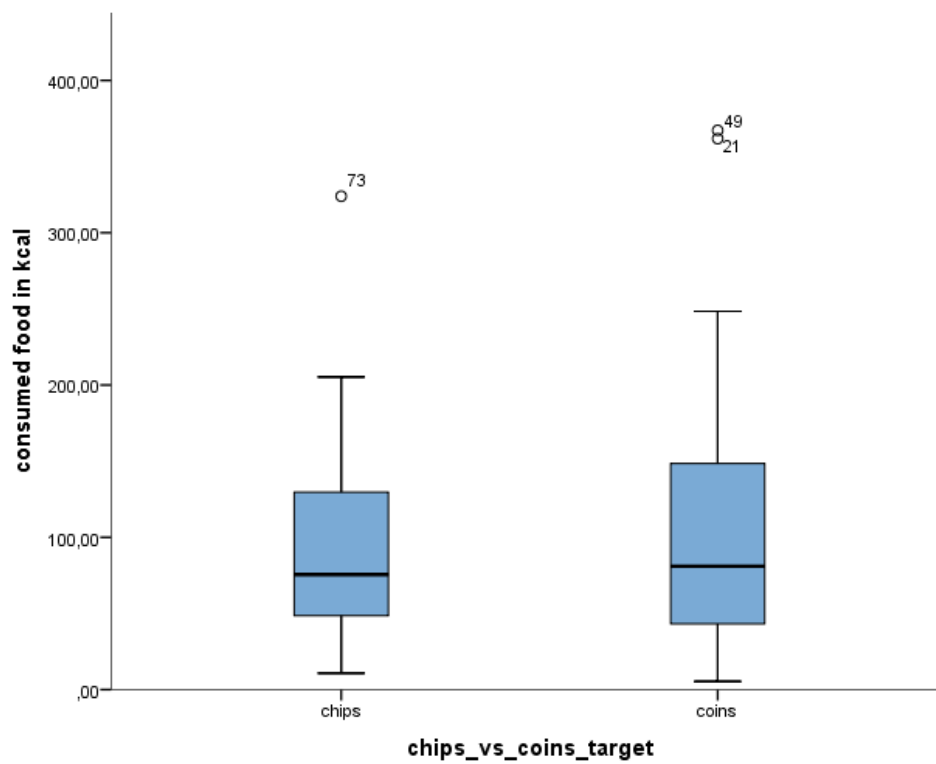


Figure 12 Chips consumption among intervention and control group

5 Discussion

According to Morewedge et al. (2010), habituation can be defined as a reduction of physiological and behavioral responses to a stimulus, resulting from extended or repeated exposure [Morewedge et al, 2010]. This means that repeated representation of a stimulus leads someone to habituate to it, shown as a decrease in the response rate [Epstein et al, 2009]. Research indicates that habituation does not occur in the light of actual food consumption only, but also during imagined food consumption [Missbach et al, 2014, Morewedge et al, 2010, Larson et al, 2014].

In the present study the mental imagery paradigm was conducted in a sample of exclusively women aged between 18 and 30 years, mainly students of natural sciences.

5.1 Sub-Hypothesis

Next to the amount of consumed chips we assessed several other parameters, to exclude their influence on consumption. According to our results, whether body mass index (BMI), restrained eating (DEBQ-RE), ability to maintain weight (PSRS), hunger, satiety, appetite (VAS) nor liking of potato chips had a significant influence on the amount of consumed chips.

5.2 Main-Hypothesis

In the present study we observed that participants who imagined chip consumption ate less than those in the control group, which imagined putting a coin into a laundry machine. Additionally, participants in the 18 repetition condition consumed less potato chips than in the 9 repetition condition. However, neither of these results reached significance.

Consequently, we were not able to replicate former findings of decreased consumption subsequent to mental imagery, or show this effect by lowering the number of repetitions.

It remains questionable, whether these results are reducible to the study conduct itself or to the choice of the food item.

Experiences of mental imagery are often referred to terms like “seeing with the mind’s eye” and “hearing with the mind’s ear”. Thereby information, which is stored in the memory, is retrieved and an internal representation is created [Kosslyn, 2010].

Mental imagery is defined by Wraga and Kosslyn as “an internal representation that gives rise to the experience of perception in the absence of appropriate sensory input.” [Wraga and Kosslyn, 2002]. This means that mental imagery and perception are similar phenomena. As opposed to mental imagery, perception only emerges when information is directly perceived from the senses. Consequently, mental imagery is able to occur in absence of sensory stimuli, also. Data supports the presumption that each modality is able to provoke mental images. Thus, mental imagery is reported to occur in forms of visual, auditory and kinaesthetic imagery [Kosslyn, 2010].

The present study was conducted with the attempt to create mental imagery of chips consumption by instruction. Thereby the imagination should be experienced like actual consumption, involving various sensory properties

However, a challenge we had to face while conducting the present study was to ensure that the mental imagery task was done properly by study participants. Additionally, it is assumed that mental imagery tasks need discipline and also cognitive resources. In practice, both are indicated to be rather low in overweight students as shown in a study conducted with middle school students [Shore et al, 2008].

Regarding the fact that our results differed from what we expected, it is important to make some considerations about the limitations of this study

5.3 Limitation of the study

Since we conducted two studies at the same time, the number of participants for intervention and control groups turned out rather small. A small sample size makes it often more difficult to prove significant differences between the groups.

Another important aspect is that the study was conducted throughout the whole day. Hunger and desire for a salty snack may differ during the day to a large extent. Also, the time of the last meal intake was not taken into account.

Hunger, satiety and appetite were measured on a scale, and participants had to slide a beam to their preferred point at the scale. There was merely no change of satiety or appetite before and after mental imagery task, but a slight increase of hunger. This keeps us wondering whether the questioning was taken seriously by the participants or they rather had difficulties with sliding the beam.

As mentioned before participants had to sign up for a time on an online schedule, but if participants did not appear or there was time in between appointments, study participants were recruited spontaneously. These might have had a large impact on our results, mainly because later recruited participants were not mentally prepared for the study conduct. Participants who registered on the online platform consciously set this time apart for the study and may also have planned their meals accordingly. Spontaneously recruited participants, however, might have taken the intervention, especially the mental imagery task, less serious and might have rushed through the task.

For further research it seems to be necessary to restrict participation to previously made appointments. Also, to minimize bias regarding the influence of hunger, satiety and appetite, it might be helpful to choose a more specific daytime for the experiment and evaluate the time of the last meal intake.

Another limitation of this study was that the experiment was supervised by four experimenters. Since we did not agree on consistent phrases, explanations and instructions might have differed in several aspects.

We also considered that the size of the bowl might have been inappropriate. The bowl was quite large and filled with 100g of chips. It might have been better to use a bowl of smaller size and less content.

Some of the participants asked if they could take a bottle of water to the intervention room. Because chips are very salty, participants probably became thirsty during the taste test. Those who were able to take a sip of water during the intervention may have eaten more chips than those who did not drink any water during the experiment. Therefore it is also important to either offer everyone water during intervention or do not allow any drinking during the intervention.

For further research it might be helpful to consider these limitations and to agree to clear and consistent instructions and supervision throughout the whole study conduct.

5.3.1 Application

Strategies using mental imagery and other cognitive tasks might be applied in the context of cravings. Several approaches for the potential use of present knowledge have been tested in field studies [May et al, 2015]. One example for successfully reducing cravings in undergraduates was the usage of the display of dynamic visual noise, whenever they were confronted with a craving experience [Kemps and Tiggemann, 2013]. Similar effect was proven by Skorka-Brown et al. (2014), who reported that playing the game Tetris® was able to reduce strength, frequency and vividness of cravings [Skorka-Brown et al, 2014]. Also the imagination of engaging in a favorite activity was found to reduce cravings in undergraduates [Knäuper et al, 2011]. Hsu et al. (2014) developed a smartphone app (iCrave) which instructed to create vivid neutral images when craving for snacks appeared. Over a period of one week participants who did the imagery task via iCrave ate fewer unhealthy, but similar amounts of healthy snacks than the control group, who just tracked their snacking behavior [Hsu et al, 2014].

Also in a clinical setting mental imagery could be applicable. Some research is dealing with vodcasts on nutritional needs, mindful eating and motivational reflection and has shown positive changes in patients with restrictive eating disorders [Cardi et al, 2012].

5.4 Conclusion

As mentioned before, the aim of this study was to replicate the findings of Missbach et al. (2014), who were able to show a habituation effect to a food item using 18 repetitions of an imagery task [Missbach et al, 2014]. In the present study, additional to the replication of these findings, it was sought to reduce the number of repetitions to nine and to introduce a novel food into the paradigm.

As seen in the results, no significant decrease of food consumption was found in participants who performed the mental imagery task. Nevertheless, participants who imagined chip consumption ate less than those in the control group, who imagined putting a coin into a laundry machine. Additionally, participants in the 18 repetition condition consumed less potato chips than in the 9 repetition condition.

It is assumed that an internal representation of a situation can be created by an imagery task. Research indicates that repeated imagination of eating a specific food can lead to habituation and satiety, consequently. Especially in our society, which is characterized by overconsumption and overweight, these findings raise hope to find new approaches to face food consumption related health issues.

Taken together, mental imagery and its ability to compete with elaboration and processing of intrusive thoughts which leads to desire is an approach to reduce craving episodes. Craving is connected to overweight and eating disorders like binge eating, which are part of the daily life of many. Therefore, further research might be necessary in order to examine the relationship of food related health issues and craving in more depth and to fully understand how craving episodes can be reduced using mental imagery.

6 Appendix

6.1 Abstract

Food craving, defined as “strong desire or intense longing” to consume a specific food, is seen as an important driver for overconsumption [Kozlowski and Wilkinson, 1987; Weingarten and Elston, 1990; May et al., 2012]. Next to food-rich environments, craving for food seem to be strongly involved in the development of overweight and obesity [Papies and Veling, 2013; Schlundt et al., 1993]. Strategies and interventions to help people to reduce energy dense food choices are important issues for research [Hill et al., 2003]. One approach deals with the use of mental images and other cognitive tasks to evoke satiation [May et al., 2015; Morewedge et al., 2010]. Especially imagination of repeated food consumption has been associated with habituation to the food stimulus and to reduced food intake, subsequently [Epstein et al., 2009; Morewedge et al., 2010]. This paradigm, referred to as mental imagery, was tested in the practical part of this work, whereas drivers for food intake and underlying cognitive processes are addressed in the theoretical part.

6.2 Abstract (deutsch)

Das Verlangen nach Essen, verbunden mit starken Gelüsten und intensivem Begehren, wird als wichtiger Faktor für Überkonsum von Nahrungsmitteln angesehen [Kozlowski und Wilkinson, 1987; Weingarten und Elston, 1990; May et al., 2012]. Neben einem Umfeld, das stark von Lebensmittelreizen geprägt ist, trägt das Verlangen nach Essen wesentlich zur Entstehung von Übergewicht und Fettleibigkeit bei [Papies und Veling, 2013; Schlundt et al., 1993]. Ein wichtiges Anliegen von Forschern ist es, Strategien und Interventionen zu finden, die Personen helfen ihre Wahl von Lebensmitteln mit hoher Energiedichte zu reduzieren [Hill et al., 2003]. Ein Forschungsansatz beschäftigt sich mit der Verwendung mentaler Bilder und anderen kognitiven Aufgaben, um Sättigung herbeizuführen [May et al., 2015; Morewedge et al., 2010]. Insbesondere ist die wiederholte Vorstellung eines Essvorgangs mit

einem Gewöhnungseffekt und folglich einer verringerte Nahrungsaufnahme verbunden [Epstein et al., 2009; Morewedge et al., 2010]. Dieses Paradigma, der bildlichen Vorstellungskraft, wurde in dem praktischen Teil der vorliegenden Arbeit getestet, während der theoretische Teil sich mit den Triebkräften für die Nahrungsmittelaufnahme und zugrundeliegenden kognitiven Prozessen beschäftigt.

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7 Attachments

7.1 Questionnaires

7.1.1 Demographic data

Geben Sie die Nummer ein, die Sie gezogen haben:

Wie alt sind Sie?

Ihre Körpergröße in m:

Ihr Körpergewicht in kg:

Was machen Sie hauptberuflich?

☐ Student der Fachrichtung:

☐

7.1.2 DEBQ-RE (Restriktives Essverhalten)

	sehr oft	oft	manchmal	selten	nie
Achten Sie genau auf das, was Sie essen?					
Essen Sie bewusst weniger, um nicht zuzunehmen?					
Wenn Sie in letzter Zeit zugenommen haben, essen Sie dann weniger als sonst?					
Wenn Sie an einem Tag zu viel gegessen haben, essen Sie dann am nächsten Tag weniger?					
Berücksichtigen Sie Ihr Gewicht bei der Entscheidung, was Sie essen?					
Wie oft versuchen Sie zwischen den Mahlzeiten nicht zu essen, weil Sie auf Ihr Gewicht achten?					
Wie oft versuchen Sie am Abend nichts zu essen, weil Sie auf Ihr Gewicht achten?					
Versuchen Sie während der Mahlzeiten weniger zu essen als Sie gerne essen					

würden?					
Wie oft lehnen Sie Speisen oder Getränke ab, weil Sie um Ihr Gewicht besorgt sind?					
Essen Sie bewusst schlankmachende Speisen?					

7.1.3 Perceived Self-Regulatory Success in Dieting Scale (PSRS)

1. Wie gut gelingt es Ihnen auf Ihr Gewicht zu achten?

überhaupt nicht gut ☐ ☐ ☐ ☐ ☐ ☐ ☐ sehr gut

2. Wie gut gelingt es Ihnen abzunehmen

überhaupt nicht gut ☐ ☐ ☐ ☐ ☐ ☐ ☐ sehr gut

3. Wie schwierig finden Sie es in Form zu bleiben?

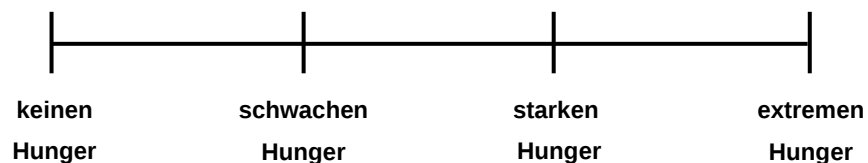
überhaupt nicht gut ☐ ☐ ☐ ☐ ☐ ☐ ☐ sehr gut

7.1.4 Assessment of hunger, satiety, appetite and preference via visual analogue scale (VAS)

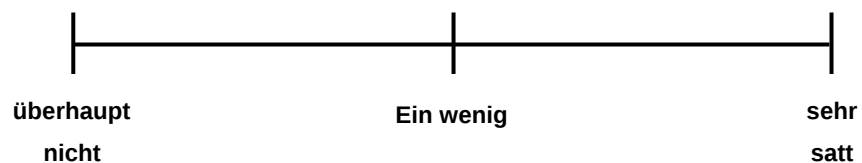
VAS I

Wie viel Hunger haben Sie?

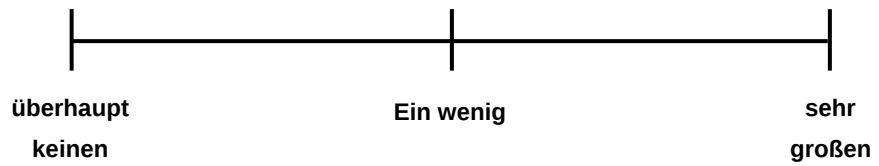
Beschreiben Sie bitte Ihr Hungergefühl indem Sie auf untenstehender Linie eine Markierung setzen.



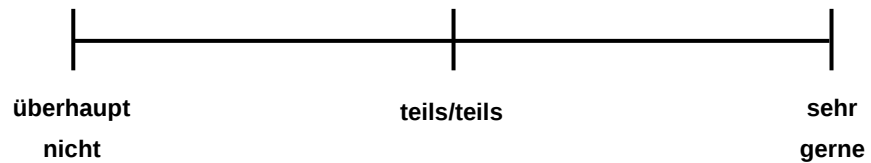
Wie satt fühlen Sie sich?



Wie viel Appetit haben Sie?



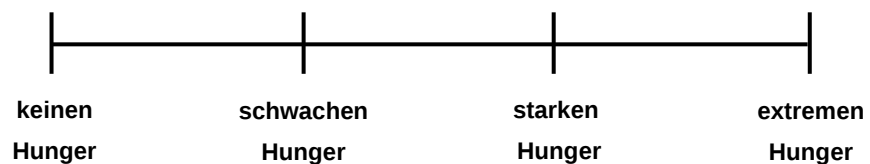
Wie sehr mögen Sie Chips im Allgemeinen?



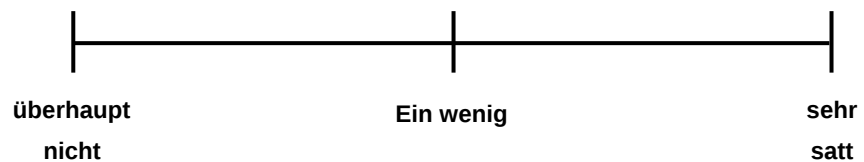
VAS II

Wie viel Hunger haben Sie?

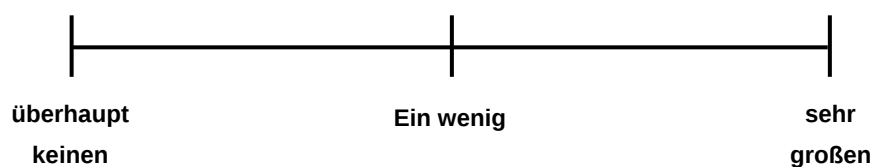
Beschreiben Sie bitte Ihr Hungergefühl indem Sie auf untenstehender Linie eine Markierung setzen.



Wie satt fühlen Sie sich?



Wie viel Appetit haben Sie?



7.1.5 Taste Test

Es folgt die sensorische Beurteilung des Lebensmittels:

Bei diesem Test sollen geschmackliche, geruchliche und texturale

Eigenschaften von einer neuen Sorte Chips bewertet werden. Bitte lassen Sie sich ruhig Zeit.

Für eine exakte sensorische Prüfung ist es außerdem wichtig, dass Sie vom Produkt ausreichend essen.

Es dürfen unbegrenzt Chips verzehrt werden.

Wie bewerten Sie das Aussehen des Produktes:	Ausgezeichnet	eher gut	passabel	weder/noch	eher nicht gut	überhaupt nicht gut
Wie bewerten Sie die Farbe:	ausgezeichnet	eher gut	passabel	weder/noch	eher nicht gut	überhaupt nicht gut
Wie bewerten Sie Ihren ersten Eindruck beim Anfassen des Produktes:	ausgezeichnet	eher gut	passabel	weder/noch	eher nicht gut	überhaupt nicht gut

Wie bewerten Sie die Festigkeit:	ausgezeichnet
	eher gut
	passabel
	weder/noch
	eher nicht gut
	überhaupt nicht gut

Wie bewerten Sie den Geruch:	ausgezeichnet
	eher gut
	passabel
	weder/noch
	eher nicht gut
	überhaupt nicht gut

Wie bewerten Sie den Geschmack:	ausgezeichnet
	eher gut
	passabel
	weder/noch
	eher nicht gut
	überhaupt nicht gut

Wie bewerten Sie das Mundgefühl während dem Kauen:	ausgezeichnet
	eher gut
	passabel
	weder/noch
	eher nicht gut
	überhaupt nicht gut

Wie bewerten Sie die „Crunchiness“:	Ausgezeichnet	eher gut	passabel	weder/noch	eher nicht gut	überhaupt nicht gut
Wie bewerten Sie die Konsistenz:	Ausgezeichnet	eher gut	passabel	weder/noch	eher nicht gut	überhaupt nicht gut
Wie bewerten Sie das Produkt gesamt:	Ausgezeichnet	eher gut	passabel	weder/noch	eher nicht gut	überhaupt nicht gut

Vermuten Sie, dass das getestete Produkt aus biologischer Landwirtschaft stammt?

- ☐ Ja
☐ Nein

Würden Sie das getestete Produkt kaufen?

- ☐ Ja
☐ Nein

Wie viel würden Sie für eine 200g Packung des getesteten Produkts ausgeben
(in Euro)?

Würden Sie das getestete Produkt weiterempfehlen?

☐ Ja

☐ Nein

7.1.6 Manipulation Check

Haben Sie wirklich die Anweisungen befolgt, um die Sie gebeten wurden?

☐ Ja

☐ Nein

7.1.7 Mental Imagery Task

Intervention group (9xMI chips)

Lesen Sie sich die Anweisungen durch und führen Sie sie durch. Die folgende Vorstellung soll jeweils mindestens 15 s dauern.

1. Setzen Sie sich gemütlich hin
2. Schließen Sie die Augen
3. Stellen Sie sich vor, dass vor Ihnen eine Schüssel mit Kartoffelchips steht. Greifen Sie in die Schüssel und nehmen sich ein Chips heraus, schauen Sie sich das Chips an und stecken sie sich das Chips in den Mund (machen Sie dabei die Handbewegung mit)
4. Stellen Sie sich vor, wie es knuspert, wenn Sie auf das Chips beißen, wie es sich anfühlt und schmeckt während Sie das Chips zerkauen und hinunterschlucken
5. Öffnen Sie Ihre Augen, machen mit dem Stift einen Strich auf dem Blatt Papier. Pausieren Sie kurz für 5-10 Sekunden und beginnen wieder von vorne

Wiederholen Sie diesen Vorgang 9-mal

Intervention group (18xMI chips)

Lesen Sie sich die Anweisungen durch und führen Sie sie durch. Die folgende Vorstellung soll jeweils mindestens 15 s dauern.

1. Setzen Sie sich gemütlich hin
2. Schließen Sie die Augen
3. Stellen Sie sich vor, dass vor Ihnen eine Schüssel mit Kartoffelchips steht. Greifen Sie in die Schüssel und nehmen sich ein Chips heraus, schauen Sie sich das Chips an und stecken sie sich das Chips in den Mund (machen Sie dabei die Handbewegung mit)
4. Stellen Sie sich vor, wie es knuspert, wenn Sie auf das Chips beißen, wie es sich anfühlt und schmeckt während Sie das Chips zerkauen und hinunterschlucken
5. Öffnen Sie Ihre Augen, machen mit dem Stift einen Strich auf dem Blatt Papier. Pausieren Sie kurz für 5-10 Sekunden und beginnen wieder von vorne

Wiederholen Sie diesen Vorgang 18-mal

Mental Imagery Task

Control group (9xMI coins)

Lesen Sie sich die Anweisungen durch und führen Sie diese durch. Die folgende Vorstellung soll jeweils mindestens 15 s dauern.

1. Setzen Sie sich bequem hin.
2. Schließen Sie Ihre Augen.
3. Stellen Sie sich vor Sie befinden sich in einer Wäscherei und stehen vor einem
4. Waschautomaten. Neben dem Waschautomaten steht eine Schüssel voller 50 ¢
5. Münzen.
6. 4. Sie entnehmen eine 50 ¢ Münze aus der Schüssel und betrachten diese genauer.
7. 5. Danach stellen Sie sich vor, wie Sie die Münze in den Waschautomaten einwerfen.
6. Abschließend drücken Sie auf „Reset“ um die Münze wieder zu bekommen und
8. legen diese in die Schüssel zurück (machen Sie dabei die entsprechenden
9. Handbewegungen mit).
7. Öffnen Sie Ihre Augen, machen Sie mit dem Stift einen Strich auf dem Blatt Papier.
10. Pausieren Sie kurz für 5-10 Sekunden und beginnen wieder von vorne.

Wiederholen Sie den Vorgang 9-mal.

Control group (18xMI coins)

Lesen Sie sich die Anweisungen durch und führen Sie diese durch. Die folgende Vorstellung soll jeweils mindestens 15 s dauern.

1. Setzen Sie sich bequem hin.
2. Schließen Sie Ihre Augen.
3. Stellen Sie sich vor Sie befinden sich in einer Wäscherei und stehen vor einem
4. Waschautomaten. Neben dem Waschautomaten steht eine Schüssel voller 50 ¢
5. Münzen.
6. 4. Sie entnehmen eine 50 ¢ Münze aus der Schüssel und betrachten diese genauer.
7. Danach stellen Sie sich vor, wie Sie die Münze in den Waschautomaten einwerfen.
8. Abschließend drücken Sie auf „Reset“ um die Münze wieder zu bekommen und
9. legen diese in die Schüssel zurück (machen Sie dabei die entsprechenden
10. Handbewegungen mit).
11. Öffnen Sie Ihre Augen, machen Sie mit dem Stift einen Strich auf dem Blatt Papier.
12. Pausieren Sie kurz für 5-10 Sekunden und beginnen wieder von vorne.

Wiederholen Sie den Vorgang 18-mal.

7.2 Procedure

