Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Testing the sour-grapes effect - how food deprivation and reward expectancy change implicit and explicit food-liking and food-wanting

Inaugural-Dissertation

zur Erlangung der Doktorwürde der

Philosophischen Fakultät II

der

Julius-Maximilians-Universität Würzburg

vorgelegt von

Philippe Türk Pereira

aus Würzburg

Würzburg, 2010

Testing the sour-grapes effect - how food deprivation and reward expectancy change implicit and explicit food-liking and food-wanting

Inaugural-Dissertation

zur Erlangung der Doktorwürde der

Philosophischen Fakultät II

der

Julius-Maximilians-Universität Würzburg

vorgelegt von

Philippe Türk Pereira

aus Würzburg

Würzburg, 2010

Erstgutachter: Professor Dr. Fritz Strack

Zweitgutachter: Professor Dr. Roland Deutsch

Tag des Kolloquiums: _____

Acknowledgements

First and foremost, I would like to thank my supervisor Fritz Strack! Dear Fritz, I am very thankful and blessed that I had the chance to work at your department with so many great colleagues, despite my firm intentions to also follow other interests! Although it might sound very banal, I am very sure that I learned much more during my PhD than just scientific skills. I learned for living! And because this was an invaluable gift for me, I once more would like to express my gratitude to you.

My profound gratitude also goes to Roland Deutsch, with whom I developed and discussed the ideas and experiments of my dissertation and who helped and trusted me through all my ups and downs with his endless professionalism, confidence and warmth. Dear Roland, I owe you very much! Thank you for everything!

To the same extent I would like to thank Michael Häfner, who escorted my academic career since my first days as a student in Würzburg. The unbelievable enthusiasm he always brought towards Social Psychology and our scientific projects was actually the reason, why I decided to start and end my PhD. Micha, you not only inspired me as a mentor, but also as a true friend. Thank you so much!

Moreover, I would like to dedicate my deepest thankfulness to my colleague and best friend Sascha Topolinski, who accompanied me not only professionally but also and foremost humanly throughout the whole endeavor. Dear Topo, to count every mutual thing that helped me to remain defiant the last years would certainly go beyond any legal scope. I am sure you know what you mean to me. Thank you! No, THANK YOU!

My heartfelt gratitude also goes to my colleague and roommate Atilla Höfling. Dear Ati, although you have been a pain in the neck sometimes, I could not imagine a better person to

share every single working day! Thank you so much for your humor, your scientific competence and support during my PhD and especially during our DFG project and for your friendship that surrounded me from morning to night.

Dear Petra, the certainty that there is also another person following the same professional goals gave me the required confidence in my own PhD project. I think that we have done a great job, and I thank you for being the brave outrider that I could follow.

I would also like to express my gratitude to my student assistants Andreas Weber, Michael Schmitt, Moritz Schäfer and Michael Schüssler. Working with you was great. Without your endless help and valuable ideas around the research the present thesis would not have been completed to the present day.

Dear Rita, for me, you are an adorable person and I would also like to thank you for your constant help and patience with my shortcomings and for keeping the department running.

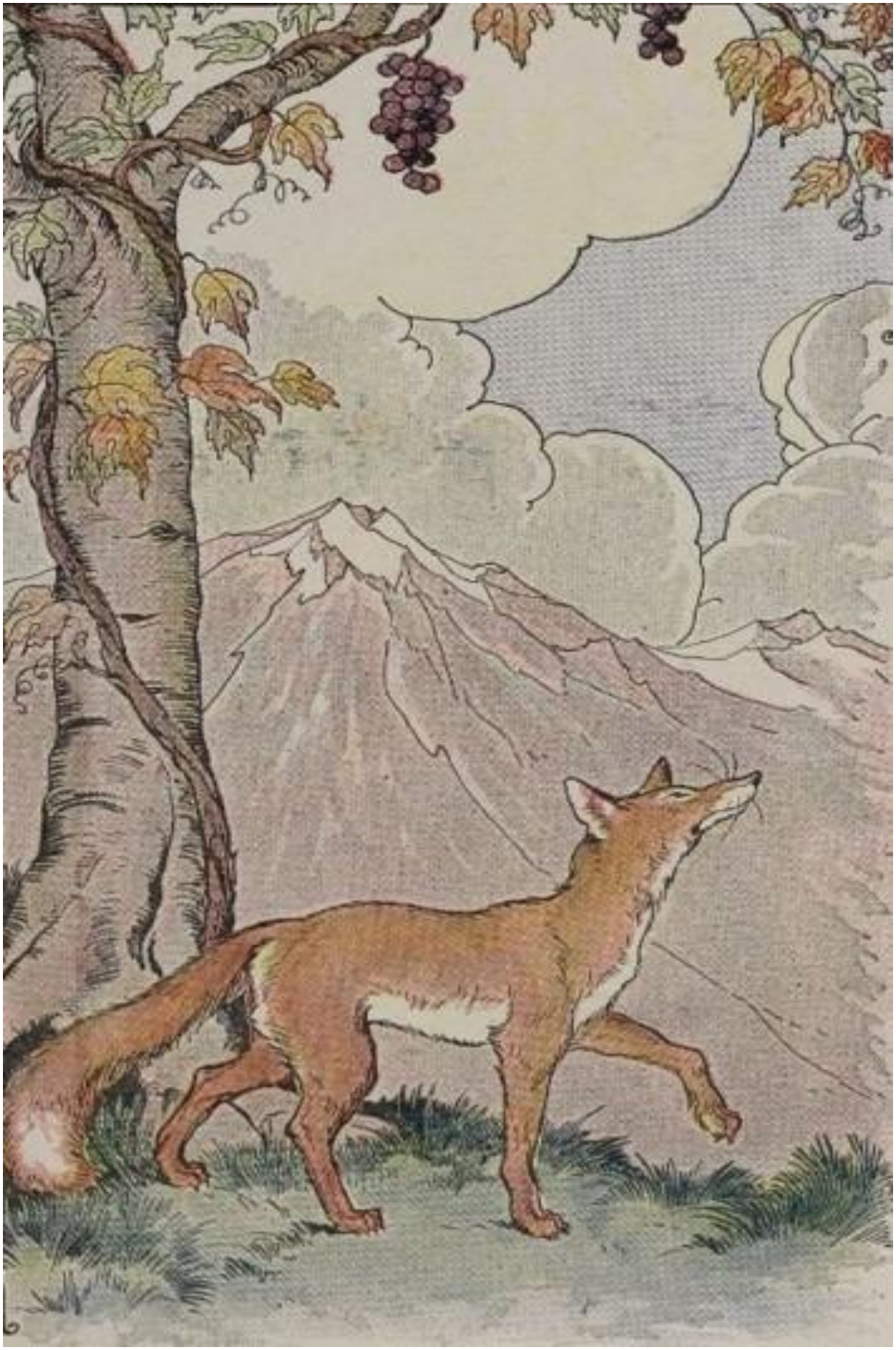
Dear Karl-Heinz, believe me or not, but in some or the other way you too has contributed an essential amount of help to the realization of my dissertation. None of the many computer problems was unsolvable for you! Our conversations at lunchtime were always very interesting and regenerative! Thank you very much!

I also would like to thank my colleagues Arnold Keller and Albin Schmitt for their help around the department and for the warm friendship we share. You both are certainly one of the few “Bayern” supporters that I like!

My special thanks also go to my colleagues Wilhelm Hofman and Robert Kordts-Freudinger for helping me on the meta-analysis. Dear Wilhelmo, dear Roberto, muito obrigado!

As a matter of course, I would also like to thank Beate Seibt, Regina Krieglmeyer, Katja Stork, Jennifer Meyer, Thomas Stemmler, Matthias Michalik and Georg Förster for being great colleagues, friends and constant sources of inspiration.

Finally, I would like to express my deepest thankfulness to my family, Mom, Dad, Fabi, Eva, Julia, Steffi, Patty, Luci, Ulla, Otmar, Sabine, Wolfgang, “Omi” and my partner Sandra for their emotional support, love, joy and confidence during the last years. I love you!



Ancient Aesop fable ‘the Fox and the Grapes’ (author unknown)

Table of Contents

INTRODUCTION

A very old anecdotal knowledge reflected in the ancient Aesop fable ‘the Fox and the Grapes’ (author unknown) tells us the story about a fox, which was very thirsty after an exhausting hunt during the day. The fox was striving around until he saw a bunch of fat and juicy grapes hanging from a wine just above his head. The grapes looked very ripe and the fox was in full anticipation of finally having the chance to quench his thirst. Thereupon, the fox stretched as high as he could to catch the grapes, but the grapes were hanging too high completely out of his reach. After repeated intensive but unfortunate attempts, the fox got tired and finally gave up. Still thirsty, the fox furiously replied saying “the grapes are sour anyway!” and went away. Beside its philosophical appeal, this sour-grapes anecdote also nicely points to the phenomenon that need-relevant but unobtainable objects are likely to be devaluated. According to Amsel (1958, 1992; see also Wagner, 1969), for example, appetitive food stimuli should lead to a state of *frustrative nonreward* and thus to negative affective reactions, when they are presented to organisms in a high drive state while the immediate consumption of real food has become impossible at the same time. As was put similarly by Berridge and Robinson (1995) “[…] when a powerful incentive is much desired but not obtainable, as in the myth of Tantalus, the experience becomes unpleasant. To be tantalized but never gratified can be a form of torture (p. 73)”.

However, assuming that the need for nutrients is perhaps one of the most central for organisms in order to survive (Pittman & Zeigler, 2007), food as the means to satisfy hunger should constitute something extremely positive, especially for hungry organisms. From such a perspective, the devaluation of food seems to be very implausible, regardless of contextual limitations. Thus, both ideas on how need states might determine the immediate valence of need-relevant objects seem to contradict each other. The aim of the present thesis was to

empirically shed more light into this inconsistency on the basis of different theoretical assumptions.

In fact, research, so far, has gathered empirical evidence in support of both ideas. On the one hand, food-deprived individuals were found to immediately evaluate food stimuli more positively than satiated ones (Hoefling & Strack, 2008; Seibt, Häfner, & Deutsch, 2007) as well as to approach them more readily (Seibt et al., 2007). These lines of research, which will be reviewed at greater detail below, imply that the immediate valence of food changes *flexibly* as a function of need state (c.f. Strack & Deutsch, 2004). This flexibility can be interpreted as being functional for organisms in order to efficiently counteract states of nutrient deficiencies by making food more rewarding. According to Lewin (1935), the valence of an object "usually derives from the fact that the object is a means to the satisfaction of a need" (p. 78). Ferguson and Bargh (2004) also add to this early motivational conceptualization of this object-valence-link by proposing the functional nature of automatic evaluation being in the service of doing.

On the other hand, however, there is also evidence showing that subjects react spontaneously with increased aversive affective responses to food cues due to food deprivation (e.g., Drobes et al., 2001; Mauler, Tuschen-Caffier, Hamm, & Weike, 2006). Although not tested directly in those studies, most authors alluded to the concept of frustrative nonreward in order to explain such unexpected findings. In particular, since eating-related stimuli presented to food-deprived subjects without a perspective to be consumed (as was the case in those studies) may instigate a frustrative experience, it could be assumed that such stimuli should therefore be evaluated more negatively. In addition to the motivational approach described above, the frustrative nonreward approach implies that the immediate valence of need-relevant objects would change as a joint function of need state and reward expectancy. To test this reasoning, the present thesis introduces two experiments in which both need state and reward expectancy were manipulated. Moreover, based on the observation

that different literatures report either positive or negative changes in immediate valence due to food deprivation according to different durations of food deprivation (Drobes et al., 2001; Levine, Cehin, & Murphy, 1942; Seibt et al., 2007), a further experiment also tested whether the immediate valence of need-relevant vs. -irrelevant objects might change as a function of deprivation strength.

Beside the specific differences between them, both the motivational and the frustrative nonreward conceptualization act on the assumption that the immediate valence of an object needs to be flexible, because it changes as a function of internal (need) and external (reward expectancy) circumstances. However, classical network models of knowledge representation (Anderson & Bower, 1973) would not assume such a flexibility of object-valence representation. Instead, later proponents of this conceptualization would rather assume relatively stable associative links between concepts (e.g., the concept of food) and attributes (e.g., positive) that should change only very slowly through repeated learning processes (Devine, 1989; Epstein & Papini, 1999; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Greenwald & Banaji, 1995; Wilson, Lindsey, & Schooler, 2000). Accordingly, such associative links between concepts and attributes form the basis for attitude formation that are stored and represented in memory. Such associations are best captured when measured indirectly i.e. mostly outside of individuals' control. Moreover, they are thought to reflect what many researchers call implicit attitudes (e.g., Greenwald & Banaji, 1995; Wilson et al., 2000). On the other hand, explicit attitudes assessed via self reports rather capture "evaluative judgments that are based on syllogistic inferences derived from any kind of propositional information that is considered relevant for a given judgment" (Gawronski & Bodenhausen, 2006, p. 694). In contrast to implicit attitudes, explicit attitudes based on propositional inferences are thought to be more flexible, but also more capacity-dependent and susceptible to correctional biases (e.g., socially desirable answers). Although the assumption that implicit attitudes change very slowly has been questioned recently by several authors (e.g., Blair, Ma,

& Lenton, 2001; Seibt et al., 2007; Wittenbrink, Judd, & Park, 2001), there is also consistent evidence that shows that implicit attitudes are significantly less flexible than explicit attitudes, especially when considering a change in valence of the attitude object (Gregg, Seibt, & Banaji, 2006; Rydell & McConnell, 2006). From such a dual attitude point of view, it could be hypothesized that the immediate valence of need-relevant stimuli should rather not change flexibly as a function of need state or reward expectancy. Instead, it would be implied that the association between stimulus and stimulus valence should be relatively positive irrespective of need state, assuming that food is in general a rewarding and therefore a positive object for human beings, because of its importance for survival.

In sum, three different predictions can be derived from the above approaches with regards to the malleability of the immediate valence of need-relevant objects as a function of need state and reward expectancy. A motivational approach would assume that the implicit and explicit attitudes towards need-relevant stimuli should be more positive in food-deprived relative to satiated subjects, regardless of reward expectancy (Seibt et al., 2007). Based on frustrative nonreward assumptions, it can be hypothesized that the immediate valence of need-relevant stimuli should vary according to need state and reward expectancy (Drobes et al., 2001). In particular, food-deprived and nonrewarded subjects should show more negative responses towards food stimuli than satiated or rewarded subjects. However, for explicit responses towards need-relevant stimuli no definite conclusions can be derived from this approach. Lastly, from a dual attitude approach, one would rather assume that the implicit (vs. explicit) attitudes towards need-relevant stimuli would not significantly change as a function of need state.

To go a step further, the present thesis also assumes that implicit associations may have different components that could also change in valence, an issue that was only scarcely addressed before. In this regard, Amodio and Devine (2006) recently proposed different affective and cognitive forms of implicit bias guiding behavior independently from each

other. In this line of research, the spreading activation of different stereotypes-related representations within a semantic network may occur at different levels of information processing and may also inhibit each other. In line with this view, Robinson and Berridge (1993) introduced a model (which will also be explained at greater detail below), in which an evaluative *liking* component of reward can be distinguished from a motivational *wanting* component of reward. Their research suggest that the extent to which someone is addicted and motivated to obtain a substance can dissociate strongly from the extent to which someone likes it and is using it. Moreover, both the liking and the wanting component are assumed to be based on automatic processes (Robinson & Berridge, 1993, p. 267). Thus, liking- and wanting-related concepts should be best captured by indirect, implicit measures of responding, such as the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). However, little research was done so far that tried to capture implicit liking- relative to implicit wanting-components of attitudes (e.g., De Houwer, Custers, & Clercq, 2006; Wiers, van Woerden, Smulders, & de Jong, 2002; Wiers, van de Luitgaarden, van den Wildenberg, & Smulders, 2005) and it remains relatively unclear, how good the measures really capture liking or wanting. Moreover, to what extent liking- vs. wanting-related attitudes towards need relevant stimuli might be sensitive to need state or reward expectancy also remains an open question. Based on this conceptualization, it could be tested whether both the motivational and the dual attitude approach share some validity, by showing that only motivational wanting-related attitudes towards need-relevant stimuli vary due to food deprivation, while liking-related attitudes - being relatively stable food-valence-associations - might be less sensitive towards need states. However, the frustrative nonreward approach would predict that only the liking-related attitudes may be more negative due to food deprivation and nonreward, while wanting-related attitudes might be less sensitive towards nonreward. In this regard, Robinson and Berridge (1993) concluded that “the sight of food may be irresistibly attractive to the starving person, but if out of reach it may torment rather than please. But food is still

much wanted" (p. 261). The aim of the present research was to test these assumptions more thoroughly. Some preliminary evidence is already suggesting that food-liking and food-wanting can be dissociated as a function of need state (e.g., Epstein, Truesdale, Wojcik, Paluch, & Raynor, 2003; Finlayson, King, & Blundell, 2007a). Specifically, food-wanting was found to increase while food-liking was found to be unaffected or even decrease due to food deprivation (Drobes et al., 2001; Epstein et al., 2003; Gibson & Desmond, 1999). Other studies report similar results (Finlayson et al., 2007a; Havermans, Janssen, Giesen, Roefs, & Jansen, 2009). Based on this evidence and having the different theoretical approaches in mind, the present experiments were designed to test how liking- and wanting-related attitudes towards need relevant stimuli might change as a function of need state and reward expectancy. In addition, the present research was also intended to assess implicit relative to explicit liking- and wanting-related attitudes. Beside the mere methodological interest, it could also be explored, for example, whether frustrative nonreward might elicit more negative attitudes towards need-relevant stimuli either via a conscious reflection about the availability of food, or whether frustrative nonreward might trigger negative responses on a more automatic level of responding.

Finally, while some authors already started to argue on the basis of frustrative nonreward when interpreting their results (e.g., Drobes et al., 2001; Hawk, Baschnagel, Ashare, & Epstein, 2004; Mauler et al., 2006; Rejeski et al., in press), they still failed to measure whether frustration was elicited at all in food-deprived participants due to nonreward. However, this information is crucial in order to test the frustrative nonreward hypothesis. Thus, the present research should also add to fill this gap. For instance, hungry and satiated participants were asked to indicate the degree to which they experienced frustration, anger, or other affects in response to the different experimental conditions. First indirect evidence can be drawn from Carver (2004) showing that a situation of frustrative nonreward (in a test achievement paradigm) may lead to participants feeling annoyed, frustrated and discouraged.

Taken together, having in mind the different theoretical approaches outlined above, the present thesis addressed the following research questions:

- Do liking- and wanting-related evaluations toward food stimuli dissociate due to food deprivation? (*Experiment 1*)
- Does nonreward compared to reward expectancy/consumption lead to liking-wanting dissociations in food-deprived participants? (*Experiment 2 & 3*)
- Do explicit food-liking and food-wanting evaluations dissociate due to food deprivation? (*Experiment 1 - 3*)
- Are food deprivation and nonreward associated with frustration and negative mood? (*Experiment 2 & 3*)
- Do implicit food-liking evaluations in contrast to evaluations toward need-irrelevant stimuli vary as a function of different levels of food deprivation? (*Experiment 4*)

It was hoped that answering those questions would provide new insights regarding the flexibility and automaticity of evaluative versus motivational responses towards rewarding stimuli as a function of need state and reward expectancy.

THEORETICAL PART

Without the ingestion of essential nutrients, animal and human organisms would hardly be able to survive. Thus, the need for food embodied in the state of hunger constitutes one of the most basic human needs (Hull, 1943)[1]. Accordingly, behaviors toward finding and ingesting food have to be most efficient in situations when organisms are deprived of food. Accordingly, when energy resources are restored, organisms should also possess mechanisms that stop food intake again. In this regard, a lot of research has been done in order to identify the mechanisms that might mediate between food deprivation and eating-related behavior in animals and humans. Therefore, the literature on biological (e.g., Johnson & Wildman, 1983; Schwartz, Woods, Porte, Seeley, & Baskin, 2000; Wisniewski, Epstein, & Caggiula, 1992), neuropsychological (Berthoud, 2004, 2006; Berthoud & Morrison, 2008; Critchley & Rolls, 1996; Kringelbach, 2005) and psychological mechanisms (Brendl, Markman, & Messner, 2003; J. S. Bruner, 1957; Cabanac, 1971; Drobes et al., 2001; Finlayson, King, & Blundell, 2007b; Havermans et al., 2009; Hoefling et al., 2009; Lucas & Sclafani, 1996; Markman, Brendl, & Kim, 2007; Mogg, Bradley, Hyare, & Lee, 1998; Nisbett & Kanouse, 1969; Sanford, 1936; Seibt et al., 2007; Wispe & Drambarean, 1953) involved in the regulation of food intake due to changes in nutritional states is large and also concordant in many aspects. Whereas biological and neurophysiological studies mainly focus on the analysis of specific humoral and neuronal correlates of hunger, satiation, and eating, the psychological approach is mostly connected to the question of how hunger may influence the way animals and humans behave in response to eating-relevant environments and food-relevant stimuli. This research was stimulated basically by classical studies developed in the beginning of the 20th

[1] Beside the need for food (hunger), Hull (1943) also mentioned the need for water (thirst), the need for air, the need to avoid pain, the need for an optimal temperature, the need to defecate and to micturate, the need for rest after exercise, the need for sleep, the need for activity after long periods of inaction as well as sexual drives as universal primary needs responsible for the maintenance of the species.

century (Hull, 1943; Richter, 1927; Sanford, 1936, 1937; Wada, 1922). Wada (1922), for example, found a relationship between gastric hunger contractions and restless body activity during sleep in humans. Specifically, Wada let human subjects swallow a tube prepared with an inflatable balloon. While the balloon itself entered the stomach, the end of the tube that came out of the mouth was connected to a pneumatic recording instrument. Subjects were then placed upon an experimental bed that was constructed to record any restless body movements of the sleeper. As a result, Wada observed increased restless movements of the participants only due to the stomach contractions that occurred over night. From this finding, the author concluded that restless body activity has once been functional for hungry organisms in search of food. Compared to organisms that preferred to stay in the same territory, restless organisms striving around were more likely to encounter new areas with food or fertile soils. As this classic example illustrates, it would be most adaptive if nutritional states were automatically detected and translated into direct behavior counteracting homeostatic energy imbalances. In line with this assumption, food deprivation consistently has been shown to automatically affect perception, attention, and evaluation of food-relevant stimuli toward the direction of need reduction. In the following, this literature should be reviewed in more detail, before also considering literature contradicting this assumption.

Facilitation Effects of Food Deprivation on the Processing and Evaluation of Food Stimuli

Several lines of research support the assumption that behavioral responses to need-relevant objects vary automatically as a function of need state. For example, food was found to taste better when hungry than when satiated (Cabanac, 1971, 1992). Accordingly, McClelland and Atkinson (1948) demonstrated that 16 hours food-deprived participants perceived food more readily by generating more eating-related thoughts upon ambiguous figures than satiated subjects on a Thematic Apperception Test (see also Epstein, 1961; Plihal,

Haenschel, Hachl, Born, & Pietrowsky, 2001; Sanford, 1936; 1937, Wispe & Drambarean, 1953, for related results on the influence of food deprivation on perception; see Bruner, 1957, for a review). Moreover, food-deprived participants were also found to show biases in selective attention to food stimuli in studies using the dot-probe task (Mogg et al., 1998; see also Placanica, Faunce, & Soames 2002), the Stroop (1935) color naming task (Channon & Hayward, 1990; Lavy & van den Hout, 1993; but see Green, Elliman, & Rogers, 1995, for null results), or the emotional blink of attention paradigm (Piech, Pastorino, & Zald, in press; but see also Nijs, Muris, Euser, & Franken, in press, for different outcomes using various attention-related tasks). In line with these findings, thirsty participants perceive ambiguous stimuli as more transparent, assuming that transparency is a characteristic that can be attributed to water (Changizi & Hall, 2001). Furthermore, food-deprived subjects were also shown to prefer bodies signaling a higher body weight over bodies with a lower body weight (Swami & Tovée, 2006; see also Nelson & Morrison, 2005). Pointing to the same conclusion, need-relevant cues have also been shown to be cognitively more accessible in a state of food deprivation (Berry, Andrade, & May, 2007; Lazarus, Yousem, & Ahrenberg, 1953). For instance, Berry et al. (2007) found faster responses for food-related items relative to neutral on a lexical decision task for hungry compared to satiated participants and that this preference correlated highly with the frequency of food-related thought intrusions during the task. Accordingly, Aarts, Dijksterhuis and De Vries (2001) also observed that thirsty[2] versus non-thirsty participants responded with an increased accessibility of thirst-relevant stimuli in a lexical decision task as well as with a better recall of drinking-related items in an incidental recall task. Most recently, Topolinski and Türk Pereira (under revision) found that food-deprived compared to non-deprived participants estimated the length of both food and non-food objects to be larger when perceived by oral versus manual haptic. This effect was

[2] Because drinking is also associated with the oral ingestion of nutrients it can equally be regarded as need-relevant behavior toward ending states of hunger.

hypothesized to be mediated by a lack of sensory stimulation of the oral mucosa associated with food deprivation.

Beside this evidence clearly pointing to a *perceptual*[3] *and attentional readiness* toward need-relevant cues due to reduced nutritional states, recent research also suggest that need-relevant cues were evaluated more positively in both explicit self-reports (Brendl et al., 2003; Cabanac, 1971; Drobes et al., 2001; Mauler et al., 2006), as well as implicit measures of attitudes designed to capture attitudes more indirectly (Ferguson & Bargh, 2004; Hoefling & Strack, 2008; Seibt et al., 2007). For instance, Seibt et al. (2007) measured subjects' implicit evaluations toward food cues using the IAT (Greenwald, McGhee, & Schwartz, 1998; Exp. 1) and the Extrinsic Affective Simon Task (EAST, De Houwer, 2003; Exp. 2) and found that food-deprived subjects showed more positive evaluations toward food cues than satiated subjects[4]. Following the authors' arguments, the latter findings not only established first evidence in favor of a *readiness*[5] to evaluate need-relevant cues more positively inherent in deprived subjects, but also imply that need-relevant stimulus associations represents malleable and not stable concepts in memory as originally proposed by traditional network models of knowledge representation (Anderson & Bower, 1973). In fact, the immediate valence of food stimuli, i.e. the implicit attitude toward these stimuli are likely to be more flexible and therefore to vary according to fluctuations of bodily states (see Strack & Deutsch, 2004). In this regard, hunger is thought to "temporarily augment the association between food and positive valence" (Seibt et al., 2007, p. 375). Finally, Seibt et al. (2007) also found food-deprived subjects to show more spontaneous approach reactions toward food cues compared to satiated participants in a joystick task (c.f. Chen & Bargh, 1999; De Houwer, Crombez, Baeyens, & Hermans, 2001), in which participants were asked to pull food stimuli presented on the screen with the joystick as quickly as possible toward themselves (representing an

[3] The term 'perceptual readiness' was formed by Bruner (1957).
[4] Similar findings were also recently reported by Häfner, Seibt and Deutsch (2009) in the domain of sexual motives.
[5] Seibt et al. (2007) prefer to use the concept of 'preparedness'.

approach reaction) or to push the stimuli as quickly as possible away from themselves (representing an avoidance reaction), respectively. Hence, this finding further suggests that food deprivation is also associated with a *behavioral/motivational readiness* to automatically approach eating-related objects in the environment.

Altogether, the view that need states can have an influence on how individuals perceive, attend, evaluate, and behave toward need-relevant stimuli holds strong empirical support. This view is also in accordance with classical motivation theories (Hull, 1943; Lewin, 1935). Hull's early drive theory, for instance, emphasizes that states of deprivation should energize subjects' cognitive and motivational processes in the direction of drive reduction. And exactly the fact that those processes were hypothesized to be in the service of efficiently ending up the state of hunger is what is defined here by *facilitation effects* of food deprivation. Hence, in order to ensure nutritional intake, food-deprived individuals perceive, attend, and approach food stimuli more readily and also automatically evaluate them more positively. In support of such a universal motivational function of food deprivation, positive effects of need state have also been demonstrated in animal studies, mostly with rats (e.g. Berridge, 1991; Lucas & Sclafani, 1996; Zimbardo & Miller, 1958). Moreover, similar effects of need state on attentional and evaluative responses in humans were also found for other needs like nicotine deprivation (Gross, Jarvik, & Rosenblatt, 1993; Sayette & Hufford, 1994; Sherman, Rose, & Koch, 2003; Waters & Feyerabend, 2000; but see Mogg & Bradley, 2002 for diverging results) or, as was already mentioned, thirst (Aarts et al., 2001; Ferguson & Bargh, 2004).

In sum, from such a motivational approach, implicit as well as explicit food-related evaluations should become more positive due to need state.

However, there is also evidence showing that food deprivation paradoxically prompts negative responses toward need-relevant cues (e.g., Drobes et al., 2001; Mauler et al., 2006). On the background of a biological function of basic needs, this evidence seems to contradict

the assumption that food deprivation is likely to foster responses in the direction of need reduction. As this inconsistency establishes the starting point for the present research, the findings showing negative responses toward food cues will now be reviewed at greater detail.

Negative Immediate Reactions toward Food Cues due to Food Deprivation

Although a substantial amount of work is suggesting facilitation effects of food deprivation on responses towards food stimuli, there is also growing evidence paradoxically showing negative immediate reactions toward food cues due to food deprivation (e.g., Drobes et al., 2001; Levine et al., 1942; Lüthy et al., 2003; Mauler et al., 2006; Rejeski et al., in press). Drobes et al. (2001), for instance, reported that 6 hours and 24 hours food-deprived compared to satiated participants were found to show enhanced startle eyeblink reflexes[6] in response to an acoustic noise while watching pictorial food stimuli. Such potentiation of the startle reflex has been taken as evidence for an increase of the immediate defensive reaction of the organism normally elicited by aversive stimuli[7]. Similarly, a study concerned with the selective processing of appetitive cues due to food deprivation failed to find evidence for a selective Stroop interference for food relative to control words in food-deprived compared to non-deprived subjects (Stewart & Samoluk, 1997). In contrast to other studies reporting enhanced selective attention to food cues due to food deprivation (e.g., Channon & Hayward, 1990; Mogg et al., 1998), Stewart and Samoluk's (1997) findings suggest that for food-deprived participants food-relevant stimuli rather lost attentional gravity. In a recent

[6] The startle eyeblink reflex is a skeletomotor response that is elicited due to potent acoustic, visual or tactile stimulation (Davis, 1984) and is usually measured in humans via eyeblink electromyography (EMG).

[7] According to the biphasic view of affect and motivation proposed by Lang and colleagues (e.g., Lang, 1995; Lang, Bradley, & Cuthbert, 1990), positive or negative affective states can be inferred from the individuals' reflexes being consistent or inconsistent with the dominant motivational orientation (i.e., reflexes indicating either appetitive or defensive reactions). In line with these considerations, several studies (e.g., Bradley, Cuthbert, & Lang, 1990; Cook, Hawk, & Davis, 1991) demonstrated that unpleasant stimuli potentiate the defensive startle reflex in response to a sudden noise, whereas pleasant stimuli normally elicit an appetitive emotional state leading to an attenuation of the defensive startle reflex. The same mechanism has also been shown in animal research (Davis, 1989).

perception study, thirsty participants visually underestimated the size of water objects when they were previously instructed to withhold impulsive responses toward subliminally presented water-related stimuli (Veling & Aarts, in press), given that rewarding objects are usually perceived as larger in order to be identified more easily in the environment (Bruner, 1957). Moreover, in hungry compared to satiated subjects, it was also found that portions of food were visually perceived to be smaller (Brogden, Sinclair, & Almiron-Roig, 2009; Brunstrom, Rogers, Pothos, Calitri, & Tapper, 2008), even though this effect could also lead people to eat more. Although the relationship between size perception and valence is still unclear, these findings seem to question a mere motivational approach putting psychological mechanisms in the service of ending the unpleasant state of hunger. But how can such diverging and partially non-intuitive results be reconciled? When and under which conditions would it be reasonable to also assume negative effects of food deprivation? Investigating possible explanations for such results, the present research was drawn upon the theory of frustrative nonreward (Amsel, 1958, 1992; Wagner, 1969). The conceptual idea behind it is that need-relevant stimuli presented to highly-deprived subjects while the immediate consumption of food has become impossible should result in frustration and more negative responses towards those stimuli. Before deriving the specific predictions for the present thesis, however, the concept of frustrative nonreward will first be outlined in more detail below.

Frustrative Nonreward

As was already outlined above, empirical evidence has accumulated that reports negative affective reactions to food cues in food-deprived participants (e.g. Drobes et al., 2001; Mauler et al., 2006; Rejeski et al., in press). Based on the fact that almost every study reviewed above represented an experimental condition of nonreward - because at the time of

the critical measurement participants were either unaware that they will have to eat at some point during the experiment, real food was part of the experiment but consumption was forbidden, or no real food was available at all - the studies showing negative effects of food deprivation may fit the interpretation in terms of frustration due to nonreward. Classic and current models of motivation define frustration as an affective reaction that results when a desired goal is being blocked or impaired (Amsel, 1958, 1992; Berkowitz, 1989; Dollard, Miller, Doob, Mowrer, & Sears, 1939; Papini & Dudley, 1997). In line with this assumption, Carver (2004, 2006), for example, also states that anger or frustration should result as a consequence of blocking the pursuit of an approach goal (e.g., to eat something). However, if the frustration could not be controlled or overcome, sadness and dejection will be likely to result (Carver, 2004; see Maier & Seligman, 1976, for a more detailed analysis of the concept of learned helplessness). Moreover, failure experiences leading to negative emotional responses to disappointing results may cause individuals to turn away from choices and options associated with that disappointment (Ratner & Herbst, 2005) and to like those options less (Litt, Khan, & Shiv, in press). Based on that notion, the frequent presentation of food stimuli (either real or presented as pictures or words on the screen) to food-deprived participants may have rendered the reward concept of eating even more salient and thus also the motivation to eat. However, not being able to satisfy hunger while dealing with food stimuli during the experiment may have prompted frustrative nonreward, which again could have been reflected in participants' negative reactions toward the presented food stimuli. Thus, the present research was aimed at testing whether frustrative nonreward might lead to more negative evaluations of need-relevant stimuli due to the negative affect elicited by frustrative nonreward. Other authors highlight the aversive nature of nonreward in deprived rats (Capaldi, 1990; Wagner, 1969). For instance, Wagner (1963) showed rats to respond with potentiated startle reflexes to food cues when food was withheld. In contrast, the author found attenuation rather than increase of the startle reflex in deprived rats, when they were presented

with different edible cues within a taste reactivity test, which they also were allowed to eat at the end of the experiment. Hawk et al. (2004) reported converging results for human subjects, who were allowed to eat during the experiment. Hawk et al. further found this effect to be most robust among participants reporting the highest craving toward the food cues. These results suggest the availability of real food and the opportunity to consume food during the experiment to be crucial moderators with respect to the affective reactions to food stimuli with which participants would be likely to respond. Moreover, in the domain of nicotine addiction, Carter and Tiffany (2001) reported that smokers responded with stronger negative affect towards smoking cues, but only when they were not allowed to smoke until the experiment had ended. The authors concluded that smoking cues constituted something appetitive only when smoking was allowed. However, when smoking was prohibited, smoking cues turned into something aversive.

Further empirical evidence in support of the concept of frustrative nonreward has been gathered from animal and human studies that focused on autonomous and behavioral responses as indicators of frustration. For example, in their classic frustration theory, Amsel and Rousell (1952) also introduced frustration as an aversive motivational state after nonreward that was described as an avoidance motivation with high arousal that in turn is hypothesized to increase instrumental behavior. In animal studies, the authors found support for their assumptions, by showing that rats run faster to a second goal box after nonrewarded compared to rewarded trials in a first box. Later studies working with amygdala[8] lesions indicate that arousal potentially mediates those effects (Henke & Maxwell, 1973). This conceptualization of frustration is also in line with the classic circumplex model of affect proposed by Russell (1980), who also classified frustration in the emotion quadrant aligned by the dimensions *misery* and *arousal*. Amsel's assumptions were later also proved to be evident

[8] The amygdala is a cerebral structure that has been shown to be associated with emotional processes (e.g. LeDoux, 1996). In line with the frustration theory of Amsel and Rousell (1992), the amygdala was also associated with increasing arousal in reaction to negative stimuli (Bernston, Bechara, Damasio, Tranel and Cacioppo, 2007).

in human studies. Specifically, it has been shown that unexpected nonreward not only leads to changes in physiological parameters associated with arousal (Weil & Katkin, 1969), but also in an increase of the vigor of instrumental behavior (Ditkoff & Ley, 1974). Given this evidence, however, research showing negative evaluations towards need-relevant cues due to nonreward and food deprivation is still missing. Therefore, the main goal of the present thesis was to test how evaluations toward need-relevant cues may be moderated by food deprivation and nonreward.

The evidence in favor of the frustrative nonreward approach presented so far was based on indirect measures of responding (e.g. the startle reflex). But what can be predicted for explicit self-reports of subjective liking for food? This question was also addressed within the present research, given that a conclusive answer to this question is still lacking. For instance, Mauler et al. (2006) found that food-deprived participants reported more positive evaluations of food cues than satiated participants, while they at the same time also showed enhanced startle eyeblink reflexes indicating rather more negative affective responses. This finding reflects a dissociation of implicit and explicit responses towards food cues, implying that negative responses towards need-relevant stimuli may occur rather automatically and not on more conscious reflective grounds. However, from a cognitive consistency approach (Festinger, 1957; Festinger & Carlsmith, 1959), nonreward should elicit dissonance, given that hungry and nonrewarded individuals may have the opposing cognitions “I like food” but “I cannot eat it”. As a result, the individuals should be likely to resolve this inconsistency by coming to the conclusion that they actually do not like the food (or as the Fox would say: “the grapes are sour anyway”). From such a point of view, explicit evaluations should also be predicted to become more negative due to food deprivation, albeit this assumption still awaits further evidence.

In conclusion, from frustrative nonreward approach, implicit food-related evaluations should become more negative due to need state. For explicit food-related evaluations, no definite prediction can yet be made.

Beside this fundamental divergence between research showing more positive (the motivational approach) versus research showing more negative responses towards need-relevant stimuli due to food deprivation (the frustrative nonreward approach), the evidence reviewed so far at least supports the notion that immediate evaluations of need-relevant objects changes flexibly as a function of need state. However, this idea does not fit with the assumption that associative links between concepts and valence attributes within a network model of knowledge representation represents rather stable constructs that should change only very slowly and effortful (e.g., Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Greenwald & Banaji, 1995; Wilson et al., 2000). In the following, the concept of dual attitudes proposed by Wilson et al. representing this assumption will be introduced shortly.

The Concept of Dual Attitudes

According to Wilson et al., implicit and explicit attitudes coexist in memory forming two evaluations of a single object. Implicit attitudes are thought to represent ‘old habits’ that have developed only slowly through both culture, socialization and experience (Devine, 1989). Thus, they should become deeply integrated in memory. Explicit attitudes represent evaluations that are consciously constructed online through the expenditure of cognitive capacity and motivation. The explicit attitude can temporarily override the implicit attitude, until “the new attitude wears off and the original implicit attitude re-emerges” (p. 110). Most crucial for the present research, however, is the assumption that implicit attitudes represent rather relatively stable object-valence associations that are very hard to change, whereas explicit attitudes can be changed more easily. Although this assumption has recently begun to

be questioned by other authors (e.g., Blair et al., 2001; Seibt et al., 2007), there is also consistent evidence showing that implicit attitudes are less flexible than explicit attitudes (Gregg et al., 2006; Kim, 2003; Rydell & McConnell, 2006). Kim, for example, observed that White participants were not able to not show any automatic preferences on an IAT after being instructed to do so. Moreover, studies reported by Gregg et al. also assessed the relative malleability of implicit versus explicit attitudes towards imagined social groups. They showed that implicit attitudes could easily be formed, but were indeed relatively resistant to change, whereas explicit attitudes were not. For instance, although participants learned that the characters of two groups have changes over time, their implicit preferences failed to reverse (Experiment 4).

Based on the dual attitude approach, it could be hypothesized that need state should not result in more positive immediate evaluations of need-relevant stimuli. Instead, subjects should respond very positively to food cues irrespective of need state, given that food is in general a positive reward for human beings. This assumption would clearly contradict the motivational or the frustrative nonreward approach. On an explicit level of responding, however, hungry participants should respond with more positive evaluation of food cues than satiated participants.

In sum, from a dual attitudes approach, explicit rather than implicit food-related evaluations should become more positive due to need state.

However, to better address the different assumptions, the concept of implicit evaluations was broadened within the present research. For instance, the widely assumed tripartite model of attitudes defines attitudes to consist of an affective, a behavioral, and a cognitive component (Breckler, 1984; Rosenberg & Hovland, 1960). However, such a conceptualization was not yet assumed for implicit attitudes. However, the present research proposes that also implicit attitudes may be constituted of different components that could also change in valence (c.f. Amodio & Devine, 2006). Adding to this view, Robinson and

Berridge (1993) argued that an evaluative *liking* component of reward can be distinguished from a motivational *wanting* component of reward and that both may operate on an automatic level of responding. The aim of the present research was to translate this idea to implicit social cognition research. In particular, addressing the divergence between the motivational and the frustrative nonreward approach, both liking- and wanting-related attitudes towards need-relevant objects were measured as a function of need state. Thus, more differentiated conclusions on the flexibility of implicit attitudes and different components of them were expected to be provided. Before outlining the specific hypotheses of the present experiments, the concepts of liking and wanting will be introduced at greater detail.

Liking versus Wanting

Basically, it is reasonable to assume that people like what they want and therefore also want what they like. In other words, people are thought to be especially motivated to approach those objects they at the same time also like and vice versa. As sound and plausible this relationship might appear at first sight, the more daring it would be to assume that what people like and what people want could also dissociate, i.e. it would be less plausible to accept that objects yielding negative responses could at the same time also lead to more approach-related responses toward them and vice versa. Recent research, however, showed that people indeed may come to want more what they like less (Litt et al., in press). For instance, it was found that when people face denials and failures in obtaining a desired reward, they are likely to increase their motivation to obtain those targets (see also Fitzsimons, 2000; Gilovich, 1983; McFarlin, Baumeister, & Blascovich, 1984), while targets become less appealing after failure experiences (see also Ratner & Herbst, 2005). In particular, participants who lost an attractive prize were on the one hand more willing to pay for it afterwards, but on the other hand were also more likely to trade it away once they

ultimately had obtained it. In other words, such findings suggest that the motivation to obtain a denied reward may increase, although the value of the reward has been decreased because of the disappointment or frustration associated with the experience of denial. Similar results were also reported by Hepworth, Mogg, Brignell, and Bradley (in press) and Willner et al. (1998), who found that negative affective states increase the reward value of food cues and thus the motivation to eat.

In order to define the concepts for the present research, the term *liking* was understood as equivalent for having a hedonic affective reaction toward an object that can also be linked to a certain sensory association of pleasure or palatability resulting from the contact with that object (Berridge, 1996; Cabanac, 1971; Epstein et al., 2003; Gibson & Desmond, 1999; Hobbs, Remington, & Glautier, 2005), leading to positive evaluations of that object (De Houwer et al., 2006). In contrast, the term *wanting* was interpreted as the appetitive motivation that is associated to rewarding objects in order to approach, obtain, or ingest them (Berridge, 2007b; Hobbs et al., 2005). The usual convergence between liking and wanting in guiding people's behavior toward rewarding objects is in line with traditional theories that claim liking and wanting to emanate from one single underlying mechanism (Bindra, 1974; Toates, 1986, 1994). Or, as Berridge and Robinson (2003) put it, "all psychological components of reward are intertwined and normally operate together as part of coordinated network integrating motivational, learning, and emotional processes in reward" (p. 510). This idea is also in line with theories of motivated behavior that propose that spontaneous motivational orientations changes as a function of the valence of an immediately perceived stimulus (Gray, 1987; Lang et al., 1990; Neumann, Förster, & Strack, 2003; Strack & Deutsch, 2004). That is, perceiving positive stimuli are thought to elicit an approach orientation, whereas the perception of negative stimuli triggers an avoidance orientation. In addition, some objects constitute natural rewards because of their biological function and are therefore indispensable for survival such as for example food, water, or oxygen. Thus need

states may obviously enhance both one's liking and one's wanting towards need-relevant objects and need satisfaction. However, a growing body of evidence is suggesting that this is not always the case (e.g., Epstein et al., 2003; Finlayson et al., 2007a).

The empirical basis for the distinction between liking and wanting was laid by neuropsychological contributions from the domain of drug addiction. This research suggests that the liking of a reward (i.e., drug cues) and the wanting to obtain the reward are independent constructs based on different cerebral circuits (Berridge, 2007b; Berridge & Robinson, 1995; Robinson & Berridge, 1993, 2003). Because the concepts of liking and wanting are very central for the present research, a more profound illustration of the neurobiology of liking- and wanting-related components of reward will be provided next.

The Neurobiology of Liking and Wanting

The distinction between a liking and a wanting component of reward was first introduced by Robinson and Berridge (1993). In their seminal incentive sensitization theory, the authors introduced a neurobiological model in which liking and wanting were theorized to be independent constructs stemming from different neural pathways i.e. different brain regions and different transmitter systems. In this regard, they especially emphasized the liking and wanting processes in their core functions to be independent from subjective feelings of liking and wanting (see also Winkielman, Berridge, & Wilbarger, 2005). Therefore, the neurobiological distinction between liking and wanting is thought to reflect mostly core affective and motivational processes that can operate without conscious awareness. Basic liking and wanting processes are attributed to subcortical brain regions (Berridge, 2007b), whereas the additional conscious experience of liking and wanting are assumed to occur in more prefrontal cortical structures (Balleine & Dickinson, 1998a; Bechara, Damasio, & Damasio, 2000; Kringelbach, O'Doherty, Rolls, & Andrews, 2003). For instance, hedonic

liking reactions to sweetness (e.g., affective facial reactions) have been shown to involve several subcortical hedonic opioid hotspots in the nucleus accumbens, the ventral pallidum, and brainstem parabrachial nucleus (see e.g. Berridge, 2009; Berridge & Kringelbach, 2008). In accordance with this knowledge, Peciña and Berridge (2000), for example, could demonstrate that a selective activation of opioid neurotransmitters inside the nucleus accumbens of rats leads to pronounced liking reactions[9] due to sweet tastes. In addition, Zahm (2000) revealed some accumbens-to-cortex projections via the ventral pallidum and thalamus that are thought to play a significant role when it comes to more conscious feelings of pleasure beyond the basic affective liking reactions previously described. Other authors also emphasized the orbitofrontal cortex and other brain regions as neural correlates for subjective hedonic experiences (de Araujo, Rolls, Kringelbach, McGlone, & Phillips, 2003; Kringelbach, O'Doherty et al., 2003), although opioid activation in the nucleus accumbens has also been shown to mediate the subsequent experience of pleasure of certain stimuli in human drug takers such as heroin (Koob & Le Moal, 2001; Wise, 1998) and also human subjective feelings of pleasure elicited by palatable food (Yeomans & Gray, 1997).

On the other hand, the core wanting component has been found to be based on mesolimbic dopamine projections arising from neurons in the midbrain ventral tegmental area and also projecting to the nucleus accumbens in the forebrain. Moreover, mesolimbic dopamine neurons are hypothesized to activate motivational properties of reward rather than pleasure per se (e.g., Carelli, 2004; Cheer et al., 2007). Whereas several other neurobiological findings also suggest that dopamine neurons are activated by pleasurable events and thus are also able to mediate pleasure (Ahn & Phillips, 1999; Fiorino, Coury, & Phillips, 1997; Schultz, 1998; Wise, 1998), experiments designed to test this relationship more systematically by disentangling liking from wanting via specific brain manipulations or specific

[9] Typical liking-related facial expressions are shared by human beings, orang-utans and rats alike. Whereas sweet tastes elicit positive liking expressions like *tongue protrusions*, bitter tastes instead evoke negative liking expressions like *gapes* (Berridge & Robinson, 2003).

manipulations of dopamine signaling failed to find evidence for a mediation of liking through dopamine systems in either animals[10] or humans (Berridge & Robinson, 1998; Brauer & De Wit, 1997; Peciña, Berridge, & Parker, 1997; Peciña, Cagniard, Berridge, Aldridge, & Zhuang, 2003; S. Robinson, Sandstrom, Deneberg, & Palmiter, 2005; Wyvell & Berridge, 2000; see Berridge, 2007b, for a review). Moreover, dopamine transmitters have also been shown to be activated in response to aversive or nonrewarding cues (e.g., Horvitz, 2000; Scott, Heitzeg, Koeppe, Stohler, & Zubieta, 2006). This compelling amount of evidence suggests that the mesolimbic dopamine system related to wanting is often unable to change hedonic pleasure reactions (liking) that in contrast have been shown to have their neural correlates in opioid hedonic hotspots in the brain (Berridge, 2007b). The specific mechanism that is assumed to underlie the processes of wanting has been conceptualized as 'incentive-sensitization' or 'incentive salience attribution' (Berridge & Robinson, 1995; Robinson & Berridge, 1993). According to the authors, "incentive salience is essentially a conditioned motivation response of the brain, usually triggered by and assigned to a reward-related stimulus" (Berridge, 2007b, p. 409). In other words, incentive motivation is thought to be primed on formerly unconditioned stimuli via associative spread among related representations. For example, once a drug has been experienced as pleasant, the sight of this drug may automatically trigger the motivation to consume more of this drug whenever it is re-encountered. In addition, it was this incentive salience attribution (wanting), but not liking that has been shown to be mediated in large part by dopamine neurotransmission (e.g., Berridge & Robinson, 1998; Kaczmarek & Kiefer, 2000; Wyvell & Berridge, 2000), leading to a phenomenon called 'irrational desire' which means 'wanting something without liking it' (Berridge, 2007a; Berridge & Robinson, 1998).

[10] For example, although experimental manipulations of the dopamine system influenced the willingness of rats to work or ran for a tasty food (wanting), their facial reactions of pleasure in response to those foods (liking) remained unchanged.

As was already denoted, liking and wanting have been conceptualized as reward processes with conscious and subconscious components (Berridge & Kringelbach, 2008; Berridge & Robinson, 2003). Accordingly, liking and wanting per se were seen as core affective and motivational processes that can operate outside of conscious awareness (Berridge & Robinson, 1995). These core processes can be separated from the more conscious subjective hedonic feelings stemming from the ingestion of a specific object or substance (explicit liking)[11] and the conscious desire (explicit wanting) for a cognitively represented outcome, for example, to consume a certain food (Berridge, 2004). This important distinction implies that core liking- and wanting-related processes should be best captured by indirect measures of responding, while explicit liking and wanting should be more prone to subjective measures of attitude. In what follows, a more detailed description how implicit and explicit liking- and wanting-related processes were used to be assessed will be presented, because the measures for the present research were mostly derived from that literature.

Explicit and Implicit Measures of Liking and Wanting

Conscious liking for a reward usually has been assessed via self-reports of subjective liking (Cabanac, 1971; Epstein et al., 2003; e.g. Finlayson et al., 2007a). Subjects' explicit wanting has often been measured via self-reports of subjective motivation, at least in human studies[12] (e.g. Drobes et al., 2001; Finlayson, King, & Blundell, 2008). For instance, Finlayson, King, and Blundell (2008) asked about the target object, e.g., "how pleasant would it be to experience a mouthful of this food now?", or "how much do you want a mouthful of this food now?" making people conscious about their subjective liking and wanting for a

[11] Berridge (2004) adopted the term 'niceness gloss' from Frijda (2001) to describe the meaning of the explicit component of liking. The term refers to the pleasantness that was added by the brain above and beyond the sensory qualities of sweetness (see also Peciña & Berridge, 2000).

[12] In animal studies, wanting for food was also operationalized by observing how fast rats would run in a runway to a box with food (e.g., Amsel & Rousell, 1952).

specific reward. The present research also applied such questions. However, although eating behavior largely takes place with individuals being aware of it, it cannot be inferred that all processes that are involved in eating are also object to awareness. But modern measurement techniques in psychophysiology (e.g., Drobes et al., 2001) as well as in social and clinical psychology (De Houwer et al., 2006; Seibt et al., 2007) allow assessing processes more automatically, inferring that they are less susceptible for conscious corrections. In this regard, implicit measures basically reflect spontaneous stimulus associations that are thought to be activated through spreading activation of represented concepts semantically linked in memory (e.g., the concept "chocolate" with the concept "high-fat"), whereas explicit self-reports mainly capture more deliberate behavioral decisions that are formed through propositional attributions that are assigned to specific objects (e.g., "I like this chocolate"). The fact that a substantial number of studies reported low or even negative correlations between implicit and explicit measures of attitudes (e.g., Karpinski & Hilton, 2001) confirms the view that both measures apparently capture quite different aspects of attitudes (see Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005, for a meta-analytical review). The measures of implicit evaluations used in the present experiments were structurally similar to those already integrated in studies in the domain of drug addiction. Therein, the standard (valence-)IAT's (see Greenwald et al., 1998) were conceptualized as reflecting implicit liking, because usually the attribute categories refer to the valence dimensions of *good* vs. *bad* or *pleasant* vs. *unpleasant*, respectively, against which the different target stimuli (e.g., food words) have to be categorized. An individual's faster evaluation of, for example, food words with pleasant than with unpleasant words can be interpreted as an index of a relative implicit preference (or liking) for food words compared to other words belonging to a contrast category. However, (implicit) wanting-related associations were normally operationalized via measurement techniques that are aimed to capture spontaneous motivational orientations towards or away from a target stimulus (see Chen & Bargh, 1999; Seibt et al., 2007). Further studies already

tried to measure implicit wanting via the IAT (De Houwer et al., 2006; Ostafin & Palfai, 2006) or via a sequential priming task (Ostafin, Palfai, & Wechsel, 2003), respectively, by renaming the standard attribute category dimension of pleasant vs. unpleasant into approach vs. avoidance with words related either to approach (e.g., approach, advance) or to avoidance (e.g., avoid, withdraw). Mirroring the growing interest in dissociating liking from wanting processes, different social-cognitive studies have already been conducted that tried to capture liking and wanting evaluations via the IAT as within-subjects variable. For instance, De Houwer et al. (2006) found a dissociation between a standard attitude-IAT (positive vs. negative) and an approach-IAT (approach vs. avoidance) in smokers compared to nonsmokers in such a way that smokers were found to associate smoking more with approach than nonsmokers. However, smokers versus nonsmokers failed to show more positive attitudes towards smoking cues on the attitude-IAT (Exp. 1)[13]. Similar findings were also provided from the domain of alcohol-related cognition (De Houwer, Crombez, Koster, & De Beul, 2004; Wiers et al., 2005; Wiers, Van Woerden, Smulders, & De Jong, 2002). Specifically, those studies revealed that although heavy drinkers showed strong wanting-related associations with alcohol on an IAT[14], they at the same time also responded with negative alcohol-related associations on a standard valence IAT. Moreover, these studies also correspond to the incentive sensitization theory of Robinson and Berridge (1993) according to which addiction depends more on wanting than on liking. Thus, it has been shown that the IAT as a measure of implicit attitudes may be a promising tool in order to differentially measure both implicit liking- and wanting-related associations. The indirect measures used within the present research were similar versions of the liking- and wanting-related IATs

[13] Although De Houwer et al. found a dissociation of liking vs. wanting related attitudes toward smoking, they failed to replicate the null-results for the liking IAT in a second experiment, in which a personalized version of the IAT (see Olson & Fazio, 2004) were used. Instead, they found positive associations with smoking in a sample of smokers. This would limit the interpretation that addiction may depend more to wanting than to liking, but instead would rather emphasize the notion that implicit attitudes may be highly context-dependent (Blair et al., 2001)

[14] Wiers et al. (2002), for example, assumed wanting to reflect sensitized arousal for a reward. Therefore, they used an arousal-sedation-IAT as a indirect measure of wanting.

described above and were conceptualized as measures of implicit liking- and wanting-related attitudes towards food stimuli. In particular, the present IAT measures were modified in two ways. On the one hand, single-target versions of the IAT (ST-IAT, Wigboldus, Holland, & Van Knippenberg, 2004; see also Karpinski & Steinman, 2006) were chosen for the present research, in order to measure associations toward food stimuli in a non-comparative way. In addition, in order to obtain associations relatively free from cultural biases and also to avoid that participants accidentally misinterpret the typically used normative labels *POSITIVE* vs. *NEGATIVE* as *I WANT* vs. *I DON'T WANT*, the labels were changed into *I LIKE* vs. *I DON'T LIKE* for the liking IAT and to *I WANT* vs. *I DON'T WANT* for the wanting IAT (Experiment 2 & 3), thus *personalizing* the measures (Olson & Fazio, 2004). A more detailed description of the measures, however, will be provided in the Empirical Part of the present thesis.

Of crucial importance for the present experiments is the fact that liking and wanting may also play a significant role in eating behavior, especially when conceptualizing food as a natural reward (Berridge, 1996, 2007a; Finlayson et al., 2007a, 2007b). In this regard, it has been shown that food-liking and food-wanting may also dissociate as a function of food deprivation (e.g., Epstein et al., 2003; Gibson & Desmond, 1999). This literature will be reviewed next.

The Role of Food Deprivation in Relation to Food-Liking and Food-Wanting

In line with the view that need states are generally thought to modulate the incentive properties of natural rewards (Berridge, 2007b), food deprivation has been shown to modulate neural correlates reflecting both the reward value as well as the subjective hedonic experience attributed to need-relevant stimuli in numerous animal and human studies (e.g., Bulik & Brinded, 1994; Lappalainen & Epstein, 1990; Gottfried, O'Doherty, & Dolan, 2003; Kringelbach, O'Doherty, Rolls, & Andrews, 2003; O'Doherty et al., 2000; Patterson et al.,

1998; Petrovich, Holland, & Gallagher, 2005; Weingarten & Martin, 1989). Although a congruent relationship between food-liking and food-wanting was proposed being the "usual case" (Berridge, 1996, p. 1; see also Chen & Bargh, 1999), there is also accumulating evidence showing that food-liking and food-wanting may also dissociate due to food deprivation. For example, in a study by Gibson and Desmond (1999), hungry and satiated participants were asked to explicitly rate their taste and cravings for chocolate for a time period of 2 weeks. As a result, during the assessment period, hungry compared to satiated participants were found to report more cravings for chocolate without any changes in the rated pleasantness of the taste of the chocolate. The findings were interpreted in terms of incentive learning (Balleine & Dickinson, 1998b) in the case of chocolate craving and in terms of habituation in the case of subjective pleasure of the chocolate. In line with this result, Epstein et al. (2003) let participants fast for 4 hours versus no fast and measured both their hedonic preferences (liking) as well as the reinforcing value (wanting) of food before and after food consumption. Specifically, the hedonic rating were measured subjectively via self-reports and objectively via coding of facial expressions, whereas the reinforcing value of food was captured via a computer task, by which participants were able to earn points in order to taste from a chosen snack food. The reinforcing value of foods was then calculated as the willingness to work for the food relative to the time playing the game. As a result, hunger did not influence hedonic preferences (on subjective and objective measures), whereas it significantly increased the motivation for food. Similar results were also obtained by Finlayson et al. (2007a) and Finlayson, King, and Blundell (2008). In line with this evidence, some authors found more intense explicit food-wanting responses despite more negative implicit food-liking responses toward food cues due to food deprivation (e.g., Mauler et al., 2006). This evidence implies that separating liking- and wanting-related responses toward need-relevant stimuli due to need state might be a promising avenue in order to test the more

general question of the present thesis, namely, if and how food deprivation and nonreward might change liking and wanting-related evaluations towards food stimuli.

Summarizing what was reviewed, whereas for food-wanting there seems to be no doubt that it should change implicitly and explicitly as a function of need state, the inconsistencies are more located within the different approaches and respective findings concerning changes in food-liking due to food deprivation.

Next, an overview of the present research summarizing the main questions will be provided.

Overview of the Present Research and Outlook on the Experiments

The present research addressed two contradicting lines of research regarding how need states might change the immediate valence of need-relevant objects. On the one hand, some researchers repeatedly showed favorable immediate reactions toward need-relevant cues as a function of food deprivation (e.g., Seibt et al., 2007), whereas on the other hand, there is also accumulating evidence showing that food deprivation paradoxically yields unfavorable reactions in response to the presentation of food cues (e.g., Drobes et al., 2001). However, very little research was invested in order to close this empirical gap (Hawk et al., 2004; Levine et al., 1942). One explanation can be derived from the frustrative-nonreward approach, which opposes the motivational explanation an in which it is claimed that need-relevant stimuli presented to deprived participants without the prospect of consumption should elicit negative responses because of frustration. This explanation was tested within the present research. Moreover, this question also comprises the general debate, whether implicit attitudes rather reflect malleable (Blair et al., 2001; Seibt et al., 2007) or stable object-valence associations (Gregg et al., 2006; Rydell & McConnell, 2006). Based on the recent conceptualization of liking and wanting (Robinson & Berridge, 1993), the present research

adopted a more fine-grained approach in order to test the malleability versus stability of both food-liking and food-wanting as a function of need state and reward expactancy. With this conceptualization in mind, it could be tested if both the motivational as well as the dual attitude approach share some validity, depending on the response that was assessed. For example, it could be tested whether food deprivation leads only to a change in motivational wanting-related attitudes towards need-relevant stimuli, while letting liking-related attitudes – reflecting rather stable food-valence-associations - unchanged. However, the frustrative nonreward approach would rather assume that liking-related attitudes should be more negative due to food deprivation and nonreward, while wanting-related attitudes should be less sensitive towards nonreward.

Finally, because liking and wanting for a reward were hypothesized to be based on automatic processes, they were assumed to be captured more reliably by implicit rather than explicit measures of responding (Robinson & Berridge, 1993, p. 267; Wiers et al., 2002). Comparing both types of measures further implies the possibility to test, for example, whether negative responses toward need-relevant stimuli due to frustrative nonreward requires a more elaborate and conscious reflection about the availability of food or whether it may also occur automatically.

Given this starting-point, the present thesis adopted a research orientation that on the one hand was theory-testing, but that on the other hand was also open to alternative interpretations implied by the data. In the following, a short overview will be given about the specific hypotheses of the present experiments. Based on the literature reviewed so far, the following predictions were derived for the present research and will be on the spotlight of all present experiments. Thus, they will be presupposed in the further course of the present thesis.

I) the motivational approach is valid: hungry participants should show more positive implicit and explicit food liking and stronger implicit and explicit food wanting than satiated participants, irrespective of reward expectancy.

II) the dual attitudes approach is valid: hungry participants should show more positive explicit food-liking and stronger explicit food-wanting than satiated participants, irrespective of reward expectancy. On the implicit level of responding, participants should show both more positive implicit liking- and stronger wanting-related evaluations towards food stimuli irrespective of need state and reward expectancy.

III) the frustrative nonreward approach is valid: hungry participants should show more negative implicit food-liking but stronger implicit and explicit food-wanting than satiated participants, but only for nonrewarded participants. For explicit food liking evaluations no definite predictions can be made so far.

IV) both the motivational and the dual attitudes approach are valid: hungry participants should show stronger wanting-related evaluations towards food stimuli than satiated participants. However, liking-related evaluations should not differ between hungry and satiated participants as a function of need state, irrespective of reward expectancy. On explicit self-reports, hungry participants should show more positive food-liking and stronger food-wanting than satiated participants, irrespective of reward expectancy.

Dissociation of liking- and wanting-related implicit evaluations as a function of food deprivation and nonreward

Experiment 1 investigated how implicit and explicit food-liking and food-wanting may change as a function of need state. In this regard, the question was also addressed to what degree need-dependent changes in object-valence associations might be based on an automatic versus a reflective process (see dual attitude approach). Experiment 2 & 3 were

conceptual add-ons to Experiment 1 and further adhered to the scarce literature concerning reward-related responses due to variations in reward expectancy (e.g., Rejeski et al., in press). In this regard, it remains unclear what exactly constitutes a reward condition and how reward expectancy might interact with need state. Two possible variations of reward expectancy were in the focus of the present research. Specifically, the question was addressed whether alone the verbal information and therefore the knowledge that eating will be part of the experiment (anticipation of consumption) was sufficient to change responses toward food stimuli, or whether the act and experience of eating (and the subsequent anticipation of need reduction) was likely to be the crucial reward condition. In order to answer this question more thoroughly, Experiment 2 varied the information participants received at the beginning of the experiment i.e. hungry and satiated participants were either informed that they will have vs. not have the opportunity to eat at some point during the experiment. A more stringent test of the frustrative nonreward account was to let participants eat during the entire experiment while responding to the tasks. Therefore, half of the participants in Experiment 3 were vs. were not allowed to eat from a self-provided snack during the entire experiment, thus giving participants full control over consumption.

In addition, a more valid test of the frustrative nonreward approach was to examine whether nonreward actually lead to more frustration. In this regard, most authors rather speculatively alluded to the concept of frustrative nonreward in order to explain why food deprivation surprisingly yielded negative affective responses to food cues (e.g., Drobes et al., 2001; Hawk et al., 2004; Mauler et al., 2006; Rejeski et al., in press). However, they failed to measure if frustration at all was elicited due to nonreward. Since the present research was also aiming at catching up on this shortfall, hungry and satiated participants in Experiment 2 & 3 were asked to indicate to what degree they experienced frustration or anger as well as other affects like for example sadness in response to the different experimental conditions.

The role of deprivation strength as a moderator of implicit evaluations toward food stimuli

Experiment 4 further addressed the questions whether normal or moderate levels of hunger may have the same impact on participants' immediate responses toward food cues as longer-lasting, abnormal states of food deprivation. With regard to the contradicting evidence for facilitation and negative effects of food deprivation, a deeper analysis of the relevant literature suggests that this is not the case. Instead of that, deprivation strength may be one of the crucial variables in accounting for negative effects of food deprivation, assuming that hunger must be strong enough to elicit negative responses towards food stimuli due to nonreward. Specifically, the aim of Experiment 4 was to test whether implicit liking-related evaluations toward food cues vary as a function of different durations of food deprivation. Specifically, a curvilinear function of deprivation strength on implicit evaluations was hypothesized to be observed. Accordingly, an experimental setup that does not allow for consumption should lead to more negative implicit evaluations toward food cues on highly-deprived compared to satiated participants. However, participants under moderate levels of hunger should respond with more positive immediate evaluations toward food cues than satiated participants. In order to test these predictions, participants were examined under high (15 hours) or low levels (2 hours) of food deprivation.

In addition, Experiment 4 was also designed to test the specificity of the effect of food deprivation on implicit food-relevant evaluations by also examining participants' implicit evaluations toward need-irrelevant stimuli. Based on the concept of the devaluation effect (Brendl et al., 2003; Markman et al., 2007), it was assumed that both levels of food deprivation compared to satiation should lead to more negative implicit evaluations toward need-irrelevant stimuli. Finding evidence for this prediction would be a replication of the devaluation effect on a more automatic level of responding.

Finally, in order to improve the statistical power and thus to verify the validity of the results in Experiment 1-4, a meta-analysis was conducted.

EMPIRICAL PART

Experiment 1

In order to test the validity of the different theoretical approaches outlined above with regard to the malleability of implicit and explicit food-related attitudes due to food deprivation, the main goal of the present experiment was to assess implicit and explicit food-liking and food-wanting in food-deprived compared to satiated participants. For this purpose, two different states of food deprivation were induced. Accordingly, participants were asked to come to the experiment satiated or 15 hours food-deprived. Therefore, the crucial manipulation was to let half of the participants fast for 15 hours and to compare their implicit and explicit responses with those yielded by non-deprived participants. The consumption of food was not included during the whole experiment, thus the experimental setup constituted a situation of nonreward for all participants.

Design

The experiment consisted of a 2 (need state: food-deprived vs. satiated) × 2 (type of measure: liking vs. wanting) factorial mixed design with the factor implicit attitude treated as within-subjects factor. However, implicit and explicit measures were analyzed separately[15].

[15] The design consisted of a 2 (need state: deprived vs. satiated) × 2 (type of measure: liking vs. wanting) factorial mixed design, respectively.

Method

Participants

A total of 61 students and non-student participants (30 female) with an average age of 21 (*SD* = 2.52) and an average BMI[16]-score of *M* = 21.92 (*SD* = 2.21) took part in the experiment in sessions up to three persons. Again, the experiment lasted about 30 minutes and was the first in a series of other unrelated experiments. The total time of the experimental session was 1 hour. As compensation, participants received 6 EUR or course credits, respectively.

Procedure

The chance to participate in the experiment announced as a study on the influence of different bodily states on different task performances (cover story) was promoted via a local internet city forum, where participants could apply for the experiment. One week prior to the experiment, participants were contacted by telephone and informed about the study. Before a participation date could be fixed, participants were checked if they conformed to the preconditions of participation. Specifically, participants were a priori excluded from further participation if they were a) currently dieting, b) vegetarian, c) suffering from any food allergy or diabetes, d) regularly refraining from at least one of the three daily meals or e) affected by any eating disordered symptoms until the day of testing. All other interested participants were invited for further participation. Participants were randomly assigned to one of the three experimental conditions. Accordingly, participants were either asked to come satiated or to refrain from eating 15 hours hours prior to their participation dates that were scheduled between 9.00 a.m. and 3.00 p.m. Upon arrival at the laboratory, participants were seated in front of the computers and were asked to complete different computer tasks and

[16] BMI = body mass index: weight/height^2 (kg/m^2)

questionnaires. Subsequently, they were given general instructions on the monitor before they were instructed to start with the different parts of the experiment. First of all, participants were presented with the ST-IAT (Wigboldus et al., 2004; see also Karpinski & Steinman, 2006) measuring their immediate associations toward food-related stimuli. The ST-IAT, like the original IAT (see Greenwald et al., 1998), is a stimulus-response compatibility task, in which participants are asked to categorize stimuli as accurate and as fast as possible by pressing one of two response keys, depending on the coupling of the stimuli to the respective response keys. The quality of categorization is indicative of the underlying implicit attitude. However, in contrast to the original IAT, the ST-IAT was designed to measure only one target category without the need of a contrast category. The advantages of this non-relative IAT-variant in comparison to the traditional IAT are twofold: on the one hand, the ST-IAT seems the more appropriate indirect measure when naturally opposing target categories (e.g. men vs. women, Protestants vs. Catholics) are lacking, as for example is the case with the concept *food*. However, traditional relative IATs are afflicted with the disadvantage that the second ("neutral") category as a contrast category to the target concept of interest often have been chosen in a highly subjective and arbitrary manner, e.g., contrasting *condoms* against *trees* (Czopp, Monteith, Zimmerman, & Lynam, 2004), resulting in methodological and interpretational ambiguities (e.g., Blanton, Jaccard, Gonzales, & Christie, 2006).

The present ST-IAT's consisted of three blocks (see Table 1) and was modeled according to the standard ST-IAT recommended by Wigboldus et al. (2004). Participants had to react as quickly and accurately as possible to words belonging to three different stimulus categories (e.g. positive, negative, and food; see *Materials*) by pressing one of two keys. At the beginning of each block, short instructions were given explaining the correct mapping of the response keys (e.g., the left key for negative words, the right key for positive words in the liking ST-IAT). The wanting ST-IAT was a conceptual adaptation of the wanting IAT proposed by Palfai and Ostafin (2003) in the context of alcohol-related associations (see also

De Houwer et al., 2006, in the context of smoking-related associations). As they suggest, the attribute labels were APPROACH and AVOID and the attribute words were either approach- or avoidance-related words (see *Materials*). For reasons of facilitation, the category labels were presented on top of the computer screen during the complete task, indicating the actual mapping of response keys.

The first (practice) block was a simple discrimination task and served to familiarize participants with the task and to charge the response keys with its respective valence (positive vs. negative). Therefore, participants were presented with the positive and negative words, each presented twice consecutively in random order. The black-colored words appeared in the middle of the computer screen in front of a grey-colored background. Participants' task was to indicate as quickly and accurately as possible whether it was a positive or a negative word. Furthermore, the assignment of the response keys to the respective valence was counter-balanced between participants, i.e. for each participant the evaluative mapping of the response keys was held constant throughout the accomplishment of all three blocks. The second and the third block of trials were the actual test trials. Within these blocks, participants were instructed to continue to categorize the attribute words according to their valence (as was practiced in Block 1) as well as to categorize the food target words presented in random order with one of two valence keys. In detail, in the first test block participants reacted to the food words and the positive words (compatible block) with one key and to the negative words with the other key. In order to keep the number of right-key and left-key responses equal, the five positive and five target words were presented once and the negative words were presented twice. In the second test block, the target words were then assigned to the same key as the negative words (incompatible block). Mirror-inverted to the first test block, the negative words and the target words were presented once and the positive words were presented twice. The order of test blocks (compatible block first vs. incompatible block first) was

counterbalanced between subjects. As in the practice block, the category labels appeared on top of the screen during all blocks. The intertrial-interval was set to 300 ms.

Originally, Wigboldus et al. (2004) also labeled the attribute dimensions with *PLEASANT* and *UNPLEASANT* conforming to the traditional IAT by Greenwald et al. (1998). But recently, some researchers argued that the traditional IAT does not only capture associations that are personally endorsed by the individual, but also associations that are "contaminated" by rather societal views and not personally shared by the individual (Karpinski & Hilton, 2001; Olson & Fazio, 2004). For instance, smokers may like cigarettes, although the majority of the society holds a strong negative view toward smoking (see De Houwer et al., 2006). Therefore, in the study by De Houwer et al., the present ST-IAT was *personalized* in the way first introduced by Olson & Fazio (2004). Specifically, participants were instructed to categorize the positive and negative attribute words on the basis of whether they themselves like or dislike the words. Accordingly, the common attribute labels *PLEASANT* vs. *UNPLEASANT* were replaced by the labels *I LIKE* vs. *I DISLIKE* (German: *MAG ICH* vs. *MAG ICH NICHT*). By doing so, it has been shown that extrapersonal associations are likely to be reduced, i.e. participants may come up with opposite responses in comparison to responses reflected by a traditional IAT procedure (De Houwer et al., 2006; Olson & Fazio, 2004). Moreover, personalizing the ST-IAT would also ensure that participants would not misinterpret it as measuring wanting. The personalized version of an IAT has not been provided with a feedback for erratic trials, because changing the category labels of *PLEASANT* and *UNPLEASANT* into I *LIKE* vs. *I DISLIKE* decreases the normative nature of the categorization task within an IAT (Olson & Fazio, 2004). Finally, given that no error feedback was usually provided in personalized versions of the IAT, the ST-IAT used in the present experiment also did not include any error feedback. The sequence of the wanting

ST-IAT was identical to that of the liking ST-IAT, except that the former was not personalized in the present experiment[17]. However, this was done in Experiment 2 and 3.

After completing the ST-IAT's, participants were asked to fill out a final questionnaire including several demographic items (e.g. gender, age, height, weight) and to indicate their hunger or fullness as a manipulation check of their current need state (see *Materials*). At the end of the entire battery, participants were paid, thanked, and debriefed.

Table 1

Exemplary Overview of the Liking ST-IAT Phases

Block	Trials	Function	Left key	Right key
1	20	attribute practice	I like	I dislike
2	20	compatible combination task	food & I like	I dislike
3	20	incompatible combination task	I like	food & I dislike

Note. The order of block 2 and 3 was counterbalanced between subjects

Materials

Manipulation check

Need state. Participants were asked to indicate their subjectively experienced hunger on a scale ranging from 1 (absolutely satiated) to 7 (extremely hungry).

ST-IAT stimuli

The liking ST-IAT consisted of one (attribute) category including five standardized positive words (German words for *love, happiness, paradise, gift, holiday*), a second evaluative category of five standardized negative words (German words for *poison, malodor,*

[17] Although the wanting ST-IAT was not personalized in the present experiment, it also did not contained any error feedback in order to ensure the best comparability between both variants of the ST-IATs.

disease, accident, death), and a target concept category including five need-relevant words[18] (German words for *chocolate, pizza, spaghetti, salad, biscuit*)

The wanting ST-IAT consisted of the same target concept category, but differed in the attribute categories. Specifically, one attribute category contained approach-related words (German words for *approach, to want, to desire, to close, and to crave*) and the second included avoidance-related words (German words for *to avoid, to withdraw, to repress, to reject, and to deny*).

Explicit evaluations

Liking. Participants had to indicate their actual liking for food on a 7-point scale from 1 (not at all) to 7 (very positive) on the item *how positive/agreeable is food for you right now?*

Wanting. Participants' explicit wanting ratings were assessed via the same 7-point scale ranging from 1 (not at all) to 7 (very strong) on the item *how strong is your desire for food at the moment?*

Results

Dropouts

Six participants had to be excluded from further analysis. From two subjects the wanting ST-IAT responses were not recorded due to computer problems. Four participants were dropped because they apparently did not adhere to the instructions given prior to the experiment. Specifically, two participants in the satiated condition indicated being very hungry (scores of 6 and 7) and two 15 hours food-deprived participants responded being very satiated (a score of 2). Those participants also constituted statistical outliers on a box-plot due to inconsistent hunger ratings. After all, a total of 55 participants (26 female) were left for further analysis.

[18] The need-relevant target concept category included 5 different food items that were thought to cover the mainstream German gusto.

Manipulation checks

In order to check whether the manipulation of need state was effective, a t-test with need state as independent and self-reported level of hunger as dependent variable was conducted. This analysis revealed that participants in the food-deprived condition were significantly hungrier (M = 5.90, SD = .71) than subjects in the non-deprived condition (M = 2.08, SD =.99), $t(53) = 16.54$, $p < .01$. Thus, the manipulation of need state was successful.

Data preparation of ST-IAT latencies

The ST-IAT scores were calculated using the scoring-algorithm proposed by Wigboldus et al. (2004). This approach was based on Greenwald et al's (1998) first scoring algorithm for the original IAT. Following Wigboldus et al's recommendations, participants' reactions to erratic trials were removed as well as the first two trials of each block that were considered as orientation trials. The reaction times of the practice block were also not considered for further calculation. In addition, outlier response times were treated as follows: reaction times below 300 ms were replaced with 300 ms and reaction times above 3000 ms were recoded with 3000 ms. All remaining responses were then log-transformed. This is recommended in order to normalize the skewed distributions of reaction time measures (Greenwald et al., 1998). Finally, the responses within each block were averaged before the ST-IAT scores were calculated by subtracting the mean latency of the compatible block (e.g. *food + I like*) from the incompatible block (*food + I don't like*). Thus, a positive score indicates that a participant associated food faster with *I like* than with *I don't like* (liking ST-IAT) and with *Approach* than with *Avoidance* (wanting ST-IAT), respectively. The scores can then be interpreted as indicating positive/approach-related associations toward food stimuli.

Reliability of the ST-IATs

To determine the reliability (split-half) of the present ST-IATs, each of the ST-IATs was divided into even- and odd-numbered trials. Based on that partition, separate ST-IAT-scores were computed for the two test-halves (following the same procedure outlined above). Then, both scores were correlated by applying the Spearman-Brown correction (c.f. Karpinski & Steinman, 2006) to obtain measures of internal consistency. The reliability analysis revealed a much better level of internal consistency for the liking ST-IAT, adjusted r = .65, compared to the wanting ST-IAT, adjusted r = .34, respectively. However, these reliability scores reflect the common reliability range also reported in other studies using the ST-IAT (e.g., r = .24-.51, Bluemke & Friese, 2008; α = .72, Wigboldus et al., 2004), whereas in the present experiment the liking ST-IAT proved to have a much higher level of internal consistency than the wanting ST-IAT. Moreover, reliability scores of ST-IATs are typically weaker than those revealed by studies using the traditional Greenwald et al.'s IAT (e.g., r = .79, Hoffmann, Gawronski; Gschwender, Le, & Schmitt, 2005). This fact may be due several processes including the ST-IAT's simpler task structure and the IAT inherent sensitivity to task-switching costs (Mierke & Klauer, 2003).

Implicit liking- and wanting-related associations toward food stimuli

To test how food deprivation influenced implicit liking- and wanting-related associations toward food stimuli, a 2 (need state: food-deprived vs. satiated) × 2 (type of measure: liking vs. wanting) repeated measures ANOVA treating type of measure as within-subject factor and need state as between factor was conducted. As a result, both the main effects of type of measure as well as of need state were not significant, both F's < 1. The two-way interaction effect between need state and type of measure was significant, $F(1,53)$ =

4.10, p = .048, η^2 = .07 (see Figure 1)[19]. Further post-hoc single pair-wise contrasts were calculated. As a result, hungry participants did not show more positive liking-related associations than satiated participants, $F < 1$, whereas for the wanting-related associations, a significant difference in responding toward food stimuli due to food deprivation was obtained, $F(1,53) = 4.73$, p = .03, η^2 = .08. In particular, food-deprived participants responded with more wanting-related associations toward food stimuli (M = 98.65, SD = 90.37, untransformed values) compared to non-deprived participants (M = 66.07, SD = 83.76, untransformed values). In addition, liking- and wanting-related responses did not differ significantly from each other in the deprived group, $F < 1$, but tended to differ in the non-deprived group, $F(1,53) = 4.71$, p = .06, η^2 = .07, respectively.

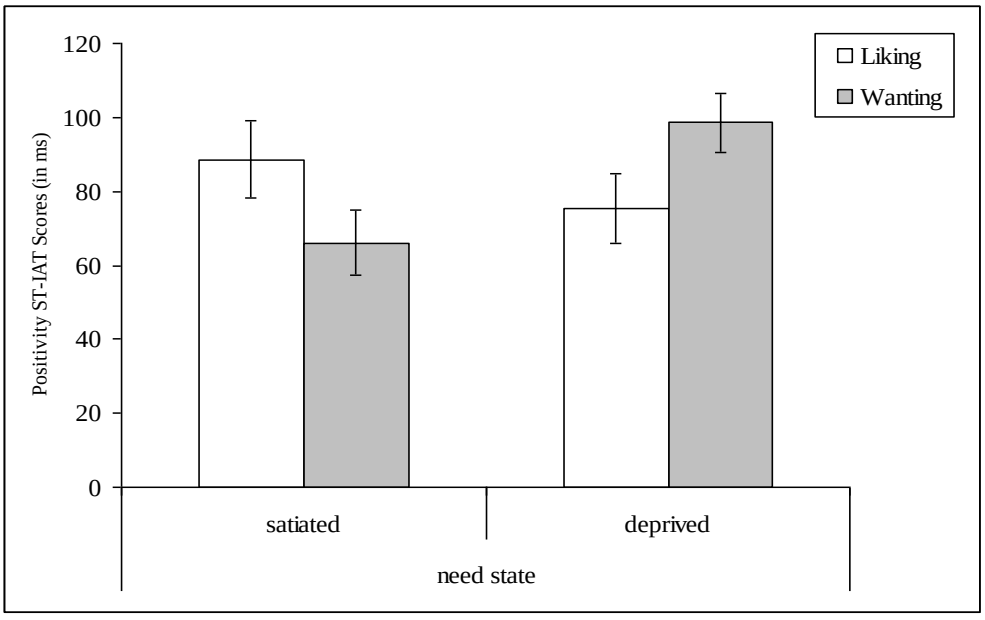


Figure 1: Positivity ST-IAT indices as a function of need state. Error bars indicate standard errors of the mean.

[19] For ease of interpretation, the y-axis displays unstandardized ST-IAT scores. This convenience will also be applied to all following experiments.

Self-reports of food-liking and food-wanting

To test the influence of food deprivation on explicit food-liking and food-wanting, both self-report indices of liking (*how positive/agreeable is food for you right now?)* and wanting (*how strong is your desire for food at the moment?*) were submitted to a 2 (need state: food-deprived vs. satiated) × 2 (type of measure: liking vs. wanting) ANOVA for repeated measures with type of measure as the within-subjects factor. First of all, this analysis yielded only a significant main effect of type of measure, $F(1,53) = 20.30$, $p < .01$, $\eta^2 = .27$, revealing that participants overall responded with more positive food-liking ($M = 5.38$, $SD = .27$) compared to food-wanting responses ($M = 4.71$, $SD = .29$). Furthermore, neither a significant main effect of need state, $F(1,53) = 2.75$, $p = .10$, $\eta^2 = .05$, nor a significant interaction effect between need state and type of measure could be revealed, $F(1,53) = 2.63$, $p = .11$, $\eta^2 = .05$ indicating that food deprivation did not influence how subjects responded explicitly with food-liking and food-wanting.

Discussion

For the moment, the results from Experiment 1 seem to best fit with the fourth prediction. Specifically, food-deprived participants did not show more liking-related associations toward food stimuli than non-deprived participants, while at the same time, food-deprived compared to satiated participants showed more wanting-related associations toward food cues. This finding can be interpreted as evidence for both the motivational as well as the dual attitudes approach. Accordingly, liking-related associations reflecting the dual attitudes approach seem to be very stable across the two deprivational states, while wanting-related associations reflecting the motivational approach seem to change very flexibly due to need state. Thus, the present experiment added some new data to the general debate concerning the flexibility of implicit attitudes. In this regard, the idea of treating liking and wanting as

separate constructs seems to be a useful approach in displaying motivational responses independently of mere evaluative responses towards a reward.

Note, however, that participants were not informed about anything concerning the active consumption of food before and during the experiment. Therefore, it could not be ruled out that some of them may have automatically implied and anticipated that the experiment would entail the possibility to eat. Arguing in favor of the frustrative nonreward approach that would have predicted more negative-liking-related associations due to food deprivation, those participants may not have felt frustration due to nonreward and therefore may also not have responded with more negative liking-related associations to food cues. In turn, this may have rendered the liking-related associations of food-deprived participants overall more ambivalent resulting in a non-significant effect of food deprivation (see de Liver, van der Pligt, & Wigboldus, 2007; see Petty & Briñol, 2009; Petty, Briñol, & DeMarree, 2007; Petty, Tormala, Briñol, & Jarvis, 2006). Thus, Experiment 2 was conducted to test this explanation more thoroughly, by manipulating the expectancy of consumption prior to the experiment. Alternatively, this finding could also have been influenced by two different processes. Specifically, one process may have reflected the organism's positive attunement to the need state resulting in more positive liking-related associations toward food stimuli (e.g., Seibt et al., 2007) that at the same time may have conflicted with the second process of frustrative nonreward hypothesized to prompt more negative immediate responses (Drobes et al., 2001). As a consequence, both could have again led to rather ambivalent implicit food-liking responses.

Moreover, the wanting ST-IAT was less internally consistent compared to the liking ST-IAT. This difference may have been due to the distinct operationalizations used for both measures e.g., a) by using completely different attribute stimuli, and b) by only personalizing the liking ST-IAT, which in turn may have improved participants' response accuracy. To test whether a personalized version of the wanting ST-IAT would reveal a better internal

consistency, which would render it structurally identical to the personalized liking ST-IAT, the wanting ST-IAT was also personalized in Experiment 2 and 3.

A quite different pattern of results, however, was obtained for the explicit attitudes. Explicit food-liking and food-wanting were not found to vary as a function of food deprivation, thus not confirming any of the predictions derived from the four approaches. In particular, this result is incompatible with the motivational approach as well as with the dual-attitudes approach, given that both approaches would have explicitly predicted an influence of food deprivation towards more food-liking and food-wanting. However, the finding rather implies that food seem to have a relatively stable and positive valence irrespective of need state according to the obtained self-report values above the mean for both food-liking and food-wanting. Alternatively, this result could also have been due to the very abstract question format that was used asking about the positivity of food *in general*. In this regard, in order to make the explicit level of responding more comparable to the implicit level, participants should have been asked about the positivity of a *special* food (the same using in the ST-IAT) at the moment. In order to test whether the mode of asking makes a difference, participants in Experiment 2 were also asked to indicate their explicit food-liking and food-wanting toward specific foods that were also presented to them in the ST-IAT.

Experiment 2

The present Experiment was designed as the first add-on to Experiment 1 and comprised three further goals. Firstly, it should be tested whether food-liking and food-wanting may change as a joint function of food deprivation and reward expectancy. This question still awaits further empirical answers, albeit the evidence gathered independently for reward versus nonreward situations. On the one hand, Hawk et al. (2004) showed that food-deprived human subjects who were informed that they were allowed to eat during the experiment were likely to react with attenuated startle reflexes in response to food cues indicating positive immediate affect. On the other hand, there is evidence from studies where participants were not provided with the prospect of consumption showing that subjects responded with startle potentiation indicating negative immediate responses towards food cues (e.g., Drobes et al., 2001). However, with a systematic variation of reward expectancy, Wagner (1963) demonstrated that rats respond with potentiated startle reflexes to food cues when food was withheld, but with attenuated startle reflexes when they were confronted with different edible cues, which they were also allowed to eat. These findings are rather indicative of the frustrative nonreward approach. To address this question, reward expectancy was varied systematically so that half of the participants were informed that they will (reward condition) versus will not (nonreward condition) have the possibility to eat their own food at some point during the experiment. Secondly, in order to gather more informative evidence concerning how participants' explicit food-liking and food-wanting might change due to food deprivation and nonreward, the present experiment asked participants to report their liking and wanting of specific foods and not of foods in general as was done in Experiment 1. Thirdly, an interpretation on the basis of frustrative nonreward would also imply that people should experience frustration due to nonreward. For instance, it was shown that unexpected nonreward leads to changes in physiological parameters associated with arousal (Weil &

Katkin, 1969), since frustration due to nonreward is known to be accompanied by increased arousal, at least in animal studies (see Henke & Maxwell, 1973). Moreover, as was already mentioned, Carver (2004) found that frustrative nonreward within an achievement task was related to more frustration, annoyance, and discouragement. Therefore, the present experiment also tested if hungry versus satiated participants would differ in self-reported negative mood and frustration due to nonreward. For this purpose, participants were asked to indicate their mood and frustration before and after the implicit attitude assessment. In this setup, it was also possible to test whether food deprivation per se might have an impact on mood. The literature concerning this question is also inconclusive to date. Because the relationship between hunger and mood, i.e. the notion that greater hunger is likely to be associated with negative mood seems very obvious, most of the research focused mainly on the converse question, namely, how different mood states affect eating[20] (e.g., Alpers & Tuschen-Caffier, 2001; Macht, 1999; Macht & Simons, 2000). However, few studies[21] that examined whether food deprivation also might have an influence on subjective mood rather provide inconsistent evidence. For instance, although 24 hours food-deprived women were found to report less positive mood than non-deprived women (Kendzor, Baillie, Adams, Stewart, & Copeland, 2008), the authors yet failed to find a significant effect for greater negative mood in deprived compared to non-deprived women. Other studies failed to find any effects of food deprivation on self-reported mood (Green et al., 1995; Hoefling et al., 2009; Hoefling & Strack, 2008). Besides this general scarcity and ambiguity concerning the question whether food deprivation is associated with negative mood, a recent study by Rejeski et al. (in press) revealed that participants exposed to a long delay of consumption and scoring high on state craving reported high explicit negative affect compared to participants scoring

[20] Findings from these studies are not further relevant for the present thesis and should therefore not be outlined in more detail.
[21] The main research interest of those studies was not on the influence of hunger on mood per se.

lower in state craving or participants anticipating shorter delays of consumption. The present experiment, therefore, also tested whether food deprivation is accompanied by negative mood.

Design

The experiment consisted of a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: given vs. not given) × 2 (type of measure: liking vs. wanting) factorial mixed design with the factor type of measure treated as within-subjects factor. However, as was already done in Experiment 1, implicit and explicit measures were analyzed separately. In order to investigate the influence of food deprivation and nonreward on mood and frustration, a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: given vs. not given) factorial design was also applied with mood and frustration scores as dependent variables.

Method

Participants

Participants were 68 (44 female) students (excluding psychology) and non-students with an average age of 25 (*SD* = 7.34) and an average BMI-score of *M* = 22.80 (*SD* = 3.54). Up to three persons were tested in one experimental session. Like the previous experiment, the present experiment also lasted about 30 minutes and was again the first in a series of other unrelated experiments leading to a total time of the experimental session of 1 hour. Participants received 6 EUR as compensation.

Procedure

Participants were recruited and deprived versus not deprived according to the same procedures as in the previous experiment. However, two important alterations were made.

Firstly, participants were also asked to bring something to eat to the experiment (e.g., a usual snack food[22]) in order to establish reward expectancy. The cover story was that it would be needed for a preference survey without further mentioning details about consumption of the snack food. At the beginning of the experiment, participants were instructed to deposit their snack food on their desk next to the computer monitor. Then, they were asked to indicate their mood including frustration (see *Materials*) for the first time. Afterwards, half of the participants were given the information that they will have the opportunity to eat from the snack during the experiment in order to accomplish the preference survey and that the experimenter will inform them when it will be okay to do so. In contrast, the other half of the participants was informed that they will need it for the preference rating during the experiment but that this does not include eating it[23]. Subsequently, they followed the ST-IAT sequences as in the previous experiments. After the ST-IATs, participants again reported their actual mood and frustration before they answered the final questionnaire including several demographic items, the question about their subjective hunger as well as their explicit food-liking and food-wanting.

Secondly, the wanting ST-IAT was also *personalized* (c.f. Olson & Fazio, 2004) in order to make both ST-IATs more comparable to each other[24]. Specifically, the former labels *APPROACH* and *AVOID* were replaced by *I WANT* versus *I DON'T WANT* (German: *WILL ICH* vs. *WILL ICH NICHT*). Moreover, the same attribute and target words were used as in the personalized liking ST-IAT, so that both measures were identical except the minor difference in the category labels (*LIKE* vs. *WANT* or in German *MAG* vs. *WILL*).

[22] Participants were asked to bring their own food to the experiment. This was done to guarantee that the personal food matches their individual preferences.

[23] In truth, all participants at the end of the experimental session were allowed to eat as much as they wanted from their snack food. Moreover, they were extensively debriefed about the purpose of the manipulation and the present hypotheses.

[24] In Experiment 1 the liking ST-IAT proved to have a much better internal consistency than the wanting ST-IAT. This finding may be due to the less normative nature of personalized versions of the IAT compared to traditional variants.

Materials

Manipulation check

Need state. Participants' subjectively experienced hunger was assessed via a self report scale ranging from 1 (absolutely satiated) to 7 (extremely hungry).

Self-reports

Mood. Participants were asked to respond twice to a mood questionnaire asking for 3 positive (positive, content, happy) and negative affective states (negative, sad, angry) as well as for frustration. The frustration item was interspersed within the other mood items (see Appendix) and all items were presented in random order. Specifically, participants had to indicate how strong they were feeling those moods and frustration at that moment on a 6-point scale ranging from 1 (totally inapplicable) to 6 (totally true) once prior and once after the implicit attitude assessment.

Explicit liking. Participants had to indicate their actual liking for the specific food items also used in the ST-IAT on a 7-point scale from 1 (not at all) to 7 (very positive) on the item *how positive/agreeable would it be for you to eat ____ (chocolate, pizza, spaghetti, salad, biscuit) right now?*

Explicit wanting. Participants' explicit wanting ratings were assessed via the same 7-point scale ranging from 1 (not at all) to 7 (very strong) on the item *how strong is your desire to eat ____ (chocolate, pizza, spaghetti, salad, biscuit) at the moment?*

Results

Dropouts

Seven participants were excluded from further analysis. Five participants were dropped because they apparently did not adhere to the instructions given prior to the experiment. Three food-deprived participants indicated being very satiated (scores of 1 and 2) and two participants in the satiated condition reported being very hungry (a score of 7). Those participants also represented statistical outliers on a box-plot due to inconsistent hunger ratings. In addition, from one participant the liking ST-IAT responses and from another the wanting ST-IAT responses were not correctly recorded due to computer problems. In sum, a total of 61 participants (40 female) were left for further analysis.

Manipulation checks

To test the effectiveness of the manipulation of need state, a t-test with need state as independent and self-reported level of hunger as dependent variable was conducted. This analysis yielded a significant result, $t(59) = 18.03$, $p < .01$, showing that, as implied, food-deprived participants were also significantly hungrier ($M = 5.82$, $SD = .98$) than non-deprived participants ($M = 1.67$, $SD = .82$).

Data preparation of ST-IAT latencies

Both liking and wanting ST-IAT scores were calculated according to the same algorithm that was also applied in the previous experiment (c.f. Greenwald et al., 1998; Wigboldus et al., 2004).

Reliability of the ST-IATs

The reliability scores for the liking and the wanting ST-IAT were calculated according the same steps as in the previous experiment. The reliability analysis revealed the same substantial level of internal consistency for both the personalized liking ST-IAT and the personalized wanting ST-IAT, both adjusted *r*'s = .68.

Implicit liking- and wanting-related associations toward food stimuli

To test how food deprivation and reward expectancy influenced participants' implicit liking- and wanting-related associations toward food stimuli, a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) × 2 (type of measure: liking vs. wanting) mixed-model ANOVA with type of measure treated as within-subject factor was conducted. As a result, the analysis revealed no main effect of any factor, all *F*'s < 1, followed by a non-significant two-way interaction effect between need state and reward expectancy, $F(1,57) = 2.42$, $p = .13$, $\eta^2 = .04$. However, a significant two-way interaction effect between need state and type of measure emerged, $F(1,57) = 4.57$, $p = .04$, $\eta^2 = .07$. The three-way interaction effect between need state, type of measure, and expectancy was also not significant, $F < 1$.

To further qualify the interaction effect between need state and type of measure, an additional 2 (need state: food-deprived vs. satiated) × 2 (type of measure: liking vs. wanting) mixed-model post-hoc ANOVA with type of measure treated as within-subject factor was calculated. The obtained interaction effect was significant, $F(1,59) = 4.55$, $p = .04$, $\eta^2 = .07$. A further post-hoc pair-wise contrast revealed that food-deprived participants were significantly found to respond with stronger wanting-related associations ($M = 121.12$, $SD = 193.37$, untransformed values) than satiated subjects ($M = 38.30$, $SD = 138.34$, untransformed values), $F(1,59) = 3.06$, $p = .04$, $\eta^2 = .05$. However, liking-related associations did not differ significantly between food-deprived and satiated participants $F(1,59) = 1.85$, $p = .18$, $\eta^2 = .03$. Moreover, a marginal significant effect revealed that hungry participant showed stronger

wanting- (*M* = 121.12, *SD* = 193.37, untransformed values) than liking-related associations (*M* = 33.79, *SD* = 170.68, untransformed values), $F(1,59) = 3.92$, $p = .06$, $\eta^2 = .06$. No further contrasts were significant (Figure 2 shows the collapsed diagram over both expectancy conditions).

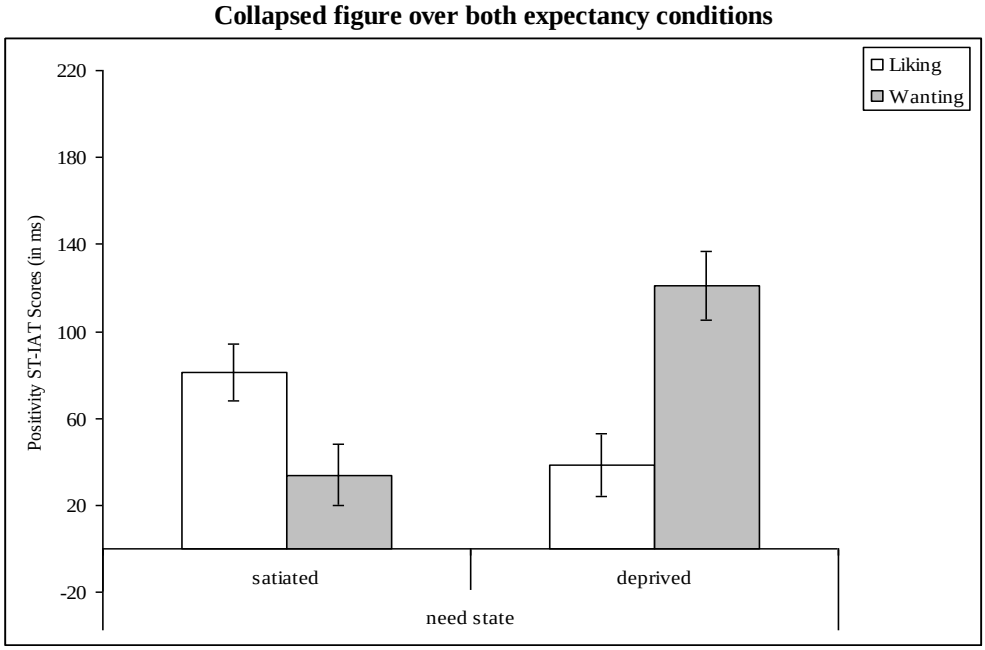


Figure 2: Positivity ST-IAT indices as a function of need state. Error bars indicate standard errors of the mean.

Self-reports of food-liking and food-wanting

Because the self-reports of both food-liking and food-wanting towards the five different food stimuli *(chocolate, pizza, spaghetti, salad, biscuit)* were highly correlated, a mean score for food-liking and food-wanting ratings was calculated, whereas both scores revealed high levels of reliability, Cronbach's $\alpha = .85$, for explicit food-liking, and Cronbach's $\alpha = .92$, for explicit food wanting. In order to test the influence of food deprivation and reward expectancy on explicit food-liking and food-wanting ratings, both food-liking and food-wanting scores were submitted to a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) × 2 (type of measure: liking vs. wanting) ANOVA for repeated measures with type of measure treated as within-subjects factor. First of

all, this analysis yielded a significant main effect of need state, $F(1,57) = 74.85$, $p < .01$, $\eta^2 = .57$, showing that hungry participants overall responded more positively ($M = 5.26$, $SD = 1.20$) than satiated participants ($M = 2.69$, $SD = 1.13$). The main effect of type of measure was also significant, $F(1,57) = 48.44$, $p < .01$, $\eta^2 = .46$, revealing that overall participants' food-liking ratings were more positive ($M = 4.24$, $SD = 1.64$) than their food-wanting ratings ($M = 3.53$, $SD = 1.89$). Overall, these results reflect positive effects of food deprivation on both food-liking and food-wanting irrespective of participants' reward expectancy. However, a significant interaction effect between need state and type of measure emerged, $F(1,57) = 7.60$, $p < .01$, $\eta^2 = .12$, revealing that satiated participants responded with more positive food-liking ($M = 3.47$, $SD = 1.28$) than food-wanting ($M = 2.13$, $SD = 1.49$), $p < .01$, whereas no such difference between food-wanting and food-liking responses emerged for hungry participants, $p > .05$. More importantly, food-deprived participants responded both with more positive explicit food-liking ($M = 5.69$, $SD = 1.38$) and food-wanting ($M = 5.54$, $SD = 1.52$) than satiated participants, all p's $< .01$, food-wanting variations being more pronounced than food-liking variations. No other main or interaction effect was significant, all F's < 1.

Self-reported frustration

To answer the question whether nonreward may lead to more frustration in food-deprived compared to satiated participants, a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) × 2 (time: before vs. after implicit attitude assessment) mixed-model ANOVA for repeated measures with time varied within-subjects was conducted on self-reported frustration. As a result, no main or interaction effect was significant, all F's < 1, with participants overall reporting being not frustrated both before and after implicit attitude assessment (see Table B1 in the Appendix). Moreover, the self-reported frustration before and after the implicit attitude assessment were highly correlated, $r(61) = .69$, $p < .01$,

additionally indicating that this emotional state did not change over the course of implicit attitude assessment.

Self-reported mood

To further test whether food deprivation and reward expectancy were associated with changes in general mood, the 6 mood items (without the frustration item) had first been averaged to separate positive and negative mean scores for both times of assessment. Because the positive and the negative scores were found to correlate negatively with each other, all *p*'s < .01, the negative items were thus reverse-coded before compound mood scores for both assessment times with higher scores indicating more positive mood were calculated. Both mood scores revealed satisfactory levels of reliability, Cronbach's α = .89 at time 1, and Cronbach's α = .87 at time 2. They were then submitted to a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) × 2 (time: before vs. after implicit attitude assessment) mixed-model ANOVA for repeated measures with time treated within-subjects. Again, this analysis revealed no significant main or interaction effect, all *p*'s > .10 and overall participants in all experimental conditions reported being in a very positive mood (see Table B2 in the Appendix). Similar to self-reported frustration, mood ratings before and after the implicit attitude assessment were highly correlated, $r(61) = .92$, $p < .01$, showing that also general mood states did not change over the course of implicit attitude assessment.

Correlations between self-reported mood, frustration, and implicit and explicit responses of food-liking and food-wanting

Although food deprivation and reward expectancy did not change self-reported mood and frustration, it was investigated whether mood and frustration nevertheless correlated with implicit and explicit food-liking and food-wanting responses. However, this was not the case, all *p*'s > .20. Not surprisingly, self-reported mood and frustration, however, were highly correlated both at time 1, $r(61) = -.68$, $p < .01$, and at time 2, $r(61) = -.77$, $p < .01$.

Discussion

Experiment 2 led to several informative findings that will be discussed in the following. First of all, additional evidence was gathered in favor of both the motivational and the dual attitudes approach, as was already reflected in Experiment 1. Specifically, food-deprived participants showed stronger wanting-related associations toward food stimuli than satiated participants, irrespective of reward expectancy. This result clearly confirmed the motivational approach. However, although reward expectancy was manipulated in the present experiment, liking-related associations did not differ across conditions, a finding, in turn, mirroring the dual attitudes approach. A possible reason for this unexpected result may lie in the fact that participants anticipating food consumption nevertheless could not influence the moment of consumption by themselves. Just seeing the snack food lying in front of them on the desk without being able to influence the time of consumption may have further sustained frustrative nonreward and thus may have resulted in more ambivalent associations toward food-stimuli, letting alone that participants did not eat anything at all during the experiment. As a consequence, the reward expectancy may have weakened the rewarding value of food stimuli even for food-deprived participants. This argument may also fit with the idea that an automatic attunement of the organism to need states should mostly be effective to the degree that food has not yet been found or that the possibility to consume has not been provided. Moreover, as was already an alternative interpretation in favor of the frustrative nonreward approach in Experiment 1, participants may not have felt frustration due to nonreward and therefore may also not have responded with more negative liking-related associations to food cues. However, this may have elicited rather more ambivalent attitudes (see de Liver et al., 2007; see Petty & Briñol, 2009; Petty et al., 2007; Petty et al., 2006) that were probably driven by both motivational and frustrative nonreward processes. In order to examine this problem more thoroughly, participants in Experiment 3 were assigned individual control to

freely decide to eat whenever they liked during the experiment, in order to avoid any kinds of negative mood in this condition. This manipulation also offered the possibility to measure the amount of food that was eaten during the experiment. Thus, it was possible to measure the behavioral consequences of food-liking and food-wanting.

Beside that, it is also worth noting that personalizing the wanting ST-IAT and equalizing it to the liking ST-IAT improved the internal consistency of the measure to the same level as the liking ST-IAT, proving the modification to be meaningful.

Also in accordance with the dual attitudes approach was the finding that explicit self-reports of both food-liking and food-wanting were found to be more positive as a function of food deprivation, irrespective of whether participants anticipated food consumption or not. On the one hand, this finding implies that both explicit food-liking and food-wanting change relatively flexible according to changes in need state compared to implicit responses. As was already shown, liking-related associations towards food stimuli did not change as a function of need state or reward expectancy. On the other hand, this finding also shows that if any process based on frustrative nonreward was nevertheless assumed to operate on an implicit level of responding, this process is not being reflected on an explicit level, thus also making an explanation on the basis of cognitive dissonance (Festinger, 1957; Festinger & Carlsmith, 1959) very unlikely. Note that the stimuli used for the explicit rating of food-liking and food-wanting were the same use in the ST-IATs, i.e. participants were asked to report their liking and wanting for *specific* food items and not just for food *in general*. However, the presented stimuli were food items either more relevant for breakfast (e.g., *biscuit*) or for lunch (e.g., *pizza, spaghetti*). Thus, the results are inconsistent with the findings reported by Markman et al. (2007). Specifically, the authors found that the expressed preferences for food not only varied according to need state but also according to the appropriateness of the foods in respect to the time of day. For instance, hungry people were found to prefer dinner foods over breakfast foods when tested in the evening compared to in the morning and vice versa,

concluding that the goal to satisfy hunger seems to be narrow and specific. However, the authors also admitted that "it is possible that the level of specificity of eating goals depends in part on the strength of the abstract need to eat. A more severe need to eat may lead to a broader preference for foods" (Markman et al., 2007, p. 683). Accordingly, the fact that participants of the present experiment were 15 hours food-deprived may have changed participants' preferences of the different food stimuli toward a general positivity. Moreover, time of day was not controlled as clear-cut as in the Markman et al's study, i.e. in the present experiment there was a substantial number of participants who participated between 10 and 12 a.m., a time span where both breakfast as well as lunch food may equally be appropriate for hungry participants, irrespective of deprivation strength. However, such an explanation remains inconsistent with the findings obtained in Experiment 1, where 15 hours food-deprived participants did not respond with more positive food-liking and food-wanting towards food in general.

Similarly opposing the frustrative nonreward approach was the finding that participants' implicit and explicit food-liking and food-wanting were not correlated with self-reported mood and frustration. Thus, the data did not reveal any substantial relationship between participants' mood state and their implicit and explicit responses. In addition, participants overall reported being not frustrated at all irrespective of need state or reward expectancy. In line with this result, also no moderation of general mood was obtained, with participants overall reporting positive mood states. Thus, mood and frustration were stable over the course of implicit attitude assessment and negatively correlated with each other. These results supported the fact that the manipulation of reward expectancy was ineffective in inducing frustration or negative mood. In this regard, such a null-finding in self-reported mood and frustration could have been resulted from the fact that participants were asked how they were feeling in the current moment and not in respect to the fact that they were hungry but were not allowed to eat. This could have posed a problem, given that participants were

asked to report their mood after and not at the same time they were presented with the stimuli. As a consequence, participants may have been influenced by recall biases. Alternatively, the respective mood may also have attenuated during stimulus presentation and self-report provided at the end of the experiment. Thus, in order to test this alternative explanation, participants in Experiment 3 were also asked to indicate whether they have felt uncomfortable considering the fact that they were hungry but not allowed to eat and to further specify the kind of affect that they have associated with that experience.

Finally, mood state and frustration also did not change due to food deprivation, replicating results reported in recent research (Green et al., 1995; Hoefling et al., 2009; Hoefling & Strack, 2008). However, although the notion that longer states of food deprivation may be likely to be associated with negative mood seems very obvious, the present findings adds further evidence to the inconsistent literature that this might no be the case.

Experiment 3

In accordance with the motivational and the dual attitudes approach, the previous experiment has shown that food deprivation led to more wanting-related associations towards food stimuli, but did not change participants' liking-related associations. Moreover, both explicit food-liking and food-wanting changes as a function of need state. Reward expectancy, however, did neither influence the implicit nor the explicit responses, making frustrative nonreward as an underlying process even more implausible. However, the present experiment was built on the preceding experiments in that it allowed (versus not allowed) participants to decide to eat whenever they want during the experiment (even during the ST-IAT). This was done in order to rule out the alternative interpretation that providing participants with reward expectancy but denying personal control over the moment of consumption may have rendered rather ambivalent liking-related associations towards food stimuli. Within this modification, participants' amount of food consumed was also recorded reflecting a behavioral measure of food-liking and food-wanting.

Furthermore, participants' mood and self-reported frustration also did not change due to need state or reward expectancy, implying that nonreward may a) not have caused frustration at all or b) may have caused frustration but participants were unable to report it before or after the stimulus presentation. Therefore, participants in the present experiment were also asked to indicate how they have felt in the specific moment where they were presented with food stimuli being hungry but not allowed to eat. These two extensions were the main conceptual changes compared to Experiment 2. All other procedural differences will be explained at greater detail in the methodological part of the present experiment.

Design

The present experiment consisted of a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) × 2 (type of measure: liking vs. wanting) factorial mixed design with the factor type of measure treated as within-subjects factor. Again, implicit and explicit measures were analyzed separately. In order to further calculate the influence of food deprivation and nonreward on affective ratings, a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) factorial design was applied.

Method

Participants

A total of 92 (70 female) students (excluding psychology) and non-students with an average age of 25 (*SD* = 5.56) and an average BMI-score of *M* = 22.81 (*SD* = 3.53) participated in the study. Again, the present experiment lasted about 30 minutes followed by a series of other unrelated experiments leading to a total time of 1 hour. Three persons were tested at the same time. For their participation, participants received 6 EUR as compensation.

Procedure

Participants were recruited and instructed according to the same procedures as in the previous experiments. They were also asked to bring a preferred snack to the experiment because it would be part of an additional preference survey. Participants were again first asked to deposit their snack food on their desk near the computer monitor in front of them for the preference rating. Then, they were presented with the first mood questionnaire (as in Experiment 2) and instructed to respond to several mood items including frustration (see

Materials) [25]. In order to provide participants with enough time to eat freely from their snack food as much as they wanted, all participants were instructed to read a neutral text (see Appendix) carefully lasting about approximately 2 minutes and to answer some questions about it at the end of the reading. At that time, half of the participants were given the permission to eat freely from their snack food whenever they want to and that they would be allowed to do so for the rest of the entire experiment. However, the other half of the participants was informed that they will need the snack for the preference rating but together with the information that it does not include eating it. After reading the text, participants were asked to put the text besides them on the floor and to continue with the questions. Participants were then guided through the liking and wanting ST-IAT procedures as in the previous experiments before they were asked to respond to the 3 irrelevant filler questions about the text (see Appendix). Moreover, participants had to indicate what kind of snack food they had brought to the experiment and to report how much (in %) they have eaten at the several experimental stages until the end of the ST-IAT sessions on an extra paper sheet that was handed to them (see Appendix). Moreover, they were also asked to report their subjective hunger. After the second measurement of self-reported mood and frustration, participants had to answer the final questionnaire including several demographic items, the questions about their explicit food-liking and food-wanting and the questions about how they felt at the specific moment where they were presented with food stimuli being hungry but not allowed to eat (only the nonrewarded participants).

[25] Although no significant results were found according to self-reported mood and frustration in Experiment 2, both measures were again measured twice in order to control for possible effects. However, this time no specific hypotheses were derived.

Materials

Manipulation check

Need state. Participants subjectively experienced hunger was assessed via a self report scale ranging from 1 (absolutely satiated) to 7 (extremely hungry).

Self-reports

Mood. The same mood- and frustration-related questions as in Experiment 3 were posed twice to participants. Moreover, nonrewarded participants were also asked to indicate whether they felt uncomfortable with respect to the fact that they were hungry but not allowed to eat (yes/no) and to describe the sort of feeling that was associated with that experience.

Explicit liking. Participants had to indicate their actual liking for the specific food items also used in the ST-IAT on a 7-point scale from 1 (not at all) to 7 (very positive) on the item *how positive/agreeable would it be for you to eat ____ (chocolate, pizza, spaghetti, salad, biscuit) right now?*

Explicit wanting. Participants' explicit wanting ratings were assessed via the same 7-point scale ranging from 1 (not at all) to 7 (very strong) on the item *how strong is your desire to eat ____ (chocolate, pizza, spaghetti, salad, biscuit) at the moment?*

Results

Dropouts

Overall, seven participants were excluded from further analyses. Three participants were dropped because of erratic data recoding due to computer problems and another four because they apparently did not adhere to the instructions given prior to the experiment. In this regard, three non-deprived participants reported being very hungry (scores of 6 and 7) and

one food-deprived participants indicated being very satiated (a score of 2), also constituting statistical outliers on a box-plot due to the inconsistent hunger ratings. A total of 85 participants (65 female) were left for further analyses.

Amount of food consumed

Within the present experiment it was also assessed whether and how much each participant consumed from his food from the beginning of the experiment until the end of the implicit attitude assessment. As was already mentioned, at the end of the ST-IAT sessions participants in the reward expectancy condition (N = 37) were asked to indicate whether and how much they have eaten during the several experimental stages so far on an extra paper sheet handed out to them after the last ST-IAT session. From the 37 participants, 7 brought candy (mostly chocolate bars), 13 brought a fruit and 17 brought biscuits or sandwiches. On average, participants have eaten nearly 60 % of their food (M = 58.11, SD = 39.69) during the several experimental stages until the end of the ST-IAT sessions. 14 participants have eaten 100 % of their food, whereas 8 participants did not even taste from their snack food[26].

Manipulation checks

In order to test whether the manipulation of food deprivation was effective as well as to examine the influence of control over consumption on self-reported hunger, a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) univariate ANOVA with need state and expectancy as independent variables and self-reported level of hunger as dependent variable was conducted. First of all, the analysis yielded a significant main effect of expectancy, $F(1,81) = 14.99$, $p < .01$, $\eta^2 = .16$, showing that overall participants in the nonreward condition reported being hungrier (M = 4.17, SD = 1.86) than participants in the

[26] Important for the present assumption was that participants have had control over consumption and not that they actually have eaten from their food.

reward condition (M = 3.03, SD = 1.62). Moreover, the analysis also yielded a significant main effect of need state, $F(1,84) = 55.13$, $p < .01$, $\eta^2 = .41$, revealing that overall food-deprived participants were significantly hungrier (M = 4.81, SD = 1.67) than non-deprived participants (M = 2.56, SD = 1.22). This main effect was qualified by an interaction effect of need state and expectancy, $F(1,81) = 5.62$, $p = .02$, $\eta^2 = .07$, showing that the effect of need state was more pronounced in the nonreward (M_{Diff} = 2.83) than in the reward condition (M_{Diff} = 1.46). Altogether, these results confirmed the effectiveness of the manipulation of need state. Moreover, reward expectancy obviously also influenced participants' subjective hunger ratings. Specifically, participants in the expectancy condition indicated less hunger than participants in the nonreward condition probably because of prior consumption of the snack food. This assumption was further supported by a significant negative correlation between amount of food consumed and self-reported hunger, $r(37) = -.27$, $p = .05$ (one-tailed).

Data preparation of ST-IAT latencies

The same scoring algorithm as in the previous experiments was applied in order to calculate the liking and wanting ST-IAT scores.

Reliability of the ST-IATs

The reliability scores for the liking and the wanting ST-IAT were calculated according to the same steps as in the previous experiments. The reliability analysis revealed the similar levels of internal consistency for the liking ST-IAT, r = .39 and the wanting ST-IAT, r = .42, both being lower than in Experiment 2.

Implicit liking- and wanting-related associations toward food stimuli

In order to test how food implicit liking- and wanting-related associations toward food stimuli have been influenced by food deprivation and reward expectancy, a 2 (need state:

food-deprived vs. satiated) × (expectancy: reward vs. nonreward) × 2 (type of measure: liking vs. wanting) mixed-model ANOVA with type of measure treated as within-subject factor was conducted. As a result, a two-way interaction effect between expectancy and type of measure emerged, $F(1,81) = 5.68$, $p = .02$, $\eta^2 = .07$, showing that irrespective of need state, participants in the reward condition tended to show stronger wanting-related associations toward food stimuli than liking-related associations, whereas no difference in liking- ($M = 85.24$, $SD = 104.80$, untransformed values) and wanting-related associations ($M = 58.60$, $SD = 127.85$, untransformed values) was found in the nonreward condition, $F(1,46) = 1.55$, $p = .22$, $\eta^2 = .03$. This result indicates that irrespective of need state, the (partial) consumption of the snack food led to a stronger activation of wanting- than liking-related concepts. No further main or interaction effect was significant. In addition, a significant three-way interaction effect between need state, expectancy, and type of measure was found, $F(1,81) = 4.02$, $p = .048$, $\eta^2 = .07$. In particular, further post-hoc pair-wise contrasts first revealed that food-deprived participants in the nonreward condition showed stronger wanting-related associations ($M = 84.13$, $SD = 86.49$, untransformed values) than non-deprived participants ($M = 33.07$, $SD = 156.72$, untransformed values), $F(1,46) = 5.52$, $p = .03$, $\eta^2 = .10$. However, liking-related associations did not differ between food-deprived ($M = 58.02$, $SD = 72.50$, untransformed values) and satiated participants ($M = 112.47$, $SD = 125.07$, untransformed values)[27], $F < 1$ (see Figure 3). In the reward condition, however, wanting-related associations did not differ between food-deprived ($M = 91.73$, $SD = 152.05$) and satiated participants ($M = 113.14$, $SD = 107.27$, untransformed values). Moreover, food-deprived participants also did not show more liking-related associations ($M = 48.18$, $SD = 76.64$, untransformed values) than satiated participants ($M = 68.05$, $SD = 129.95$, untransformed values), both F's < 1 (see Figure 4). Additionally, satiated compared to food-deprived participants in the nonreward

[27] Note that the significance test on the untransformed values revealed a marginal significant effect of liking-related associations due to need state, $p = .07$.

condition tended to respond with stronger wanting- (M = 102.72, SD = 129.57, untransformed values) than liking-related associations (M = 58.38, SD = 106.38, untransformed values), $F(1,35) = 3.89$, $p = .06$, $\eta^2 = .10$. No further main or interaction effect was significant, all p's < .05.

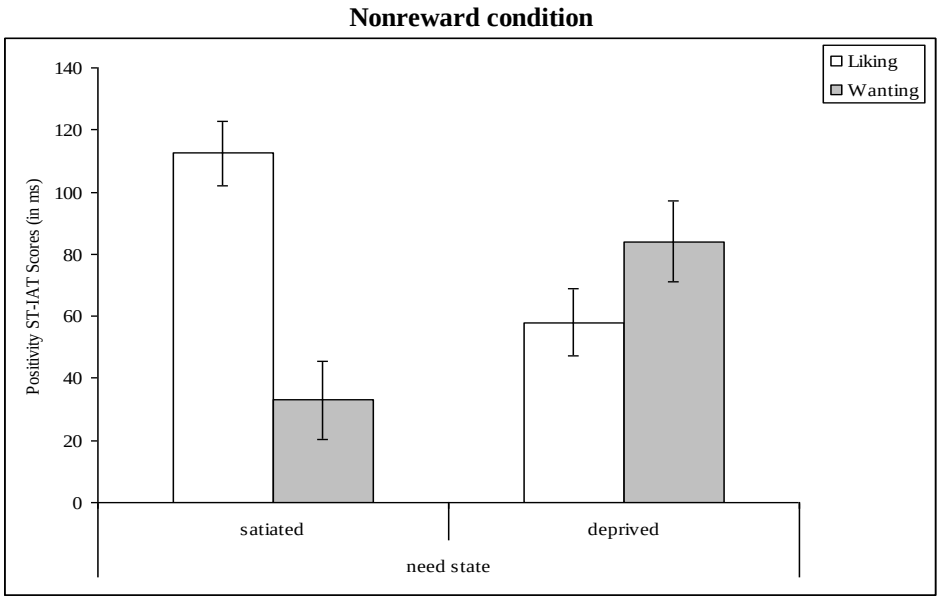


Figure 3: Positivity ST-IAT indices as a function of need state. Error bars indicate standard errors of the mean.

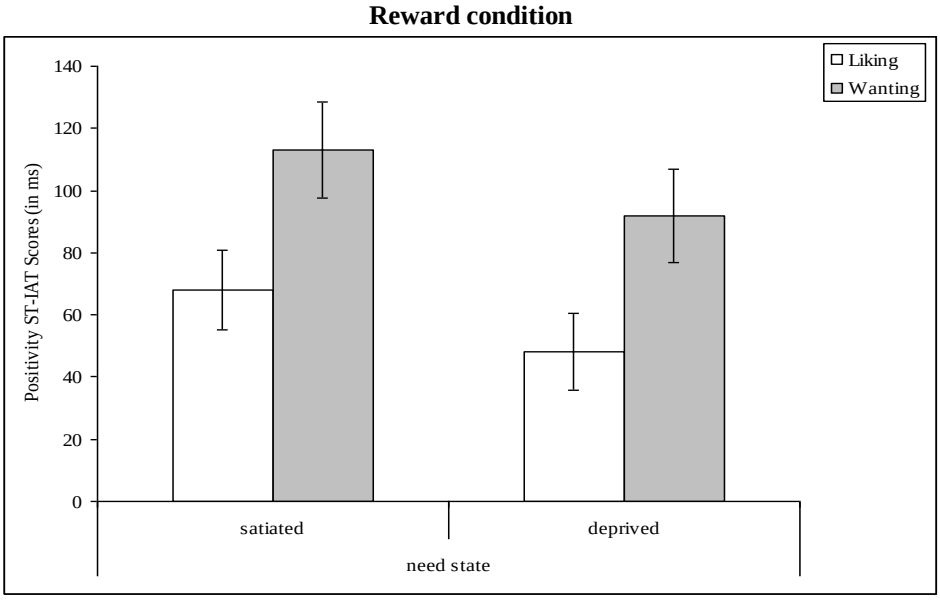


Figure 4: Positivity ST-IAT indices as a function of need state. Error bars indicate standard errors of the mean.

Self-reports of food-liking and food-wanting

As in the previous experiments, self-reports of both food-liking and food-wanting towards the five different food stimuli *(chocolate, pizza, spaghetti, salad, biscuit)* were highly correlated. Thus, a mean score for food-liking and food-wanting ratings was calculated, whereas both scores revealed high levels of reliability, Cronbach's α = .86 for explicit food-liking, and Cronbach's α = .89 for explicit food wanting. In order to test the influence of food deprivation and reward expectancy on explicit food-liking and food-wanting ratings, both food-liking and food-wanting scores were submitted to a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) × 2 (type of measure: liking vs. wanting) ANOVA for repeated measures with type of measure treated as within-subjects factor. This analysis yielded several significant effects. First of all, a main effect of need state, $F(1,81) = 32.40$, $p < .01$, $\eta^2 = .29$, as well as a main effect of type of measure was obtained, $F(1,81) = 31.86$, $p < .01$, $\eta^2 = .28$, showing a) that hungry participants overall responded more positively ($M = 5.38$, $SD = 1.29$) than non-deprived participants ($M = 3.65$, $SD = 1.71$), and b) that overall participants' food-liking responses were more positive ($M = 4.76$, $SD = 1.62$) than their food-wanting responses ($M = 4.25$, $SD = 1.88$). The analysis also revealed a main effect of expectancy, $F(1,81) = 14.20$, $p < .01$, $\eta^2 = .15$, indicating that participants in the nonreward condition overall responded more favorably ($M = 5.00$, $SD = 1.59$) than participants in the reward condition ($M = 3.87$, $SD = 1.74$). Moreover, a significant interaction effect between expectancy and type of measure emerged, $F(1,81) = 9.66$, $p < .01$, $\eta^2 = .11$, revealing that participants in the reward condition responded with more negative food-wanting ($M = 3.43$, $SD = 1.78$) than participants in the nonreward condition ($M = 4.87$, $SD = 1.71$), $F(1,83) = 14.30$, $p < .01$, $\eta^2 = .15$, and with more negative food-liking ($M = 4.30$, $SD = 1.69$ for reward, and $M = 5.13$, $SD = 1.47$ for nonreward participants), $F(1,83) = 5.79$, $p = .02$, $\eta^2 = .07$,

irrespective of need state. However, this effect was more pronounced for food-wanting than for food-liking. No further main or interaction effect was significant, all p's > .05.

Relationship between amount of snack food consumed and implicit and explicit food-liking and food-wanting responses

Pearson correlations were calculated in order to test if the amount of snack food consumed was associated with implicit and explicit food-liking and food-wanting responses. As a result, no significant correlations emerged, all p's > .20.

Subjective experience due to nonreward

In order to more closely tap into the subjective experience participants might have felt in response to frustrative nonreward, nonrewarded participants (N = 48) were explicitly asked to indicate if they felt uncomfortable knowing that they were hungry but not allowed to eat and to describe the sort of feeling that was associated with that experience. From the 24 nonrewarded and non-deprived participants no one indicated having felt discomfort in response to the fact that they were not allowed to eat. However, from the 24 nonrewarded and food-deprived participants, 8 participants reported discomfort facing nonreward. Furthermore and in support of the frustrative nonreward hypotheses, 4 of them reported that they experienced this situation to be frustrating, another 2 that they have felt frustrated and depressed and 2 participants that it was even horrible being hungry without the possibility to eat the snack food, $\chi^2(1, N = 48) = 9.60$, $p < .01$.

Self-reported frustration

As in the previous experiment, it was further tested whether nonreward also generally led to more self-reported frustration in food-deprived compared to satiated participants. Thus, a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) × 2 (time:

before vs. after implicit attitude assessment) mixed-model ANOVA for repeated measures with time varied within-subjects was conducted on self-reported frustration. The pattern that emerged replicated the results of Experiment 2, i.e. no main or interaction effect was significant, all *p*'s > .05, again with participants overall reporting being not frustrated both before as well as after implicit attitude assessment (see Table C1 in the Appendix). Also in accordance with Experiment 2, the self-reported frustration before and after the implicit attitude assessment were highly correlated, $r(85) = .79$, $p < .01$, additionally indicating that self-reported frustration did not change over the course of implicit attitude assessment.

Self-reported mood

As was done in Experiment 2, it was further tested whether food deprivation and reward expectancy were also associated with changes in general mood. Therefore, mood scores for both assessment times were calculated with higher scores indicating more positive mood. Both mood scores revealed satisfactory levels of reliability, Cronbach's $\alpha = .91$ at time 1, and Cronbach's $\alpha = .89$ at time 2. They were then submitted to a 2 (need state: food-deprived vs. satiated) × 2 (expectancy: reward vs. nonreward) × 2 (time: before vs. after implicit attitude assessment) mixed-model ANOVA for repeated measures with time treated within-subjects. This analysis only revealed a significant main effect of time, $F(1,81) = 14.80$, $p < .01$, $\eta^2 = .16$, showing that participants had a slightly better mood at time 2 ($M = 4.84$, $SD = .96$) than at time 1 ($M = 4.67$, $SD = 1.05$). All other main or interaction effects were not significant, all *F*'s < 1. But overall, as was also the case in Experiment 2, participants in all experimental conditions reported being in a very positive mood (see Table C2 in the Appendix). Moreover, mood ratings at time 1 and time 2 were also highly correlated, $r(85) = .93$, $p < .01$, showing that general mood states did not change over the course of time 1 to time 2.

Correlations between self-reported mood, frustration and implicit and explicit responses of food-liking and food-wanting

It was further analyzed whether mood and frustration correlated with implicit and explicit food-liking and food-wanting responses. However, this was not the case. As in Experiment 2, self-reported mood and frustration did not correlate with the implicit and explicit responses toward food stimuli, all p's > .10.

Discussion

Experiment 3 yielded a mixed pattern of results in respect to the present theoretical approaches. Again, as was already found in the previous experiments, food-deprived and nonrewarded participants showed stronger wanting-related associations toward food stimuli, while at the time their liking-related associations did not differ from those of satiated participants. This finding therefore adds to the conclusion that both the motivational and the dual attitudes approach are predictive of how the immediate valence of need-relevant stimuli changes as a function of need state and reward expectancy. In this regard, food-wanting reflects the motivational approach assuming that implicit attitudes change flexibly due to food deprivation irrespective of reward expectancy, while food-liking rather mirrors the dual attitude approach proposing that implicit attitudes are rather stable constructs that can hardly be influenced by external or internal factors.

In contrast, within the reward condition (control over consumption), no dissociation of implicit food-liking and food-wanting occurred. Both satiated and food-deprived participants responded with overall equal positive liking- and wanting-related associations. Thus, giving participants in the reward expectancy condition full control over their consumption seems to abolish the dissociation between implicit food-liking and food-wanting. However, in this condition reward expectancy probably was confounded with anticipated satiation, since this

result might have been caused by the fact that food-deprived participants in the reward condition may have anticipated satiation due to the (partial) consumption. This, in turn, may have prompted weaker associations of food-liking and food-wanting in food-deprived participants in the reward expectancy condition. However, although the amount of snack food consumed was negatively correlated with subjective hunger, it was not reliably related to explicit and implicit food-liking and food-wanting, thus questioning the above argument. Although rewarded participants' liking- and wanting-related responses toward food stimuli may mirror the concept of sensory-specific satiety (Cabanac, 1971; Havermans et al., 2009) - which refers to the decrease of liking of a consumed compared to a non-consumed food - this account, however, should not apply to the fact that participants in the present experiment mostly responded to food stimuli different from their eaten snack foods. However, as was already mentioned in Experiment 2, it could nevertheless be guessed, whether food stimuli automatically may have lost their incentive value for food-deprived participants after food consumption irrespective of whether they have experienced complete satiation or not. Thus, control over consumption and expected satiety after consumption may have sufficed to delay cue-triggered liking- and wanting-related associations in food-deprived participants to the same extent as in non-deprived participants. The significant correlation between liking- and wanting-related associations may also reflect this result.

With regard to the reliability of the ST-IAT measurement, both the liking and the wanting ST-IAT revealed similar levels of internal consistency that were, however, lower than the levels reached in Experiment 2. Nevertheless both measures fitted to the common range that was constituted by other studies using the ST-IAT (e.g., r = .24-.51, Bluemke & Friese, 2008; α = .72, Wigboldus et al., 2004).

Once again, participants' explicit self-reports of food-liking and food-wanting did not mirror their implicit responses. As the main result, hungry participants were found to explicitly respond more positively with food-liking and food-wanting than non-deprived

participants over all experimental conditions. A significant correlation between both measures further affirms this finding. Moreover, nonrewarded participants were found to respond with more explicit food-wanting but not more explicit food-liking than rewarded participants, irrespective of need state. This additional result are in line with findings from the domain of decision making, that nonreward also let to a similar dissociation of liking and wanting (Litt et al., in press). The present discrepancy between participants' implicit and explicit was also reflected in the non-significant correlation between implicit and explicit responses. On the one hand, this finding is consistent with the dual attitude approach, showing that especially food-liking is more malleable on an explicit than on an implicit level of responding. Thus, implicit liking seems to reflect more stable associative links between food and valence, while explicit food-liking reflects more malleable evaluations that are consciously constructed on the spot. On the other hand, this finding also suggests that eating-related attenuations in the immediate responses towards food stimuli might be reflected more on implicit rather than on explicit responses, as far as the ST-IAT results in the reward condition were interpreted this way.

In addition, participants' self-reported frustration and mood were not moderated by need state or frustrative nonreward. Contrary to the frustrative nonreward approach, participants overall reported being not frustrated at all and being in a positive mood. Moreover, the level of self-reported mood and frustration did not change over the course of implicit attitude assessment and also did not correlate with implicit and explicit food-liking and food-wanting. On the one hand, these results replicated the obtained null-findings of Experiment 2, but also conflicted with results from Rejeski et al. (in press) reporting higher self-reported negative affect among high cravers anticipating a long delay of consumption. Thus, it can be concluded the manipulation of frustrative nonreward was again not effective in the present experiment. However, assuming that participants were relatively unaware about their implicit responses due to the reward expectancy manipulation, it can also be hypothesized that the affective response that may have been elicited by frustrative nonreward

and leading to more negative liking-related associations toward food stimuli has been very subtle and therefore has occurred outside of peoples' awareness (see e.g. Kihlstrom, 1999; Winkielman et al., 2005). A more indirect physiological measurement of participants' (facial) affective reactions in response to nonreward would certainly provide more definite answers to this question. Alternatively, retrospective reports of hedonic experiences were often found to be wrong (e.g., Redelmeier & Kahneman, 1996; Wilson & Schooler, 1991). Thus, participants might have quite felt a slight affective change consciously at a specific moment in the course of the experiment, but simply may have failed to remember it later when being asked to explicitly report it. Because of this earlier finding, participants in the present experiment were also asked to more specifically indicate their subjective experience in response to nonreward, namely to report how and what they have felt in consideration of the fact that they were hungry but not allowed to eat. The analysis at least revealed that a third of the relevant participants reported having felt discomfort and frustration. This finding can be regarded as first evidence that hungry and nonrewarded participants indeed are likely to feel frustration, as would be assumed by the frustrative nonreward hypothesis. However, the findings also suggest that participants need to be asked more specifically about their affective reactions in the concrete situation in order to obtain relevant responses.

Finally, replicating the results of Experiment 2, no changes in mood state and frustration were found due to food deprivation, questioning the appealing notion that longer states of food deprivation may be likely to be associated with negative mood and thus adding further evidence that this might no be the case (see also Green et al., 1995; Hoefling et al., 2009; Hoefling & Strack, 2008).

Experiment 4

So far, no direct evidence for the frustrative nonreward approach was found, given that liking-related associations were not moderated by need state or reward expectancy. Moreover, the results of Experiment 1-3 also imply that implicit food-wanting seems to be the better measure in order to assess immediate motivational responses towards need-relevant stimuli. However, the previous experiments only tested one deprivational state, namely 15 hours of food deprivation, while letting less extreme states of hunger unconsidered. However, a closer look at the literature reveals that the relationship between need state an immediate evaluations seem to depend on the duration of hunger states. For instance, while some studies working with very short periods of food deprivation (approx. 2-4 hours) repeatedly found favorable immediate responses to food stimuli in food-deprived compared to satiated participants (e.g., Ferguson, 2008; Seibt et al., 2007), studies that let participants fast for up to 24 hours reported rather unfavorable immediate responding to food cues as a function of need state (Drobes et al., 2001; Lüthy et al., 2003; Mauler et al., 2006)[28]. Moreover, Levine et al. (1942) tested participants after one, three, six and nine hours fast and measured the degree to which ambiguous chromatic and achromatic cards were perceived as representing food; i.e. they assessed the amount of attentional bias due to different intensities of hunger. As a result, the number of eating-related responses to the chromatic and achromatic cards given to the participants increased at three and at six hours of food deprivation, but decreased thereafter. Levine et al. concluded from this result that with increasing hunger, subjects will be likely to turn away their attention from the cards toward real objects in the environment, because ambiguous figures finally do not have the potential to satisfy the need. The authors term this the "reality process", which increases as a function of deprivation strength. Although this

[28] Beside deprivation strength, the studies also differed in the kind of response measures that were used. Whereas the former researchers used indirect measures from the social cognition domain like the affective priming task (Fazio, Jackson, Dunton, & Williams, 1995) and the IAT, the latter worked with established physiological procedures like the startle eye-blink or the prepulse inhibition procedure.

interpretation is rather speculative, the results already indicate that food seems to lose its incentive value when hunger becomes too intense. Moreover, a study by Epstein, Truesdale, Woijcik, Paluch, and Raynor (2003) found that 17 hours food deprivation (vs. satiation) did not influence taste reactivity to food via coding of different facial expressions. Based on this evidence, the present experiment focused only on implicit associations of food-liking[29]. Thus, the present experiment was run in order to test the curvilinear function of immediate liking-related associations toward food cues due to deprivation strength (e.g., satiation vs. moderate hunger vs. intense food deprivation). Accordingly, being normally hungry should elicit more positive responses towards food stimuli, while being food-deprived for 15 hours should rather lead to more negative responses, given that participants were not rewarded. Addressing this question would provide a more complete answer regarding the malleability of evaluative associations of need-relevant stimuli as a function of need state.

In addition, the present experiment examined participants' implicit associations toward need-irrelevant stimuli as a function of deprivation strength. According to studies constituting the devaluation effect, activating a focal need (e.g., to eat) has been shown to make objects unrelated to the need (e.g., shampoo) less valuable compared to objects closely related to the need (that in turn got increased in value), respectively (Brendl et al., 2003). Furthermore, Markman, Brendl, and Kim (2007) extended this finding on the devaluation effect and demonstrated that this effect even occurs depending on the time of day. Specifically, participants with the goal to eat devaluated foods that were contextually inappropriate to the time of day the study has been conducted. For instance, the authors obtained devaluation effects for breakfast foods in the evening and vice versa, concluding that the goal to satisfy hunger was very narrow in nature. In these studies, however, valuation and devaluation of

[29] Negative responses toward food stimuli due to food deprivation were only observed in participants' immediate reactions rather than on explicit self-reports (Mauler et al., 2006; Seibt et al., 2007).

need-relevant stimuli were exclusively measured via explicit liking ratings[30]. But first evidence that such devaluation effects might also occur more implicitly comes from a recent study by Fishbach, Zhang, and Trope (2010).

The present experiment was the first to test this idea. Specifically, it was hypothesized that both levels of food deprivation compared to satiation should lead to more negative implicit associations toward need-irrelevant stimuli. In support of this prediction, the devaluation effects on explicit self-reports reported by Markman et al. (2007) and Brendl et al. (2003) were already found with 45 minutes of food deprivation or no specific manipulation of physiological deprivation at all[31], respectively.

In order to test the above assumptions, participants were randomly assigned to 3 between-subjects conditions of hunger. They were either asked to sufficiently eat immediately prior to the experiment (satiated group), to fast for 2 hours (moderately hungry group), or for 15 hours (food-deprived group), respectively, before coming to the experiment. Half of the participants were instructed to respond to a need-relevant ST-IAT depicting food words as targets, whereas the other half of participants were asked to respond to a need-irrelevant ST-IAT depicting furniture words as target stimuli. Note that neither consumption of real food was part of the experiment, nor did participants receive any information about the possibility to consume food during the experiment.

Design

The experiment consisted of a 3 (need state: satiated vs. 2 hours vs. 15 hours since last meal) × 2 (stimuli: need-relevant vs. need–irrelevant) factorial design with both factors varied

[30] Although Brendl et al. (2003) assumed that the mechanism underlying the devaluation effect seems to occur outside of participants' awareness and that it follows goal-dependent automaticity criteria, they did not test it with adequate measures designed to capture associative responses.

[31] In the study by Brendl et al. (2003, Experiment 2) food deprivation was not actively varied. Instead, the authors let participants taste a small amount of food (popcorn) as appetizer in order to trigger their physiological need.

between-subjects. As dependent variable, separate ST-IAT scores were calculated, providing an index for participants' implicit associations toward need-relevant and need–irrelevant stimuli.

Method

Participants

A total of 110 normal-weight (BMI: *M* = 22.47, *SD* = 2.43) non-psychology participants (83 female) from various professional backgrounds with an average age of 24 (*SD* = 2.64) took part in the experiment in sessions up to three persons. The present experiment lasted about 30 minutes being the first in a battery of other unrelated experiments also lasting about 30 minutes. As compensation, participants received 6 EUR for a total experiment time of one hour.

Procedure

Participants followed the same experimental procedures as in Experiment 1 with following modifications. Because changes in wanting-related associations towards food stimuli due to need state were consistently found in the previous experiments and this result also does not challenges the frustrative nonreward approach, only liking-related associations were measured within the present experiment. However, liking-related associations toward need-irrelevant stimuli were also measured. Beside the target stimuli of the need-irrelevant ST-IAT (see *Materials*), the ST-IATs were structurally identical to the ST-IATs of the previous experiments. In addition, as was already described, the present experiment manipulated three stages of hunger instead of two.

Materials

Manipulation check

Need state. Participants were asked to indicate their subjectively experienced hunger on a bipolar 7-point scale ranging from 1 (absolutely satiated) to 7 (extremely hungry).

ST-IAT stimuli

The need-relevant liking ST-IAT was identical to the ST-IATs in the previous experiments. The need-irrelevant ST-IAT, however, consisted of five need-irrelevant words belonging to the category furniture (German words for *storage rack, chair, dresser, closet, wardrobe*), respectively.[32]

Results

Dropouts

The data from five participants were excluded because they apparently did not adhere to the instructions given prior to the experiment. Specifically, two participants in the satiated condition indicated being very hungry (a score of 7) and 3 participants in the 15 hours food deprivation condition responded being very satiated (scores of 1 and 2). Moreover, these inconsistent hunger ratings also constituted statistical outliers on a box-plot. Thus, the data of 105 participants (80 female) were further analyzed.

Manipulation checks

To test whether the manipulation of need state was effective, two t-tests with need state as independent and self-reported level of hunger as dependent variable were conducted.

[32] The need-relevant target concept category included 5 different food items that were thought to cover the mainstream German gusto.

As a result, both t-tests revealed a significant effect of need state. Specifically, 2 hours food-deprived subjects were significantly hungrier (M = 4.41, SD = .86) than non-deprived subjects (M = 2.35, SD = 1.19), $t(72) = 8.42$, $p < .01$, as well as that 15 hours food-deprived subjects were significantly hungrier (M = 5.55, SD = .77) than 2 hours food-deprived subjects, $t(63) = 5.61$, $p < .01$. Thus, as was crucial for the present experiment, subjective hunger ratings varied significantly as a function of need state (time since last meal).

Data preparation of ST-IAT latencies

Both need-relevant and -irrelevant ST-IAT scores were calculated according to the same algorithm that was also applied in the previous experiment (c.f. Greenwald et al., 1998; Wigboldus et al., 2004).

Reliability of the ST-IATs

The reliability analysis revealed different levels of internal consistency, whereas the need-relevant ST-IAT proved to have a much higher level of internal consistency (adjusted r = .73) compared to the need-irrelevant ST-IAT (adjusted r = .36, respectively).

Implicit associations toward need-relevant and –irrelevant stimuli

To test how different durations of food deprivation influence the implicit associations toward food- as well as need-irrelevant stimuli, a 3 (need state: satiated vs. 2 hours vs. 15 hours since last meal) × 2 (stimuli: need-relevant vs. –irrelevant) between-subjects factorial univariate ANOVA with implicit associations as dependent variable was conducted. As expected, a significant main effect of need state was obtained, $F(2,105) = 3.14$, $p = .048$, $\eta^2 = .06$, which indicates that overall 15 hours food-deprived participants showed more negative associations to stimuli than the other two groups. The main effect of stimuli was marginally significant, $F(1,105) = 2.97$, $p = .09$, $\eta^2 = .03$, indicating that need-irrelevant stimuli tended to

yield more negative implicit associations than need-relevant stimuli. However, the main effects were of no further importance for the present predictions. More importantly, a significant interaction between need state and stimuli was found, $F(2,105) = 4.51$, $p = .01$, $\eta^2 = .08$, revealing that need state differentially influenced participants' immediate responding toward need-relevant compared to need–irrelevant stimuli (see Figure 5). To further qualify this interaction effect, post-hoc single contrast analyses were calculated. Specifically, whereas 2 hours food-deprived participants responded with more positive implicit associations toward food stimuli ($M = 158.59$, $SD = 125.43$, untransformed values) compared to satiated participants ($M = 92.54$, $SD = 171.23$, untransformed values), $F(1,46) = 3.06$, $p = .04$, $\eta^2 = .06$, 15 hours food-deprived participants ($M = 34.78$, $SD = 101.82$, untransformed values) indeed showed significantly more negative food-related associations toward food stimuli than the 2 hours food-deprived participants, $F(1,39) = 13.45$, $p < .01$, $\eta^2 = .26$, and also tended to show more negative associations than the satiated participants, $F(1,47) = 1.78$, $p = .15$, $\eta^2 = .04$.

In contrast, as was hypothesized, 2 hours food-deprived participants ($M = 30.63$, $SD = 97.15$, untransformed values) showed significantly more negative associations toward need-irrelevant stimuli than satiated participants ($M = 68.38$, $SD = 103.04$, untransformed values), $F(1,27) = 6.13$, $p = .04$, $\eta^2 = .19$. This was also true for the 15 hours food-deprived participants ($M = 25.84$, $SD = 74.84$, untransformed values) compared to satiated participants, albeit the contrast was only marginally significant, $F(1,24) = 4.85$, $p = .07$, $\eta^2 = .18$. Moreover and also in line with the predictions, whereas implicit associations toward need-irrelevant stimuli were significantly more negative compared to associations toward need-relevant stimuli in the 2 hours food deprivation condition, $F(1,32) = 12.66$, $p < .01$, $\eta^2 = .28$, no such difference regarding stimuli emerged in the other two experimental groups, both F's < 1.

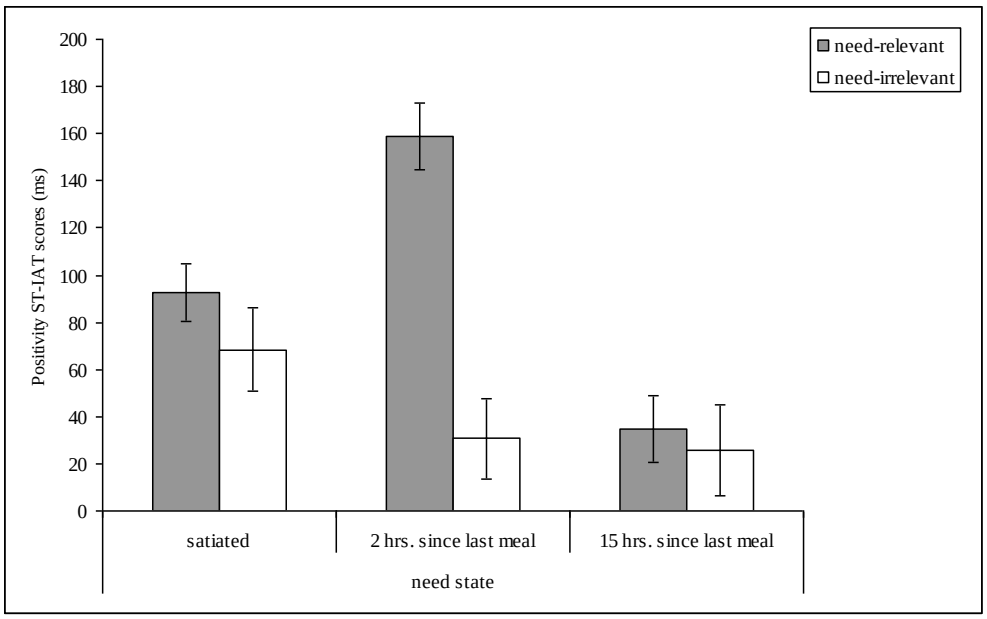


Figure 5: Positivity ST-IAT indices as a function of need state. Error bars indicate standard errors of the mean.

Curvilinear function of deprivation strength

In addition, in order to test the predicted quadratic function of deprivation strength on implicit associations toward food cues, a further curve-fitting regression-analysis was calculated with ST-IAT scores for need-relevant stimuli as criterion and need state as predictor. The total test of the quadratic function was significant, $F(2,64) = 4.77$, $p = .01$. As hypothesized, the implicit associations toward food stimuli became more positive within "normal" states of hunger (120 minutes), $\beta = 2.28$, $p < .01$, but turned out to be more negative as soon as hunger became too intense, $\beta = -2.44$, $p < 01$.

Discussion

The presentation of need-relevant vs. need-irrelevant stimuli yielded different implicit responses depending on the subjects' need state. For need-relevant stimuli, it was shown that moderately-hungry compared to satiated participants responded with more positive associations, whereas 15 hours food-deprived participants responded with more negative

associations compared to moderately-hungry and satiated participants. However, although the single contrast between need-relevant associations of 15 hours food-deprived compared to satiated participants was not significant, a curvilinear function of need state could nevertheless be observed. In contrast, 2 hours of food deprivation compared to satiation let to more favorable implicit associations. Thus, this result can be seen as first systematic test of deprivation strength as possible moderator of immediate responses toward need-relevant stimuli filling the gap between the so far inconsistent literatures independently reporting either facilitating effects of food deprivation (e.g., Seibt et al., 2007) or negative affective responses due to food deprivation (e.g., Drobes et al., 2001). In particular, the present finding suggests that the automatic link between need state and liking-related evaluations of need-relevant stimuli seems to be much more flexible than expected with regard to the previous experiments, deprivation strength being the crucial factor. Given that food is essential for survival, hungry subjects show more positive associations towards need-relevant stimuli and more negative associations towards need-irrelevant stimuli, reflecting a functional self-regulatory mechanism. According to the motivational approach, such mechanisms help people to get prepared for consumption and therefore may also facilitate the regular intake of nutrients. However, this mechanism does not automatically follow a linear distribution. Instead, the organism also has installed a mechanism that automatically attenuates the incentive value of need-relevant stimuli at higher (and usually abnormal) levels of food deprivation. The results also imply that this seems to happen quite automatically, thus rather offering evidence in favor of the idea that implicit attitudes are malleable and contradicting the dual attitude approach. However, although highly food-deprived participants did not show significantly more negative liking-related associations towards food stimuli than satiated participants, a mechanism due to frustrative nonreward could nevertheless be responsible for the present findings. This point will be discussed in more detail in the general discussion.

The present findings also confirm early findings by Levine et al. (Levine et al., 1942) that shows that the number of eating-related responses given to ambiguous stimuli as an index of attentional bias increased until six hours of food deprivation, but decreased thereafter. However, other studies in the domain of attentional processes rather found quite opposite results as a function of deprivation strength. In fact, results revealed stronger attentional biases to need-relevant cues in 24 hours food-deprived subjects (e.g., Channon & Hayward, 1990; Mogg et al., 1998), but failed to find such effects in 6 hours food-deprived participants (Stewart & Samoluk, 1997). Accordingly, Stewart and Samoluk (1997) argued that "longer periods of food deprivation may be required to facilitate the organization of cognitive schemata around appetitive-related material that in turn guide the selective processing of appetitive cues" (p. 134). However, since attentional biases are thought to provide an objective index of motivational rather than of positive or negative affective states (Mogg & Bradley, 1998), this inconsistency between both literatures does not contradict the assumptions of the present thesis. Instead, these lines of research rather add to the postulation of independent processes underlying affective- versus motivation-related responses.

Moreover, the present experiment also revealed an immediate devaluation effect for implicit associations toward need-irrelevant stimuli, thus extending the classic finding (e.g., Brendl et al., 2003) to an implicit level of responding. Specifically, need-irrelevant stimuli were immediately associated more negatively as soon as participants became moderately hungry. Taken together, need-relevant stimuli presented to highly-deprived subjects may become similar aversive as need-irrelevant stimuli, given that participants were not rewarded.

Meta-analysis on the Dissociation of Implicit Food-Liking and Food-Wanting

The findings of the Experiments 1-3 revealed significant effects of implicit food-wanting as a function of need state, but no effects of need state on implicit food-liking responses. In particular, nonrewarded participants were found to show stronger wanting-related associations toward food stimuli, while their liking-related associations did not differ due to food deprivation, implying that implicit evaluations towards need-relevant stimuli seem to be quite robust against changes in hunger. Within the separate experiments, no statistical reliable effect of food-deprivation and nonreward was found on the liking-related associations, although the means description indicates that food-deprived and nonrewarded participants evaluated need-relevant stimuli more negatively than satiated participants in each of these experiments. However, Experiment 4 provided first evidence that liking-related associations might be more malleable as previously expected and that the variation follows a curvilinear function, assimilating more to the frustrative nonreward approach. Two of the contrast-effects due to hunger in the nonreward condition were substantial, though not significant, (p = .18, Exp. 2; p = .15, Exp. 4). Thus, in order to test whether the non-significant results were due to low power, a meta-analysis over the four present experiments with a total number of 179 participants was conducted. Because no dissociation of implicit food-liking and food-wanting due to food deprivation was expected in the reward expectancy conditions of Experiment 2 and 3, these conditions were not considered in the meta-analytic comparison. In particular, effect sizes for two contrasts were calculated: a) liking-related associations (over 4 experiments) and b) wanting-related associations toward food stimuli (over 3 experiments) of 15 hours food-deprived compared to non-deprived participants. From Experiment 4, the 3 hours food-deprived condition was not considered in the present analyses, because all other experiments did not entail this experimental condition.

Procedure

To account for statistical biases due to small sample sizes, a unbiased *d* effect size offered by Hedges (1981, see also Lipsey & Wilson, 2001) was calculated for both contrasts. Furthermore, standard errors, weights, *z*-scores were also calculated for the effect sizes in order to compute the significance test (Lipsey & Wilson, 2001, pp. 49, 115). To test the significance of the mean effect size a z-test was computed. The result is distributed as a standard normal variate. Values exceeding 1.96 were statistically significant with $p < .05$, values exceeding 2.58 were significant with $p < .01$. Finally, the *Q-value* and the recent I^2-value for the homogeneity analysis of the effects across the studies were calculated (Higgins, Thompson, Deeks, & Altman, 2003). The effect sizes for all 4 experiments, the weighted mean effect sizes across all experiments and the related *z* scores are presented in Table 2.

Table 2

Effects Sizes, Weighted Mean Effect Size and z Scores.

	Liking	Wanting
	d	*d*
Experiment 1	.15	.58
Experiment 2	.13	.73
Experiment 3	.14	.65
Experiment 4	.39	
Weighted mean effect	.21	.64**
z	1.35	3.56

Notes. *d* denotes Hedges' (1981) effect size.
** $p < .01$

Results

First of all, a significant medium to large effect of need state on implicit food-wanting was obtained, $d = .64$, $p < .01$. The effect of need-state on implicit food-liking was small and not significant, $d = .21$, $p = .18$, indicating that nonrewarded participants did not responded differently with implicit food-liking due to food deprivation[33]. Also important, all experiments can be regarded as homogeneous with respect to the analyzed liking, $\chi^2 < 7.81$, $p > .05$; $I^2 = 0$, and wanting effect, $\chi^2 < 5.99$, $p > .05$; $I^2 = 0$.

Discussion

The present meta-analysis integrates the data from the previous experiments showing that implicit food-liking and food-wanting might dissociate due to food deprivation and nonreward. This set of findings is very informative considering the lack of empirical studies conceptualizing a dissociation of implicit processes (e.g., Amodio & Devine, 2006). That is, different associations towards and attitude object might be activated at the same time and even contradict each other (Baumeister, Vohs, DeWall, & Zhang, 2007). Based on the present findings, wanting-related associations may reflect motivational aspects linked to an object, while liking-related associations may rather mirror evaluative aspects. According to the specific situation in which those associations might be activated, they may trigger different responses either facilitating or inhibiting the approach of an object. The results are also in line with studies showing increased food-wanting irrespective of food-liking responses in food-deprived compared to non-deprived participants (Epstein et al., 2003; Gibson & Desmond, 1999). Moreover, this finding is also concordant with research showing that wanting for a

[33] Concordant results were also obtained after calculating a 2 (need state: food-deprived vs. satiated) × 2 (type of measure: liking vs. wanting) ANOVA including the data of all four experiments controlling for the factor experiment.

rewarding target is enhanced after denials and failures in obtaining it (Litt et al., in press; McFarlin et al., 1984), despite less liking for it afterwards (Litt et al., in press).

However, the present results are also very informative with regards to the different approaches that may account for malleability effects of implicit (versus) explicit attitudes due to, for example, food deprivation. While Experiments 1-3 rather suggest that liking-related associations did not change due to need state, Experiment 4, however, implies that this assumption may be premature. A more profound discussion of the implications on the basis of the different theoretical approaches together with a summary of the key findings of the present experiment will be provided next.

GENERAL DISCUSSION

Summary of Core Assumptions

The present thesis was focused on several research goals concerning the relationship between food deprivation, reward expectancy, and the evaluation of need-relevant stimuli.

Firstly, the aim of the present research was to reconcile contradicting evidence on the immediate evaluation of need-relevant stimuli due to food deprivation. While some authors found clear evidence showing that individuals tend to immediately evaluate food stimuli more positively when being hungry (Hoefling & Strack, 2008; Seibt et al., 2007), others reported the opposite results, namely that food deprivation rather elicits aversive affective responses to food cues (e.g., Drobes et al., 2001; Mauler et al., 2006). Based on the controversy whether implicit attitudes rather reflect malleable or stable object-valence associations, the present research was guided by different predictions following different theoretical approaches, being the motivational, the frustrative nonreward, and the dual attitudes approach. While the motivational and the frustrative nonreward approach would assume implicit attitudes to change flexibly across different situations (e.g. internal drives or reward expectancy), the latter approach rather hypothesizes that this should only be the case for explicit attitudes. The present studies investigated which of these predictions concerning the relationship between food deprivation, reward expectancy and the evaluation of need-relevant stimuli would be valid (see predictions I-IV).

Secondly, the present research differentiated between evaluative and motivational aspects of implicit attitudes that may be activated simultaneously and may lead to different affective responses, thus building up on the idea that implicit associations may have different components that could also change in valence (Amodio & Devine, 2006). Based on preliminary evidence already suggesting that food-liking and food-wanting can be dissociated

as a function of food deprivation (Epstein et al, 2003; Finlayson et al., 2007a; Gibson & Desmond, 1999), the present research extended these findings by exploring how food deprivation and nonreward may influence participants' disposition to respond with evaluative (liking-related) responses in contrast to motivational (wanting-related) responses toward food stimuli. In this regard, the present findings also adds new insight into the more general conceptualization of a tripartite structure of attitudes (Breckler, 1984; Rosenberg & Hovland, 1960). According to this model, an attitude consists of an affective, a behavioral, and a cognitive component. Usually all three components can be activated at the same time and thus predict the occurrence of one or the other. Although this model is widely accepted as the basic conceptualization of attitudes, little predictions could be derived from it with regards to attitude change and whether the three components might change simultaneously and in the same direction. Assuming that liking-related evaluations reflect the affective and the wanting-related evaluations the behavioral component, the present research revealed that one or more components might change simultaneously but not always in the same direction. This further implies that in certain contexts predicting one from the other might be a more complex process than previously expected. Moreover, the present research even extends the tripartite model of attitudes by assuming that not only explicit but also implicit attitudes may be organized in such a way.

Thirdly, it was also explored whether different states of hunger (deprivation strength) may differentially change the immediate valence of need-relevant versus –irrelevant stimuli. This question was also based on contradicting literature reporting either favorable immediate responses to food stimuli in food-deprived compared to satiated participants under poor levels of food deprivation (e.g., Ferguson, 2008; Seibt et al., 2007) or unfavorable immediate responding to food stimuli as a function of high levels of food deprivation (Drobes et al., 2001; Lüthy et al., 2003; Mauler et al., 2006). The present research thus captured participants' immediate evaluative responses toward need-relevant and need-irrelevant stimuli while

participants were exposed to 0, 2, or 15 hours of food deprivation. Assuming that food stimuli presented to highly food-deprived participants without reward expectancy may elicit a state of frustrative nonreward (Amsel, 1958; Wagner, 1963), it was hypothesized that only longer lasting periods of fast (compared to satiation) should lead to more negative evaluative responses to food stimuli. Moderate levels of fast (compared to satiation), however, should result in more positive immediate evaluations of food stimuli, given that participants in this conditions were not expected to be frustrated. Moreover, based on the concept of the devaluation effect of need-irrelevant stimuli (Brendl et al., 2003; Markman et al., 2007), such a curvilinear function of food deprivation was only assumed to be found for immediate responses toward food-stimuli, but not for need-irrelevant stimuli.

Fourthly, testing the sour-grapes effect illustrated at the beginning of the thesis, it was examined whether frustrative nonreward actually elicits frustration in food-deprived participants (c.f. Carver, 2004). Recent studies arguing on the basis of frustrative nonreward failed to measure this relationship (Drobes et al., 2001; Hawk et al., 2004; Mauler et al., 2006). Therefore, food-deprived and satiated participants reported the degree to which they experienced frustration along with positive or negative affect in response to the different experimental conditions. In the following, the results together with interpretations and alternative explanations will be considered. For ease of traceability, the results from Experiment 1-4 are summarized in separate sections for implicit associations, explicit attitudes, and self-reports of frustration and mood.

Summary of Results and Implications

Do implicit liking- and wanting-related evaluations toward food stimuli dissociate as a function of food deprivation and nonreward?

Experiment 1-3 were successful in revealing that liking- and wanting-related associations toward food stimuli might dissociate as a function of food deprivation, given that participants were not rewarded with real food during the experiment. More specifically, whereas food-deprived participants showed more wanting-related evaluations toward food stimuli than satiated participants, the liking-related evaluations did not differ across both conditions of hunger. Overall, this effect could be replicated in 3 experiments using different manipulations of nonreward versus reward expectancy. Participants in Experiment 1 were given no information about eating at all and were also not provided with food during the experiment. In this setup, it could not be ruled out that some participants nevertheless reasoned about eating (because of the former instruction to refrain from eating or not) and therefore expected to be provided with the possibility to eat. For Experiment 2 and 3, participants were indeed asked to bring a snack food to the experiment and then were given the information that they would or would not be allowed to eat during the experiment. Surprisingly, participants of Experiment 2 anticipating food consumption showed the same liking- and wanting-related responses due to food deprivation than participants in the nonreward condition. But providing participants with individual control over food consumption abolished the dissociation of liking- and wanting-related associations. In this condition, however, participants' liking- and wanting-related associations were not moderated by need state, maybe due to the (partial) consumption of snack food before the implicit attitude assessment. This, in turn, may have reduced participants' disposition to respond with more liking- and wanting-related associations when being hungry.

Again, Experiments 1-3 demonstrated that high levels of food deprivation and nonreward let liking- and wanting-related associations toward food stimuli dissociate, in such a way that food-deprived and nonrewarded participants showed more wanting-related but no more liking-related associations than satiated participants. These findings imply that wanting-related associations are more malleable than liking-related associations, the former speaking in favor of the motivational approach, and the latter speaking in favor of the dual attitudes approach. Thus, food-wanting seems to be better suited in order to measure changes in implicit associations due to motivational factors. Moreover, the fact that liking-related associations did not change due to food deprivation mirrors the notion that need-relevant stimuli may have started to lose its hedonic value for individuals as soon as hunger becomes too intense (c.f. Pinel, Assanand, & Lehman, 2000). However, Experiment 4 revealed that liking-related associations are also quite sensitive to changes in need state, but that in this case the strength of deprivational state seems to play an important role. Nevertheless, high levels of food deprivation did not result in more negative responses as would have been suggested by the frustrative nonreward approach. Instead, they could have reflected rather ambivalent responses (c.f. Petty et al., 2006). Specifically, the fact that nonrewarded participants did neither show more positive nor more negative liking-related evaluations toward food stimuli due to food deprivation may reflect the fact that individuals can also have strong positive *and* negative associations toward an attitude object (e.g., food) at the same time (e.g., Cacioppo, Gardner, & Bernston, 1997). The simultaneous existence of positive and negative attitudes toward an attitude objects is defined as ambivalence (Thompson, Zanna, & Griffin, 1995). Such a state of evaluative conflict has been shown to usually result in more neutral evaluations because of the joint activation of positive and negative associations toward an object (de Liver et al., 2007; Petty et al., 2006). Moreover, ambivalence is known to also occur without people recognizing it explicitly, a state referred to as ‘implicit ambivalence’ (Petty & Briñol, 2009; Petty et al., 2007). For instance, Petty et al. (2006) could demonstrate

that individuals whose attitudes toward a target individual were changed responded with more neutral attitudes on a measure of automatic compared to explicit evaluation. Probably, the same could have happened in the present experiments, in which a positive implicit attitude resulting from the organism's positive attunement to need states (e.g., Seibt et al., 2007) may have collided with a negative implicit response prompted by a state of frustrative nonreward (Drobes et al., 2001). In this case, the effects that were observed for implicit food-liking would be compatible with the motivational and the frustrative nonreward approach. This argument also fits with the findings obtained in Experiment 4, given that need-relevant responses were positive at shorter durations of food deprivation, but turned to be less positive when food deprivation became too intense. However, this assumption remains speculative, as far as Experiment 1-3 did not reveal any indications of frustration or negative mood due to food deprivation and nonreward on the explicit measures of affect. Thus, further research beyond the scope of the present research is needed in order to more fully explore what kind of effect is elicited by food deprivation and reward expectancy. For instance, ambivalence could be induced by letting participants undergo an attitude change toward need-relevant stimuli and then to examine what kind of evaluations will be reported (cf. Petty et al., 2006).

Moreover, studies would also be very valuable that investigate whether frustration is associated with rather negative implicit object representations. In line with the implicit ambivalence literature, participants of the present experiments never showed any ambivalence on explicit self-reports of food liking. Instead, food-deprived participants almost reported more positive explicit food-liking than satiated participants, irrespective of reward expectancy. This finding further supports the notion that ambivalent need-relevant responses may occur rather on an automatic level of responding.

Alternatively, 15 hours of food deprivation could have been still not enough to elicit frustration. In case that the following state can be induced experimentally, it would be interesting to run experiments with deprivational states of 20 and more hours and to examine

whether hungry participants would show more negative liking-related associations than satiated participants due to nonreward. In this regard, however, it would be very crucial to show that these participants would also indicate feeling more frustration.

For the moment it can be summarized that implicit food-wanting seems to be the most sensitive measure to assess changes in implicit valence of need-relevant object due to changes in motivational states, thus confirming the motivational approach. However, implicit food-liking are also very sensitive to different motivational states, but seems to underlie a different process than just a motivational one, as was reflected by a curvilinear function due to different deprivational states. One possible explanation may lie in the frustrative nonreward approach that further remains hypothetical. However, more research would probably provide more assurance for it.

Do explicit food-liking- and food-wanting dissociate as a function of food deprivation and nonreward?

Contrary to the implicit liking- and wanting-related evaluations, self-reported explicit food-liking and food-wanting did not dissociate as a function of food deprivation and nonreward, revealing that participants' explicit self-reports of food-liking and food-wanting did not mirror their implicit responses. As the most important result, it could be demonstrated that explicit food-liking and food-wanting varied positively as a function of need state; a result that is quite congruent with the literature reporting similar results on the influence of hunger on subjects' explicit preferences for food (Cabanac, 1971; Finlayson et al., 2008; Lavy & van den Hout, 1993; Mauler et al., 2006). Thus, the present explicit data reflects both the motivational as well as the dual attitude approach, revealing that explicit attitudes are quite sensitive for internal (e.g. need states) and external (e.g. reward expectancy) situational changes. These findings are also supportive of the notion that liking- and wanting-related processes have an explicit and an implicit component that are also mediated by different

cerebral circuits (Berridge & Kringelbach, 2008; Berridge & Robinson, 2003) and that dissociations of liking and wanting are postulated to mainly occur automatically (Berridge & Robinson, 1995). Berridge and Robinson (2003) further emphasized that explicit versus implicit processes can also operate by quite different rules and serve different functions. Accordingly, explicit liking and wanting may for example reflect conscious cognitive likes and desires for incentives based on expectations and goal-directed plans, whereas conditioned cue-triggered incentive salience may be based on associative processes. Usually, both components work together to motivate behavior in the same direction. However, they might also diverge under some conditions where the hedonic value of the reward may (suddenly) change, for example, due to nonreward of that object. For instance, Dickinson and Balleine (1994) argued and experimentally proved that the cognitive incentive process might be too rational in the sense that it expects an incentive always to be as positive as it has been in the future. Accordingly, once someone has learned that a specific food is positive in a state of hunger, then this explicit representation will also hold true in a similar situation in the past. Moreover, cognitive incentive processes have been shown to be relatively immune to manipulations of mesolimbic dopamine systems that change implicit wanting (Dickinson, Smith, & Mirenowicz, 2000).

However, manipulations of nonreward versus reward expectancy were only effective in changing participants' explicit attitudes in Experiment 3, where nonrewarded participants were found to respond with more positive explicit food-wanting but not more explicit food-liking than rewarded participants, irrespective of need state. This additional result reflects recent findings from the domain of decision making, evidencing similar findings of nonreward on liking and wanting (Litt et al., in press). Litt et al. proposed that "such disjunctions arise because wanting can be enhanced afters denials and failures in obtaining a target, whereas liking of the target may suffer as pursuit failures emotionally taint it" (p. 6).

A possible alternative explanation for this finding could be drawn from cognitive dissonance literature (Festinger, 1957; Festinger & Carlsmith, 1959; see also Elster, 1983; Kay et al., 2002, that allude to the theory of cognitive dissonance). Accordingly, a uncomfortable feeling of cognitive dissonance normally occurs when a person holds simultaneously two cognitions in his mind that are logically inconsistent to each other or when a person acts in a counter attitudinal manner. In order to reduce the uncomfortable feeling resulting from the inconsistency between both cognitions, individuals are motivated to change their personal attitudes, their behaviors or the importance they initially attributed to an attitude object in the direction of cognitive consistency (Festinger, 1957). Bringing it to the present findings, an individual facing nonreward may have had the opposing cognitions "I like food" but "I cannot eat food". As a result, the individual may then have come to the conclusion that he actually does not like the food (or as the Fox in the sour-grapes fable would say: "the grapes are sour anyway") and may have responded with less favorable liking. At least, it would not have been dissonant any more to dislike foods that cannot be eaten. Of crucial importance, however, is the fact that cognitive dissonance is assumed to emerge only when people do not have an external justification for their counter attitudinal opinion or behavior. For example, in a classic experiment by Festinger and Carlsmith (1959), subjects first took part in a boring experiment and were then asked to tell the subsequent participant that the experiment was actually very interesting. They were either paid a high or a very low incentive as justification. Hence, only participants in the low incentive condition were likely to report a more positive attitude toward the experiment compared to participants in the high incentive condition. But given that all participants in the present experiments knew that they would be gratified with either money or course credits for their participation in the experiment, is seems very unlikely that participants have felt cognitive dissonance.

In addition, based on the research by Gawronski and Strack (2004), an explanation based on cognitive dissonance is also very implausible with regards to the present findings on

implicit food-liking and food-wanting. For instance, inferring that both, the dissonance evoking experience as well as the attempt to reduce dissonance are propositional in nature, Gawronski and Strack (2004) showed that cognitive dissonance in fact only influences explicit self reports, but not implicit attitudes measured via the IAT. Applying Gawronski & Strack's results to the present findings, this would imply both the experience of cognitive dissonance during the situation of nonreward (i.e. "I am liking a food although is not available at the moment") as well as the subsequent attenuation of implicit liking-related responses towards need-relevant stimuli to occur on propositional rather than automatic grounds (measured by explicit self-reports vs. ST-IAT).

Are food deprivation and nonreward associated with frustration and negative mood?

In discordance with the frustrative nonreward approach, neither food deprivation nor nonreward were found to influence participants' self-reported mood and frustration. Moreover, participants overall reported being in a good mood and not feeling frustrated at all during the experiment. These results either imply that the manipulation of frustrative nonreward was not effective (e.g. because food-deprivation was still not strong enough) and participants did not feel frustrated, or that the manipulation was effective but that participants were unable to report their affective states. Regarding the latter case, recent research showed that subliminally elicited positive or negative affect may influence subjects' evaluations and behaviors without them being consciously aware of those affects and thus being able to report them (c.f. Winkielman & Berridge, 2004; Winkielman et al., 2005). Accordingly, subjects in the present experiments may have responded immediately to frustrative nonreward without noticing it consciously. In order to be able to derive more definite conclusions in respect to this question, it would be necessary for future studies to record participants' immediate affective reactions more indirectly via physiological measures of emotional responding, like, for instance electromyography (Hazlett, 2003), since the activity of the corrugator muscle

leading to frowns is associated with negative mood, aversiveness of presented stimuli (Hazlett & Hoehn-Saric, 2000), and the encounter of goal obstacles (Pope & Smith, 1994).

However, Litt et al. (in press) showed that liking-wanting disjunctions are moderated by individuals' felt affect intensity in such a way that individuals high in affect intensity should rather show concordant liking and wanting responses because the stronger negative affect may overwhelm any continuous increases in wanting to obtain a reward. Although the present research did not measure affect intensity, the present results may also reflect Litt et al's assumptions, showing that food-liking and food-wanting dissociate despite any changes in self-reported affect or frustration due to food deprivation or nonreward, assuming that overall participants did not feel frustrated or negatively tempered.

Beside this consideration, it could nevertheless be shown that a third of the participants that were asked to more specifically indicate their subjective experience in response to the nonreward induction in Experiment 3 reported that they indeed have felt discomfort and frustration. Thus, this result can be seen as the first indirect evidence for the frustrative nonreward assumptions, beside the fact that overall no relationship between food deprivation, nonreward, mood, and frustration was found. This finding also shows that participants needed to be asked more specifically about their affective changes in a respective situation, in order to help them come up with possible subjective experiences. Nevertheless, it remains open whether the presentation of need-relevant stimuli is crucial for frustrative nonreward, or whether the situation that they are not rewarded while food-deprived is sufficient to eventually feel frustrated. Finally, the present findings could also not rule out that participants may have responded in a socially desirable manner (Maccoby & Maccoby, 1954), namely that they may have denied to explicit their possible feelings of frustration or negative mood due to frustrative nonreward.

Do implicit food-liking evaluations in contrast to evaluations toward need-irrelevant stimuli vary as a function of different levels of food deprivation?

Experiment 4 revealed that the presentation of need-relevant vs. need-irrelevant stimuli prompted different implicit evaluative responses depending on the time participants had fasted before the experiment. Specifically, it could be demonstrated that whereas moderately-hungry compared to satiated participants responded with more positive associations toward need-relevant stimuli, 15 hours food-deprived participants responded with more negative associations compared to moderately-hungry and satiated participants. Respectively, a significant curvilinear function of need state was obtained. Thus, this finding provided first evidence that was thought to reconcile the so far inconsistent literature regarding facilitating (e.g., Seibt et al., 2007) versus inhibiting (Drobes et al., 2001) effects of food deprivation, by systematically measuring participants with different deprivational states.

Moreover, these results imply that implicit food-liking is also very sensitive to changes in hunger, thus conforming to the motivational approach. However, the curvilinear function reflects that this sensitivity is more fine-grained than for implicit food-wanting. That is, implicit food liking seems to vary differently according to the strength of the deprivational state. This again implies that an additional mechanism like for example frustrative nonreward is operating beside just a motivational one. However, this issue awaits further research.

In addition, participants were found to immediately respond more negatively to need-irrelevant stimuli as soon as they became moderately hungry, evidencing devaluation effects (Brendl et al., 2003; Markman et al., 2007) to also occur on an implicit level of responding. Given that participants were facing nonreward, these findings can also be explained in terms of a defensive reaction against stimuli threatening subjects current need states or goals (e.g., Minard, 1965). This argument may especially hold true when considering need-relevant as well as need-irrelevant stimuli to elicit frustration while presented to participants without a perspective to consume food. However, these results are by now only indicative when

considering implicit and explicit attitudes as dependent variables. In this regard, studies that would show similar systematic effects of deprivation strength (and also nonreward) on other domains of responding (e.g., selective attention or startle reflex) would certainly help to promote this interpretation more firmly.

Further Implications

Altogether, the present research supports the notion that implicit evaluations are flexible and thus are likely to change as a function of need state (c.f. Seibt et al., 2007; Strack & Deutsch, 2004), i.e., the implicit valence of food changes according to whether participants are hungry or satiated. Moreover, high levels of food deprivation could also been shown to promote wanting-related evaluations independent from liking-related evaluations depending on nonreward versus reward expectancy. Thus, the present findings challenge classical network models of knowledge representation (e.g. Anderson & Bower, 1973) and the dual attitudes approach (Gregg et al., 2006; Wilson et al., 2000) that do not assume such a flexibility.

Moreover, it was shown that implicit food-liking and food-wanting capture different processes underlying changes in hunger and reward expectancy, food-wanting being more effective in reflecting the motivational approach than food-liking. This implication is quite innovative and will hopefully stimulate further research in this field (but see also Amodio & Devine, 2006). For the moment the present result concerning changes in implicit food-liking responses should nevertheless call for caution when trying to assess motivational effects on evaluation with liking-related measures.

However, beside the more general conceptual implications already discussed above, the present research also touches related issues, which could also benefit from the present findings.

Direct Link versus Goal-dependent Mechanism

Another important issue emanating from the present work is the question whether need states are always linked directly to spontaneous evaluative and motivational responses as was proposed by the present findings (see also Seibt et al., 2007). This question arises when taking another line of research into account, showing that specific need-relevant evaluative and motivational responses do not stem directly from deprivation per se, but that the accessibility of goal-related concepts might moderate this effect, being it the concept to drink (Ferguson & Bargh, 2004; Veltkamp, Aarts, & Custers, 2008) or the concept to eat (Ferguson, 2008). Specifically, it was shown that deprivation in fact led to more positive implicit evaluations of need-relevant stimuli and to a facilitation of need-related behavior, but this effect could only be observed in participants in which the goal to eat or to drink has been (subliminally) primed before. Accordingly, a hungry person would only automatically respond more favorably to food cues as long as he is also (unconsciously) pursuing the goal to eat. Without the goal being activated, hunger should not foster eating-relevant behavior. Although the present work certainly could not provide a definite answer to this issue, it speculatively suggests that high levels of food deprivation may always involve the activation of the goal to eat[34]. Thus, as was also already hypothesized by Veltkamp et al. (see also Veltkamp, Aarts, & Custers, 2009, for a review), extreme levels of deprivation induced in the present experiments may have lead automatically to an over-activation of the respective goal, independent of the concrete experimental instructions.[35] As a result, deprivation and goal accessibility may have no longer been independent processes.

Further support for this assumption can be gathered from the notion that extremely deprived individuals are no longer able to think of anything else than of need-relevant contents (see Fitzsimons, 1972; Murray, 1938). For example, castaways or survivors are

[34] Note that participants in those studies were only moderately deprived of nutrients.
[35] However, Veltkamp et al. would not predict more negative evaluations of need-relevant stimuli due to high levels of food deprivation.

known to fantasize about water and food as soon as thirst and hunger become too intense (Read, 1974; Wolf, 1958). In line with this evidence is also the fact that people are likely to ruminate about current concerns (Klinger, 1975). However, future studies may provide more insights into this issue by testing the influence of deprivational states on the automatic activation of goal concepts, for example via a lexical decision task (Meyer & Schvaneveldt, 1971). Thereby, of foremost relevance for the present thesis would be the question whether conditions of frustrative nonreward (in comparison to conditions of reward expectancy) would also lead to a reduction of goal-relevant concept activation. Such a finding would certainly expand the notion that individuals tend to perceptually defend against stimuli threatening their current need state (Bruner, 1992; Lazarus, Eriksen, & Fonda, 1951; Minard, 1965; Postman, Bruner, & McGinnies, 1948). Moreover, from the perspective of Ferguson and Bargh's (2004) assumptions, this finding would also explain why food-deprived participants did not respond with more positive liking-related associations towards food stimuli than satiated participants. Based on their own findings, Ferguson and Bargh argue that goals (or goal pursuit) should mediate between needs and subsequent evaluations and behaviors. Accordingly, both liking and wanting should be tied to the respective goal and should thus change simultaneously according to the activation or deactivation of the goal. However, Ferguson and Bargh's assumptions would not account for why liking- and wanting-related evaluations might dissociate; a result that was found reliably in the present experiments. But from another point of view, given that frustrative nonreward are hypothesized to be a threatening experience for hungry organisms, automatically reducing the level of goal-relevant concept activation may further help the organism to better endure or even overcome the frustrative event.

Implications for Eating Disorders

The present results might also reveal some interesting implications for research on eating disorders, especially concerning chronic dieters. Whereas many people try to diet in order to lose weight but then often fail to do so, patients suffering from anorexia nervosa can be regarded as very successful dieters. Typically for this symptom is the pathological and intentional restriction of food intake that is often associated with severe health problems due to the loss of nutrional supply (DSM 4th ed., APA, 1994). According to Pinel et al. (2000), the restrictive eating that defines anorexia nervosa is therefore likely to be associated with a decline in the positive-incentive value of food. That is, unlike healthy individuals, anorectic patients should no longer experience the rewarding effects of food. Given the present results, it can be hypothesized that the immediate attenuation of food-liking due to nonreward may later be even very functional for eating disordered patients in order to keep up with their diet. Thus, it could be assumed that anorectic patients should respond with less positivity toward food stimuli compared to healthy individuals. In support of this argument, anorectic patients and fasting subjects were found to show a reduced reactivity to the palatability of food stimuli (e.g., Lappalainen, Sjödén, Hursti, & Vesa, 1990; LeGoff, Leichner, & Spigelman, 1988) in studies using psychophysiological and explicit self-report measures. Congruent with this evidence, Davis and Woodside (2002) also found anorectic patients to respond with higher anhedonia scores than healthy individuals and argue that the high anhedonia scores of anorectic patients may make food less pleasurable and thus restriction easier. Accordingly, it should be easier to resist something that no longer has incentive value. Moreover, Roefs et al. (2005) further found that anorectic patients also did not display any immediate preferences for palatable versus unpalatable food stimuli on an affective priming task (Fazio et al., 1986), suggesting that for anorectic patients the palatability of food may no longer be a crucial

characteristic of edible objects[36]. This in turn might facilitate food restriction. Similar results were also reported for restrained eaters[37] (Hoefling & Strack, 2008; Papies, Stroebe, & Aarts, 2009), although they are also known to have serious difficulties in maintaining their dieting goals. In respect to the present thesis, these findings may reflect the notion that the immediate disposition to respond less positive to the presentation of food stimuli due to acute food deprivation and nonreward may become chronic and functional for chronic dieters due to a constant rejection of food. This reduced liking of food may thus again help chronic dieters to better resist the eventual temptation of (palatable) food stimuli over an extended period of time (see Blechert, Feige, Hajcak, & Tuschen-Caffier, in press).

Some Final Considerations

Repeated measures and conversational norm effects

In the present experiments food-liking and food-wanting were assessed within subjects, therefore allowing more specific conclusions about disjunctions of food-liking and food-wanting having been expressed by a single individual. However, this operationalization could not have counted for possible confounds and cross-effects of liking onto wanting and vice versa due to conversational norm effects (see Grice, 1975; Smith, 1979; Strack, 1994; Strack, Schwarz, & Wänke, 1991). The same caveat can also be expressed with regard to the repeated measurement of implicit liking- and wanting-related attitudes. Although indirect measures are thought to be immune against such influences such as conversational order effects, according to Gawronski, Hofmann and Wilbur (2006), however, this view seems

[36] In the study by Seibt el al. (2007), however, anorectic patients were also found to show immediate behavioral tendencies towards approach than avoidance of pictorial food stimuli. This and Roefs et al.'s finding may reflect a dissociation of food-liking and food-wanting also in eating disordered patients.

[37] Restrained eaters are defined as chronic dieters on the basis of permanent weight concerns (Herman & Polivy, 1980). Crucially, although they are very motivated to control their weight, they are not very successful in these attempts. Thus, their eating behavior is often characterized by periods of food restriction followed by frequent lapses of restraint (Gorman & Allison, 1995).

inadequate. Drawing on their findings, there is no reason to assume that participants do not have conscious awareness of indirectly assessed attitudes or their contents. However, the order of consecutively presenting several indirect measures was counterbalanced between participants in the present experiments, a method that was usually adopted in order to overcome such biasing effects (see De Houwer et al., 2006; Wiers et al., 2002a). Another possible approach would certainly be to measure liking and wanting within a between-subjects design. Of course, future studies following this approach would additionally contribute to the understanding of the interplay between liking- versus wanting-related processes (e.g., Litt et al., in press).

Validity and Generalization of the Results

In order to improve the impact and ecological validity of the present research in future studies, it would be interesting to use pictures instead of words as IAT stimuli (see Drobes et al., 2001; Seibt et al., 2007). Given that pictures compared to words have privileged access to a semantic network containing affective information (De Houwer & Herman, 1994), the stimuli words in the present ST-IATs may have not be affective enough to elicit more negative affective responses. Thus, it could be speculated whether pictures of food as stimuli would have a greater potential as frustrative stimuli.

Finally, for reasons of generalization of the sour-grapes effect, it would also be very informative to investigate the function of deprivation and nonreward on need-relevant responses considering other deprivations like thirst, nicotine, or sexual deprivation. For instance, Carter and Tiffany (2001) already found smokers to show stronger negative affective responses (across three domains of responding: self reports, autonomic responding, and drug-seeking behavior) towards the presentation of smoking cues, but only when smoking was not allowed upon exposure to the cues. However, nicotine deprivation was not considered in that study.

Final Conclusions

Against the background of inconsistent literature concerning the influence of need states on immediate evaluations of need-relevant stimuli and concerning the question, whether implicit attitudes are malleable or not, the present research offers interesting new results. Across four experiments it could be demonstrated that immediate evaluations of need-relevant stimuli can flexibly change as a function of different deprivational states, a result that contradicts the dual attitudes approach. However, the present results also suggest that a more stringent differentiation between liking- and wanting-related responses should be taken into account in future studies, a view that has often been neglected in previous studies. In this regard, wanting-related measures seem to better display changes in implicit associations due to motivational factors, while liking-related measures seem to uncover attitudinal changes due other processes such as deprivation strength or frustrative nonreward.

To come back to the ancient Aesop Fable 'the Fox and the Grapes' mentioned in the beginning of the present thesis, it is told that the thirsty fox, repeatedly trying to reach the grapes hanging on a tree too high for him, finally gave up saying furiously "the grapes are sour anyway!" This fable usually refers to the paradoxical effect of denying something sought but not acquired. The present research brings this fable to the empirical test. It was shown that whereas highly food-deprived but nonrewarded participants responded with more wanting-related associations towards food stimuli, they did not respond with more positive associations. However, such a dissociation of food-liking and food-wanting did not occur on an explicit level of evaluative responding. Thus, as far as the present results reflect a sour-grapes effect, it is likely to occur automatically. Based on the notion that nonreward may constitute something negative to a highly deprived organism and that this organism should be prone to efficiently defend itself against such distress (without the charging of much cognitive resources), this process can be considered as a highly functional and 'intelligent' one.

Interestingly, this process can even be helpful for individuals trying to refrain from eating for longer periods of time, e.g. for women suffering from anorexia nervosa. In addition, the present research is also indicative of the fact that attitude objects are likely to be linked to both positive and negative associations that may flexibly change according to the affordances of the organism and of the environment. In this regard, evaluative and motivational responses may sometimes also dissociate and thus constitute different processes in the service of need-relevant behavior. To conclude in accordance with Robinson & Berridge (1993), "we don't always like what we want, but we may not know or feel it!"

REFERENCES

Aarts, H., Dijksterhuis, A., & De Vries, P. (2001). On the psychology of drinking: Being thirsty and perceptually ready. *British Journal of Psychology, 92*(4), 631.

Ahn, S., & Phillips, A. G. (1999). Dopaminergic correlates of sensory-specific satiety in the medial prefrontal cortex and nucleus accumbens of the rat. *Journal of Neuroscience, 19*, B1-B6.

Alpers, G. W., & Tuschen-Caffier, B. (2001). Negative feelings and the desire to eat in bulimia nervosa. *Eating Behaviors, 2*, 339-352.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington DC: Author.

Amodio, D. M., & Devine, P. G. (2006). Stereotyping and evaluation in implicit race bias: evidence for independent constructs and unique effects on behavior. *Journal of Personality and Social Psychology, 97*, 652-661.

Amsel, A. (1958). The role of frustrative nonreward in non-continuous reward situations. *Psychological Bulletin, 55*, 102-199.

Amsel, A. (1992). *Frustration Theory: An analysis of dispositioned learning and memory.* New York: Cambridge University Press.

Amsel, A., & Rousell, J. (1952). Motivational properties of frustration: I. Effect on a running response of the addition of frustration to the motivational complex. *Journal of Experimental Psychology, 43*, 363-368.

Anderson, J. R., & Bower, G. H. (1973). *Human associative memory*. New York: Wiley.

Balleine, B. W., & Dickinson, A. (1998a). Goal-directed instrumental action: Contingency and incentive learning and their cortical substrates. *Neuropharmacology, 37*, 407-419.

Balleine, B. W., & Dickinson, A. (1998b). The role of incentive learning in instrumental outcome revaluation by sensory-specific satiety. *Animal Learning and Behavior, 26*, 46-59.

Baumeister, R. F., Vohs, K. D., DeWall, C. N., & Zhang, L. (2007). How Emotion Shapes Behavior: Feedback, anticipation, and reflection, rather than direct causation. *Personality and Social Psychology Review, 11*, 167-203.

Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral Cortex, 10*, 295-307.

Berkowitz, L. (1989). Frustration-aggression hypothesis: Examination and reformulation. *Psychological Bulletin, 106*, 59-73.

Berridge, K. C. (1991). Modulation of taste affect by hunger. *Appetite, 16*, 103-120.

Berridge, K. C. (1996). Food reward: Brains substrates of wanting and liking. *Neuroscience and Biobehavioral Reviews, 20*, 1-25.

Berridge, K. C. (2004). Pleasure, unconscious affect and irrational desire. In A. S. R. Manstead, N. H. Frijda & A. H. Fischer (Eds.), *Feelings and Emotions: The Amsterdam Symposium* (pp. 43-62). Cambridge: Cambridge University Press.

Berridge, K. C. (2007a). Brain reward systems for food incentives and hedonics in normal appetite and eating disorders. In T. C. Kirkham & S. J. Cooper (Eds.), *Progress in Brain Research: Appetite and Body Weight* (pp. 191-216): Academic Press.

Berridge, K. C. (2007b). The debate over dopamine's role in reward: the case for incentive salience. *Psychopharmacology, 191*, 391-431.

Berridge, K. C. (2009). 'Liking' and 'wanting' food rewards: Brain substrates and roles in eating disorders. *Physiology & Behavior, 97*, 537-550.

Berridge, K. C., & Kringelbach, M. L. (2008). Affective neuroscience of pleasure: reward in humans and animals. *Psychopharmacology, 199*, 457-480.

Berridge, K. C., & Robinson, T. E. (1995). The mind of an addicted brain: Neural sensitization of wanting vs. liking. *Current Directions in Psychological Science, 4*, 71-76.

Berridge, K. C., & Robinson, T. E. (1998). What is the role of dopamine in reward: Hedonic impact, reward learning, or incentive salience? *Brain Research Reviews, 28*, 309-369.

Berridge, K. C., & Robinson, T. E. (2003). Parsing reward. *Trends in Neurosciences, 26*, 507-513.

Berry, L. M., Andrade, J., & May, J. (2007). Hunger-related intrusive thoughts reflect increased accessibility of food items. *Cognition and Emotion, 21*, 865-878.

Berthoud, H. R. (2004). Neural control of appetite: cross-talk between homeostatic and non-homeostatic systems. *Appetite, 43*, 315-317.

Berthoud, H. R. (2006). Homeostatic and non-homeostatic pathways involved in the control of food intake and energy balance. *Obesity, 14*, 197-200.

Berthoud, H. R., & Morrison, C. (2008). The brain, appetite and obesity. *Annual Review of Psychology, 59*, 55-92.

Bindra, D. (1974). A motivational view of learning: performance and behaviour modification. *Psychological Review, 81*, 199-213.

Blair, I. V., Ma, J. E., & Lenton, A. P. (2001). Imagining stereotypes away: The moderation of implicit stereotypes through mental imagery. *Journal of Personality and Social Psychology, 81*(5), 828-841.

Blanton, H., Jaccard, J., Gonzales, P. M., & Christie, C. (2006). Decoding the implicit association test: Implications for criterion prediction. *Journal of Experimental Social Psychology, 42*, 192-212.

Blechert, J., Feige, B., Hajcak, G., & Tuschen-Caffier, B. (in press). To eat or not to eat? Availability of food modulates the electrocortical response to food pictures in restrained eaters. *Appetite*.

Bluemke, M., & Friese, M. (2008). Reliability and validity of the Single-Target IAT (ST-IAT): Assessing automatic affect towards multiple attitude objects. *European Journal of Social Psychology, 38*, 977-997.

Bradley, M. M., Cuthbert, B. N., & Lang, P. J. (1990). Startle reflex modification: emotion or attention. *Psychophysiology, 27*, 513-522.

Brauer, L. H., & De Wit, H. (1997). High dose pimozide does not block amphetamine-induced euphoria in normal volunteers. *Pharmacology Biochemistry and Behavior, 56*, 265-272.

Breckler, S. J. (1984). Empirical validation of affect, behavior, and cognition as distinct components of attitude. *Journal of Personality and Social Psychology, 47*, 1191-1205.

Brendl, C. M., Markman, A. B., & Messner, C. (2003). The devaluation effect: Activating a need devaluates unrelated objects. *Journal of Consumer Research, 29*, 463-473.

Brogden, N., Sinclair, C., & Almiron-Roig, E. (2009). Effects of hunger and experience on portion size estimation by men. *Appetite, 52*, 821.

Bruner, J. S. (1957). On perceptual readiness. *Psychological Review, 64*, 123-152.

Bruner, J. S. (1992). Another look at New Look 1. *American Psychologist, 47*, 780-783.

Brunstrom, J. M., Rogers, P. J., Pothos, E. M., Calitri, R., & Tapper, K. (2008). Estimating everyday portion size using a 'method of constant stimuli': In a student sample, portion size is predicted by gender, dietary behaviour, and hunger, but not BMI. *Appetite, 51*, 296-301.

Bulik, C. M., & Brinded, E. C. (1994). The effect of food deprivation on the reinforcing value of food and smoking in bulimic and control women. *Physiology & Behavior, 55*, 665-672.

Cabanac, M. (1971). Physiological role of pleasure. *Science, 173*, 1103-1107.

Cabanac, M. (1992). Pleasure: the common currency. *Journal of Theoretical Biology, 155*, 173-200.

Cacioppo, J. T., Gardner, W. L., & Bernston, G. G. (1997). Beyond bipolar conceptualizations and measures: The case of attitudes and evaluative space. *Personality and Social Psychology Review, 1*, 3-25.

Capaldi, E. D. (1990). Hunger and conditioned flavor preferences. In E. D. Capaldi & T. L. Powley (Eds.), *Taste, Experience, and Feeling: Development and Learning.* (pp. 157-169). Washington DC: Psychological Association.

Carelli, R. M. (2004). Nucleus accumbens cell firing and rapid dopamine signalling during goal-directed behaviors in rats. *Neuropharmacology, 47*(47), 180-189.

Carter, B. L., & Tiffany, S. T. (2001). The cue-availability paradigm: the effects of cigarette availability on cue reactivity in smokers. *Experimental and Clinical Psychopharmacology, 9*, 183-190.

Carver, C. S. (2004). Negative affects deriving from the behavioral approach system. *Emotion, 4*, 3-22.

Carver, C. S. (2006). Approach, avoidance, and the self-regulation of affect and action. *Motivation and Emotion, 30*, 105-110.

Changizi, M. A., & Hall, W. G. (2001). Thirst modulates a perception. *Perception, 30*, 1489-1497.

Channon, S., & Hayward, A. (1990). The effects of short-term fasting on processing of food cues in normal subjects. *International Journal of Eating Disorders, 9*, 447-452.

Cheer, J. F., Aragona, B. J., Heien, M. L., Seipel, A. T., Carelli, R. M., & Wightman, R. M. (2007). Coordinated accumbal dopamine release and neural activity drive goal-directed behavior. *Neuron, 54*, 237-244.

Chen, M., & Bargh, J. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin, 25*, 215-224.

Cook, E. W., Hawk, L. W., & Davis, T. L. (1991). Affective individual differences and startle reflex modulation. *Journal of Abnormal Psychology, 100*, 5-13.

Critchley, H. D., & Rolls, E. T. (1996). Hunger and satiety modify the responses of olfactory and visual neurons in the primate orbitofrontal cortex. *Journal of Neurophysiology, 75*, 1673-1686.

Czopp, A. M., Monteith, M. J., Zimmerman, R. S., & Lynam, D. R. (2004). Implicit attitudes as potential protection from risky sex: Predicting condom use with the IAT. *Basic and Applied Social Psychology, 26*, 227-236.

Davis, C., & Woodside, D. B. (2002). Sensitivity to the rewarding effects of food and exercise in the eating disorders. *Comprehensive Psychiatry, 43*, 189–194.

Davis, M. (1984). The mammalian startle response. In R. C. Eaton (Ed.), *Neural mechanisms of startle behavior* (pp. 287-351). New York: Plenum Press.

Davis, M. (1989). Sensitization of the acoustic startle reflex by footshock. *Behavioral Neuroscience, 103*, 495-503.

de Araujo, I. E., Rolls, E. T., Kringelbach, M. L., McGlone, F., & Phillips, N. (2003). Taste-olfactory convergence, and the representation of the pleasantness of flavour, in the human brain. *European Journal of Neuroscience, 18*, 2059-2068.

De Houwer, J. (2003). The extrinsic affective Simon task. *Experimental Psychology, 50*, 77-85.

De Houwer, J., Crombez, G., Baeyens, F., & Hermans, D. (2001). On the generality of the affective Simon effect. *Cognition and Emotion, 15*, 189-206.

De Houwer, J., Crombez, G., Koster, E. H. W., & De Beul, N. (2004). Implicit alcohol-related cognitions in a clinical sample of heavy drinkers. *Journal of Behavior Therapy and Experimental Psychiatry, 35*, 275-286.

De Houwer, J., Custers, R., & Clercq, D. (2006). Do smokers have a negative implicit attitude toward smoking? *Cognition and Emotion, 20*, 1274-1284.

De Houwer, J., & Herman, D. (1994). Differences in the affective processing of words and pictures. *Cognition & Emotion, 8*, 1-20.

de Liver, Y., van der Pligt, J., & Wigboldus, D. (2007). Positive and negative associations underlying ambivalent attitudes. *Journal of Experimental Social Psychology, 43*, 319-326.

Devine, P. G. (1989). Stereotypes and prejudice: Their automatic and controlled components. *Journal of Personality and Social Psychology, 56*, 5-18.

Dickinson, A., & Balleine, B. (1994). Motivational control of goal-directed action. *Animal Learning and Behavior, 22*, 1-18.

Dickinson, A., Smith, J., & Mirenowicz, J. (2000). Dissociation of Pavlovian and instrumental incentive learning under dopamine antagonists. *Behavioral Neuroscience, 114*, 468-483.

Ditkoff, G., & Ley, R. (1974). Effects of positive and negative force-contigent reinforcement on the frustration effect in humans. *Journal of Experimental Psychology, 102*, 818-823.

Dollard, J., Miller, N. E., Doob, L. W., Mowrer, O. H., & Sears, R. R. (1939). *Frustration and aggression.* New Haven, CT: Yale University Press.

Drobes, D. J., Miller, E. J., Hillman, C. H., Bradley, M. M., Cuthbert, B. N., & Lang, P. J. (2001). Food deprivation and emotional reactions to food cues: Implications for eating disorders. *Biological Psychology, 57*, 153-177.

Elster, J. (1983). *Sour grapes: studies in the subversion of rationality.* Cambridge: Cambridge University Press.

Epstein, L. H., Truesdale, R., Wojcik, A., Paluch, R. A., & Raynor, H. A. (2003). Effects of deprivation on hedonics and reinforcing value of food. *Physiology & Behavior, 78*, 221-227.

Epstein, S. (1961). Food-related responses to ambiguous stimuli as a function of hunger and ego strenght. *Journal of Consulting Psychology, 25*, 463-469.

Epstein, S., & Papini, R. (1999). Some basic issues regarding dual-process theories from the perspective of cognitive-experiential self-theory. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology*. New York: Guilford Press.

Fazio, R. H., Jackson, J. R., Dunton, B. C., & Williams, C. J. (1995). Variability in automatic activation as an unobtrusive measure of racial attitudes: A bona fide pipeline? *Journal of Personality and Social Psychology, 69*(6), 1013-1027.

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology, 50*, 229-238.

Ferguson, M. J. (2008). On becoming ready to pursue a goal you don't know you have: Effects of nonconscious goals on evaluative readiness. *Journal of Personality and Social Psychology, 95*, 1268-1294.

Ferguson, M. J., & Bargh, J. A. (2004). Liking is for doing: The effects of goal pursuit on automatic evaluation. *Journal of Personality and Social Psychology, 87*, 557-572.

Festinger, L. (Ed.). (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Festinger, L., & Carlsmith, J. M. (1959). Cognitive consequences of forced compliance. *Journal of Abnormal and Social Psychology, 58*, 203-210.

Finlayson, G., King, N., & Blundell, J. E. (2007a). It is possible to dissociate 'liking' and 'wanting' for foods in humans? A novel experimental procedure. *Physiology & Behavior, 90*, 36-42.

Finlayson, G., King, N., & Blundell, J. E. (2007b). Liking vs. wanting food: Importance for human appetite control and weight regulation. *Neuroscience and Biobehavioral Reviews, 31*, 987-1002.

Finlayson, G., King, N., & Blundell, J. E. (2008). The role of implicit wanting in relation to explicit liking and wanting for food: Implications for appetite control. *Appetite, 50*, 120-127.

Fiorino, D. F., Coury, A., & Phillips, A. G. (1997). Dynamic changes in nucleus accumbens dopamine efflux during the Coolidge effect in male rats. *Journal of Neuroscience, 17*, 4849-4855.

Fishbach, A., Zhang, Y., & Trope, Y. (2010). Counteractive evaluation: asymmetric shifts in the implicit value of conflicitng motivations. *Journal of Experimental Social Psychology, 46*, 29-38.

Fitzsimons, G. J. (2000). Consumer response to stockouts. *Journal of Consumer Research, 27*, 249–266.

Fitzsimons, J. T. (1972). Thirst. *Physiological Reviews, 52*, 468-529.

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and Propositional Processes in Evaluation: An Integrative Review of Implicit and Explicit Attitude Change. *Psychological Bulletin, 132*(5), 692-731.

Gawronski, B., Hofmann, W., & Wilbur, C. J. (2006). Are "implicit" attitudes unconscious? *Consciousness and Cognition: An International Journal, 15*(3), 485.

Gawronski, B., & Strack, F. (2004). On the propositional nature of cognitive consistency. Dissonance changes explicit, but not implicit attitudes. *Journal of Experimental Social Psychology, 40*, 535-542.

Gibson, E. L., & Desmond, E. (1999). Chocolate craving and hunger state: Implications for the Acquisition and Expression of appetite and food choice. *Appetite, 32*, 219-240.

Gilovich, T. (1983). Biased evaluation and persistence in gambling. *Journal of Personality and Social Psychology, 44*, 1110–1126.

Gorman, B. S., & Allison, D. B. (1995). Measures of restrained eating. In D. B. Allison (Ed.), *Handbook of assessment methods for eating behaviors and weight related problems:*

Measures, theory, and research. (pp. 149–184). Thousand Oaks, CA: Sage Publications, Inc.

Gottfried, J. A., O'Doherty, J., & Dolan, R. J. (2003). Encoding predictive reward value in human amygdala and orbitofrontal cortex. *Science, 301*, 1104–1107.

Gray, J. A. (1987). *The psychology of fear and stress*. Cambridge: Cambridge University Press.

Green, M. W., Ellimann, N. A., & Rogers, P. J. (1995). Lack of effect of short-term fasting on cognitive function. *Journal of Psychiatric Research, 29*, 245-253.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review, 102*(1), 4-27.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The Implicit Association Test. *Journal of Personality and Social Psychology, 74*, 1464-1480.

Gregg, A. P., Seibt, B., & Banaji, M. R. (2006). Easier done than undone: Asymmetry in the malleability of implicit preferences. *Journal of Personality and Social Psychology, 90*, 1-20.

Grice, H. P. (1975). Logic and conversation. In P. Cole & J. L. Morgan (Eds.), *Syntax and semantics: Vol. 3. Speech acts* (pp. 41-58). New York: Academic Press.

Gross, T. M., Jarvik, M. E., & Rosenblatt, M. R. (1993). Nicotine abstinence produces content-specific Stroop interference. *Psychopharmacology, 110*, 333-336.

Häfner, M., Seibt, B., & Deutsch, R. (2009). *Motivated Erotic Cognition: On the Interaction of Motives and Motivational States in the Perception of Sexual Cues* Unpublished manuscript.

Havermans, R. C., Janssen, T., Giesen, J. C. A. H., Roefs, A., & Jansen, A. (2009). Food liking, food wanting, and sensory-specific satiety. *Appetite, 52*, 222-225.

Hawk, L. W., Baschnagel, J. S., Ashare, R. L., & Epstein, L. H. (2004). Craving and startle modification during in vivo exposure to food cues. *Appetite, 43*, 285-294.

Hazlett, R. L. (2003). *Measurement of user frustration: a biologic approach.* Paper presented at the CHI 2003 New Horizons: Conference on Human Factors in Computing Systems.

Hazlett, R. L., & Hoehn-Saric, R. (2000). Effects of perceived physical attractiveness on female's facial displays and affect. *Evolution and Human Behavior, 21*, 49-57.

Hedges, L. V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational Statistics, 7*, 119-137.

Henke, P. G., & Maxwell, D. (1973). Lesions in amygdala and frustration effect. *Physiology & Behavior, 10*, 647-650.

Hepworth, R., Mogg, K., Brignell, C., & Bradley, B. P. (in press). Negative mood increases selective attention to food cues and subjective appetite. *Appetite*.

Herman, C. P., & Polivy, J. (1980). Restrained eating. In A. J. Stunkard (Ed.), *Obesity* (pp. 208-225). Philadelphia: Saunders.

Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ: British Medical Journal, 327*, 557-560.

Hobbs, M., Remington, B., & Glautier, S. (2005). Dissociation of wanting and liking for alcohol in humans: a test of the incentive-sensitisation theory. *Psychopharmacology, 178*, 493-499.

Hoefling, A., Likowski, K., Deutsch, R., Häfner, M., Seibt, B., Mühlberger, A., et al. (2009). When hunger finds no fault with moldy corn: food deprivation reduces food-related disgust. *Emotion, 9*, 50-58.

Hoefling, A., & Strack, F. (2008). The tempting effect of forbidden foods: High calorie content evokes conflicting implicit and explicit evaluations in restrained eaters. *Appetite, 51*, 681-689.

Hofmann, W., Gawronski, B., Gschwendner, T., Le, H., & Schmitt, M. (2005). A meta-analysis on the correlation between the Implicit Association Test and explicit self-report measures. *Personality and Social Psychology Bulletin, 31,* 1369-1385.

Horvitz, J. C. (2000). Mesolimbocortical and nigrostriatal dopamine responses to salient non-reward events. *Neuroscience, 96,* 651-656.

Hull, C. L. (1943). *Principles of behavior.* New York: Appleton-Century-Crofts.

Johnson, W. G., & Wildman, H. E. (1983). Influence of external and covert food stimuli on insulin secretion in obese and normal persons. *Behavioral Neuroscience, 97,* 1025-1028.

Kaczmarek, H. J., & Kiefer, S. W. (2000). Microinjections of dopaminergic agents in the nucleus accumbens affect ethanol consumption but not palatability. *Pharmacology Biochemistry and Behavior, 66,* 307-312.

Karpinski, A., & Hilton, J. L. (2001). Attitudes and the Implicit Association Test. *Journal of Personality and Social Psychology, 81*(5), 774-788.

Karpinski, A., & Steinman, R. B. (2006). The single category implicit association test as a measure of implicit social cognition. *Journal of Personality and Social Psychology, 91,* 16-32.

Kay, A. C., Jimenez, M. C., & Jost, J. T. (2002). Sour grapes, sweet lemons, and the anticipatory rationalization of the status quo. *Personality and Social Psychology Bulletin, 28,* 1300-1312.

Kendzor, D. E., Baillie, L. E., Adams, C. E., Stewart, D. W., & Copeland, A. L. (2008). The effect of food deprivation on cigarette smoking in females. *Addictive Behaviors, 33,* 1353-1359.

Kihlstrom, J. F. (1999). The psychological unconscious. In Pervin (Ed.), *Handbook of personality theory and research*.

Kim, D. Y. (2003). Voluntary controllability of the Implicit Association Test (IAT). *Social Psychology Quarterly, 66*(1), 83-96.

Klinger, E. (1975). Consequences of commitment to and disengagement from incentives. *Psychological Review, 82*, 1-25.

Koob, G. F., & Le Moal, M. (2001). Drug addiction, dysregulation of reward, and allostasis. *Neuropsychopharmacology, 24*, 97-129.

Kringelbach, M. L. (2005). The human orbitofrontal cortex: linking reward to hedonic experience. *Nature Reviews Neuroscience, 6*, 691-702.

Kringelbach, M. L., O'Doherty, J., Rolls, E. T., & Andrews, C. (2003). Activation of the human orbitofrontal cortex to a liquid food food stimulus is correlated with its subjective pleasantness. *Cerebral Cortex, 13*, 1064-1071.

Kringelbach, M. L., O'Doherty, J., Rolls, E. T., & Andrews, C. (2003). Activation of the human orbitofrontal cortex to a liquid food stimulus is correlated with its subjective pleasantness. *Cerebral Cortex, 13*, 1064-1071.

Lang, P. J. (1995). The emotion probe: studies of motivation and attention. *American Psychologist, 50*, 372-385.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1990). Emotion, attention, and the startle reflex. . *Psychological Review, 97*, 377-395.

Lappalainen, R., & Epstein, L. H. (1990). A behavioral economics analysis of food choice in humans. *Appetite, 14*, 81-93.

Lappalainen, R., Sjödén, P., Hursti, T., & Vesa, V. (1990). Hunger/craving responses and reactivity to food stimuli during fasting and dieting *International Journal of Obesity, 14*, 679–688.

Lavy, E. H., & van den Hout, M. A. (1993). Attentional bias for appetitive cues: effects of fasting in normal subjects. *Behavioural and Cognitive Psychotherapy, 21*, 297-310.

Lazarus, R., Eriksen, C., & Fonda, P. (1951). Personality dynamics and auditory perceptual recognition. *Journal of Personality, 19*, 471-482.

Lazarus, R. S., Yousem, H., & Ahrenberg, D. (1953). Hunger and perception. *Journal of Personality, 21*, 312-328.

LeGoff, D. B., Leichner, P., & Spigelman, M. N. (1988). Salivary response to olfactory food stimuli in anorexics and bulimics. *Appetite, 11*, 15-25.

Levine, R., Cehin, I., & Murphy, G. (1942). The relation of the intensity of a need to the amount of perceptual distortion: A preliminary report. *Journal of Psychology: Interdisciplinary and Applied, 13*, 283-293.

Lewin, K. (1935). *A dynamic theory of personality*. New York: McGraw-Hill.

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage.

Litt, A., Khan, U., & Shiv, B. (in press). Lusting while loathing: parallel counterdriving of wanting and liking. *Psychological Science.*

Lucas, F., & Sclafani, A. (1996). Food deprivation increases the rat's preference for a fatty over a sweet taste. *Chemical Senses, 21*, 169-179.

Lüthy, M., Blumenthal, T. D., Langewitz, W., Kiss, A., Keller, U., & Schächinger, H. (2003). Prepulse inhibition of the human startle eye blink response by visual food cues. *Appetite, 41*, 191-195.

Maccoby, E. E., & Maccoby, N. A. (1954). The interview: a tool of social science. In G. Lindzey (Ed.), *Handbook of Social Psychology* (Vol. 1, pp. 449-487). Cambridge, MA: Addison-Wesley.

Macht, M. (1999). Characteristics of eating in anger, fear, sadness and joy. *Appetite, 33*, 129-139.

Macht, M., & Simons, G. (2000). Emotions and eating in everyday life. *Appetite, 35*, 65-71.

Maier, S. F., & Seligman, M. E. P. (1976). Learned helplessness: Theory and evidence. *Journal of Experimental Psychology: General, 105*, 3-46.

Markman, A. B., Brendl, C. M., & Kim, K. (2007). Preference and the specifity of goals. *Emotion, 7*, 680-684.

Mauler, B. I., Tuschen-Caffier, B., Hamm, A. O., & Weike, A. I. (2006). Affect regulation and food intake in bulimia nervosa: emotional responding to food cues after deprivation and subsequent eating. *Journal of Abnormal Psychology, 115*, 567-579.

McClelland, D. C., & Atkinson, J. W. (1948). The projective expression of needs: I. The effect of different intensities of the hunger drive on perception. *Journal of Psychology, 25*, 205-222.

McFarlin, D. B., Baumeister, R. F., & Blascovich, J. (1984). On knowing when to quit: task failure, self-esteem, advice, and nonproductive persistence. *Journal of Personality, 52*, 138-155.

Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology, 90*, 227-234.

Mierke, J., & Klauer, K. C. (2003). Method-specific variance in the Implicit Association Test. *Journal of Personality and Social Psychology, 85*, 1180-1192.

Minard, J. G. (1965). Response-bias interpretation of "Perceptual Defence". A selective review and an evaluation of recent research. *Psychological Review, 72*, 74-88.

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy, 36*, 809-848.

Mogg, K., & Bradley, B. P. (2002). Selective processing of smoking-related cues in smokers: manipulation of deprivation level and comparison of three measures of processing bias. *Journal of Psychopharmacology, 16*, 385-392.

Mogg, K., Bradley, B. P., Hyare, H., & Lee, S. (1998). Selective attention to food-related stimuli in hunger: Are attentional biases specific to emotional and psychopathological

states, or are they also found in normal drive states? *Behaviour Research and Therapy, 36*, 227-237.

Murray, H. A. (Ed.). (1938). *Explorations in personality*. New York: Oxford.

Nelson, L. D., & Morrison, E. L. (2005). The symptoms of resource scarcity: Judgements of food and finances influence preference for potential partners. *Psychological Science, 16*, 167-173.

Neumann, R., Förster, J., & Strack, F. (2003). Motor compatibility: The bidirectional link between behavior and evaluation. In J. Musch & K. C. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion* (pp. 7-49). Mahwah, NJ: Erlbaum.

Nijs, I. M. T., Muris, P., Euser, A. S., & Franken, I. A. H. (in press). Differences in attention to food and food intake between overweight/obese and normal-weight females under conditions of hunger and satiety. *Appetite*.

Nisbett, R. E., & Kanouse, D. E. (1969). Obesity, food deprivation, and supermarket shopping behavior. *Journal of Personality and Social Psychology, 12*, 289-294.

O'Doherty, J., Rolls, E. T., Francis, S., Bowtell, R., McGlone, F., G., K., et al. (2000). Sensory-specific satiety-related olfactory activation of the human orbitofrontal cortex. *Neuroreport, 11*, 893-897.

Olson, M. A., & Fazio, R. H. (2004). Reducing the influence of extrapersonal associations on the Implicit Association Test: personalizing the IAT. *Journal of Personality and Social Psychology, 86*(5), 653-667.

Ostafin, B. D., & Palfai, T. P. (2006). Compelled to consume: the implicit association test and automatic alcohol motivation. *Psychology of Addicitive Behaviors, 20*, 322-327.

Ostafin, B. D., Palfai, T. P., & Wechsel, C. E. (2003). The accessibility of motivational tendencies toward alcohol: approach, avoidance, and disinhibited drinking. *Experimental and Clinical Psychopharmacology, 11*, 294-301.

Palfai, T. P., & Ostafin, B. D. (2003). Alcohol-related motivational tendencies in hazardous drinkers: assessing implicit response tendencies using the modified-IAT. *Behaviour Research and Therapy, 41*, 1149-1162.

Papies, E. K., Stroebe, W., & Aarts, H. (2009). Who likes it more? Restrained eaters' implicit attitudes towards food. *Appetite, 53*, 279-287.

Papini, M. R., & Dudley, R. T. (1997). Consequences of surprising reward omissions. *Review of General Psychology, 1*, 175-197.

Patterson, T. A., Brot, M. D., Zavosh, A., Schenk, J. O., Szot, P., & Figlewicz, D. P. (1998). Food deprivation decreases mRNA and activity of the rat dopamine transporter. *Neuroendocrinology, 68*, 11-20.

Peciña, S., & Berridge, K. C. (2000). Opioid eating site in accumbens shell mediates food intake and hedonic 'liking': map based on microinjection Fos plumes. *Brain Research, 863*, 71-86.

Peciña, S., Berridge, K. C., & Parker, L. A. (1997). Pimozide does not shift palatability: Separation of anhedonia from sensorimotor suppression by taste reactivity. *Pharmacology Biochemistry and Behavior, 58*, 801-811.

Peciña, S., Cagniard, B., Berridge, K. C., Aldridge, J. W., & Zhuang, X. (2003). Hyperdompaminergic mutant mice have higher "wanting" but not "liking" for sweet rewards. *Journal of Neuroscience, 23*, 9395-9402.

Petrovich, G. D., Holland, P. C., & Gallagher, M. (2005). Amygdalar and prefrontal pathways to the lateral hypothalamus are activated by a learned cue that stimulates eating. *Journal of Neuroscience, 25*, 8295-8302.

Petty, R. E., & Briñol, P. (2009). Implicit ambivalence: A meta-cognitive approach. In R. E. Petty, R. H. Fazio & P. Briñol (Eds.), *Attitudes: Insights from the new implicit measures*. New York Psychology Press.

Petty, R. E., Briñol, P., & DeMarree, K. G. (2007). The meta-cognitive model (MCM) of attitudes: implications for attitude measurement, change, and strength. *Social Cognition, 25*, 1-15.

Petty, R. E., Tormala, Z. L., Briñol, P., & Jarvis, W. B. G. (2006). Implicit ambivalence from attitude change: An exploration of the PAST Model. *Journal of Personality and Social Psychology, 90*, 21-41.

Piech, R. M., Pastorino, M. T., & Zald, D. H. (in press). All I saw was the cake. Hunger effects on attentional capture by visual food cues. *Appetite*.

Pinel, J. P. J., Assanand, S., & Lehman, D. R. (2000). Hunger, eating and ill health. *American Psychologist, 55*, 1105-1116.

Pittman, T. S., & Zeigler, K. R. (2007). Basic human needs. In A. W. Kruglanski & E. T. Higgins (Eds.), *Social Psychology: Handbook of basic principles* (2nd ed.). New York: Guilford.

Placanica, J., Faunce, G., & Soames , J. (2002). The effect of fasting on attentional biases for food and body shape/weight words in high and low Eating Disorder Inventory scorers. . *International Journal of Eating Disorders, 32*, 79-90.

Plihal, W., Haenschel, C., Hachl, P., Born, J., & Pietrowsky, R. (2001). The effect of food deprivation on ERP during identification of tachistoscopically presented food-related words. *Journal of Psychophysiology, 15*, 163-172.

Pope, L. K., & Smith, C. A. (1994). On the distinct meanings of smiles and frowns. *Cognition and Emotion, 8*, 65-72.

Postman, L., Bruner, J. S., & McGinnies, E. (1948). Personal values as selective factors in perception. *Journal of Abnormal and Social Psychology, 43*, 142-154.

Ratner, R. K., & Herbst, K. C. (2005). When good decisions have bad outcomes: The impact of affect on switching behavior. *Organizational Behavior and Human Decision Processes, 96*, 23-37.

Read, P. P. (1974). *Alive: The Story of the Andes Survivors*. New York: Lippincott.

Redelmeier, D. A., & Kahneman, D. (1996). Patients' memories of painful medical treatments: Real-time and retrospective evaluations of two minimal invasive procedures. *Pain, 66,* 3-8.

Rejeski, W. J., Blumenthal, T. D., Miller, G. D., Lobe, M., Davis, C., & Brown, L. (in press). State craving, food availability, and reactivity to preferred snack foods. *Appetite.*

Richter, C. P. (1927). Animal behavior and internal drives. *Quarterly Review of Biology, 2,* 307-343.

Robinson, S., Sandstrom, S. M., Deneberg, V. H., & Palmiter, R. D. (2005). Distinguishing whether dopamine regulates liking, wanting, and/or learning about rewards. *Behavioral Neuroscience, 119,* 5-15.

Robinson, T. E., & Berridge, K. C. (1993). The neural basis of drug craving: An incentive-sensitization theory of addiction. *Brain Research Reviews, 18,* 247-291.

Robinson, T. E., & Berridge, K. C. (2003). Addiction. *Annual Review of Psychology, 54,* 25-53.

Roefs, A., Staperta, D., Isabella, L. S. A., Wolters, G., Wojciechowskic, F., & Jansen, A. (2005). Early associations with food in anorexia nervosa patients and obese people assessed in the affective priming paradigm. *Eating Behaviors, 6*, 151–163.

Rosenberg, M. J., & Hovland, C. I. (1960). Cognitive, affective, and behavioral components of attitudes. In C. I. Hovland & M. J. Rosenberg (Eds.), *Attitude organization and change* (pp. 1-14). New Haven, CT: Yale University Press.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39,* 1161-1178.

Rydell, R. J., & McConnell, A. R. (2006). Understanding implicit and explicit attitude change: A systems of reasoning analysis. *Journal of Personality and Social Psychology, 91,* 995-1008.

Sanford, R. N. (1936). The effects of abstinence from food upon imaginal processes: A preliminary experiment. *Journal of Psychology: Interdisciplinary and Applied, 2*, 129-136.

Sanford, R. N. (1937). The effects of abstinence from food upon imaginal processes: A further experiment. *Journal of Psychology: Interdisciplinary and Applied, 3*, 145-159.

Sayette, M. A., & Hufford, M. R. (1994). Effects of cue exposure and deprivation on cognitive resources in smokers. *Journal of Abnormal Psychology, 103*, 812-818.

Schultz, W. (1998). Predictive reward signal of dopamine neurons. *Journal of Neurophysiology, 80*, 1-27.

Schwartz, M. W., Woods, S. C., Porte, D., Seeley, R. J., & Baskin, D. G. (2000). Central nervous system control of food intake. *Nature, 404*, 661-671.

Scott, D. J., Heitzeg, M. M., Koeppe, R. A., Stohler, C. S., & Zubieta, J. K. (2006). Variations in the human pain stress experience mediated by ventral and dorsal basal ganglia dopamine activity. *Journal of Neuroscience, 26*, 10789-10795.

Seibt, B., Häfner, M., & Deutsch, R. (2007). Prepared to eat: How immediate affective and motivational responses to food cues are influenced by food deprivation. *European Journal of Social Psychology, 37*, 359-379.

Sherman, S. J., Rose, J. S., & Koch, K. (2003). Implicit and explicit attitudes toward cigarette smoking: the effects of context and motivation. *Journal of Social and Clinical Psychology, 22*, 13-39.

Smith, T. W. (1979). Happiness: Time trends, seasonal variations, inter-survey differences, and other mysteries. *Social Psychology Quarterly, 42*, 18-30.

Stewart, S. H., & Samoluk, S. B. (1997). Effects of short-term food deprivation and chronic dietary restraint on the selective processing of appetitive-related cues. *International Journal of Eating Disorders, 21*, 129-135.

Strack, F. (1994). *Zur Psychologie der standardisierten Befragung : kognitive und kommunikative Prozesse* (Vol. 48). Berlin: Springer.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*, 220-247.

Strack, F., Schwarz, N., & Wänke, M. (1991). Semantic and pragmatic aspects of context effects in social and psychological reserach. *Social Cognition, 9*, 111-125.

Stroop, C. D. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*, 643-662.

Swami, V., & Tovée, M. J. (2006). Does hunger influence judgments of female physical attractiveness? *British Journal of Psychology, 97*, 353-363.

Thompson, M. M., Zanna, M. P., & Griffin, D. W. (1995). Let's not be indifferent about (attitudinal) ambivalence. In R. E. Petty & J. A. Korsnick (Eds.), *Attitude strength: Antecedents and consequences.* (pp. 361-386). Mahwah, NJ: Lawrence Erlbaum.

Toates, F. M. (1986). *Motivational systems*. Cambridge: Cambridge University Press.

Toates, F. M. (1994). Comparing motivational systems - an incentive motivation perspective. In C. R. Legg & D. A. Booth (Eds.), *Appetite: neural and behavioural bases* (pp. 305-327). Oxford: Oxford University Press.

Topolinski, S., & Türk Pereira, P. (under revision). Mapping the tip of the tongue – deprivation sensory sensitization and oral haptic. *Journal of Experimental Psychology: Human Perception and Performance*.

Veling, H., & Aarts, H. (in press). Putting behavior on hold decreases reward value of need-instrumental objects outside of awareness. *Journal of Experimental Social Psychology*.

Veltkamp, M., Aarts, H., & Custers, R. (2008). On the emergence of deprivation-reducing behaviors: Subliminal priming of behavior representations turns deprivation into motivation. *Journal of Experimental Social Psychology, 44*, 866-873.

Veltkamp, M., Aarts, H., & Custers, R. (2009). Unravelling the motivational yarn: a framework for understanding the instigation of implicitly motivated behaviour resulting from deprivation and positive affect. *European Review of Social Psychology, 20*, 345-381.

Wada, T. (1922). An experimental study of hunger in its relation to activity. *Archives of Psychology, 8*, 1-6.

Wagner, A. R. (1963). Conditioned frustration as a learned drive. *Journal of Experimental Psychology, 66*, 142-148.

Wagner, A. R. (1969). Frustrative non-reward: a variety of punishment. In B. A. Campbell & R. M. Church (Eds.), *Punishment and Aversive Behavior*. (pp. 157-181). New York: Appleton-Century-Crofts.

Waters, A. J., & Feyerabend, C. (2000). Determinants and effects of attentional bias on smokers. *Psychology of Addictive Behaviors, 14*, 111-120.

Weil, M., & Katkin, E. S. (1969). Galvanic skin reactions associated with nonrepresentation of an accustomed valued object in humans. *Psychonomic Science, 16*, 171-172.

Weingarten, H. P., & Martin, G. M. (1989). Mechanisms of conditioned meal initiation. *Physiology & Behavior, 45*, 735-740.

Wiers, R. W., van de Luitgaarden, J., van den Wildenberg, E., & Smulders, F. T. Y. (2005). Challenging implicit and explicit alcohol-related cognitions in young heavy drinkers. *Addiction, 100*, 806-819.

Wiers, R. W., van Woerden, N., Smulders, F. T., & de Jong, P. J. (2002a). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology, 111*(4), 648-658.

Wiers, R. W., Van Woerden, N., Smulders, F. T. Y., & De Jong, P. J. (2002b). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology, 111*(4), 648-658.

Wigboldus, D. H. J., Holland, R. W., & Van Knippenberg, A. (2004). Single target implicit associations. *Unpublished manuscript*.

Willner, P., Benton, D., Brown, E., Cheeta, S., Davies, G., Morgan, J., et al. (1998). Depression increases craving for sweet rewards in animal and human models of depression and craving *Psychopharmacology, 136*, 272-283.

Wilson, T. D., Lindsey, S., & Schooler, T. Y. (2000). A model of dual attitudes. *Psychological Review, 107*, 101-126.

Wilson, T. D., & Schooler, J. W. (1991). Thinking too much: Introspection can reduce the quality of preferences and decisions. *Journal of Personality and Social Psychology, 60*, 181-191.

Winkielman, P., & Berridge, K. C. (2004). Unconscious emotion. *Current Directions in Psychological Science 13*, 120-123.

Winkielman, P., Berridge, K. C., & Wilbarger, J. L. (2005). Unconscious affective reactions to masked happy versus angry faces influence consumption behavior and judgments of value. *Personality and Social Psychology Bulletin, 31*, 121-135.

Wise, R. A. (1998). Drug-activation of brain reward pathways. *Drug and Alcohol Dependence, 51*, 13-22.

Wisniewski, L., Epstein, L. H., & Caggiula, A. R. (1992). Effect of food change on consumption, hedonics, and salivation. *Physiology and Behavior, 52*, 21-26.

Wispe, L. G., & Drambarean, N. C. (1953). Physiological need, word frequency, and visual duration thresholds. *Journal of Experimental Psychology, 46*, 25-31.

Wittenbrink, B., Judd, C. M., & Park, B. (2001). Spontaneous prejudice in context: Variability in automatically activated attitudes. *Journal of Personality and Social Psychology, 81*(5), 815-827.

Wolf, A. V. (1958). *Thirst. Physiology of the urge to drink and problems of water lack*. Springfield, Il: Charles C. Thomas Publisher.

Wyvell, C. L., & Berridge, K. C. (2000). Intra-accumbens amphetamine increases the conditioned incentive salience of sucrose reward: Enhancement of reward "wanting" without enhanced "liking" or response reinforcement. *Journal of Neuroscience, 20,* 8122-8130.

Yeomans, M. R., & Gray, R. W. (1997). Effects of naltrexone on food intake and changes in subjective appetite during eating: Evidence for opioid involvement in the appetizer effect. *Physiology and Behavior, 62,* 15-21.

Zahm, D. S. (2000). An integrative neuroanatomical perspective on some subcortical substrates of adaptive responding with emphasis on the nucleus accumbens. *Neuroscience and Biobehavioral Reviews, 24,* 85-105.

Zimbardo, P. G., & Miller, N. E. (1958). Facilitation of exploration by hunger in rats. *Journal of Comparative and Physiological Psychology, 51*(1), 43-46.

APPENDIX

Experiment 1

Instructions

General Instructions

Liebe/r Teilnehmer/in! Erstmal herzlichen Dank, dass Sie bei diesem Versuch mitmachen. Wie angekündigt wird der Versuch etwa 60 Minuten in Anspruch nehmen. Dabei bitten wir Sie sowohl eine Reaktionszeitaufgabe zu bearbeiten sowie einige allgemeine Fragen zu beantworten. Sie werden zu jedem Abschnitt eine ausführliche Instruktion am Computer erhalten. Bei Fragen wenden Sie sich bitte an die Versuchsleitung. Bevor es losgeht, vergewissern Sie sich, ob Sie angenehm und entspannt sitzen und stellen Sie bitte ihr Handy auf lautlos! Vielen Dank. Um weiterzumachen klicken Sie bitte mit der Maus rechts unten auf CONTINUE.

Liking ST-IAT: Practice

Zunächst wird es darum gehen, eine Reihe von Wörtern danach zu unterteilen, ob Sie sie MÖGEN oder NICHT MÖGEN. Die Wörter erscheinen nacheinander in der Mitte des Bildschirms. Drücken Sie bitte die linke[38] rote Taste für ein Wort, das sie MÖGEN und die rechte rote Taste für ein Wort, das sie NICHT MÖGEN. Bitte reagieren sie dabei so SCHNELL wie möglich. Um es Ihnen etwas einfacher zu machen, erscheinen die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte (also mag ich vs. mag ich nicht). Im Folgenden können sie einige Male üben, diese Zuordnung auszuführen. Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

[38] Response assignment was counterbalanced between participants

Liking ST-IAT: Test

Jetzt wird es etwas schwieriger! Im Folgenden wird es darum gehen, zusätzlich zu den bisherigen Wörtern, essensbezogene Wörter (z.B. Salat) ebenfalls zuzuordnen. Bitte reagieren Sie dazu im Folgenden mit der linken roten Taste zusätzlich noch auf essensbezogene Wörter. Reagieren Sie bitte außerdem weiterhin mit der linken roten Taste auf ein Wort, das sie MÖGEN und mit der rechten roten Taste auf ein Wort, das sie NICHT MÖGEN[39]. Bitte reagieren sie dabei so SCHNELL und so GENAU wie möglich. Weiterhin werden die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte erscheinen (also mag ich oder Essen vs. mag ich nicht). Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Liking ST-IAT: Change of Blocks

ACHTUNG! Jetzt ändert sich die Tastenzuordnung für die essensbezogenen Wörter! Bitte reagieren Sie jetzt nicht mehr mit der linken Taste auf Essenswörter sondern mit der rechten Taste. Weiterhin werden die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte erscheinen (also mag ich vs. mag ich nicht oder Essen). Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Wanting ST-IAT: Practice

Zunächst wird es darum gehen, eine Reihe von Wörtern danach zu unterteilen, ob Sie etwas mit ANNÄHERUNG oder VERLANGEN oder aber etwas mit VERMEIDUNG zu tun haben. Die Wörter erscheinen nacheinander in der Mitte des Bildschirms. Drücken Sie bitte die linke rote Taste für ein Wort, das mit ANNÄHERUNG zu tun hat und die rechte rote Taste für ein Wort, das mit VERMEIDUNG zu tun hat. Bitte reagieren sie dabei so SCHNELL und so GENAU wie möglich. Um es Ihnen etwas einfacher zu machen, erscheinen die

[39] The order of test block (compatible vs. incompatible) was counterbalanced between participants

Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte (also Annäherung vs. Vermeidung). Im Folgenden können sie einige Male üben, diese Zuordnung auszuführen. Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Wanting ST-IAT: Test

Jetzt wird es etwas schwieriger! Im Folgenden wird es darum gehen, zusätzlich zu den bisherigen Wörtern, essensbezogene Wörter (z.B. Salat) ebenfalls zuzuordnen. Bitte reagieren Sie dazu im Folgenden mit der linken roten Taste zusätzlich noch auf essensbezogene Wörter. Reagieren Sie bitte außerdem weiterhin mit der linken roten Taste auf ein Wort, das mit ANNÄHERUNG zu tun hat und mit der rechten roten Taste auf ein Wort, das mit VERMEIDUNG zu tun hat. Bitte reagieren sie dabei so SCHNELL und so GENAU wie möglich. Weiterhin werden die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte erscheinen (also Annäherung oder Essen vs. Vermeidung). Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Wanting ST-IAT: Change of Blocks

ACHTUNG! Jetzt ändert sich die Tastenzuordnung für die essensbezogenen Wörter! Bitte reagieren Sie jetzt nicht mehr mit der linken Taste auf Essenswörter sondern mit der rechten Taste. Weiterhin werden die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte erscheinen (also Annäherung vs. Vermeidung oder Essen). Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Stimuli

Liking ST-IAT:

Positive attribute words: Liebe, Freude, Paradies, Geschenk, Urlaub

Negative attribute words: Krieg, Gestank, Krankheit, Unglück, Schmerz

Need-relevant target words: Schokolade, Pizza, Spaghetti, Salat, Brötchen

Wanting ST-IAT:

Approach-related attribute words: annähern, wollen, wünschen, zugehen, verlangen

Avoidance-related attribute words: vermeiden, verdrängen, zurückweisen, verweigern, flüchten

Need-relevant target words: Schokolade, Pizza, Spaghetti, Salat, Brötchen

Experiment 2

Instructions

General Instructions

See Appendix A (Experiment 1)

Liking ST-IAT: Practice

See Appendix A (Experiment 1)

Liking ST-IAT: Test

See Appendix A (Experiment 1)

Liking ST-IAT: Change of Blocks

See Appendix A (Experiment 1)

Wanting ST-IAT: Practice

Es geht im Folgenden darum, Wörter, die in der Mitte des Bildschirmes erscheinen werden, danach zuzuordnen, ob sie Dinge beschreiben, die Sie im Allgemeinen PERSÖNLICH WOLLEN oder NICHT WOLLEN. Dabei steht WOLLEN in dieser Aufgabe für "sich annähern" bzw. "auf etwas zugehen" und NICHT WOLLEN für "etwas vermeiden" bzw. "von etwas weggehen". Drücken Sie bitte die linke rote Taste für ein Wort, das sie WOLLEN und die rechte rote Taste für ein Wort, das sie NICHT WOLLEN. Bitte reagieren sie dabei so SCHNELL wie möglich. Um es Ihnen etwas einfacher zu machen, erscheinen die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte (also will

ich vs. will ich nicht). Im Folgenden können sie einige Male üben, diese Zuordnung auszuführen. Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Wanting ST-IAT: Test

Jetzt wird es etwas schwieriger! Im Folgenden wird es darum gehen, zusätzlich zu den bisherigen Wörtern, essensbezogene Wörter (z.B. Salat) ebenfalls zuzuordnen. Bitte reagieren Sie dazu im Folgenden mit der linken roten Taste zusätzlich noch auf essensbezogene Wörter. Reagieren Sie bitte außerdem weiterhin mit der linken roten Taste auf ein Wort, das sie WOLLEN und mit der rechten roten Taste auf ein Wort, das sie NICHT WOLLEN. Bitte reagieren sie dabei so SCHNELL und so GENAU wie möglich. Weiterhin werden die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte erscheinen (also will ich oder Essen vs. will ich nicht). Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Wanting ST-IAT: Change of Blocks

ACHTUNG! Jetzt ändert sich die Tastenzuordnung für die essensbezogenen Wörter! Bitte reagieren Sie jetzt nicht mehr mit der linken Taste auf Essenswörter sondern mit der rechten Taste. Weiterhin werden die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte erscheinen (also will ich vs. will ich nicht oder Essen). Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Stimuli

Liking ST-IAT:

See Appendix A (Experiment 1)

Wanting ST-IAT:

Positive attribute words: Liebe, Freude, Paradies, Geschenk, Urlaub

Negative attribute words: Krieg, Gestank, Krankheit, Unglück, Schmerz

Need-relevant target words: Schokolade, Pizza, Spaghetti, Salat, Brötchen

Questions

Mood & Frustration Questionnaire

Wir möchten Sie bitten, einige Fragen zu Ihrer momentanen Befindlichkeit zu beantworten. Klicken Sie dazu denjenigen Zahlenwert an, der am besten Ihre momentane Stimmung widerspiegelt bzw. der am besten beschreibt, was Ihnen im Moment durch den Kopf geht. Antworten Sie zügig und spontan! Bitte weiter mit CONTINUE.

Response Scale

1	2	3	4	5	6
trifft überhaupt nicht zu					trifft voll und ganz zu

Items[40]

Ich bin gut gelaunt.

Ich bin glücklich.

Ich bin zufrieden.

Ich bin schlecht gelaunt.

Ich bin traurig.

Ich bin ärgerlich.

Ich bin frustriert.

[40] Items were presented in ramdomized order.

Additional Analyses

Table B1

Mean Frustration Scores as a Function of Need State (Food-deprived vs. Satiated), Expectancy (Reward vs. Nonreward) and Time (Before vs. After Implicit Attitude Assessment)

	Expectancy			
	Reward		Nonreward	
	Need State			
Time	Food-deprived (N = 16)	Satiated (N = 16)	Food-deprived (N = 12)	Satiated (N = 17)
Before				
M	1.69	1.75	1.75	1.53
SD	1.14	1.34	1.34	.80
After				
M	1.63	1.69	1.50	1.65
SD	1.09	1.14	.67	1.06

Table B2

Mean Mood Scores as a Function of Need State (Food-deprived vs. Satiated), Expectancy (Reward vs. Nonreward) and Time (Before vs. After Implicit Attitude Assessment)

	Expectancy			
	Reward		Nonreward	
	Need State			
Time	Food-deprived (N = 16)	Satiated (N = 16)	Food-deprived (N = 12)	Satiated (N = 17)
Before				
M	4.69	4.85	4.98	5.04
SD	.81	.70	.73	.73
After				
M	4.89	4.83	4.94	5.03
SD	.76	.82	.79	.82

Experiment 3

Instructions

General Instructions: Reward Expectancy

Liebe/r Teilnehmer/in! Erstmal herzlichen Dank, dass Sie bei diesem Versuch mitmachen. Wie angekündigt wird der Versuch etwa 60 Minuten in Anspruch nehmen. Dabei sollen Sie mehrere Aufgaben bearbeiten. Sie werden zu jedem Abschnitt eine ausführliche Instruktion am Computer erhalten. Das mitgebrachte Essen legen Sie sich bitte wie vom Versuchsleiter angeordnet neben sich auf den Tisch. Sie werden gleich die Möglichkeit haben, während der nächsten Aufgabe davon zu essen. Bei weiteren Fragen wenden Sie sich bitte an die Versuchsleitung. Bevor es losgeht, vergewissern Sie sich, ob Sie angenehm und entspannt sitzen und stellen Sie bitte ihr Handy auf lautlos! Vielen Dank. Um weiterzumachen klicken Sie bitte mit der Maus rechts unten auf CONTINUE.

General Instructions: Nonreward Condition

Liebe/r Teilnehmer/in! Erstmal herzlichen Dank, dass Sie bei diesem Versuch mitmachen. Wie angekündigt wird der Versuch etwa 60 Minuten in Anspruch nehmen. Dabei sollen Sie mehrere Aufgaben bearbeiten. Sie werden zu jedem Abschnitt eine ausführliche Instruktion am Computer erhalten. Das mitgebrachte Essen legen Sie sich bitte wie vom Versuchsleiter angeordnet neben sich auf den Tisch. Sie werden es am Ende des Versuches für eine Evaluationsstudie brauchen. Sie werden aber zu keiner Zeit während des Versuches und auch nicht während der Evaluationsstudie die Möglichkeit haben, davon etwas zu essen. Bei weiteren Fragen wenden Sie sich bitte an die Versuchsleitung. Bevor es losgeht, vergewissern Sie sich, ob Sie angenehm und entspannt sitzen und stellen Sie bitte ihr Handy auf lautlos!

Vielen Dank. Um weiterzumachen klicken Sie bitte mit der Maus rechts unten auf CONTINUE.

Liking ST-IAT: Practice

See Appendix A (Experiment 1)

Liking ST-IAT: Test

See Appendix A (Experiment 1)

Liking ST-IAT: Change of Blocks

See Appendix A (Experiment 1)

Wanting ST-IAT: Practice

See Appendix B (Experiment 2)

Wanting ST-IAT: Test

See Appendix B (Experiment 2)

Wanting ST-IAT: Change of Blocks

See Appendix B (Experiment 2)

Instructions for the Neutral Text: Reward Condition

Lesen Sie den Text (2 Seiten) bitte in Ruhe durch. Sie werden dazu etwa 2 Minuten benötigen. Wir werden Ihnen später einige Fragen dazu stellen. Sie dürfen ab sofort und während der nächsten Aufgaben gerne von Ihrem mitgebrachten Essen verspeisen. Sie dürfen zu jeder Zeit davon essen so viel Sie wollen. Wenn Sie den Text fertig gelesen haben, legen

Sie den Text bitte neben sich auf den Boden und klicken mit der Maus rechts unten auf CONTINUE um weiterzumachen.

Instructions for the Neutral Text: Nonreward Condition

Lesen Sie den Text (2 Seiten) bitte in Ruhe durch. Sie werden dazu etwa 2 Minuten benötigen. Wir werden Ihnen später einige Fragen dazu stellen. Wenn Sie den Text fertig gelesen haben, legen Sie den Text bitte neben sich auf den Boden und klicken mit der Maus rechts unten auf CONTINUE um weiterzumachen.

Stimuli

Liking ST-IAT:

See Appendix A (Experiment 1)

Wanting ST-IAT:

See Appendix B (Experiment 2)

Neutral Text: Page 1

Unternehmensführung

Manager in der Krise: Kreide für den Leitwolf

Anke Henrich, Jürgen Salz

12.07.2009 2,1 (17) **Legende**

Die Finanzkrise hat die Alpha-Manager in eine Sinnkrise gestürzt. In den Konzernen sind künftig andere Rudelführer gefragt.

Porsche-Chef Wendelin Wiedeking (links) und Finanzvorstand Holger Härter: Alphatiere in der Krise AP

Georg Fischer ist der Mann, dem die Manager vertrauen. In seiner Praxis an der Düsseldorfer Königsallee bietet der Psychoanalytiker Top-Managern Gespräche auf Augenhöhe. Fischers Spezialgebiet: nicht das Jonglieren von Finanzzahlen, sondern die Aufarbeitung seelischer Konflikte. Die Finanzkrise, sagt der 50-jährige Führungsberater griechischer Abstammung, habe ihm Zulauf beschert – etliche Männer und Frauen aus den Top-Etagen deutscher Unternehmen suchen Fischers Beistand, bis vor Kurzem wagte kaum ein Mitglied einer Chefetage diesen Seelenstriptease.

Fischer hört zu, wenn Menschen, die sonst über Milliardenumsätze und das Wohl und Wehe Tausender Arbeitsplätze bestimmen, plötzlich nicht mehr über zweistellige Renditen nachdenken. Sondern anfangen, Fragen zu stellen: Wie habe ich geführt? Wie auf Druck reagiert? Wie viel Kritik habe ich verhindert? Wo habe ich geschwiegen, statt mich zu Wort zu melden? Lohnt sich der tägliche Kampf überhaupt für meinen Job? Sie sinnieren darüber, ob ihre Unternehmen grundsätzlich auf dem richtigen Weg sind. Und sie selbst noch an der richtigen Position. „Sie stellen sich selbst, ihre Werte und ihren Führungsstil infrage", sagt Fischer.

Es bleibt ihnen auch nichts anderes übrig. Die nun zwei Jahre andauernde Finanzkrise hat sich zum Kehraus selbst für sogenannte Alpha-Tiere unter den Managern entwickelt. Jeder sechste Chef eines deutschen Unternehmens verlor im vergangenen Jahr seinen Job, in der Finanzbranche war es jeder fünfte, so eine Studie der Strategieberatung Booz & Company.

Von Hamburg bis München mussten die Chefs der Landesbanken abtreten. Der Immobilienfinanzierer Hypo Real Estate ist knapp der Pleite entkommen. Stefan Ortseifen, Ex-Chef der IKB, ist wegen des Vorwurfs der Börsenmanipulation angeklagt. Die staatliche KfW servierte ihren Risiko-Vorstand ab, der die 320-Millionen-Euro-Überweisung an das Stunden später bankrotte Bankhaus Lehman Brothers nicht stoppte. Düsseldorfer Sparkassen-Lokalfürsten strauchelten ebenso wie Kölner Privatbankiers über bevorzugte Kunden.

Neutral Text: Page 2

Manager in der Krise

87 Prozent der Manager klagen, dass sich ihr Ansehen stark verschlechtert hat

80 Prozent der Manager spüren seit der Krise einen höheren Leistungsdruck

33 Prozent der Führungskräfte sind bereit, den Arbeitgeber zu wechseln

Schlagworte zum Thema

Manager

Finanzkrise entwickelt sich zum Kehraus für Alpha-Tiere

Auch staatliche Bankenkontrolleure wie Finanzstaatssekretär Jörg Asmussen und Jochen Sanio, Chef der Bankenaufsicht, stehen unter Beschuss. Selbst erprobte Alpha-Männchen wie Porsche-Chef Wendelin Wiedeking und sein Finanzvorstand Holger Härter oder Schaeffler-Chef Jürgen Geißinger kamen vom Kurs ab, die Nächsten dürften bald folgen. Gescheitert sind sie alle aus dem gleichen Grund: an ihrer Selbstüberschätzung – mit der sie im Übrigen erheblichen Anteil hatten an Ausbruch und Ausbreitung der globalen Wirtschaftskrise.

Sinnkrise erfasst Finanzmanager

Was aber treibt Alpha-Tiere an? Verhaltensforscher charakterisieren diese Leittiere nicht unbedingt als statusorientiertestes, aber meist stärkstes und schlauestes, häufig ältestes Tier einer Herde. Psychoanalytiker Fischer schreibt den Alpha-Tieren der Wirtschaft eine herausragende Intelligenz, Führungswillen, Mut und Entschlossenheit zu. Dazu Charisma, Visionen, Rhetorik und Dialektik. Doch all das sei nicht zwangsläufig gepaart mit der Fähigkeit, Kritik und ebenbürtige Geister in der eigenen Nähe zu ertragen.

Nach außen vor Selbstbewusstsein strotzend, fehlt solchen Alpha-Tieren in Politik und Wirtschaft oft ein verlässliches Selbstwertgefühl. Sie verfügen über einen inneren Treiber, aber keinen inneren Kompass, der sie Kritik wertschätzen ließe – und sei es nur aus purem Egoismus. Sie umgeben sich mit Jasagern, oft entstehen um sie herum kritikfreie Zonen. „Nachdem sie sich während ihres Aufstiegs Schritt für Schritt ihre Überlegenheit haben bestätigen lassen, ist es für sie schwer vorstellbar, fehlbar zu sein", beschreibt Fischer die verhängnisvolle Selbsttäuschung.

Inzwischen hat die Sinnkrise die Finanzmanager erfasst. Die Zeiten, in denen sich vermeintliche Alpha-Tiere in den Banktürmen auf der ganzen Welt als „Masters of the Universe" gerierten und mit schnellen Erfolgen glänzten, sind längst vorbei.

„Die Bankenwelt war immer schon viel internationaler als die deutsche Industrie. Sie verlangt hohe Flexibilität und schnelle Auffassungsgabe. Alles das, was die besten und risikofreudigsten unter den Absolventen angezogen hat", beschreibt Christine Stimpel, Geschäftsführerin der Personalberatung Heidrick & Struggles Deutschland, die Anziehungskraft der Branche, „zudem agieren Banker mit sehr abstrakten Produkten, die sie anderen Bankern verkaufen." Dabei wussten die Finanzmanager oft kaum, womit sie da gerade handelten. Kein mittelständischer Maschinenbauer würde etwa seinen Kunden Maschinen verkaufen, deren Funktionsweise er nicht genau kennt.

„Mit Sicherheit waren es die materiellen Anreize, das Denken ‚nach mir die Sintflut', das extreme Streben nach schnellen und hohen Gewinnen, das die Banker antrieb", sagt Dieter Frey, Professor für Klassische Sozialpsychologie in München. „Und sie wussten genau, dass sie weder zur Verantwortung noch zur persönlichen Haftung gezwungen werden konnten."

Questions

Mood & Frustration Questionnaire

See Appendix B (Experiment 2)

Filler Questions Concerning the Neutral Text:

Wie schwer fanden Sie den Text zu Beginn des Versuches?

(1 = gar nicht schwer – 7 = sehr schwer)

Wie informativ war der Text für Sie?

(1 = gar nicht informativ – 7 = sehr informativ)

Wie stark würden Sie der folgenden Aussage zustimmen "es war längst an der Zeit, dass Manager zum Therapeuten gehen"?

(1 = stimme überhaupt nicht zu – 7 = stimme voll und ganz zu)

Questionnaire Concerning the Amount of Food Consumed:

VP-Nr.: _____

Bitte tragen Sie im Folgenden ein, wie viel (in Prozent) Sie in etwa von Ihrem mitgebrachten Essen zu den unterschiedlichen Zeitpunkten konsumiert haben.
Wenn Sie beim Lesen des Textes beispielsweise alles bereits gegessen haben sollten, dann tragen sie ins erste Feld 100 % ein und in alle weiteren 0 % usw. Für den Fall, dass Sie zum jetzigen Zeitpunkt bereits alles gegessen haben sollten, müsste die Summe aller Kästchen 100 % ergeben, ansonsten eine Zahl unter 100 %.
Bei Fragen wenden Sie sich bitte an den Versuchsleiter!

Zur Erinnerung: es gab insgesamt 2 Reaktionszeitaufgaben, eine mit „mag ich" vs. „mag ich nicht" und eine mit „will ich" vs. „will ich nicht"

Welches Essen haben Sie sich mitgebracht? _____

Hier bitte die gegessene Menge eintragen

%	%	%	%	%	%
Lesen vom Text „Manager in der Krise"	Lesen der Instruktion zur 1. Reaktionszeit-aufgabe	während der 1. Reaktionszeitaufgabe	während der Pause zwischen den beiden Reaktionszeitaufgaben	Lesen der Instruktion zur 2. Reaktionszeit-aufgabe	während der 2. Reaktionszeitaufgabe

Additional Analyses

Table C1

Mean Frustration Scores as a Function of Need State (Food-deprived vs. Satiated), Expectancy (Reward vs. Nonreward) and Time (Before vs. After Implicit Attitude Assessment)

	Expectancy			
	Reward		Nonreward	
	Need State			
Time	Food-deprived (N = 18)	Satiated (N = 19)	Food-deprived (N = 24)	Satiated (N = 24)
Before				
M	1.78	1.68	1.83	2.08
SD	1.43	1.00	1.24	1.41
After				
M	1.61	1.84	1.42	1.92
SD	1.19	1.02	.88	1.28

Table C2

Mean Mood Scores as a Function of Need State (Food-deprived vs. Satiated), Expectancy (Reward vs. Nonreward) and Time (Before vs. After Implicit Attitude Assessment)

	Expectancy			
	Reward		Nonreward	
	Need State			
Time	Food-deprived (N = 18)	Satiated (N = 19)	Food-deprived (N = 24)	Satiated (N = 24)
Before				
M	4.74	4.90	4.68	4.43
SD	.99	.87	1.06	1.21
After				
M	4.94	5.00	4.86	4.63
SD	.99	.65	1.03	1.07

Experiment 4

Instructions

General Instructions

See Appendix A (Experiment 1)

Need-relevant Liking ST-IAT: Practice

See Appendix A (Experiment 1)

Need-relevant Liking ST-IAT: Test

See Appendix A (Experiment 1)

Need-relevant Liking ST-IAT: Change of Blocks

See Appendix A (Experiment 1)

Need-irrelevant Liking ST-IAT: Practice

See Appendix A (Experiment 1)

Need-irrelevant Liking ST-IAT: Test

Jetzt wird es etwas schwieriger! Im Folgenden wird es darum gehen, zusätzlich zu den bisherigen Wörtern, Wörter, die Möbelstücke beschreiben (z.B. Schrank) ebenfalls zuzuordnen. Bitte reagieren Sie dazu im Folgenden mit der linken roten Taste zusätzlich noch auf Möbel-Wörter. Reagieren Sie bitte außerdem weiterhin mit der linken roten Taste auf ein Wort, das sie MÖGEN und mit der rechten roten Taste auf ein Wort, das sie NICHT MÖGEN. Bitte reagieren sie dabei so SCHNELL und so GENAU wie möglich. Weiterhin

werden die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte erscheinen (also mag ich oder Möbel vs. mag ich nicht). Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Need-irrelevant Liking ST-IAT: Change of Blocks

ACHTUNG! Jetzt ändert sich die Tastenzuordnung für die Möbel-Wörter! Bitte reagieren Sie jetzt nicht mehr mit der linken Taste auf Möbel-Wörter sondern mit der rechten Taste. Weiterhin werden die Tastenbeschreibungen bei jedem Durchgang immer auf der oberen Bildschirmhälfte erscheinen (also mag ich vs. mag ich nicht oder Möbel). Falls Sie alles verstanden haben gehts weiter mit der Leertaste.

Stimuli

Need-relevant Liking ST-IAT:

See Appendix A (Experiment 1)

Need-irrelevant Liking ST-IAT:

Positive attribute words: Liebe, Freude, Paradies, Geschenk, Urlaub

Negative attribute words: Krieg, Gestank, Krankheit, Unglück, Schmerz

Need-irrelevant target words: Regal, Stuhl, Kommode, Schrank, Garderobe

Erklärung gemäß §4 Abs. 4 Nr. 3 der PromO vom 14.06.2001

Hiermit versichere ich an Eides statt, dass ich die Dissertation selbstständig angefertigt und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe.

Würzburg, den 21.5.2010 _____

Philippe Türk Pereira

ZUSAMMENFASSUNG

Basierend auf unterschiedlichen theoretischen Annahmen zur Stabilität von Objekt-Valenz Repräsentationen, war das Hauptziel der vorliegenden Dissertation herauszufinden, ob Bedürfniszustände und Belohnungserwartung die unmittelbare Valenz von bedürfnisrelevanten Reizen verändert. Dabei stand die Unterscheidung zwischen expliziten und impliziten motivationsbezogenen (= wanting) und evaluationsbezogenen (= liking) Urteilen auf nahrungsbezogene Reize in Abhängigkeit des Hungerzustandes und der Konsumerwartung im Mittelpunkt der Untersuchungen.

Theoretischer Hintergrund und Hauptziele der vorliegenden Arbeit

Da die regelmäßige Nahrungsaufnahme eines der wichtigsten Bedürfnisse von Lebewesen darstellt (Hull, 1943; Pittmann & Zeigler, 2007), sollten essensbezogene Reize speziell für hungrige Organismen einen sehr positiven Anreiz haben, da diese die optimalen Mittel repräsentieren, das Bedürfnis nach Nährstoffen zu befriedigen (Lewin, 1935) d.h. dass sich die Valenz von essensbezogenen Reizen in Abhängigkeit vom Hungerzustand flexibel verändert. Diese Flexibilität sollte einen funktionalen Mechanismus darstellen, welcher es dem Organismus befähigt, möglichst effektiv und automatisch auf bestimmte Bedürfniszustände zu reagieren (vgl. Seibt, Häfner, & Deutsch, 2007). So sollte also die Valenz eines bedürfnisrelevanten Objektes im Dienste der entsprechenden bedürfnisbefriedigenden Handlung stehen d.h. die Bewertung eines bedürfnisrelevanten Objektes sollte unmittelbar auch die Motivation anstoßen, sich diesem Objekt zu nähern (vgl. Ferguson & Bargh, 2004). Da womöglich jeder Mensch in seinem Leben nicht nur schon einmal die Erfahrung gemacht hat, wie essentiell Essen im hungrigen Zustand werden kann und auch wie positiv die Folgen der darauf folgenden Nahrungsaufnahme sein können, so erscheint die obige Annahme intuitiv recht offensichtlich. Während auf der einen Seite bereits schon sehr viel Evidenz für diese Annahme vorgebracht werden konnte, die belegt, dass

hungrige Probanden essensbezogene Reize positiver beurteilen als satte Probanden (z.B. Brendl, Markman, & Messner, 2003; Cabanac, 1971) und dies sogar sehr schnell und automatisch tun (Ferguson & Bargh, 2004; Höfling & Strack, 2008; Seibt et al., 2007), mehren sich auf der anderen Seite jedoch auch gegenteilige Befunde. Beispielsweise fanden neuere Untersuchungen heraus, dass hungrige im Vergleich zu satten Probanden unmittelbar negativer auf essensbezogene Reize reagieren (Drobes et al., 2001; Mauler, Tuschen-Caffier, Hamm, & Weike, 2006). In Anlehnung an die Auffassung, dass positive oder negative affektive Reaktionen auf bestimmte visuelle Reize aus der Stärke des Schutzreflexes (startle eyeblink reflex) auf einen unangenehmen Reiz (z.B. Geräusch) schlussfolgert werden können und zwar in Abhängigkeit davon, ob dieser unangenehme Reiz zu der Valenz der visuellen Reize passt oder nicht (z.B. Bradley, Cuthbert, & Lang, 1990), fanden Drobes et al. (2001) und Mauler et al. (2006) heraus, dass ein unangenehmer Reiz bei den Probanden stärkere Blinzelreaktionen der Augen auslöste, wenn ihnen essensbezogene vs. nicht-essensbezogene Reize präsentiert wurden. Die Autoren schlussfolgern, dass essensbezogene Reize für hungrige negativer waren als für satte Personen. Dieser Befund steht somit zunächst im Widerspruch zur eingangs erläuterten motivationalen Annahme (vgl. Ferguson & Bargh, 2004; Seibt et al., 2007). Um diese widersprüchlichen Befunde zu erklären, wurde hauptsächlich auf die *frustrative nonreward* Hypothese von Amsel (1958, 1992, siehe auch Wagner, 1969) Bezug genommen. Diese postuliert, dass die Konfrontation mit bedürfnisrelevanten Reizen zu Frustration führt, wenn a) ein starkes Bedürfnis vorhanden und wenn b) keine Belohnung in Form von Konsum von Seiten der Probanden zu erwarten ist, was in den jeweiligen Untersuchungsdesign auch der Fall gewesen ist. Darüber hinaus ist bekannt, dass das Ausbleiben einer Belohnungserfahrung dazu führt, dass Personen ehemals angestrebte Objekte auch weniger mögen (Litt, Khan, & Shiv, in press). Daraus ließe sich ableiten, dass Personen frustriert wurden, die nicht in der Lage waren, ihr Bedürfnis zu befriedigen während sie mit bedürfnisrelevanten Reizen konfrontiert wurden und diese Reize

deshalb auch unmittelbar negativer beurteilten, obwohl sie hungrig waren. Im Vergleich zur motivationalen Annahme, impliziert die frustrative nonreward Hypothese, dass sich die unmittelbare Valenz von essensbezogenen Reizen also nicht nur in Abhängigkeit eines Bedürfniszustandes flexibel verändert, sondern auch in Abhängigkeit der Belohnungserwartung bzw. Wahrscheinlichkeit des Konsums. Diese Annahme im Kontext von Nahrungsdeprivation und Konsumerwartung zu testen war Ziel der vorliegenden Dissertation. Dazu wurden sowohl Bedürfniszustand als auch die Belohnungserwartung manipuliert und implizite sowie explizite Einstellungen der Probanden gegenüber essensbezogenen Reizen erfasst.

Zudem konnte bei genauer Betrachtung der unterschiedlichen Quellen ein scheinbar systematischer Zusammenhang zwischen der Deprivationsdauer und der automatischen (impliziten) Bewertung bedürfnisrelevanter Reize festgestellt werden, dergestalt, dass nahrungsbezogene Reize bei schwacher Nahrungsdeprivation positiver und bei starker Nahrungsdeprivation negativer beurteilt werden (vgl. Drobes et al., 2001; Levine, Cehin, & Murphy, 1942; Seibt et al., 2007). Vor diesem Hintergrund wurde ein Experiment durchgeführt, dass untersuchte, inwieweit sich die unmittelbare Valenz bedürfnisrelevanter im Vergleich zu bedürfnisirrelevanter Reize in Abhängigkeit der Deprivationsdauer verändert.

Sowohl die motivationale als auch die frustrative nonreward Annahme implizieren somit beide die Hypothese, dass die unmittelbare Valenz eines Objektes flexibel sei, da sie sich in Abhängigkeit des Bedürfniszustandes und der Belohnungserwartung verändere. Allerdings würden Vertreter klassischer Netzwerkmodelle von Gedächtnisrepräsentationen (z.B. Anderson & Bower, 1973) eine solche Flexibilität von Objekt-Valenz Assoziationen nicht annehmen. Stattdessen gehen diese eher von sehr stabilen assoziativen Verknüpfungen zwischen Konzepten (z.B. das Konzept Essen) und Attributen (z.B. positiv) aus, die sich nur sehr langsam und mit großem Lernaufwand verändern lassen (Devine, 1989; Epstein & Papini, 1999; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Greenwald & Banaji, 1995;

Wilson, Lindsey, & Schooler, 2000). Obwohl diese Annahme von einigen Autoren bereits ernsthaft in Frage gestellt wird (z.B. Blair, Ma, & Lenton, 2001; Seibt et al., 2007; Wittenbrink, Judd, & Park, 2001), so gibt es auch einige Untersuchungen die zeigen konnten, dass assoziative Objekt-Valenz Repräsentationen im Gedächtnis tatsächlich relativ veränderungsresistent sind (Gregg, Seibt, & Banaji, 2006; Rydell & McConnell, 2006). Genauer gesagt konnte gezeigt werden, dass sich das Umlernen von Assoziationen sich nur auf direkten nicht aber auf indirekten Einstellungsmaßen wie dem Impliziten Assoziationstest (IAT; Greenwald, McGhee, & Schwartz, 1998) widerspiegelte. Dabei wird davon ausgegangen, dass solche assoziativen Repräsentationen die Basis für implizite oder automatischen Einstellungen bilden (Greenwald & Banaji, 1995; Wilson et al., 2000), wobei explizite Einstellungen eher als die Folge zusätzlicher bewusster propositionaler Inferenzen interpretiert werden (Gawronski & Bodenhausen, 2006, Strack & Deutsch, 2004). Im Gegensatz zu der motivationalen und der frustrative nonreward Annahme, würde eine solche Sichtweise dualer Einstellungen postulieren, dass sich die unmittelbare Valenz von bedürfnisrelevanten Reizen nicht in Abhängigkeit von Nahrungsdeprivation oder Belohnungserwartung verändern sollte. Stattdessen sollte die Assoziation zu Essen aufgrund seiner überlebenswichtigen Funktion generell positiv sein.

Ein weiterer ganz wesentlicher Aspekt der vorliegenden Dissertation lag dabei in der Unterscheidung zwischen motivationsbezogenen und evaluationsbezogenen bedürfnisrelevanten Einstellungen. Insbesondere der Aspekt, dass nicht nur expliziten sondern auch impliziten Einstellungen unterschiedliche Einstellungskomponenten unterliegen fand in diesem Zusammenhang in der Literatur bislang noch wenig Beachtung. Jedoch differenzieren Amodio und Devine (2006) bereits zwischen affektiven und kognitiven Formen von impliziten Vorurteilen, die Verhalten unterschiedlich beeinflussen können. Des Weiteren unterscheiden Robinson und Berridge (1993) in ihrer *incentive sensitization* Theorie der Subtanzabhängigkeit zwei wesentliche Belohnungskomponenten voneinander. Ihre

überwiegend neuropsychologische Forschung legt nahe, dass die Motivation (= Wanting) eine Substanz konsumieren zu wollen nicht immer auch das Ausmaß widerspiegelt, wie stark diese Subtanz gemocht wird (= Liking) und dass Wanting und Liking unabhängig voneinander Verhalten beeinflussen können (Berridge, 1996, 2004; Berridge & Robinson, 1995, 2003; Robinson & Berridge, 1993, 2003). Darüber hinaus wird postuliert, dass liking- und wanting-bezogene Prozesse überwiegend auf automatischen Mechanismen basieren (Robinson & Berridge, 1993, p. 267) und deshalb am besten mit indirekten Verfahren der Einstellungsmessung wie dem IAT erfasst werden können. Wenngleich einige Autoren bereits versucht haben, im Suchtkontext implizite liking- und wanting-bezogene Einstellungen zu erfassen (De Houwer, Custers, & Clercq, 2006; Wiers, van Woerden, Smulders, & de Jong, 2002; Wiers, van de Luitgaarden, van den Wildenberg, & Smulders, 2005), ist noch immer unklar, wie genau diese Maße liking- und wanting-bezogene Einstellungen abbilden.

Das Ziel war es, implizite und explizite liking- und wanting-bezogene Einstellungen gegenüber bedürfnisrelevanten Reizen in Abhängigkeit des Deprivationszustandes sowie der Belohnungserwartung zu erfassen. Dieses Ziel zu verfolgen erschien vor allem vor dem Hintergrund sinnvoll, die unterschiedlichen theoretischen Annahmen spezifischer validieren zu können. Beispielsweise wäre denkbar, sowohl für den motivationalen als auch für den Ansatz dualer Einstellungen positive Evidenz zu finden, wenn gezeigt werden könnte, dass vor allem die impliziten wanting-bezogenen Einstellungen sich in Abhängigkeit unterschiedlicher Bedürfniszustände verändern, während implizite liking-bezogene Einstellungen veränderungsresistent blieben und somit eher stabile Objekt-Valenz-Repräsentationen abbilden würden. Dagegen würde der frustrative nonreward Ansatz vorhersagen, dass nur implizite liking-bezogene Einstellungen in Abhängigkeit von Nahrungsdeprivation und fehlender Belohnungserwartung negativer werden, wohingegen implizite wanting-bezogene Einstellungen weniger sensitiv sein sollten gegenüber Belohnungserwartungen. In beiden Fällen müsste man von einer Dissoziation impliziter

liking- und wanting-bezogener Einstellungen ausgehen. Einige Autoren konnten bereits zeigen, dass essensbezogenes Liking und Wanting in Abhängigkeit des Hungers dissoziieren und zwar dergestalt, dass hungrige Probanden stärkeres Wanting, gleichzeitig jedoch weniger oder gleich viel Liking berichten als satte (z.B. Drobes et al., 2001; Epstein, Truesdale, Wojcik, Paluch, & Raynor, 2003; Finlayson, King, & Blundell, 2007a; Gibson & Desmond, 1999). In Erweiterung dieser Untersuchungen, verfolgte die vorliegende Arbeit auch das Ziel, implizites essensbezogenes Liking und Wanting mit expliziten zu vergleichen. Beispielsweise konnte dadurch untersucht werden, inwieweit frustrative nonreward automatische liking- und wanting-bezogene Reaktionen auslöst, oder eher Einstellungen hervorruft, die auf einer bewussten Reflektion über die Verfügbarkeit von Essen beruhen. Beispielsweise sollte überprüft werden, ob vor dem Hintergrund der Annahme dualer Einstellungen nur die expliziten im Vergleich zu den impliziten Einstellungen in Abhängigkeit der Nahrungsdeprivation und Belohnungserwartung variieren.

Des Weiteren konnte in Humanstudien bislang auch noch nicht hinreichend geklärt werden, ob die Erwartung keine Belohnung zu erhalten (frustrative nonreward) überhaupt mit Frustration oder negativer Stimmung zusammenhängt. Um auch hierfür neue Evidenz vorbringen zu können, wurde in Abhängigkeit der unterschiedlichen Bedingungen erfasst, wie stark die Probanden negative Stimmung wie Frustration explizit empfanden.

Aufbau der Experimente

Um diese Fragen möglichst umfassend klären zu können, wurden die Probanden in den Experimenten 1-3 in einem hungrigen (15 Stunden nüchtern) oder satten (max. 1 Stunde nüchtern) Zustand untersucht. Dabei wurden nahrungsbezogenes Liking und Wanting sowohl indirekt via unterschiedlicher (personalisierter) Single-Target-IATs (ST-IAT; Wigboldus, Holland, & Van Knippenberg, 2004; see also Karpinski & Steinman, 2006) als auch direkt über Selbstberichte erhoben (z.B. „wie positiv wäre es jetzt für Sie, eine Pizza zu essen?“ bzw. „wie stark ist im Moment Ihr Bedürfnis nach einer Pizza?“). Der ST-IAT bildete dabei

eine Reaktionszeitaufgabe, bei der Probanden so schnell wie möglich antworten sollen, wie positiv (mag ich) vs. negativ (mag ich nicht) sie unterschiedlich Wörter (z.B. Krieg, Geschenk) und nahrungsbezogene Wörter (z.B. Spaghetti, Pizza) fanden. Die Variante um implizites Wanting zu erfassen beinhaltete entsprechende Antwortalternativen, die Annäherung (will ich) vs. Verweidung (will ich nicht) gegenüber dieser Stimuli implizierten. Im Experiment 1 wurden den Probanden weder Informationen über Konsummöglichkeiten gegeben, noch waren echte Nahrungsmittel Bestandteil des Experiments, so dass das Experiment per se eher eine frustrative nonreward Bedingung darstellte. Um zusätzlich Belohnungserwatung zu variieren, wurde den Probanden im Experiment 2 vor der Erfassung des Liking und des Wantings die Information gegeben, dass sie im Laufe des Versuches etwas essen vs. nicht essen dürften. Da Probanden im Experiment 2 den Zeitpunkt des möglichen Verzehrs jedoch nicht selber bestimmen durften, wurde im Experiment 3 variiert, ob die Probanden Kontrolle über ihren Verzehr hatten oder nicht. Darüber hinaus sollten die Probanden in den Experimenten 2 und 3 auch angeben, wie stark sie negative Stimmung wie Frustration oder Ärger erlebten. Experiment 4 wich in einigen Punkten vom Aufbau der ersten drei Experimente ab. Zunächst wurden drei statt zwei unterschiedliche Deprivationsstufen untersucht (satt vs. 2 Stunden nüchtern vs. 15 Stunden nüchtern). Darüber hinaus wurden nur implizite liking-bezogene Urteile erfasst in Bezug auf bedürfnisrelevante im Vergleich zu – irrelevanten Stimuli. Belohnungserwartung wurde wie im Experiment 1 ebenfalls nicht variiert.

Da speziell in Bezug auf die impliziten liking-bezogenen Antworten in den frustrative nonreward Bedingungen der verschiedenen Experimente unterschiedlich starke Effekte auftraten, wurden alle impliziten liking- sowie wanting-bezogenen Einstellungen in Abhängigkeit der Nahrungsdeprivation der frustrative nonreward Bedingungen der Experimente 1-4 gemeinsam in einer Metaanalyse zusammenfassend ausgewertet.

Kernbefunde der vorliegenden Arbeit

Dissoziation impliziter liking- und wanting-bezogener Einstellungen gegenüber bedürfnisrelevanter Stimuli in Abhängigkeit der Nahrungsdeprivation und Konsumerwartung

Experimente 1-3 konnten aufzeigen, dass hungrige Probanden ohne Konsumerwartung auf nahrungsbezogene Stimuli stärker mit Wanting nicht aber mit Liking reagierten als satte Probanden. Liking-bezogene Einstellungen unterschieden sich dabei nicht in Abhängigkeit des Bedürfniszustandes der Probanden. Hungrige Probanden mit Konsumerwartung zeigten im Experiment 2 sogar die gleichen liking- und wanting-bezogenen Einstellungen wie Probanden ohne Konsumerwartung. Sobald den Probanden jedoch eigene Kontrolle über den Konsum gegeben wurde, so verschwand diese Dissoziation (Experiment 3). In diesem Fall jedoch wurden liking- und wanting-bezogene Antworten auch nicht durch Nahrungsdeprivation moderiert, ein Ergebnis, das möglicherweise auf eine bereits eintretende Sättigung aufgrund des Konsums vor der indirekten Messung zurückzuführen sein könnte.

Diese Ergebnisse implizieren zunächst, dass wanting-bezogene Einstellungen eher durch unterschiedliche Bedürfniszustände beeinflusst werden als liking-bezogene Einstellungen, sodass das Wanting die motivationale und das Liking eher die Annahme dualer Einstellungen widerspiegelt. Aus diesem Grund scheint ein wanting-bezogenes Maß besser geeignet zu sein, um Unterschiede der Motivation in Abhängigkeit des Bedürfniszustandes zu erfassen. Wenngleich Experiment 4 zeigen konnte, dass das Liking ebenfalls sensitiv zu sein scheint für Veränderungen des Bedürfniszustandes, so führte starke Nahrungsdeprivation jedoch nicht dazu, dass hungrige Probanden negativere liking-bezogene Antworten zeigten als satte Probanden. Ein solcher Befund ist zunächst zwar nicht im Einklang mit der frustrative nonreward Annahme, lässt jedoch den Schluss zu, dass dabei möglicherweise ambivalente Einstellungen erfasst wurden (vgl. Petty, Tormala, Briñol, & Jarvis, 2006), also das gleichzeitige Vorhandensein von positiven und negativen Einstellungen gegenüber einem Objekt (Thompson, Zanna, & Griffin, 1995). Jedoch müssen ambivalente Einstellungen den

Probanden explizit nicht unbedingt zugänglich sein (z.B. Petty & Briñol, 2009). Übertragen auf die vorliegenden Untersuchungen könnte man ableiten, dass bedürfnisrelevante Reize bei hungrigen Probanden ohne Belohnungserwatung sowohl positive als auch negative Einstellungen aktivierten. Dabei würden positive Einstelllungen aus einer motivationalen Annahmen (vgl. Seibt et al., 2007) und negative Einstellungen eher aus der frustrative nonreward Annahme heraus resultieren (vgl. Drobes et al., 2001). Diese Schlussfolgerungen sind jedoch noch spekulativer Natur und bedürfen weiterer Forschung.

Keine Dissoziation expliziter liking- und wanting-bezogener Einstellungen gegenüber bedürfnisrelevanter Stimuli in Abhängigkeit der Nahrungsdeprivation und Konsumerwartung

Im Gegensatz zu den impliziten Einstellungen, dissoziierten das selbstberichtete essensbezogene Liking und Wanting nicht in Abhängigkeit der Nahrungsdeprivation und Konsumerwartung. Als wichtigsten Befund konnte gezeigt werden, dass hungrige Probanden sowohl positivere liking- als auch wanting-bezogene Einstellungen zeigten als satte Probanden, ein Befund, der im Einklang mit bisheriger Literatur steht (Cabanac, 1971; Finlayson et al., 2008; Lavy & van den Hout, 1993; Mauler et al., 2006). Basierend auf diesen Ergebnissen, die nahe legen, dass explizite Einstellungen sehr sensitiv für internale (z.B. Bedürfnisse) und externale (z.B. Belohnungserwartung) Veränderungen sind, spiegeln diese Befunde sowohl die motivationale als auch die Annahme dualer Einstellungen wider. Des Weiteren unterstützen diese Befunde auch die Annahme, dass liking- und wanting-bezogene Prozesse eine explizite und implizite Komponente haben, wobei Dissoziationen beider Prozesse eher impliziten Mechanismen zugeordnet werden (z.B. Berridge & Robinson, 1995).

Lösen Nahrungsdeprivation und fehlende Belohnungserwartung Frustration und negative Stimmung aus?

Im Widerspruch zur frustrative nonreward Annahme, führten weder Nahrungsdeprivation noch ausbleibende Belohnungserwartung dazu, dass Probanden mehr Frustration oder negative Stimmung berichteten. Stattdessen berichteten sie in allen

Bedingungen eine generell positive Stimmung. Dieses Ergebnis lässt entweder darauf schließen, dass die Manipulation von Belohnungserwartung bzw. frustrative nonreward nicht erfolgreich war (z.B. weil Nahrungsdeprivation immer noch nicht stark genug war), oder dass die Manipulation zwar effektiv war, die Probanden jedoch unfähig waren, ihren affektiven Zustand korrekt zu berichten. Im Hinblick auf Letzteres konnte bereits gezeigt werden, dass subliminal evozierter positiver oder negativer Affekt Einstellungen und Verhalten gegenüber bedürfnisrelevanten Objekten durchaus beeinflusst, ohne dass Probanden sich dessen bewusst waren bzw. darüber berichten konnten (vgl. Winkielman, Berridge, & Wilbarger, 2005). Um diese Alternativerklärung testen zu können, wäre ein Vorgehen interessant, dass den Fokus auf die indirekte Messung von affektiven Reaktionen legen würde, zum Beispiel über die Aktivierung verschiedener Gesichtsmuskeln (Hazlett, 2003; Hazlett & Hoehn-Saric, 2000).

Implizites nahrungsbezogenes Liking variiert im Vergleich zu Einstellungen gegenüber bedürfnisirrelevanten Stimuli in Abhängigkeit unterschiedlicher Deprivationsstufen

Die Ergebnisse aus Experiment 4 legen nahe, dass moderat hungrige (2 Stunden nüchtern) im Vergleich zu statten Probanden positivere implizite Einstellungen gegenüber bedürfnisrelevanten Reizen zeigten, stark deprivierte Probanden (15 Stunden nüchtern) jedoch tendenziell negativere implizite Einstellungen zeigten als moderat hungrige und satte Probanden. Dieses Muster konnte zusätzlich durch eine signifikante kurviliniare Funktion des Bedürfniszustandes zusätzlich statistisch abgesichert werden. Somit muss davon ausgegangen werden, dass auch implizites nahrungsbezogenes Liking sensitiv zu sein scheint für Veränderung des Bedürfniszustandes. Diese Sensitivität scheint im Vergleich zum impliziten nahrungsbezogenen Wanting jedoch anderen Mechanismen zugrunde zu liegen wie beispielsweise frustrative nonreward. Als ein interessanter Nebenbefund konnte zusätzlich gezeigt werden, dass bedürfnisirrelevante Reize schon bei moderatem Hunger unmittelbar negativer bewertet werden. Somit konnte der Devaluationseffekt (siehe Brendl, Markman, & Messner, 2003; Markman, Brendl, & Kim, 2007) mit indirekten Maßen repliziert werden.

Fazit und Schlussbemerkung

Vor dem Hintergrund uneinheitlicher Literatur bezüglich des Einflusses von Nahrungsdeprivation auf unmittelbare Reaktionen gegenüber bedürfnisrelevanten Reizen und bezüglich der Frage, wie veränderungsresistent implizite Einstellungen tatsächlich sind, konnte die vorliegende Arbeit interessante Befunde ermitteln. In vier Experimenten konnte gezeigt werden, dass auch implizite im Vergleich zu expliziten Einstellungen durchaus sensitiv sind für Veränderungen der Bedürfnislage, ein Befund, das mit der Annahme dualer Einstellungen nicht übereinstimmt. Des Weiteren kann aus den vorliegenden Forschungsergebnissen abgeleitet werden, dass in Zukunft noch stärker zwischen motivationsbezogenen (Wanting) und evaluationsbezogenen (Liking) impliziten Einstellungen differenziert werden muss, eine bislang noch zu wenig berücksichtigte Sichtweise. Dabei scheinen wanting-bezogene Maße geeigneter zu sein, um Unterschiede der motivationalen Lage in Abhängigkeit des Bedürfniszustandes zu erfassen, wobei liking-bezogene Maße spezifischere Prozesse abbilden könnten wie beispielsweise frustrative nonreward. Darüber hinaus sollten zukünftige Studien bei der Interpretation ihrer Ergebnisse genauer die Dauer der Deprivation als zusätzlichen Faktor berücksichtigen.

Abschließend kann in Anlehnung an Robinson & Berridge (1993) festgehalten werden, dass wir nicht immer das mögen, was wir wollen und dies sogar nicht einmal unbedingt wissen müssen.