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Observing the mind instead of acting on it: How mindfulness empowers people to live healthily

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Observing the mind instead of acting on it: How mindfulness empowers people to live healthily

Het observeren van de geest in plaats van erop te reageren:
Hoe mindfulness mensen in staat stelt om gezonder te leven
(met een samenvatting in het Nederlands)

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How mindfulness empowers people to live healthily

CHAPTER 1

Introduction and overview

The human mind is extraordinary. It allows us to imagine potential future situations, to plan for action, and to effectively navigate through complex social environments. Without it, there would be no art, no science, and no civilization. But, although the human mind offers many benefits, it also has the drawback of causing suffering. Examples of this include suicidal thoughts, phobias, and cravings to consume unhealthy substances. Furthermore, the mind heavily interacts with bodily processes in shaping behavior, such that psychosocial stress slows the healing of wounds and induces appetite (Epel, Lapidus, McEwen, & Brownell, 2001; Marucha, Kiecolt-Glaser, & Favagehi, 1998), and imagery of consumption induces salivation and unhealthy eating (e.g. Chapter 4; May, Kavanagh, & Andrade, 2015).

To counter the drawbacks of the mind, various cultures and civilizations have developed mind-tools to diminish the qualities of the mind they consider undesirable, and to foster the qualities of the mind they find desirable. One such mind-tool recently became popular in the West as an adaptation from Buddhist contemplative practices, and is called mindfulness, i.e. "awareness that arises through paying attention, on purpose, in the present moment, non-judgmentally. It's about knowing what is on your mind" (Kabat-Zinn, 1982, 1994). One recent study estimates that 8% of Americans have practiced or are currently practicing some form of mindfulness – often to decrease their suffering, and this amount is still increasing (Clarke, Black, Stussman, Barnes, & Nahin, 2015). While much research suggests that taking an 8-week or longer course on mindfulness reduces anxiety, depression, and substance use (Hofmann, Sawyer, Witt, & Oh, 2010; Oikonomou, Arvanitis, & Sokolove, 2016), less is known about how mindfulness exactly works. Is it about relaxation, about avoiding problems by focusing on the present moment, or does mindfulness work on the mind in some other way? The main aim of the present dissertation is to fill this knowledge gap by promoting a better understanding and examination of the psychological mechanism by which mindfulness works.

Background

This dissertation could have studied the mind and the mechanisms of mindfulness in any domain, with stress and negative affect being most common for mindfulness. I chose the domain of appetite and cravings for food and beverages, however, as this is an increasingly problematic and unsolved issue in society associated with the mind. Various interventions already target appetitive reactivity such as cravings and unhealthy eating, sometimes successful, but often not. Most of these interventions - albeit explicitly or implicitly - consider the mind as an entity that needs to be modulated and strengthened by external cues (e.g., providing incentives for good behavior), instructions (e.g., aimed at suppressing unwanted thoughts), or education (e.g., increasing knowledge, persuasion), in order to alter responses to foods and beverages. While these interventions take into account the importance of changing and reinforcing people's mind about their behavior, they might have overlooked an intriguing aspect of the operation of the human mind: The way the mind represents the world in which it acts when information flows in by different modalities, such as vision, hearing, and taste. The process of building representations of the environment is typical for understanding how the body turns cognition into action, and forms an important starting point in most Buddhist approaches to understanding the mind and modulating it using mindfulness.

Accordingly, in the current dissertation I aim to take two steps in examining how mindfulness might operate on appetitive reactivity. First, I focus on the role of the mind in inducing appetitive reactivity such as salivation and cravings; and second, I will scrutinize

the active component of mindfulness that can bring about changes in appetitive reactivity. If this active component of mindfulness then effectively reduces appetitive reactivity, this research would also be a step towards making this specific active component of mindfulness accessible for integration in existing interventions to reduce appetitive reactivity to foods and beverages. Before providing a detailed overview on the role of the mind and mindfulness in modulating appetitive reactivity (see Chapter 2), I first provide an overview of the field of appetite and existing interventions to facilitate a healthy diet.

The difficulty of starting and maintaining a healthy diet

People continue to consume energy-dense foods and beverages despite the fact that consuming these products leads to weight gain and other negative health outcomes (Ledikwe et al., 2006). To sketch the size of the issue, 52% of the population in Western countries is currently overweight, and 19% is obese, and the average weight is still rising (Organisation for Economic Co-operation and Development, 2015). This weight-gain and obesity is linked to a lower quality of life for the individual (Kolotkin, Meter, & Williams, 2001), and to major health care costs for society, such as for treating cardiovascular disease and diabetes (Behan et al., 2010). Therefore, it is vital to counter the consumption of energy-dense foods and beverages (Ledikwe et al., 2006).

Based on the idea that people act in a reasoned fashion – especially when it comes to health behavior (Ajzen, 1991), past interventions have largely focused on increasing people's knowledge about, for instance, a healthy diet, and on stimulating people to have the intention to eat healthily (Armitage & Conner, 2001; Cooke, Dahdah, Norman, & French, 2016). Obviously successfully, as the majority of people that are currently overweight or obese intend to live more healthily (Fagan, Diamond, Myers, & Gill, 2008). In the light of the current 'obesity epidemic' and the ever-increasing consumption of energy-dense products, however, creating good intentions does not seem to suffice (Mann et al., 2007). Indeed, good intentions might fail to produce a better food regime because they are heavily counteracted by strong habits to eat unhealthy (Aarts, Verplanken, Van Knippenberg, 1998). Moreover, in the case people do successfully act on their intentions and reduce their intake of energy-dense products in the short run, they often fail to do so in the long run: A large majority of people regains their lost weight within one year, or gains even more weight than before the diet started (Mann et al., 2007). How the consumption of fewer energy-dense foods and beverages can be facilitated is thus a major question that still requires an answer.

Changing the environment to facilitate a healthy diet.

A notable feature of energy-dense foods and beverages in Western societies is that they are widely available and cheap. Furthermore, their consumption is widely promoted

and advertised. Banning these energy-dense products and their advertisements altogether would be one effective starting point to decrease their consumption (Dhar & Baylis, 2011; Resnik, 2010). The prices of these energy-dense products could also be increased, for instance through taxation, which causes people to purchase and consume fewer of these products (Sarlio-Lähteenkorva & Winkler, 2015).

Instead of making the energy-dense products less attractive, their healthy alternatives could be made more attractive. For instance, financial incentives could be provided for consuming healthy foods and beverages, which stimulates their consumption (Benishek et al., 2014; Mantzari et al., 2015), at least for as long as the incentive structure is kept intact. The choice architecture in shops could also be adjusted to favor the healthy option (i.e. nudging; Marchiori, Adriaanse, & De Ridder, 2017), for instance by placing healthy rather than unhealthy products at the cash-register (Kroese, Marchiori, & de Ridder 2016). Alternatively, by reminding people of their health intentions in areas where energy-dense foods and beverages are available, they are more likely to follow up on these intentions (i.e. priming; Papies & Hamstra, 2010; Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014). Energy-dense products could also be offered in smaller quantities, or their healthy alternatives in larger quantities. This favors a healthy diet because people tend to consume more when more is available, without an apparent reason other than more being available (i.e. the portion size effect; Zlatevska, Dubelaar, & Holden, 2014). It is also possible to decrease the amount of food a person can eat through bodily modifications, such as gastric bypass surgery, which includes a procedure to reduce the size of the stomach. This method is highly effective at achieving weight loss among obese individuals (Cummings, Overduin, & Foster-Schubert, 2004). Thus, there are many approaches to change the 'obesogenic' environment and body in favor of a healthier diet.

Most of the interventions mentioned above rely on the method of altering the environment to assist people to behave in line with their long-term intentions to live healthily. Hence, these interventions implicitly share the assumption that people are not the masters of their own behavior, and that their mind lacks wisdom and power to change their behavior (Baumeister, Bratslavsky, Muraven, & Tice, 1998). But is that really the case? Aren't there ways to empower people to act more independently of their environment? Using insights from psychological research, the current dissertation project aimed to empower people to make the healthy choice irrespective of their environment.

Psychological processes underlying appetitive reactivity

To best empower people to live healthily, irrespective of their environment, the drivers of people's behavior must be understood. Insights from psychological research suggest that human behavior is not just driven by people's rational reflections and intentions to reach long-term outcomes, i.e. "homo economicus", but that automatic and non-conscious

processes play a vital role in driving behavior, too (Bargh & Ferguson, 2000; Evans, 2008; W. Hofmann, Friese, & Wiers, 2008; Strack & Deutsch, 2004; Stroebe, van Koningsbruggen, Papies, & Aarts, 2013). For instance, habits are better predictors of consumption than intentions (Albery, Collins, Moss, Frings, & Spada, 2015; Danner, Aarts, & de Vries, 2008). Merely seeing an attractive food can spontaneously trigger approach impulses to grab it (Papies, Barsalou, & Custers, 2012), especially when hungry (Seibt, Häfner, & Deutsch, 2007). Furthermore, the release of the hormone ghrelin increases appetite and food intake, and people have little conscious control over the release of such hormones (Wren et al., 2001). It has therefore been suggested that to empower people to live more healthily, people's automatic and non-conscious processes must be taken into account (see Marteau, Hollands, & Fletcher, 2012; Sheeran et al., 2016; Sheeran, Gollwitzer, & Bargh, 2013). In other words, to give people the opportunity to act on their conscious reflections and intentions, the impact of their automatic and non-conscious processes must first be reduced (W. Hofmann et al., 2008; Stroebe et al., 2013).

Past experiences are stored in memory as representations.

To best reduce the influence of people's automatic processes on behavior, it is vital to understand their origin. Much research on the regulation of behavior takes as premise that representations, i.e. storage structures of information about the world (Barsalou, 2008), play a key role in driving appetitive reactivity (W. Hofmann et al., 2008; Jones, Corbin, & Fromme, 2001; Papies & Barsalou, 2015; Smith, 1998; Stacy & Wiers, 2010). These representations are formed through experiences of the world (e.g. when eating crisps), during which the properties of experiences (e.g. "salty", "seeing yellow", "watching TV", "rewarding"; Papies, 2013) are stored and associated together in memory (Smith, 1998; Wyer Jr., 2007). In addition, repetition of such experiences causes the associations between properties in a representation to become increasingly entrenched in memory (Barsalou, 2008; Niedenthal, 2007). The information stored in representations can be used to motivate behavior, such that someone who represents chocolate as reducing sorrow may be motivated to eat when trying to cope with a relationship breakup. Furthermore, Sheeran and colleagues (2005) found drinking habits to automatically induce appetitive reactivity when people were cued with "socializing", but not when cued with "studying". The result was interpreted such that habits only induce appetitive reactivity to alcohol when part of an alcohol-related representation is active, such as the concept of "socializing".

While research clearly suggests that representations play an important role in inducing behavior (Wyer Jr., 2007), little is known about their contents and about how they can be measured. To better predict consumptive behaviors, and to better regulate them using mind-tools such as mindfulness, it is thus vital to obtain systematic insight

into the content of people's idiosyncratic representations about energy-dense products. We address this issue in Chapter 3, and introduce the property generation task as a tool to examine the content of people's representations of energy-dense beverages. It extends the earlier research of Papies (2013) by taking into account past experience, and by providing a coding scheme to analyze the content of people's representations in great detail.

Representations are expressed as simulations

When a situation maps onto the properties in a representation (e.g. when watching TV and seeing crisps), it activates other associated properties in the representations as simulations, i.e. the aggregate of earlier situations is cognitively "re-experienced" (e.g. "salty", "crunchy", "rewarding"; Barsalou, 2003, 2009, 2015; J. Chen, Papies, & Barsalou, 2016; Niedenthal, 2007). Thus, experiences strongly entrenched in memory are more likely to be expressed as simulation. In other words, for people who snack a lot and have become obese or overweight as a consequence, eating-related situations are especially likely to trigger simulations of consumption (May et al., 2015; Papies & Barsalou, 2015). This process of simulation is triggered automatically and occurs largely unconsciously, but can become conscious in the form of mental imagery (May, Kavanagh, & Andrade, 2015; Papies & Barsalou, 2015).

It has been suggested that simulation and mental imagery of reward are key cognitive mechanisms in driving appetitive reactivity to energy-dense products (May et al., 2015; Papies & Barsalou, 2015). In line with this suggestion, much research has demonstrated that perceiving energy-dense products triggers simulations of their consumption (Chen, Papies, & Barsalou, 2016; van der Laan, de Ridder, Viergever, & Smeets, 2011). Experiencing such simulations of consumption to cues of energy-dense products in the lab is also correlated with weight-gain over time (Stice, Yokum, Bohon, Marti, & Smolen, 2010; Stice, Yokum, Burger, Epstein, & Small, 2011).The relationship of simulation with product exposure and consumption remains unclear, however, as simulations of consumption could merely co-occur with exposure to energy-dense products and during appetitive reactivity, but simulations could also be a cause of appetitive reactivity in response to food exposure (Barsalou, 2016; Papies & Barsalou, 2015). The best way to test the role of simulation in triggering appetitive reactivity is with an objective measure of appetitive reactivity, one that is difficult to consciously control and precludes effects of social desirability. Therefore, Chapter 4 of the current dissertation examined whether simulations of consumption cause appetitive reactivity in the form of salivation.

Examining mind-tools that empower people to live healthily

Empowering people to live healthily by diminishing the processes leading to appetitive reactivity is difficult. People often have little conscious awareness of their automatic processes such as the elicitation of simulations or the release of ghrelin, and people also seem to have little conscious control over them. Even when people are consciously aware of these processes, they need to consciously decide to resist the potentially rewarding taste or good feeling that could be obtained by consuming the product. Furthermore, having a long personal history of consumption leads to the development of strong representations of consumption for energy-dense products. An important consequence of these strongly ingrained representations of consumption is that they increase the likelihood of triggering rewarding simulations and imagery about consumption. Subsequently, these simulations and imagery subsequently lead to increasingly strong appetitive reactivity such as cravings and actual consumption. For a psychological tool such as mindfulness to be effective, it thus needs to counter these automatic and non-conscious processes that have developed over one's lifetime. To best contribute to this domain with the current dissertation project, the most promising tools for interventions to empower people to live more healthily were examined first (see also van Beurden, Greaves, Smith, & Abraham, 2016).

Inhibition training

One promising line of tools to reduce the consumption of energy-dense products seems to directly work on people's consumption representations, by breaking the associative links of specific energy-dense products and the approach impulse they can induce. Often, these tools are referred to as inhibition training. During inhibition training, people are repeatedly exposed to energy-dense products, and each time inhibit their initial impulse to grab them. This might then break the associative link between the object and the subsequent automatic action. On future encounters, this should then prevent impulses from being triggered by these products, giving people the opportunity to respond reflectively. This approach consistently reduces the consumption of alcoholic beverages (Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011), but it's effectiveness remains unclear in the domain of food (Becker, Jostmann, Wiers, & Holland, 2015; Veling, Lawrence, Chen, van Koningsbruggen, & Holland, 2017). Furthermore, a drawback is that people must extensively engage in the inhibition training before entering a situation where the energy-dense product is available. It should also ideally be taken on several occasions, such as during counselling sessions or on a computer at home. Currently, researchers at Cardiff University are setting up a study with 36,000 participants to test the long-term effects of inhibition training and other cognitive control interventions ("The psychology and neurobiology of cognitive control training in humans",

ERC-2014-COG). The outcomes of this trial will be of major importance for determining whether such inhibition training is effective in reducing impulses and in facilitating a healthy diet in general.

Eye Movement Desensitization and Reprocessing (EMDR)

Another tool that effectively reduces automatic reactivity towards specific stimuli, and that is also highly effective in clinical samples is eye movement desensitization and reprocessing (EMDR). During EMDR, people move their eyes while recollecting a certain situation or object from memory. The eye movements during recollection tax working memory, and thereby decrease the vividness and richness of the recollection (van den Hout & Engelhard, 2012). Subsequently, this weaker – "disrupted" – version of the recollection is re-encoded in memory. In research on unpleasant autobiographic memories, it was found that the target object or situation triggered less reactivity after EMDR (Y.-R. Chen et al., 2014; van den Hout & Engelhard, 2012). This has been found both in healthy populations and in clinical populations, such as with people suffering from post-traumatic stress disorder (Y.-R. Chen et al., 2014; van den Hout & Engelhard, 2012). Recent research also found EMDR to reduce appetitive reactivity towards energy-dense foods compared to a control training (Littel, van den Hout, & Engelhard, 2016). While EMDR has shown these promising results after one session in the lab, it is best conducted by trained therapists, and over various sessions. It may therefore be most useful for clinical samples that frequently consume a specific product (e.g. beer), rather than for people who consume various energy-dense products in varying situations.

Implementation intentions

Rather than inhibiting automatic processes, people could also learn to use them to their advantage. A new – alternative – action could for instance be coupled to a specific situation. This approach is referred to as the formation of an implementation intention (e.g. "if I am home and crave a snack, then I will eat an apple"; Gollwitzer & Sheeran, 2006). In comparison to when only a goal intention is formed (e.g. "I want to eat fewer snacks" or "I want to eat more apples"), the implementation intention makes an alternative action more accessible in the specified situation, thereby facilitating its execution over the typical action as stored in a representation (Verhoeven, Adriaanse, de Ridder, de Vet, & Fennis, 2013). In other words, rather than inhibiting an existing automatic process, the tool works around the automatic action by executing a desired and pre-specified alternative action. The formation of an implementation intention consistently leads to the enactment of the planned behavior (Gollwitzer & Sheeran, 2006). However, it must be formed in advance, and only works to facilitate the specified action in the specified situation. Implementation intentions thus provide no benefit for situations or products that

were not part of the implementation intention. A further caveat is that forming multiple implementation intentions is less effective for reduce unhealthy snacking than forming a single implementation intention (Verhoeven et al., 2013).

In sum, inhibition training, EMDR, implementation intentions, are useful tools for empowering people to live a healthy life, but none of them can be used in the heat of temptation. Each of these tools need to be used in advance, before entering a potential consumption situation. Yet, not every consumption situation can be predicted in advance. One might spontaneously go out for drinks or dinner with colleagues, or one might encounter various kinds of snacks in the store and cafeteria, and these products may not have been targeted in the intervention. In addition to using the abovementioned tools, it is therefore useful to also consider a psychological tool that can be implemented in the heat of the moment, towards novel products, and in novel situations. In other words, to best empower people to make the healthy choice, it is best to also use tools that can be directed at the mind at any time, in any situation.

Examining mind-tools that can be applied in the heat of the moment

A range of psychological tools that can be flexibly applied in various circumstances relate to the reinterpretation of experiences. Such reinterpretation has frequently been studied as it can be flexibly applied in the heat of the moment, towards novel stimuli, and in novel situations (Etkin, Büchel, & Gross, 2015; Mischel & Baker, 1975). Here, I highlight two of the main approaches to reinterpretation. People can interpret situations from a broader why-perspective, e.g. “why did I eat that cookie?”, instead of the typical what-perspective, e.g. “I ate a cookie and it was delicious”. These why-perspectives can be used in counselling sessions to understand the contributors of undesired consumption, and to make plans to prevent this on future occasions. Adopting this why-perspective may still trigger automatic reactivity, such as an urge to eat or an impulse to grab a cookie. When also cognitively distancing oneself from these why-reinterpretations, however, this reactivity is reduced (i.e. observing it from the perspective of a fly on the wall; Kross & Ayduk, 2011; Kross, Ayduk, & Mischel, 2005). Importantly, merely adopting a self-distanced perspective does not reduce immediate reactivity towards concrete “what-experiences”, these experiences must first be reinterpreted from a broader why-perspective (Kross & Ayduk, 2011).

Another approach to the reinterpretation of experiences is applying reappraisal (Etkin et al., 2015), i.e. transforming the meaning of experiences, such as seeing marshmallows as puffy clouds. This reinterpretation makes the food seem less rewarding, thereby decreasing the role of automatic processes in favor of more reflective ones (see e.g. “hot” vs “cool” systems; Metcalfe & Mischel, 1999). Indeed, even though the application of reappraisal is highly reflective, it reduces not only reflective reactivity towards

energy dense foods (Mischel & Baker, 1975), but also automatic reactivity (W. Hofmann, Deutsch, Lancaster, & Banaji, 2009). The reappraisals must be congruent with the object or situation, however, such that reinterpreting chocolates as white and puffy clouds does not reduce appetitive reactivity (Mischel & Baker, 1975).

Applying reappraisal towards novel products and in novel situations is thus possible, but cognitively demanding, as the reappraisal must be congruent to the properties of the product or situation. This may make reappraisal a difficult strategy to adopt, as the tool must be adapted to match every product. Reappraisal may be especially difficult in the heat of the moment, when being tempted by a novel food or beverage. An open question is thus how appetitive reactivity can be reduced more broadly, in the heat of the moment, without having to adjust the psychological tool to each specific product or situation. One popular approach that may work to reduce appetitive reactivity and that is of focal interest to the current dissertation is *Mindfulness*.

Examining mindfulness as a mind-tool to empower people to live healthily

Mindfulness is defined in Merriam-Webster's dictionary as "the practice of maintaining a nonjudgmental state of heightened or complete awareness of one's thoughts, emotions, or experiences on a moment-to-moment basis" (Mindfulness, n.d.). It is increasingly popular in Western societies (Clarke et al., 2015), and mindfulness-based interventions have consistently been suggested to decrease unhealthy eating, smoking, anxiety, and depression (Baer, 2003; S. G. Hofmann, Sawyer, Witt, & Oh, 2010; Khoury, Lecomte, Gaudiano, & Paquin, 2013; Oikonomou, Arvanitis, & Sokolove, 2016). Furthermore, mindfulness is a flexible tool that can be used in various ways. For instance, when adopting a mindful perspective towards attractive foods in a training session, it reduces automatic reactivity on future encounters (Papies et al., 2012; Papies, Pronk, Keesman, & Barsalou, 2015). Mindfulness has trait-like benefits, such as increasing the ability to regulate attention (van Dillen & Papies, 2015; Jha, Krompinger, & Baime, 2007), and increasing working memory capacity (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013), both of which are associated with an increased ability to regulate the consumption of energy-dense products (van Dillen & Papies, 2015; W. Hofmann et al., 2008). In addition, a mindful perspective can in the same way be adopted towards any stimulus, and in any situation, making it relatively easy to use in the heat of the moment and towards novel stimuli, at least compared to reappraisal (Grant, Courtemanche, & Rainville, 2011; Jenkins & Tapper, 2014; Lebois et al., 2015). There also is evidence that the adoption of a mindful perspective can be habitualized, further facilitating its usage in any situation (Grant, Courtemanche, & Rainville, 2011; Shoham, Goldstein, Oren, Spivak, & Bernstein, 2017). Taken together, the flexibility and effectiveness of mindfulness make it an interesting candidate as a powerful tool to reduce appetitive reactivity, and to empower people to live more healthily.

While mindfulness has a lot of potential for empowering people to live more healthily, it has the major drawback of being time intensive. In Buddhist practices, from which mindfulness originates, contemplatives can engage in tens of thousands of hours of meditative practice and contemplative discourse (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007). When mindfulness was brought to the West as a tool to reduce chronic pain, a relatively short course was developed that takes participants 8 weeks to complete (Mindfulness-Based Stress Reduction; Kabat-Zinn, 1982, 1994). In this course, participants meditate 45 minutes per day in addition to attending 8 group meetings ("MBSR Standards of Practice," 2014). Adherence is vital, as meditative practice throughout the course is predictive of the beneficial outcomes of such mindfulness-based interventions (Creswell, Myers, Cole, & Irwin, 2009; Rosenzweig et al., 2010). Thus, an important drawback of mindfulness is that although standardized courses are comparatively brief, people may still find it difficult to adhere to their minimal requirements.

People may further be hesitant to use mindfulness because of its stigma of being 'airy-fairy' (Wiering, 2016), rather than being evidence-based. A contributor to this stigma is that mindfulness finds its origin in Buddhist contemplative practices, which may be at odds with an increasingly secular society (Chadha, 2015; Kuan, 2012; Wiering, 2016). The practice of meditation and observing thoughts or one's breathing may further be at odds of what people expect from a training to change behavior. In contrast to what is common in evidence-based therapies in the West, mindfulness also has a somewhat vague definition that does not pinpoint one specific psychological mechanism. This vague definition is further spread by the increased discussion of mindfulness in the media, often by people with limited meditation experience, leading to reports such as *mindfulness is akin to avoiding your problems* or *mindfulness fights symptoms but not causes* (Derwort, 2015; "Mindfulness has huge health potential – but McMindfulness is no panacea," 2015; Walsh, 2016). Such reports may further increase people's hesitance to use mindfulness. Thus, to improve the efficacy and usage of mindfulness, scientific research must provide clear and precise evidence on its active component with respect to reducing appetitive reactivity.

The current dissertation

In the present dissertation I took up the challenge to design a research program aimed at acquiring more detailed knowledge about the workings of mindfulness in the context of the consumption of energy-dense products as induced by cravings and other appetitive reactivity. Therefore, I first examined the content and role of representations and simulation for inducing appetitive reactivity. Then, I developed a 3-minute mindfulness training and examined if it reduces reactivity to simulations and imagery that may enter the mind in meditation-naïve participants. Afterwards, I examined whether the same

component of mindfulness is associated with reduced reactivity to stressful events and foods among highly experienced meditators. I then reviewed previous research in this domain as well as the empirical work from the current dissertation and a review on using mindfulness to reduce appetitive reactivity. Below, I outline the remaining part of this dissertation.

Part 1 continues with Chapter 2, which provides a mechanistic account of the role of the mind for inducing appetitive reactivity, and zooms in on the mechanisms of mindfulness to empower people to reduce this appetitive reactivity and consume fewer energy-dense products. To this end, previous research in this domain as well as the empirical work from the current dissertation is discussed. The chapter takes as a starting point that mindfulness-based interventions are becoming increasingly popular as a means to facilitate healthy eating. I suggest that especially the decentering component of mindfulness, which is the metacognitive insight that all experiences are impermanent, plays an important role in such interventions. To facilitate the application of decentering, I address its psychological mechanism to reduce reactivity to food cues, proposing that it makes thoughts and simulations in response to food cues less compelling. Therefore, I summarize experimental and correlational studies - including the ones reported in the current dissertation. These studies consistently find that the adoption of a decentering perspective reduces subjective cravings, physiological reactivity such as salivation, and also the consumption of energy-dense foods. I conclude the chapter with a discussion of applications and challenges for future research. In sum, I suggest that the decentering perspective can be adopted in any situation to reduce reactivity to food cues. Considering people's high exposure to food temptations in daily life, this makes it a powerful tool to empower people to maintain a healthy diet.

Part 2 of this dissertation continues with the empirical research that was conducted. Chapter 3 examines the content of people's minds, and specifically focuses on representations of energy-dense beverages. As a starting point, it takes the fact that previous research suggests that people's representations of alcoholic beverages play an important role in drinking behavior. However, relatively little is known about the content of these representations, and they are therefore rarely taken into account in research. Here, I introduce the property generation task as a tool to explore them. In a laboratory study (N = 110), and a field study (N = 56), participants listed typical properties of alcoholic beverages, sugary beverages, and water. Each of these properties was then categorized using a previously developed coding scheme. For example, the property "sweet" was categorized as referring to "taste", which falls under "sensory experience", which falls under "consumption situation". Afterwards, participants completed measures of drinking behavior and alcohol craving. Alcoholic beverages were strongly represented in terms of consumption situations, with 57% and 69% of properties relating to

consumption in the laboratory and the bar study, respectively. Specifically, alcoholic beverages were more strongly represented in terms of the *social context* of consumption (e.g., "with friends") than the other beverages. In addition, alcoholic beverages were strongly represented in terms of *sensory experiences* (e.g. "sweet") and *positive outcomes* (e.g. "creates fun"), as were the sugary beverages and water. In Study 1, the extent to which alcoholic beverages were represented in terms of social context was positively associated with craving and regularly consuming alcohol. The property generation task provides a useful tool to access people's idiosyncratic representations of alcoholic beverages. This may further our understanding of drinking behavior, and help to tailor research and interventions to reduce drinking of alcoholic and other high-calorie beverages.

Chapter 4 examines the role of the mind for inducing appetitive reactivity, more specifically, it examined whether simulations induce salivation to food cues. It takes as starting point that salivation to food cues is typically explained in terms of mere stimulus-response links, without a clear role for the mind. However, food cues seem to especially increase salivation when food is attractive, suggesting a role of the mind for inducing salivation to food cues. I suggest that perceiving a food triggers simulations of consuming it, especially when attractive. These simulations then induce salivation, which effectively prepares the body for eating the food. In two experiments, I systematically examined the effect of simulations on salivation to food cues. As stimuli, both experiments used an attractive, a neutral, and a sour food, as well as a non-food control object. In Experiment 1, participants were instructed to simulate eating every object they would be exposed to, and were then exposed to each of the objects. Salivation was assessed by having participants spit their saliva into a cup after one minute of exposure. In Experiment 2, I instructed half of participants to simulate eating each object, and half to merely look at them, while measuring salivation as in Experiment 1. As predicted, foods increased salivation compared to the non-food control object, especially when they were attractive or sour (Exp. 1 and 2). Importantly, attractive and sour foods especially increased salivation when participants were instructed to simulate consumption (Exp. 2). These findings suggest that consumption simulations play an important role in inducing salivary responses to food cues. I discuss directions for future research as well as the role of simulations for other appetitive processes.

Chapter 5 examines the role of the decentering component of mindfulness, i.e. the insight that thoughts are impermanent rather than permanent or reflecting an objective reality, for reducing reactivity to mental imagery of unpleasant past experiences and of attractive yet unhealthy foods. To do so, meditation-naïve participants were briefly instructed on how to engage in decentering. Participants then imagined an unpleasant autobiographical event (Experiment 1 and replication experiment) or imagined an

attractive yet unhealthy food (Experiment 2). When participants were also instructed to engage in decentering, the unpleasant imagery elicited less negative affect, and the rewarding imagery elicited fewer cravings to eat. Moving to an objective measure of appetitive reactivity, I assessed participants' salivation to food exposure (Experiment 3). I further assessed whether participants mentally imagined consuming the food. There was no difference in imagery of consumption between decentering and control participants. However, less salivation was elicited in decentering relative to control participants. Thus, in these meditation-naïve samples, decentering reduced reactivity even when unpleasant or rewarding imagery was kept active in mind (Experiment 1, its replication, and Experiment 2), and decentering participants did not have reduced imagery (Experiment 3). Rather than changing people's automatic processes, it thus seems that decentering reduced the effect of people's automatic processes.

Overall, this research supports the use of decentering as a tool to reduce reactivity from both unpleasant and rewarding mental imagery. Decentering thereby might provide a useful complement to existing lifestyle interventions. Chapter 6 examines whether, among meditators, the decentering component of mindfulness underlies the beneficial effects of meditation on resilience to stressful events and on food cravings. Much research already shows that extensive meditative practice increases resilience to unpleasant experiences, and reduces cravings for pleasant experiences, such as eating high-calorie food. I suggest that the psychological component underlying beneficial effects of meditation is decentering, which is defined as a metacognitive insight into one's experiences as impermanent mental events rather than as necessarily accurate reflections of reality. This study recruited experienced meditators (N = 86) to investigate the role of decentering in the effects of meditation. Participants reported lifetime meditation experience, decentering and awareness of thoughts, resilience to unpleasant experiences, and trait food cravings. Regression analyses showed that meditation experience was associated with increased resilience to unpleasant experiences, and with decreased food cravings. Importantly, these effects were mediated by adopting a decentering perspective. There was no evidence that awareness of thoughts mediated these effects. These results suggest that adopting a decentering perspective provides important benefits to meditators' health and well-being.

Reading guide

The remaining part of this dissertation provides a more detailed account of the issues addressed in the introduction part, and the empirical work briefly summarized above. As a note: Chapter 2-6 were written as a separate articles for scientific journals, thereby creating some overlap in content across the chapters. All chapters can thus be read separately and on their own.

Overall, the work conducted and reviewed for this dissertation suggests that simulations and imagery play a key role in inducing appetitive reactivity. Furthermore, the decentering component of mindfulness seems key in making these simulations and imagery less compelling, thereby reducing the extent to which they induce reactivity such as salivation and cravings to eat. By reducing appetitive reactivity to energy-dense products, decentering offers people a window of opportunity to act in line with their conscious reflections and intentions, such as that of eating healthily. This decentering can be taught to meditation-naïve people within 3 to 15 minutes, and people can then engage in decentering towards novel stimuli. By providing an account of how decentering works to reduce appetitive reactivity, and by providing a brief decentering training, the current dissertation makes this active component of mindfulness accessible to researchers, and to psychologists who wish to complement existing lifestyle interventions with decentering. In sum, the research of this dissertation highlights the working mechanism and potential application of decentering as a mind-tool to empower people to live healthily in a world full of temptations.

CHAPTER 2

Theoretical background and discussion

Mindfulness reduces reactivity to food cues: Underlying mechanisms and applications in daily life

This chapter is based on:

Keesman, M., Aarts, H., Häfner, M., & Papies, E. K. (2017). Mindfulness Reduces Reactivity to Food Cues: Underlying Mechanisms and Applications in Daily Life. *Current Addiction Reports*, 4(2), 151–157. http://doi.org/10.1007/s40429-017-0134-2

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All authors approved the final version.

Introduction and theoretical background

In the history of mankind many great discoveries and achievements have been attributed to the existence and workings of the human mind. Despite the amazing capacity to realize discoveries and innovative solutions to deal with major challenges and threats, the mind can sometimes impede desirable behavior, such as is the case of maintaining a healthy diet. People's 'obesogenic' environment seems to trigger psychological processes leading to unhealthy eating (Mann et al., 2007). This impediment is especially striking considering the fact that even when people have the intention to eat healthily, they often fail to do so (Fagan, Diamond, Myers, & Gill, 2008). Existing psychological tools show some promise in increasing healthy eating despite these influences (van Beurden, Greaves, Smith, & Abraham, 2016). However, they often require changes to be made in the environment, rely on extensive training, work only on specific foods, in specific situations, or are cognitively demanding (van Beurden et al., 2016). Here, I discuss the role of the mind for triggering the motivation to eat, focusing especially on the process of simulation. Then, I discuss how mindfulness can work as a tool to facilitate healthy eating behavior in a way that may suffer much less from the limitations of other interventions, along with discussing evidence for its effectiveness, implications, and challenges for further research.

The key interest here is *mindfulness*, which has been suggested to consist of two main components (Bishop, Lau, Shapiro, Carlson, Andersion & Carmody, 2004). The first component is well known in the literature as the regulation of attention to focus and maintain awareness on a stimulus (Bishop et al., 2004). The second component is the meta-cognitive insight that all experiences are impermanent in nature, rather than them being permanent or reflecting an objective reality (Bishop et al., 2004; Dreyfus, 2011; Teasdale & Chaskalson, 2011). This particular quality of attention is often referred to as decentering. Psychological research has frequently focused on decentering as a means to reduce negative affect, such as focusing on the treatment of depression or anxiety, and the construct is also known as 'cognitive defusion' or as 'teflon mind' (for a review in this domain, see Bernstein, Hadash, Lichtash, Tanay, Shepherd, & Fresco, 2015). However, adopting this decentering perspective may play a key role in reducing reactivity to both aversive *and* rewarding stimuli alike (Desbordes et al., 2015; Hadash, Segev, Tanay, Goldstein, & Bernstein, 2016; Ostafin, 2015). While much recent research shows that multi-component mindfulness-based interventions decrease unhealthy eating (Kristeller & Wolever, 2010; Alberts, Thewissen, & Raes, 2012; Baer, Fisher, & Huss, 2005), I suggest that specifically the decentering component of mindfulness plays a key role in contributing to these effects. To make optimal use of a psychological intervention such as mindfulness, and decentering more specifically, it is vital to understand how it works (Bonell, Fletcher, Morton, Lorenc, & Moore, 2012). Therefore, the current chapter

first addresses the role of the mind in inducing unhealthy eating behavior, for example by inducing cravings and other motivational processes to food cues, and then discusses the mechanisms through which decentering can reduce such reactivity. Next, I summarize empirical evidence of the effects of decentering on food cravings and food intake. Finally, I discuss how decentering can best be applied to empower people to maintain healthy eating behavior in a world full of temptations, and address some challenges for both research and applications.

The role of simulation in reactivity to food cues

To best explain how decentering reduces reactivity to food cues, I need to first outline the mechanism underlying this reactivity. Here, I build on the grounded cognition theory of desire (Papies & Barsalou, 2015), and suggest that the properties of experience are associated and stored together in memory as representations (Barsalou, 2008; Wyer Jr., 2007; Smith, 1998). Considering the key role that these earlier experiences stored as representations play in driving behavior (Barsalou, 2008; 2016; Wyer Jr., 2007; Smith, 1998), comparatively little research has examined their content with respect to consumptive products. This may in part be because it is difficult to do so, as there is no standardized psychological method to measure and analyze such representations.

To provide insight into people's representations of energy-dense products, I adapted the property generation task as used in the cognitive sciences (McRae, Cree, Seidenberg, & McNorgan, 2005; for earlier work in this domain, see also Papies, 2013). In this task, participants are asked to list the properties of objects presented to them (McRae et al., 2005; Papies, 2013). As these properties emerge from people's representations, they give insight into the content of those representations (Santos, Chaigneau, Simmons, & Barsalou, 2011). I conducted two studies using this task (see Chapter 3), and found that energy-dense beverages were strongly represented in terms of the sensory properties of consumption, such as taste and texture (e.g. "sweet", "fizzy"), and the hedonic consequences of consumption (e.g. "delicious"), especially when these beverages were frequently consumed. Furthermore, alcoholic relative to non-alcoholic beverages were strongly represented in terms of the social context of their consumption (e.g. "with friends"), but only for alcoholic beverages that the participants frequently consumed. These findings thus show how the content of people's representations of energy-dense products can be examined. Importantly, and in line with the grounded cognition theory of desire (Papies & Barsalou, 2015), further analyses revealed that people represented energy-dense products such as alcoholic beverages in terms of their consumption, especially when they frequently consumed these products. Getting more insight into the content of people's representations is important, as these representations may underlie much of people's motivations and behaviors to consume energy-dense products

(Chapter 3 discusses this in greater detail).

Perceiving cues of attractive food triggers simulations ("re-experiences") of earlier consumption experiences as stored in people's representations. These simulations can then lead to craving and to motivated behavior, such as choosing and grabbing the food, and physiological responses preparing the body to eat (Papies & Barsalou, 2015). In other words, simulations can be conceived of as predictions of upcoming situations that are based on earlier experiences and the likelihood of their recurrence (Barsalou, 2016, Clark, 2013). While this process of simulation can occur unconsciously, it can reach consciousness in the form of imagery, for instance by explicitly directing attention to the simulations (Kavanagh, Andrade, & May, 2005; Papies & Barsalou, 2015). A recent review of fMRI experiments indeed shows that merely seeing a food picture or food word triggers simulations of consumption, such that the brain's core eating network (involving brain areas that process information such as taste and reward) becomes active (Chen, Papies, & Barsalou, 2016). This is especially the case when the food is rewarding, such as when it is energy-dense, or when the participant is hungry. Behavioral studies similarly show that exposure to a rewarding food, in comparison to a neutral food or a non-food object, elicits increased simulations of consumption, such that participants spontaneously think about the taste, hedonic enjoyment, and context of eating the food (Papies, 2013; see also Chapter 3 and 4). In addition, fMRI research on humans shows that the extent to which food cues elicit rewarding simulations predicts food consumption and weight-gain over time (Stice, Yokum, Bohon, Marti, & Smolen, 2010; Stice, Yokum, Burger, Epstein, & Small, 2011). Overall, this research provides evidence for the notion that food cues trigger simulations of consumption, which motivate eating behavior.

Cues of rewarding foods, relative to neutral foods, have also been found to induce bodily preparations to eat, such as approach impulses to grab food (Papies, Barsalou, & Custers, 2012), salivation (Buzalaf, Hannas, & Kato, 2012; Kaplan & Baum, 1993), and the release of the hormone ghrelin, which aids digestion in the stomach and enhances appetite (Schmid, Held, Ising, Uhr, Weikel, & Steiger, 2005; Wren et al., 2010). These bodily processes are difficult to consciously control, and they are often argued to occur automatically. Salivation to food cues, for instance, is typically explained as a direct stimulus-response link, not requiring a psychological process to operate (Jansen, Houben, & Roefs, 2015; Spence, 2011). Following the grounded cognition theory of desire (Barsalou, 2016; Papies & Barsalou, 2015), however, I suggest that simulations of consumption play an important role in inducing all forms of appetitive reactivity, especially for rewarding food.

In Chapter 4, I tested the hypothesis of whether the mind – in the form of simulations of consumption – plays a role in causing salivation. Two experiments found that when participants were exposed to a food compared to a non-food object, they reported

increased simulations of consumption, and salivated more, especially when the food was rewarding. Furthermore, participants who were instructed to simulate consumption, compared to participants who were merely exposed to these foods, had increased salivary responses. This was especially the case when the food was rewarding. In line with suggestions from the grounded cognition theory of desire, these findings show that simulations of consumption indeed cause bodily preparations to eat, at least in the form of salivation to food cues. This may be a somewhat surprising result, as explanations of how food cues lead to salivation often relate to an automatic and direct stimulus-response link (Jansen, 1998; Spence, 2011). Furthermore, because salivation is difficult to consciously control, it is often regarded as an objective measure of appetitive reactivity, precluding effects of social desirability and making the findings especially strong. The findings thus provide strong evidence for the notion that the mind plays a key role in inducing appetitive reactivity (Chapter 4 discusses this in greater detail).

The conscious and vivid elaboration of these simulations, which I refer to as immersion (Papies, Pronk, Keesman, & Barsalou, 2015), might further increase the extent to which simulations induce appetitive reactivity such as salivation and eating behavior (Kavanagh, Andrade, & May, 2005). People can get fully absorbed in a simulation, instead of being aware of the present moment of the actual world. They might for instance think of the hedonic enjoyment of the potential eating experience, and how good eating the salty and crunchy chips would make them feel (Papies, 2013). A recent review of fMRI studies shows that activity in the neural network implicated in creating the experience of immersion is predictive of subjective cravings (e.g. including the posterior cingulate cortex; Brewer, Garrison, & Whitfield-Gabrieli, 2013). Furthermore, people with lesions in this neural network are better at resisting temptations (Brewer et al., 2013). Again, this suggests that rewarding simulations of consumption play a key role in increasing the likelihood of consumption, especially when people get immersed in these simulations.

Decentering targets the simulations that induce reactivity to food cues

As simulations play an important role in inducing reactivity to food cues, it is important to specifically target these simulations to decrease the likelihood of unhealthy eating. I suggest that decentering can be a useful tool to do so. When adopting the perspective of decentering, all experiences such as simulations and imagery are conceived of as impermanent states of one's own mind, rather than as permanent states of the world, making them less compelling. Furthermore, by observing these experiences as events that arise and dissipate again, elaboration and immersion in these experiences are reduced (Lebois et al., 2015). As an example, consider having just come home from a long day of work, sitting on the couch, and watching TV. If you often eat chips in such a situation, this may trigger simulations of consumption, for instance consisting of the taste of chips,

grabbing them, and the hedonic enjoyment of eating. This process may then induce all sorts of reactivity, such as conscious imagery of consumption and cravings to eat chips. Being immersed in these experiences and continuing to elaborate on them, such as on the potentially good feeling of eating the chips, further increases this reactivity (Brewer et al., 2013; Kavanagh et al., 2005), such that you may find yourself wandering to the kitchen in search of a bag of chips. Conversely, when adopting the perspective of decentering towards these experiences, you observe them as no more than impermanent mental events, making them less vivid and compelling. Thus, any imagery or simulations such as about the taste and texture of the food, the pleasure of eating, and the rewarding feeling of satiation are observed as mere passing mental events. As a result, elaboration and immersion are not precipitated, and consumption and reward simulations become less compelling to act on. In this way, decentering can work to prevent cravings, bodily preparations to eat, and actual consumption.

Recent research provides important evidence for the notion that decentering reduces reactivity through decreased immersion and elaboration, albeit in domains other than food and eating behavior. In an fMRI experiment on craving for cigarettes, for instance, participants who adopted a decentering perspective had reduced activity in the neural network corresponding to craving, compared to control participants (Westbrook, Creswell, Tabibnia, Julson, Kober, & Tindle, 2013). Importantly, functional connectivity between prefrontal and craving-related areas was not increased, suggesting the absence of top-down regulation. Instead, several fMRI experiments show that the adoption of a decentering perspective leads to reduced activity in the neural network corresponding to immersion (Brewer, Elwafi, & Davis, 2013; Brewer & Garrison, 2014; Lebois et al., 2015; Tang, Tang, & Posner, 2013). In addition, an fMRI experiment on pain processing provides an excellent example of how reduced reactivity to pain is achieved through decentering (Grant, Courtemanche, & Rainville, 2011). Zen meditators, whose mindset is heavily focused on adopting a decentering perspective (Suzuki, 2010), had reduced reactivity to painful heat stimulations compared to non-mediators, even though they showed increased activity in the neural network corresponding to sensory and pain processing. A decoupling of this network from prefrontal areas, however, was associated with the reduced reactivity to the painful stimulation. In other words, these results suggest that decentering does not lead to extensive top-down downregulation of experiences, but rather works to reduce reactivity by decreasing cognitive elaboration on and immersion in experiences.

Decentering reduces reactivity to cues of food and unpleasant events

Decentering may be an especially effective tool for reducing reactivity to food cues because it targets its underlying mechanism, namely vivid and compelling consumption and reward simulations. Indeed, several lines of evidence have recently shown that

decentering inductions among non-meditators can affect responses to food cues (Jenkins & Tapper, 2014; LaCaille, Ly, Zacchia, Bourkas, Glaser, & Knäuper, 2014; Papies et al., 2012). Such decentering inductions for non-meditators typically take anywhere from 3 to 15 minutes, and focus on the insight that experiences are merely impermanent events that arise and dissipate again. They also often include a metaphor to portray how this might work, such as looking at a flowing river rather than being carried away by it, or being the driver of a 'mindbus' with thoughts as the passengers that hop on and after some time hop off again. In carefully designed experiments, participants are then instructed to adopt this decentering perspective or a control perspective towards any experience that a food cue might elicit.

In one line of studies (Papies et al., 2012; 2015), participants were instructed to adopt a decentering or control perspective to any thoughts and experiences elicited by images of energy-dense snacks. The control perspective consisted of instructions to immerse oneself fully in the presented images, of instructions to view the images in a very relaxed manner, or control participants received no intervention at all. Adopting a decentering perspective to the experiences elicited by the images was expected to make them less compelling, and thus decrease the reward expected from them. This less rewarding experienced would then be re-encoded in people's representation of the snack. Future encounters with these snacks should then elicit less reactivity as a consequence. Indeed, in three experiments, subsequent exposure to images of energy-dense snacks no longer elicited approach impulses in participants in the decentering condition, whereas participants in the control condition still exhibited them (Papies et al., 2012). In addition, decentering also reduced hypothetical unhealthy food choices in a laboratory task, experienced cravings, and actual unhealthy food choices in a buffet setting (Papies et al., 2015). In the buffet setting, decentering participants chose to eat fewer unhealthy snacks and more salads than control participants, and their entire lunch consisted of fewer calories (Papies et al., 2015). These experiments thus show that practicing decentering towards images of energy-dense foods can effectively reduce reactivity to subsequent encounters of these foods, such that approach impulses, cravings, and unhealthy food choices are less likely to ensue.

Decentering can also be adopted in the heat of the moment, such as in a situation where one is tempted to eat. In several recent experiments, for instance, participants were instructed to adopt a decentering perspective towards any of their food-related thoughts, or to adopt a control perspective. When decentering participants were then reminded of an energy-dense snack, or when an attractive snack was put in front of them, they reported reduced cravings (Lacaille et al., 2014). Another set of studies has demonstrated further effects of decentering on actual eating behavior outside the laboratory, such as reducing chocolate consumption in participants' natural environment,

over a period of 5 and 7 days (respectively, Jenkins & Tapper, 2014; Moffitt, Brinkworth, Noakes, & Mohr, 2012). In sum, these experiments show that a decentering perspective can successfully be adopted towards food temptations, which then reduces reactivity and actual consumption.

My recent research provides further insight into the beneficial effects of decentering (Chapter 5). Moreover, it examined if decentering works to reduce reactivity such as cravings and bodily preparations to consume even when imagery is kept active in mind, thus precluding that decentering works through suppression or distraction. In three experiments, each consisting of two phases, participants imagined an attractive food or unpleasant event in one phase, and imagined the same in another phase where they also engaged in decentering. When instructed to engage in decentering during imagery, participants experienced reduced cravings to consume the food, and experienced reduced negative affect (i.e. a potential source of unhealthy eating; Epel, Lapidus, McEwen, & Brownell, 2001). Thus, even when the content of the rewarding or unpleasant imagery for an individual was the same in both phases, decentering still reduced reactivity. This work was extended with an experiment that also assessed the amount of imagery about consumption. There, participants were just exposed to an attractive food, or they were instructed to also engage in decentering. Exposure and decentering participants reported to experience a similar amount of rewarding imagery of consumption, however, decentering participants experienced reduced salivation compared to exposure participants. The findings thus suggest that decentering works to reduce appetitive reactivity even when rewarding imagery of consumption is kept active in mind (Chapter 5 discusses this in greater detail).

As most skills improve with extended practice (Campitelli & Gobet, 2011; Hambrick, Oswwald, Altmann, Meinz, Gobet, & Campitelli, 2014), the skill of adopting a decentering perspective should also be enhanced by adopting it repeatedly. A recent experience sampling study indeed found that repeated practice of mindfulness meditation by a meditation naïve sample led to increased adoption of decentering in daily life (Shoham, Goldstein, Oren, Spivak, & Bernstein, 2017). Furthermore, in one of my recent studies, the amount of meditation practice – which typically includes elements of decentering – predicted the adoption of a decentering perspective in daily life among meditators. Importantly, the extent to which these meditators adopted a decentering perspective towards their thoughts in turn predicted decreased food cravings in daily life, as well as increased resilience to stressful events (with stress being a potential source for eating unhealthy; Epel, Lapidus, McEwen, & Brownell, 2001). Mere awareness of these thoughts, however, did not predict reduced cravings or increased resilience (Chapter 6; for similar findings, see Papies, van Winckel, & Keesman, 2016). Overall, extended practice of adopting a decentering perspective may facilitate its adoption in daily life, which may then reduce the

reactivity to food cues that one encounters throughout the day (Chapter 6 discusses this in greater detail).

Discussion and conclusion

Summary of findings

In sum, the research discussed in the current chapter provides support for the notion that upon exposure to an energy-dense product, people's earlier experiences as stored in representations are simulated, which can become conscious in one's mind as mental imagery. To the extent that the simulations or imagery is rewarding and involves consumption, this induces appetitive reactivity, such as cravings, salivation, and approach impulses. This appetitive reactivity may then hinder the regulation of behavior, such that it is not in line with one's intentions or conscious reflections to live healthily. Adopting a decentering perspective makes the elicited imagery less compelling, and thereby reduces appetitive reactivity. The evidence for this can be found on various measures, ranging from self-reported cravings to more objective measures such as salivation and actual food choices. Moreover, even a brief decentering instruction can empower people to refrain from consuming an energy-dense snack.

Benefits of using decentering as a mind-tool to reduce reactivity to food cues

Decentering targets the psychological process of simulation that underlies reactivity to food cues. I suggest that this approach to preventing food cue reactivity has many benefits over perhaps more traditional approaches to facilitating healthy eating. One important benefit is that by targeting consumption simulations, decentering may prevent potent cravings from arising in the first place. In addition, adopting a decentering perspective before a craving has fully developed may be less cognitively demanding than coping with a full-blown craving, especially when in a situation where tempting foods are highly accessible and eating and reward simulations can easily be elaborated on. Furthermore, targeting consumption simulations diminishes not only cravings, but also other reactivity that may facilitate consumption, such as approach impulses. A further benefit is that in situations in which a health goal may not be at the forefront of one's mind, a decentering perspective would still help to reduce the risk of unhealthy intake. This is important as food temptations are present in many such daily situations, for example when going out with others, when passing the candy bowl in the office, or when returning home after a long day at work. Previous interventions have been shown to effectively activate health goals in situations where eating decision are made, such as in a supermarket (Papies, 2016; Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014). As food reactivity may work to subsequently overpower and inhibit these health goals (Stroebe, van Koningsbruggen, Papies, & Aarts, 2013), decentering may work well to complement

such interventions. In sum, I suggest that decentering can be a powerful tool to facilitate a lifestyle of healthy eating precisely because it targets the simulations and imagery that underlie appetitive reactivity to the obesogenic environment.

Another benefit of decentering is its broad applicability. As all experiences are impermanent in nature, decentering can be applied to any experience, and in any situation – as long as one remembers to do so (Papies, 2017). Moreover, the benefits of decentering in daily life have been found to materialize in multiple domains. Among meditators, for instance, adopting a decentering perspective was associated with both reduced food cravings and increased resilience to stressful events (Chapter 6). Decentering has also been found to underlie the effects of mindfulness trainings to reduce depression and anxiety (Fresco et al., 2007; Hoge, Bui, Goetter, Robinaugh, Ojserkis, & Freco, 2014). As a result, decentering could potentially not only counter cravings from food cues, such as in the supermarket or from food advertisements, but may also counter cravings stemming from stressors (Epel et al., 2001), such as a heavy workload. Decentering has also been shown to reduce cravings for other substances, such as for alcohol and cigarettes, helping to maintain an overall healthy lifestyle (Westbrook et al., 2013; Bowen & Marlatt, 2009; Ostafin, Bauer, & Myxter, 2012; Papies, 2017). Thus, decentering can be broadly applied to reduce reactivity in various circumstances, towards various rewarding and aversive stimuli, and may therefore help people to attain better health outcomes.

Decentering can also be applied in different forms. For instance, during counseling sessions, decentering might be applied towards energy-dense foods, or their images (Hölzel et al., 2011), potentially making their representation less rewarding. As a result of this approach, future encounters with this food may lead to reduced reactivity, making it easier not to eat it. People with strong habits of unhealthy eating and people who are obese might especially benefit from applying decentering in such controlled settings, as they often exhibit particularly strong reactivity to food cues that make it difficult for them to reduce reactivity in the heat of temptation (Jansen, Houben, & Roefs, 2015). For others, however, it might be especially useful to adopt a decentering perspective towards the experiences that are elicited by food cues in the heat of the moment, in daily life (e.g. Jenkins & Tapper, 2014). Possibly, being taught the perspective of decentering and realizing the impermanent nature of one's food-related thoughts, may allow one to adopt this stance independently and without further instruction in any tempting situation. Decentering could thereby empower people to eat healthily despite food temptations in the environment. This option may require significant cognitive capacity at first, because it may be effortful or difficult to apply and maintain this perspective. Repeated practice, however, would make it less effortful on future occasions as extended practice leads to increasingly automated execution (Anders Ericsson, 2008). Indeed, evidence so far suggests that repeated meditative practice facilitates the adoption of a decentering

perspective in daily life, with beneficial consequences for health behavior (Shoham et al., 2017; Chapter 6).

Applications and challenges for future research

The mind plays a key role in eliciting appetitive reactivity through simulating representations as stored in memory. Therefore, it is vital to get insight into the content of people's representations, which can then be precisely targeted with mind-tools such as decentering. In Chapter 3, I introduced the property generation task to provide a first insight into the content of people's representations of alcohol and other energy-dense beverages. It would be interesting to extend this research to find out how representations of alcoholic beverages compare between members from the general population and subpopulations, such as those who are addicted to alcohol. In other domains of consumption, there is just one study providing preliminary insight into the representations of attractive and neutral foods (Papies, 2013). That study did not take into account past experience, however, and used a less elaborate coding scheme. It would therefore be interesting to examine people's representations of food in more detail, using the methods from the current Chapter 3. While the property generation task is an interesting and vital method for this purpose (McRae et al., 2005; Santos, Chaigneau, Simmons, & Barsalou, 2011; Wu & Barsalou, 2009), it has the limitation of relying on language. As some relevant properties of consumption are difficult to express in words, such as odor, it would be worthwhile to also use other methods to examine representations of consumptive products (e.g. relying on sensory processing measures, see also Dotsch & Todorov, 2012).

The simulations and imagery that enter the mind, and subsequently influence behavior, are highly reliant on someone's representations. As such, it may seem obvious to take into account individual differences in representations in research and practice (e.g. Barsalou, 2016; Papies & Barsalou, 2015; see also Chapter 3). But, this is rarely done. Even when a research paradigm relies on activating representations, it is rarely tailored to the individual (for examples, see Hill & Paynter, 1992; Papies et al., 2014; Sheeran et al., 2005; Stein, Goldman, & Del Boca, 2000). It may therefore come as no surprise that this type of research – referred to as "social priming" – has recently been called into question, with priming effects being regarded as unreliable and difficult to replicate (for a review on this issue, see Cesario, 2014). This potential issue could be overcome by using the property generation task. The properties of a participant's specific representation could first be assessed. Then, this information could be used to tailor the paradigm to him or her. This could then increase likelihood of actually activating an existing representation, consequently increasing the likelihood of finding the expected effect. The insights from grounded cognition as discussed in the current work thus suggest that

research on the psychological processes underlying behavior should take into account individual differences, such as by using the property generation task. This then aids the application of intervention tools such as decentering, as these target these idiosyncratic processes such as an individuals' representations and simulations. In other words, it is vital to correctly establish the psychological processes underlying consumption to best empower people to behave in line with their long-term intentions to live healthily.

One mind-tool that seems to have great potential for reducing appetitive reactivity to food cues and simulations of consumption is decentering. Research in this area is still relatively limited, however, especially considering the vast literature on mindfulness more generally (for reviews, see Creswell, 2017; Hölzel et al., 2011; Tang, Hölzel, & Pasner, 2015. Indeed, although decentering is considered key in reducing reactivity in Buddhist contemplative traditions (Bodhi, 2011; Dreyfus, 2011; Grabovac, Lau, & Willett, 2011; Teasdale & Chaskalson, 2011), it is given comparatively little attention in the Western mindfulness literature, which puts a stronger focus on the attention regulation component of mindfulness (for reviews, see Creswell, 2017; van Dillen & Papies, 2015; Hölzel et al., 2011; Malinowski, 2013; Tang, Hölzel, & Posner, 2015; Tapper, 2017). To the extent that decentering is examined, this is primarily done in relation to reducing negative affective reactivity, in correlational research, and as part of larger meditation or mindfulness-based interventions (Fresco et al., 2007; Hoge et al., 2014; Lau et al., 2006; Shoham et al, 2017; for a review see Bernstein et al., 2015). Therefore, few conclusions can be drawn about decentering in isolation of other mindfulness components, about the causal relationship between decentering and reactivity, and in the domain of appetite.

It has also been suggested that participants in mindfulness interventions score higher on questionnaires related to mindfulness because they know what the "right" answer should be, whereas control participants do not (for a discussion, see e.g. Grossman, 2011; Grossman & Van Dam, 2011). Results on mindfulness questionnaires might thus reflect whether participants attended their 8-week mindfulness course rather than whether participants actually engage in decentering in daily life, calling the validity of these measures into question. The current dissertation adds to this field of mindfulness by showing that decentering can be experimentally induced, and in separation from larger mindfulness-based interventions or meditation. This approach thereby reduces reliance on questionnaires, and on active meditators, and allows research to draw causal conclusions about how specific components of mindfulness, such as decentering, really work.

So far, there has been little empirical research on the mechanism by which decentering works to reduce appetitive reactivity. There is some evidence suggesting that a general mindfulness perspective works to reduce appetitive reactivity by reducing mental imagery and simulations altogether (May, Andrade, Batey, Berry, & Kavanagh, 2010; Ostafin, Kassman, & Wessel, 2013), because it taxes working memory (van den

Hout et al., 2011). In addition, the same has been suggested for the decentering component of mindfulness more specifically (Tapper, 2017). Recent results using a brief decentering training also do not exclude the abovementioned mechanism. For example, Papies and colleagues (2012) exposed participants to images of attractive foods, and participants adopted a decentering or control perspective towards the imagery elicited by these foods. Later, participants were exposed to the same images and their approach impulses were then measured. The decentering relative to control participants then exhibited fewer approach impulses. These effects could be explained by fewer simulations and imagery of consumption being elicited during the second phase of the experiment, because the foods were re-encoded as less attractive in that setting, similar to how exposure therapy works. The research reported in this article therefore adds to a better understanding of the mechanisms of decentering by systematically showing that decentering works to reduce reactivity to mental imagery, even when this imagery is kept active in mind, thus precluding accounts of distraction or suppression (see Chapter 5 for a detailed discussion).

For decentering to reach its maximum potential as a tool to empower people to live a healthy life, it is important to focus on how it can best be taught and applied. In many Buddhist contemplative traditions, people both meditate and receive instruction from highly experienced teachers. Essentially, many Western mindfulness-based interventions derived from them take a similar approach, such as the standardized 8-week course of Mindfulness-Based Stress Reduction (MBSR). Developing decentering through meditation has the benefit that the first component of mindfulness, attention regulation, is typically also developed. In meditation, for instance, one may have the repeated experience of becoming aware of distractions and bringing attention back to a focal object (Jha, Krompinger, & Baime, 2007). Training this component of mindfulness increases the likelihood of experiences reaching awareness. This may in turn facilitate the effective application of a decentering perspective, as one may be more likely to notice food-related thoughts and cravings arising at a very early stage (Dreyfus, 2011; Papies, 2017). The ability to regulate attention may furthermore facilitate body awareness, such as of satiety. It may also increase awareness of one's behavior being instigated by habit rather than reflective choice, and thereby assist people to make fewer impulsive eating choices (Baer, 2003; Kristeller & Wolever, 2010). For enhancing healthy eating, the traditional path of developing decentering through meditation may thus offer additional benefits compared to learning decentering in a "stand-alone manner".

For some people, however, it may be more attractive to develop decentering without meditation, such as by direct instruction, as was done in most of the experiments among non-meditators addressed in the current review. Such an instruction is brief

yet effective, whereas standardized mindfulness-based interventions such as MBSR typically assign participants to 45 minutes of meditation per day for a period of eight weeks (see MBSR Standards of Practice). Moving from no meditation experience to 45 minutes of meditation per day may be cognitively demanding, and may also be difficult to implement in daily life. Furthermore, some people may be unwilling to meditate, as they hold preconceived notions of meditation being 'airy-fairy' (Wiering, 2016). I suggest that the potential drawback of not developing the first component of mindfulness may be offset by combining an intervention using decentering instructions with the monitoring of behavior, such as by keeping a food diary. However, this remains to be tested. Future longitudinal research on the brief decentering instruction and eating behavior, especially in combination with interventions that enhance awareness of eating behavior (Harkin et al., 2016), would increase our understanding of the process of successfully adopting a decentering perspective. For now, it seems promising that decentering can be developed both through meditation and by using instructions that do not require meditation.

A potential concern regarding decentering as an intervention is its decontextualized use in the West as compared to within a Buddhist ethical framework (Grossman, 2015; Monteiro, Musten, & Compson, 2014). From a practical perspective, this may lead to the suboptimal application of decentering, and to undesirable outcomes. It is important, for instance, to not conflate decentering with a license for apathy merely because it reduces immediate reactivity to food cues. Becoming less influenced by environmental food cues through decentering should rather be used as an opportunity to act in line with one's goals, such as eating healthily. Furthermore, while decentering may help to deal with set-backs, such as an occasional violation of one's health goals, it should not be conflated with non-judgment (Dreyfus, 2011), or be used as a way to not discriminate between healthy and unhealthy eating. Indeed, the mere acceptance of food-related thoughts without deconstructing them through decentering has been shown to actually increase, rather than decrease, food cravings (Alberts, Thewissen, & Middelweerd, 2013). Decentering also goes beyond merely taking distance from one's thoughts, e.g. from a fly on the wall perspective. The crucial distinction is that decentering involves the insight that experiences are impermanent in nature, rather than permanent or reflecting an objective reality. In terms of effects, unlike decentering, distancing does not reduce reactivity to concrete imagery or situations, such as about the taste of a snack or how eating it would make one feel. Distancing only reduces reactivity to experiences that are deliberately analyzed from a broader "why" perspective (Kross & Ayduk, 2011; Kross, Ayduk, & Mischel, 2005). For people to optimally benefit from adopting a decentering perspective, it is thus important that they are provided with a clear instruction of what it is, and how to best apply it to reduce reactivity to food cues.

Conclusion

To conclude, decentering is the metacognitive insight that all experiences are impermanent. This perspective can be learned through meditation, but non-meditators can also adopt it through brief non-meditative decentering instructions. In various well-controlled experiments, such as in the current dissertation, decentering has been found to consistently and effectively reduce reactivity in the forms of approach impulses, subjective cravings, and actual consumption of energy-dense foods. I suggest that decentering is a powerful tool to reduce reactivity because it directly targets the simulations and immersion in someone's mind, which underlies this reactivity. One added benefit of decentering as a tool to reduce unhealthy eating is that it is broadly applicable, towards any stimulus, and in any situation. Furthermore, as the adoption of decentering can be considered a skill, repeated practice further facilitates its application in daily life, which may underlie the effectiveness of more comprehensive mindfulness interventions that typically include a decentering element. If appetitive reactivity to the 'obesogenic' environment is reduced, such as by using decentering, this may offer people the opportunity to act in line with their long-term intentions to make the healthy choice. Thus, in this world full of temptations, decentering may play an important role in empowering people to live healthily.

PART II

The empirical research

CHAPTER 3

Empirical investigation of beverage representations

Alcohol representations are socially situated: An investigation of beverage representations by using a property generation task

This chapter is based on:

Keesman, M., Aarts, H., Ostafin, B. D., Verwei, S., Häfner, M., & Papies, E. K. (2018). Alcohol representations are socially situated: An investigation of beverage representations by using a property generation task. *Appetite, 120*, 654-665.

Author contributions:

MK, EKP, and BDO designed Study 1, and MK, EKP, and SV designed Study 2; SV conducted the research; MK analyzed the data; MK drafted the manuscript and revised it with HA and EKP; BAO and MH provided feedback for further revisions. All authors approved the final version.

Introduction

Alcoholic beverages supply many calories and their consumption contributes to the rise in obesity (Shelton & Knott, 2014). To develop effective interventions to reduce alcohol consumption, much research has therefore focused on exploring its predictors, such as on norms, implicit and explicit attitudes, and habits (for reviews, see Rooke, Hine, & Thorsteinsson, 2008; Stacy & Wiers, 2010). Importantly, these predictors of drinking behavior all rely on specific psychological representations of alcoholic beverages, i.e. storage structures of information about the world (Barsalou, 2008). For example, someone who represents alcohol as reducing sorrow may be motivated drink when trying to cope with an illness in the family. Furthermore, when a representation related to drinking is activated, such as the context of "socializing", this may initiate the habitual behavior to drink (Sheeran et al., 2005). Even though these and other findings clearly suggest that representations play an important role in drinking behavior (Wyer Jr., 2007), little is known about the *content* of alcohol representations. Partially this may be because it is difficult to study them well, and because they are highly idiosyncratic. For example, while some people have a positive implicit attitude towards alcohol because it is part of their fun times with friends, others' positive attitudes may be driven by past experiences where a drink lightened up difficult situations. Here, we suggest that a property generation task can be a useful tool to examine these representations (McRae, Cree, Seidenberg, & McNorgan, 2005). To demonstrate how this tool can be used, we examined people's representations of alcoholic beverages in two studies. Furthermore, we examined if specific aspects of an alcohol representation were associated with the motivation to drink. We therefore also included established measures of drinking-related cognitions and behavior in our research, such as state alcohol craving, explicit motives to drink alcohol, and actual drinking choices.

Formation and expression of representations

The formation of representations occurs continuously while interacting with the world, and they emerge from, amongst others, bodily states, sensory information, and the environment (Barsalou, 2008; Barsalou, Simmons, Barbey, & Wilson, 2003; Borghi, 2015). The relevant properties of one's experiences are then stored and associated together in memory as comprehensive representations (Barsalou, 2016). These representations are based on an individuals' own learning experience, and are therefore highly idiosyncratic. The properties that are encoded from the experience of drinking a beer may for instance include sensory input (e.g. "cold", "bitter taste") and positive outcomes (e.g. "hedonic enjoyment"). Furthermore, as appetitive objects are consumed within a certain situation, representations may also include information about the physical context (e.g. "in a bar") as well as the social context ("with friends").

The beverages are thus not represented in isolation, but may include relevant contextual information (Barsalou, 2016; Barsalou et al., 2003). To the degree that one has similar experiences over time, the associations between the shared features of these experiences become increasingly entrenched in memory.

The fact that representations become increasingly entrenched in memory allows them to be easily activated again in similar situations, in order to prepare for action, such as the consumption of alcohol (Barsalou, 2009). When any part of a representation gets activated, properties in the associative pattern of the representation may then also get activated through pattern completion inferences (Barsalou, 2009). All these activated properties are then "re-experienced" (i.e., simulated; Hesslow, 2002), such that the brain is brought into a similar state as when the object was actually there and experienced (Barsalou, 2002). These processes of pattern completion and simulation assist prediction and preparation for action (Holyoak, Novick, & Melz, 1994). For instance, when a property that is part of the representation of "beer" is perceived, such as the contextual information of being at a party (Reich, Goldman, & Noll, 2004), a pattern completion process may activate associated features. This may then result in simulations of the taste and hedonic enjoyment of drinking beer, as well as approach responses that facilitate the process of actually grabbing the beer someone is offering, or walking to the bar and ordering one. Conversely, the perception of an alcoholic beverage itself may also trigger rewarding simulations through pattern completion inferences, making the beverage seem even more attractive. For instance, one might simulate feeling "buzzed", being with good friends, or dancing at a party, making the beverage seem more attractive, and thereby increasing the motivation to drink it. In short, any property may activate a previously stored situated representation in the form of simulations, which then prepare for action, such as drinking alcohol.

Although the abovementioned line of reasoning has never been directly tested in the domain of alcohol, much research provides evidence that alcohol-related representations influence thought and behavior with regards to alcohol (for reviews, see Rooke, Hine, & Thorsteinsson, 2008; Stacy & Wiers, 2010). Activating outcome representations of alcohol consumption with word exposure (e.g. "buzzed", "sexy"), for instance, increases accessibility to other alcohol-related properties and increases alcohol consumption (Hill & Paynter, 1992; Stein, Goldman, & Del Boca, 2000; Weingardt et al., 1996). Furthermore, habits automatically initiate drinking behavior in response to a contextual drinking cue, such as thoughts about "socializing" (Aarts & Dijksterhuis, 2000; Albery, Collins, Moss, Frings, & Spada, 2015; Sheeran et al., 2005). Moreover, merely exposing people to images of alcoholic beverages can facilitate aggressive behavior, especially for people who associate drinking with aggression (Bartholow & Heinz, 2006). From a grounded cognition perspective (Papies & Barsalou, 2016), the perception of an alcoholic

beverage trigger simulations of properties in the alcohol representation through pattern completion inferences, such that it triggers simulations of sensory experiences (e.g. "bitter", "sparkling"), cognitions (e.g. "aggressive") or behaviors (e.g. "drinking"). These simulations effectively prepare for action, such as the actual consumption of alcohol or aggressive behavior.

Content of representations

While many lines of research indicate that the idiosyncratic representations of alcohol are potentially important for understanding drinking behavior (for reviews, see Rooke, Hine, & Thorsteinsson, 2008; Stacy & Wiers, 2010), little is known about their content. Previous research found that representing alcoholic beverages in terms of positive expectancies (e.g. "feeling calm") rather than negative expectancies (e.g. "feeling dizzy") is correlated with alcohol consumption (Jones, Corbin, & Fromme, 2001). In another line of research, participants freely listed outcome expectancies to the prompt "Alcohol makes one ...." (Rather & Goldman, 1992; Rather, Goldman, Roehrich, & Brannick, 1992; Dunn & Goldman, 1998; Goldman, 1999). Here, participants were found to strongly represent alcoholic beverages on the dimensions of sedation-arousal and negative/antisocial-positive/social. Another line of research found that representing the act of drinking alcohol at a higher level (e.g. "quenching my thirst", "getting drunk"), rather than at a lower level (e.g. "swallowing different beverages"), is correlated with difficulty in controlling consumption (Palfai & Ostafin, 2010; Wegner & Vallacher, 1986; Wegner, Vallacher, & Dizadji, 1989). An explanation for this effect is that representations at a higher level provide a motivation to drink (Palfai & Ostafin, 2010). These studies are informative but typically only focus on one aspect of the representation, such as outcome expectancies or action identifications.

Using a property generation task allows us to examine all aspects of people's representations simultaneously. In this task, participants list typical properties of a stimulus presented to them (McRae et al., 2005; Santos et al., 2011). Typically, participants are not aware of the construct being measured in a property generation task, rendering this a somewhat implicit measure (De Houwer & Moors, 2007). Earlier research in the domain of food (Papies, 2013), for instance, found strong representations in terms of the sensory system, hedonic features, and eating situations for attractive relative to neutral foods – examples of outcomes for chips being "salty, delicious, at night, edible". Based on this earlier research, an example outcome from the task for a beer might be "with friends, bitter, delicious, made from hops". As these representations depend on a person's earlier experiences, they are highly idiosyncratic. Furthermore, representations are highly context dependent: on a night out with friends, an alcoholic beverage likely elicits different representations than in the morning after a night of

heavy drinking. This can also be reflected in the results of a property generation task.

The current work adds to the domain of alcohol by exploring the full breadth of people's representations of alcohol, including outcome expectances, sensory information, action information, and context. The outcome expectancy literature for instance focuses on the outcome expectancies aspect of people's representations. This is also enforced in the used methods, e.g. asking participants to respond to: "Alcohol makes one...". Representations of alcohol may be much broader, however (e.g. Barsalou, 2002; Papies, 2013), including sensory information and context information. The literature on habits also suggests that this context information -- independent of outcome expectancies -- is vital for inducing behavior (e.g. Danner, Aarts, & de Vries, 2008). The current manuscript thus connects the outcome expectancy literature with the literature on habits, as any property including context or outcome expectancies can be listed in the property generation task. This is useful as both context and outcome expectancies may be important aspects of people's representations, and in predicting drinking behavior.

Although based on verbal reports, recent research shows that the property generation task reveals more than superficial word associations (Santos et al., 2011; Simmons, Hamann, Harenski, Hu, & Barsalou, 2008). In research by Wu & Barsalou (2009), for instance, participants were instructed to describe their imagery, engage in property generation, or list mere word associations. The distribution of properties from imagery and property generation instructions differed from those produced during word association, such that only in the first two conditions, participants listed properties that come up when one simulates engaging with the object. Furthermore, when using the property generation task in the domain of food, Papies (2013) found participants to list eating simulation properties reflecting taste and texture, rather than them merely listing superficial word associations (e.g. "monster" for cookie) or category information (e.g. "food" for chips). Thus, responses in the property generation task go beyond mere word associations.

When using the property generation task to study features of representations at the group level, the listed properties are categorized using a systematic coding scheme as described in the section *property generation task*. This allows us to learn about certain drinking traditions in a culture, such as drinking during lunch or social occasions. In contrast, by studying representations on the individual level, we can learn more about what aspects of drinking episodes are relevant to an individual, which can be used to tailor research and interventions to the individual.

The present research

We examined representations of alcoholic beverages using a property generation task in the laboratory at the university (Study 1) and in two local bars (Study 2). Our research was largely exploratory, but based on similar research in the domain of eating (Papies, 2013), we hypothesized that the content of people's representations of alcoholic beverages would be dominated by features of consumption situations, such as sensory features, context features, and consequences of drinking. Parallel to findings in the domain of eating (Papies, 2013), we further hypothesized that representing alcohol in terms of a consumption situation would be positively associated with measures of drinking behavior, such as alcohol craving.

Study 1

Methods

Participants

110 participants were included in the analyses (41 male; age mean = 21 years). Four additional participants indicated that they never drink alcohol, and one participant selected the same beverages for frequently consumed alcohol as for alcohol that he/she never consumed. These participants were therefore excluded from the analyses.

Design and stimuli

The study had a within-participants design comparing four types of beverages. As critical type of beverage, participants (1) selected their three most frequently consumed alcoholic beverages out of 12 commonly consumed alcoholic beverages (e.g. beer, white wine). As controls, participants selected (2) three alcoholic beverages with which they were familiar, but which they did not drink themselves, (3) their three most frequently consumed sugary beverages out of an array of 12 commonly consumed sugary beverages (e.g. cola, ice tea), and all participants were shown (4) a bottle of water.

Materials

Craving

Participants indicated the extent to which they craved an alcoholic beverage (beer, wine, cocktail etc.) on a Likert scale ranging from 0 (no craving at all) to 10 (a strong craving; Rohsenow et al., 1997). Afterwards, they indicated the extent to what extent they desired to drink water on a similar scale.

Drink choice task

Participants were informed that there was a bar opposite to the laboratory building. A picture of the bar interior and three vouchers were presented on the screen. Participants were asked what type of voucher they would like to receive, if this study offered such vouchers as rewards. They could then select one out of three options: "Soft-drink/Juice" or "Coffee/Tea" or "Beer/Wine". For the analyses, we recoded their choice as "non-alcoholic beverage" or "alcoholic beverage".

Drinking motives

The drinking motive questionnaire-revised-short form (DMQ-R-SF; Kuntsche & Kuntsche, 2009) was used to assess drinking motives (enjoyment, social, conformity, coping). Each motive was assessed with 3 items on a scale from 1 (never/almost never) to 5 (always/almost always), all $\alpha > .68$.

Uncontrollability of alcohol thoughts

An uncontrollability/thought-action fusion scale (Hoyer, Hacker, & Lindenmeyer, 2007) was used to assess the amount of control that participants experience over their alcohol-related thoughts. This scale has 8 items (e.g. "alcohol-related thoughts really make me drink"), to which participants could respond to from 0 (completely disagree) – 4 (completely agree), $\alpha = .80$.

Temptation

To assess alcohol temptations experienced by participants, we used a scale of 9 items (e.g. "When you feel alone, does that make you want to drink alcohol?"; Collins & Lapp, 1992; $\alpha = .82$). Participants could respond from 1 (never) to 9 (always).

AUDIT

The alcohol use disorders identification test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) was used to detect harmful alcohol usage. It has 10 items (e.g. "In the last year, did you need alcohol in the morning to get going?"), $\alpha = .79$. Sum scores of 8 or over indicate hazardous drinking behavior, which is the increased risk of negative physical and mental health consequences for the drinker.

Additional measures

At the end, participants were asked how many alcoholic beverages they drink on a normal day, and on a "party night". Participants were furthermore asked to rate on a scale from each selected beverage on liking, frequency of consumption, and the extent to which the beverages were consumed in similar contexts. This was all done on a scale from 1 (not

at all) to 7 (very much). As habits have been argued to constitute frequent behaviors in a stable context (Danner et al., 2008; Aarts & Dijksterhuis, 2000), we multiplied both these ratings, allowing for a habit index ranging from 1(no drinking habit at all) to 49 (very strong drinking habit). Participants were asked to indicate how they evaluate being drunk on a scale from 1 (negative) to 7 (positive).

Property generation task

For the property generation task, participants were informed that they would see several objects. They were asked to write down the typical properties of each object that spontaneously came to mind (McRae et al., 2005; Papies, 2013), and to name at least 5 properties. To illustrate, participants were shown images of two example objects (e.g., *sponge*) and potential properties (such as "yellow", "soft", "wet").

In the actual task, participants were presented with images of the 10 beverages as described in the design and stimuli section (i.e. 3 frequently consumed alcoholic beverages, 3 alcoholic beverages the participant never consumes, 3 frequently consumed sugary beverages, and water), and 10 neutral objects (e.g. envelope, pen) in random order, with a textbox to list the properties. The images were presented on the screen until the participant finished responding. There was a 1500ms interval between objects.

We coded each property using a previously developed coding scheme consisting of 41 categories organized in a hierarchical structure (Keesman, Papies, Lindner, & Barsalou, unpublished manuscript). The main overarching categories contained consumption situations (i.e. any aspect of a consumption episode, such as the taste of the object), non-consumption situations (i.e. any aspect of a situation unrelated to consumption, such as how the object is produced or stored), and situation-independent (i.e. any aspect that is present in both a consumption as well as in a non-consumption situation, such as the ingredients of the object or its visual properties). To further clarify the distinction between these categories, red wine is used as an example beverage. Some properties are consumption-situation specific, such that "taste" is only experienced when consuming the product. Some properties are non-consumption specific, such that "stored in a bottle" only holds true for red wine in the "non-consumption situation" of storage – wine cannot be stored and consumed at the same time. The visual property of "red", on the other hand, is true for red wine regardless of its situation: it is true both when it is being consumed and when it is being stored. Thus, some properties are consumption-situation specific (e.g. taste), some are non-consumption situation specific (e.g. storage), and some are independent of these situations (e.g. visual). This coding scheme is based on previous coding schemes (McRae et al., 2005; Papies, 2013; Wu & Barsalou, 2009), and was further adapted to capture experiences with consumptive objects. An overview of the category structure with examples is included as Figure 1

The first author and an independent rater coded the data of the property generation

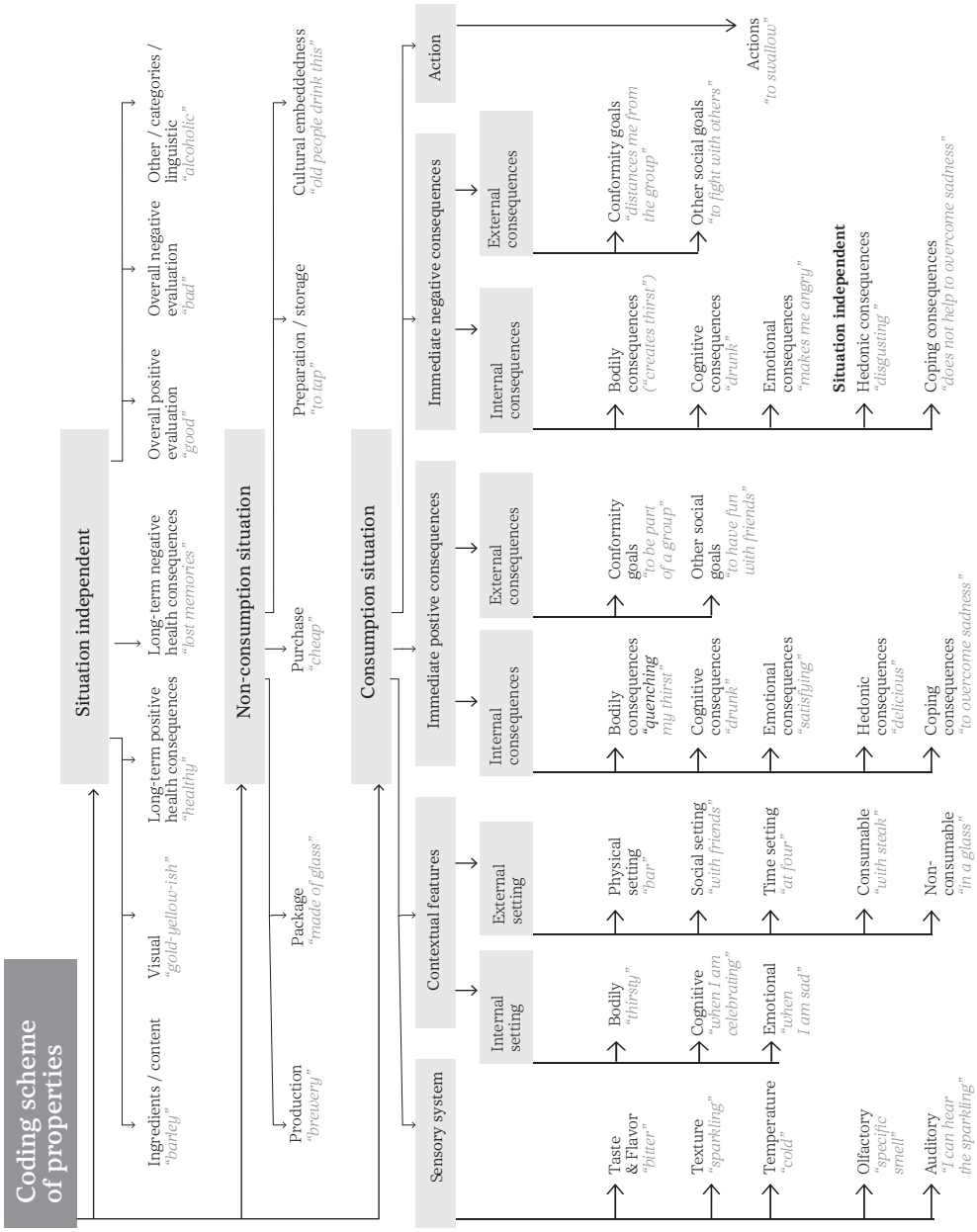

Figure 1.

To code a property, follow the hierarchical structure to the best fitting category and/or subcategory. For instance, "bitter" is experienced in a consumption situation, by the sensory system, and it is a taste. "Bitter" is thus coded under Taste & Flavor.

task. Of the 41 available coding categories, 35 were used. We summed all unique properties per beverage, which indicated that a total of 3224 coding decisions were made by each rater. We used an online calculator to calculate the inter-rater agreement and reliability (Geertzen, 2012). Despite the large number of coding categories, the inter-rater agreement was 71.8%. Importantly, reproducibility as measured by Krippendorff's alpha was fair, at .70 (Cohens's kappa = .70), which indicates that disagreements were not systematic. On average, participants generated 5.49 properties per beverage. We analyzed the coding of the first author. We first calculated the percentage of properties that each category contained and then averaged those over the beverages per beverage category (frequently consumed alcohol, alcohol that is never consumed, frequently consumed sugary beverages)[1].

Procedure

After providing informed consent, participants performed the study on a computer in an individual cubicle. Participants first selected the beverages as described above. Then, they reported their cravings. The property generation task followed. Then, participants again reported current alcohol cravings, and made the hypothetical drink choice. This was followed by all other questionnaires as described in the materials section. Finally, participants provided demographic information.

Results

General content of representations

We controlled for multiplicity using Bonferroni corrections, α was set at .05 / 3 tests = .0167. On average, 57% of the representations of frequently consumed alcoholic beverages referred to a consumption situation, 95% CI [53, 61]. Confirming our hypothesis, this was higher than for alcoholic beverages that are never consumed and water (respectively, mean = 49%, 95% CI [45, 52]), $t(109) = 4.67$, $p < .001$, $d = .45$, and mean = 42%, 95% CI [37, 46]), $t(109) = 6.55$, $p < .001$, $d = .62$). Contrary to our hypothesis, however, frequently consumed alcoholic beverages were not more strongly represented in terms of their consumption than sugary beverages (mean = 61%, 95% CI [57, 64]), $t(109) = 2.14$, $p = .035$, $d = .20$). There even was a trend in the direction of sugary beverages being more strongly represented in terms of consumption than alcohol. For a draught beer, for example, some of the listed properties were "bitter", "tasty", "friends", "tipsy", and "pub."

Exploring consumption representations in more detail

We then explored the consumption-related representations in more detail. The distribution of properties indicated that all beverages were primarily represented in terms of sensory experiences, context, and immediate positive consequences of consumption,

see Figure 2. To explore the sizes of the differences in consumption representations among the different types of beverages, we used an estimation approach. We reported Cohen's *d* standardized mean differences as point-estimates, and we reported their 95% confidence intervals. For representations in terms of drinking context, the size of the difference between frequently consumed alcoholic beverages and the other beverages was: *d* = .22 with 95% CI [.03, .41] for alcohol that is never consumed; *d* = .53 with 95% CI [.33, .73] for water; *d* = .42 with 95% CI [.23, .62] for sugary beverages. For representations in terms of sensory experiences, the size of the difference between sugary beverages and the other beverages was: *d* = .60 with 95% CI [.40, .80] for frequently consumed alcoholic beverages; *d* = .66 with 95% CI [.45, .87] for alcohol that is never consumed; *d* = .92 with 95% CI [.70, 1.14] ; for water. For representations in terms of positive consequences, the size of the difference between frequently consumed alcoholic beverages and the other beverages was: *d* = .55 with 95% CI [.35, .75] for alcohol that is never consumed; *d* = -.27 with 95% CI [-.45, -.07] for sugary beverages; *d* = -.27 with 95% CI [-.46, -.08] for water.

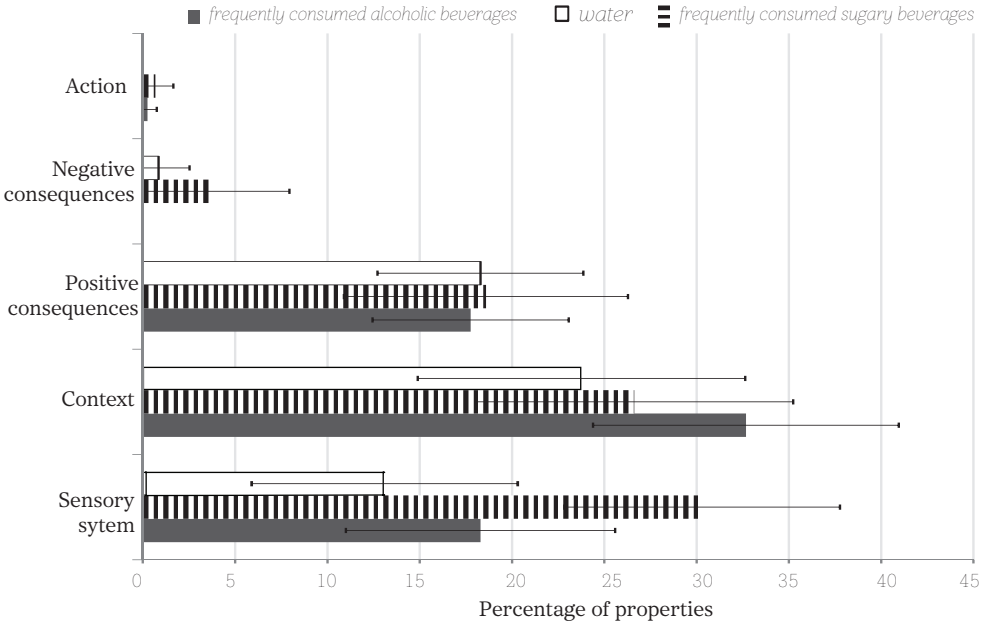

Figure 2.

The consumption representation of each beverage in Study 1, presented with 95% confidence intervals. Overall, participants strongly represented the beverages in terms of the sensory experiences, positive consequences, and context of consumption. Frequently consumed alcoholic beverages were more strongly represented in terms of context than the other beverages.

Exploring context-related representations in more detail

Because alcoholic beverages were more strongly represented in terms of drinking context than the other types of beverages, we examined this drinking context in more detail. Visual inspection indicated that for frequently consumed alcoholic beverages, social context (e.g. "with friends") was the most prominent category, which is shown in Figure 3. Indeed, for representations in terms of social context, the size of the difference between frequently consumed alcoholic beverages and the other beverages was: d = .38 with 95% CI [.18, .57] for alcoholic beverages that are never consumed; d = .59 with 95% CI [.39, .79] for sugary beverages; d = 42 with 95% CI [.23, .62] for water. For a draught beer, some of the listed properties were "when it is gemütlich", "friends", "you do not drink it when alone", "together."

Exploring the representations of long-term negative health consequences

The caloric and other unhealthy aspects of frequently consumed alcoholic beverages did not seem salient in people's representations, with only 1.18% of properties being related to the long-term negative consequences of drinking (95% CI [.39, 1.96]).

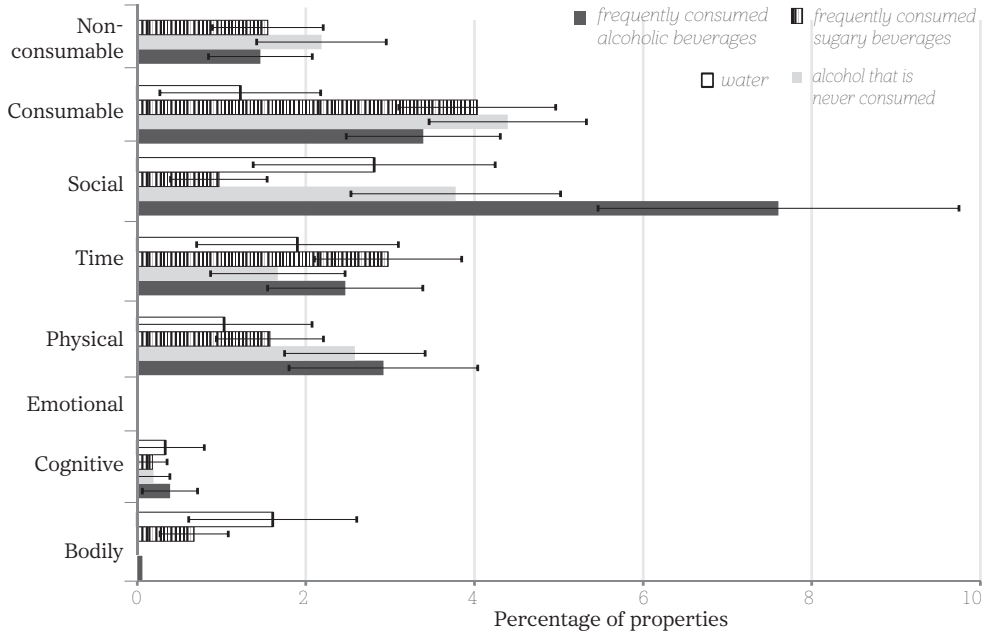

Figure 3.

The types of context representation of each beverage in Study 1, presented with 95% confidence intervals. Participants represented the frequently consumed alcoholic beverages more in terms of the social context relative to the other types of context and to the other types of beverages

Table 1

Study 1: Partial correlation matrix for social context representation and scores on measures of drinking behavior, controlling for gender effects, reported with 95% confidence intervals.

		1	2	3	4	5	6
1	Social context representation	-					
2	Alcohol choice	.23 [.03, .40]	-				
3	Alcohol craving	.18 [-.01, .36]	.46 [.30, .60]	-			
4	Drinking at party	.20 [.00 .37]	.32 [.14, .49]	.30 [.12, .47]	-		
5	AUDIT score	.18 [-.016, .35]	.26 [.07, .43]	.31 [.13, .48]	.68 [.57, .77]	-	
6	Temptation	.25 [.06, .42]	.28 [.10, .45]	.39 [.22, .54]	.37 [.20, .53]	.61 [.48, .72]	-
7	Uncontrollability	.23 [.04, .40]	.30 [11, .46]	.40 [.23, .55]	.32 [.14, .48]	.42 [.25, .57]	.63 [.50, .73]
8	Enjoyment motive	.12 [-.07, .30]	.12 [-.07, .31]	.13 [-.06, .31]	.40 [.23, .55]	.45 [.28, .59]	.28 [.09, .44]
9	Social motive	.12 [-.07, .31]	-.03 [-.22, .16]	.23 [.04, .40]	.21 [.02, .38]	.23 [.04, .40]	.26 [.07, .43]
10	Conformity motive	-.00 [-.19, .19]	-.19 [-.36, .01]	.16 [-.04, .34]	-.03 [-.22, .16]	.16 [-.03, .34]	.20 [.01, .37]
11	Coping motive	.16 [-.03, .34]	.36 [.18, .52]	.14 [-.05, .32]	.17 [-.02, .35]	.26 [.07, .43]	.47 [.30, .60]
12	Liking of taste	.06 [-.13, .25]	.21 [.02, .38]	.13 [-.32, .06]	.14 [-.05, .32]	.21 [.02, .39]	.29 [.10, .45]
13	Habit strength	.04 [-.15, .23]	.11 [-.08, .29]	.20 [.01, .37]	.15 [-.05, .33]	.16 [-.03, .34]	.20 [.01, .38]
14	Perspective on being drunk	.01 [-.18, .20]	.05 [-.14, .23]	.18 [-.01, .36]	.31 [.12, .46]	.31 [.12, .47]	.35 [.18, .51]
Means *(SD)*		7.6 (11.5)	.44 (.50)	4.7 (2.6)	7-8 drinks	11.7 (5.6)	2.4 (1.1)

	7	8	9	10	11	12	13	14
	-							
	.10 [-.09, .28]	-						
	.12 [-.07, .31]	.50 [.34, .63]	-					
	.21 [.02, .39]	.17 [-.02, .35]	.39 [.21, .54]	-				
	.33 [.15, .49]	.22 [.03, .39]	.13 [-.06, .31]	.12 [-.07, .31]	-			
	.09 [-.10, .28]	.17 [-.02, .35]	.25 [.06, .42]	-.01 [-.20, .18]	.11 [-.08, .30]	-		
	.11 [-.08, .29]	.06 [-.12, .25]	.25 [.06, .42]	.06 [-.13, .25]	.06 [-.13, .25]	.26 [.08, .43]	-	
	.22 [.03, .40]	.42 [.25, .57]	.34 [.16, .50]	.10 [-.09, .29]	.17 [-.02, .35]	.18 [-.01, .36]	.15 [-.04, .33]	-
	.9 (.6)	3.1 (.8)	3.0 (1.1)	1.6 (.7)	1.6 (5.4)	5.5 (1.1)	20.7 (8.4)	3.8 (1.6)

Associations with craving and drinking behavior

We found that only the extent to which participants represented alcoholic beverages in terms of social context was positively associated with various measures of drinking behavior, see Table 1. Results show that people who had a strong social context representation of alcohol also had stronger alcohol cravings and intrusive thoughts about alcohol, found alcohol harder to resist, and reported to drink more alcohol. Most of these measures were also positively correlated with one another.

Discussion

We used a property generation task to assess representations of beverages, and showed that beverages were strongly represented in terms of their consumption. Furthermore, alcoholic beverages that participants frequently consumed were more represented in terms of their consumption than alcoholic beverages that participants infrequently consumed and water. In contrast, soft-drinks were more represented in terms of their consumption than these alcoholic beverages.

When examining the consumption representations in more detail, beverages were all found to be largely represented in terms of sensory experiences, context, and immediate positive consequences of consumption. Immediate negative consequences of consumption and motor action properties were largely absent from people's representations of the beverages. Importantly, and in line with our hypothesis, relative to the other beverages, alcoholic beverages were more represented in terms of the context of consumption, especially the *social* context of consumption (e.g. "with friends"). On the other hand, alcoholic beverages were comparatively less represented in terms of sensory experiences than soft-drinks, and were less represented in terms of immediate positive consequences than both soft-drinks and water.

We found that for the frequently consumed alcoholic beverages, social context representation was associated with various measures of the motivation to drink alcohol, such as the choice for an alcoholic beverage, state alcohol craving, and uncontrollability over alcohol-related thoughts. Additionally, the several alcohol-related measures included in this study were mostly correlated with each other.

Study 2

As context influences how people think about alcohol (Reich et al., 2004), we conducted Study 2 in a bar environment. This allowed us to assess alcohol representations in another sample, and in a more natural drinking environment than the laboratory. We reasoned that the expression of representations in terms of consumption could be higher in this natural drinking environment than in the non-drinking environment of the university laboratory used in Study 1. We again examined the representation of alcoholic beverages, and whether this representation is associated with alcohol consumption.

Methods

Participants

56 participants were included in the analyses (29 male; age mean= 29 years). One participant listed only one property per beverage and was therefore excluded from the analyses.

Design and stimuli

For the sake of brevity in the field setting, we limited the number of stimuli and measures. The study had a within-participants design comparing (1) frequently consumed alcoholic beverages, (2) frequently consumed sugary beverages, and (3) water. We used draught beer, white wine, ale, cola, and ice-tea as stimuli, based on the most frequently selected beverages in Study 1. For the analyses, we selected the alcoholic and sugary beverage that the participant indicated to drink most frequently. If there was no difference, the one they liked the most, and if there was again no difference, we computed an average of the scores for these multiple beverages.

Materials

Craving

Participants indicated the extent to which they currently craved their favorite alcoholic beverage from 1 (no craving at all) to 5 (a strong craving; Rohsenow et al., 1997).

Property generation task

On average, participants listed 4.21 properties per beverage. The data were again independently coded by the same two raters as in Study 1. Out of 41 coding categories, 33 were used, and each coder made 667 unique coding decisions. Overall inter-rater agreement was 71.9%. A fair reliability was again achieved with Krippendorff's alpha at .71 (Cohen's kappa = .71). The coding from the first author was again used for the analyses.

Drinking motives

The same drinking motives questionnaire (DMQ-R-SF; Kuntsche & Kuntsche, 2009) was used as in Study 1, all $\alpha > .69$.

Uncontrollability

The same measure of uncontrollability of alcohol-related thoughts (Hoyer et al., 2007) was used as in Study 1, $\alpha = .76$.

AUDIT

The alcohol use disorders identification test (AUDIT; Saunders et al., 1993) was again used to detect hazardous drinking behavior, $\alpha = .67$.

Additional measures

Liking and the index of habit strength were computed in the same way as in Study 1, using scales from 1 (not at all) to 7 (very much) (Danner et al., 2008). Participants also indicated whether they evaluated being drunk as primarily positive or as primarily negative.

Procedure

The study was conducted on three Fridays and Saturdays after 8 p.m. in two neighboring bars in the center of a small town in the Netherlands. Patrons entering the bar were asked if they wanted to participate in the study. If they agreed, they were handed the paper questionnaire, of which the first page consisted of a consent form. Six versions of the questionnaire were created with each one having a different random order of the three beverages included. Participants' drink order was then immediately taken by the bartender, but through coordination of the researchers with the bartenders, the participants received their beverage only after completing the questionnaire. We kept track of all drinks that were ordered by the participants in the course of the evening, and participants were made aware of this in the consent form. After this stage, the procedure was largely the same as in Study 1, but Study 2 contained fewer stimuli and fewer measures related to drinking behavior. Participants provided demographic information at the end of the questionnaire.

Results

General content of representations

We applied Bonferroni correction to control for multiplicity, with $\alpha = .05 / 2$ tests $= .025$. Overall, the pattern of content in people's representations was similar to the pattern found in Study 1. For the alcoholic beverages, 70% of properties referred to consumption, 95% CI [64, 76], again confirming our hypothesis that this would be more than for water (mean= 57%, 95% CI [50, 65]), $t(53) = 2.82$, $p = .007$, $d = .38$.

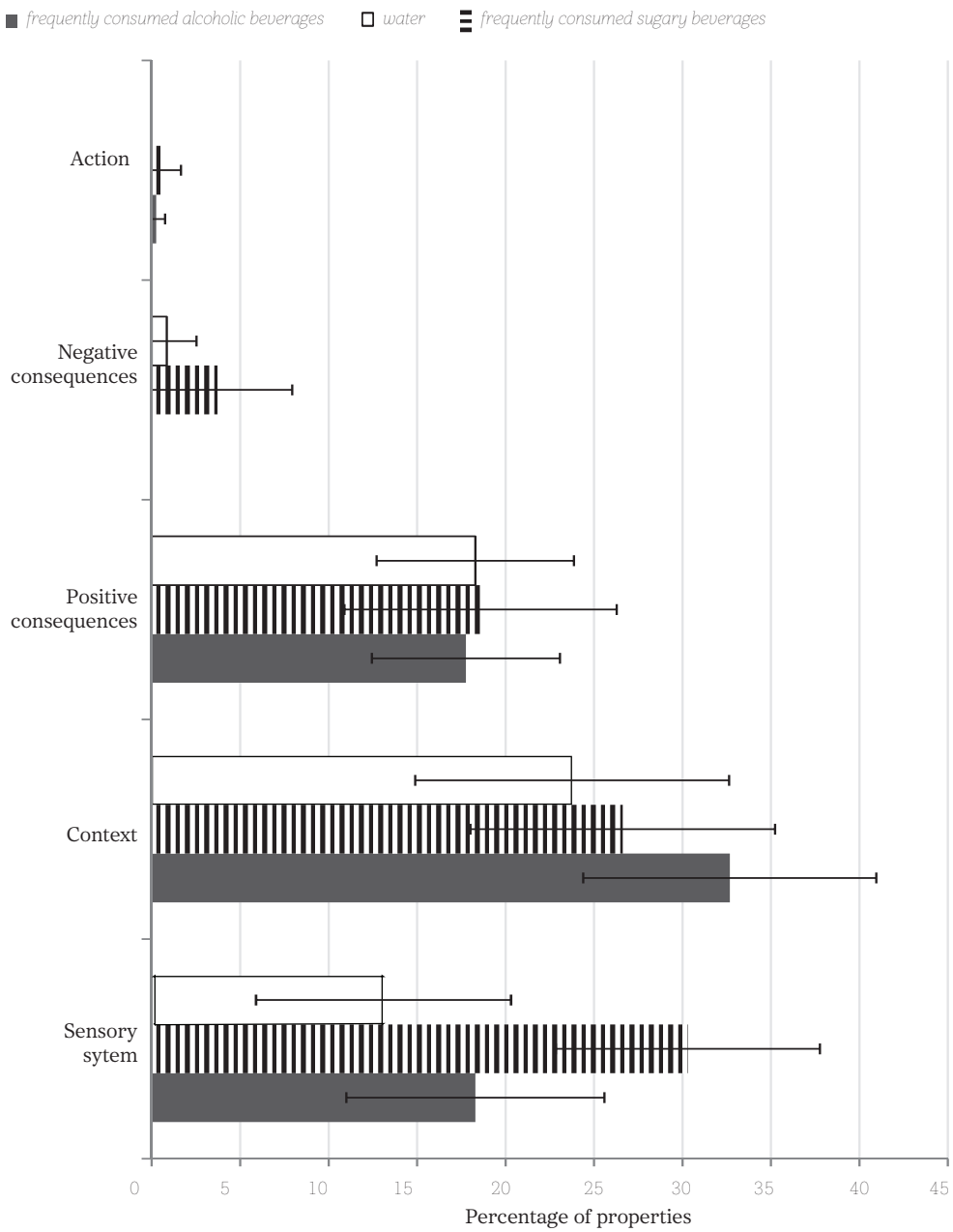

Figure 4.

The consumption representation of each beverage in Study 2, presented with 95% confidence intervals. Overall, participants strongly represented the beverages in terms of the sensory experiences, positive consequences, and context of consumption.

Similar to Study 1, frequently consumed alcoholic beverages were not more strongly represented in terms of their consumption than sugary beverages (mean= 80%, 95% CI [74, 87]), $t(47) = 2.13$, $p = .038$, $d = .30$. In contrast, there was a trend in the direction of sugary beverages being more strongly represented in terms of consumption than alcoholic beverages.

Exploring consumption representations in more detail

When exploring the consumption-related representations in more detail, similar trends were observed as in Study 1, see Figure 4. The distribution of properties again indicated that all beverages were primarily represented in terms of sensory experiences, context, and immediate positive consequences of consumption.

For representations in terms of drinking context, the size of the difference between frequently consumed alcoholic beverages and the other beverages was: $d = .24$ with 95% CI [-.04, .51] for water; $d = .20$ with 95% CI [-.09, .48] for sugary beverages.
For representations in terms of sensory experiences, the size of the difference between sugary beverages and the other beverages was: $d = .43$ with 95% CI [.13 .73] for frequently consumed alcoholic beverages; $d = .73$ with 95% CI [.41, 1.04] for water. For representations in terms of positive consequences, the size of the difference between frequently consumed alcoholic beverages and the other beverages was: $d = -.06$ with 95% CI [-.32, .21] for sugary beverages; $d = .04$ with 95% CI [-.24, .32] for water.

Exploring context-related representations in more detail

We examined the representations in terms of drinking context in more detail because alcoholic beverages were more strongly represented in terms of drinking context than the other types of beverages in Study 1, and a similar trend was visible for Study 2 (see Figure 5). Similar to Study 1, visual inspection indicated that for frequently consumed alcoholic beverages, social context was the most prominent representation category. For representations in terms of social context, the size of the difference between frequently consumed alcoholic beverages and the other beverages was: $d = .92$ with 95% CI [.58, 1.25] for sugary beverages; $d = .81$ with 95% CI [.50, 1.11] for water.

Exploring the representations of long-term negative health consequences

The results concerning the long-term negative consequences of drinking were similar to Study 1, with only 1.30% of all properties 95% CI [-.25, 2.84] being related to them.

Associations with craving and drinking behavior

A similar correlation matrix was computed for Study 2 as for Study 1, see Table 2. Alcohol consumption in the bar was correlated with *state* cravings for alcohol.

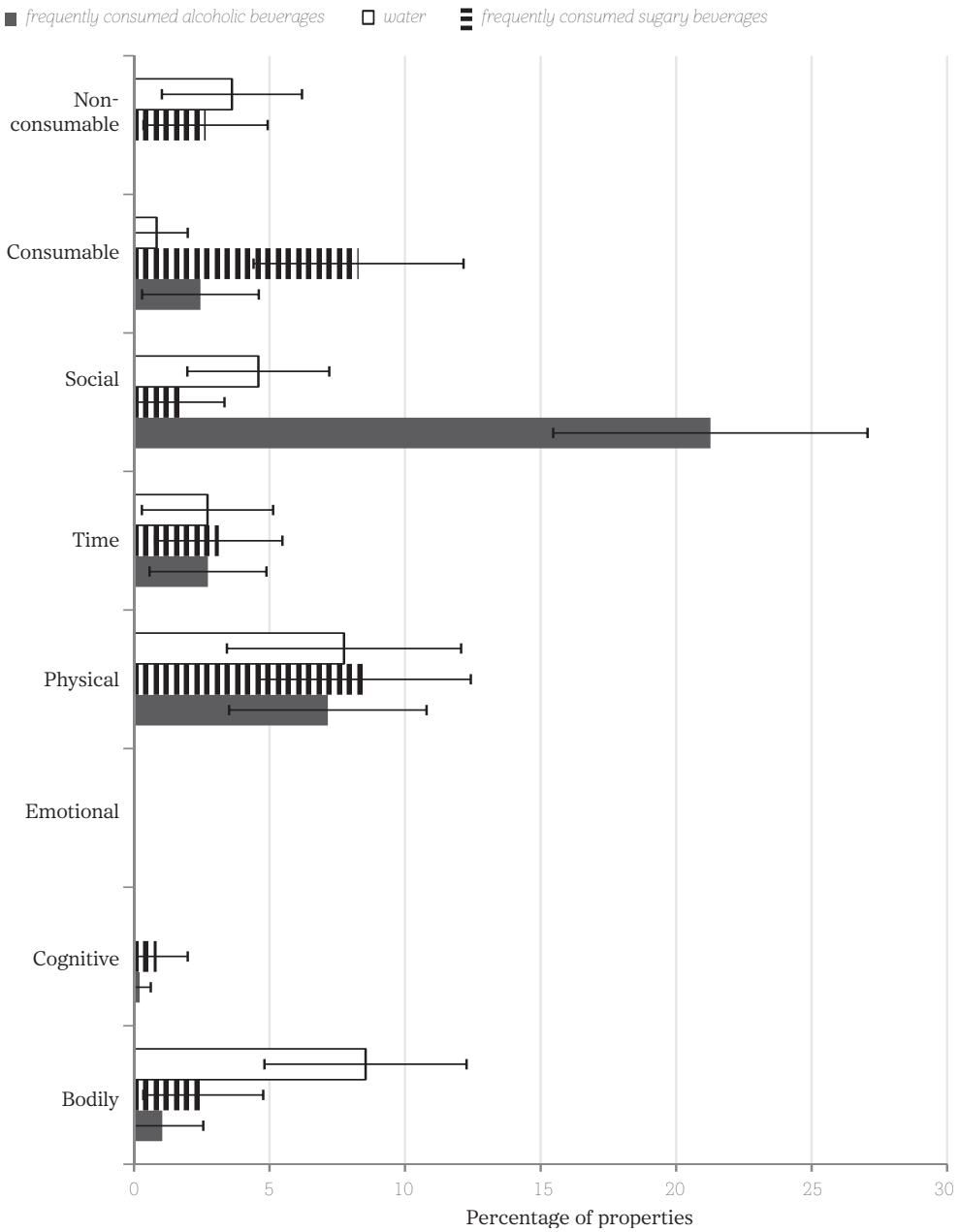

Figure 5.

The types of context representation of each beverage in Study 2, presented with 95% confidence intervals. Participants represented the frequently consumed alcoholic beverages more in terms of the social context relative to the other types of context, and other types of beverages.

Table 2

Study 2: Partial correlation matrix for social context representation and scores on measures of drinking behavior, controlling for gender effects, reported with 95% confidence intervals.

	1	2	3	4	5
1 Social context representation	-				
2 Alcohol choice	.11 [-.18, .38]	-			
3 Alcohol craving	.18 [-.10, .44]	.38 [.11, .59]	-		
4 AUDIT score	-.24 [-.48, .04]	.19 [-.10, .44]	.32 [.05, .54]	-	
5 Uncontrollability	-.34 [-.56, .06]	.17 [-.12, .43]	.18 [-.10, .43]	.67 [.49, .80]	-
6 Enjoyment motive	-.04 [-.31, .24]	.14 [-.15, .40]	.30 [.03, .53]	.55 [.32, .71]	.59 [.38, .74]
7 Social motive	.03 [-.25, .31]	-.01 [-.29, .27]	.04 [-.24, .31]	.43 [.18, .63]	.43 [.18, .63]
8 Conformity motive	-.16 [-.42, .12]	.08 [-.21, .35]	.06 [-.22, .33]	.21 [-.07, .46]	.22 [-.05, .47]
9 Coping motive	-.28 [-.51, .01]	.37 [.10, .59]	.28 [.01, .51]	.37 [.10, .58]	.40 [.14, .60]
10 Liking of taste	.22 [-.10, .43]	-.02 [-.31, .26]	.25 [-.03, .49]	.10 [-.18, .37]	.14 [-.14, .41]
11 Habit strength	.12 [-.21, .34]	.06 [-.23, .34]	.49 [.24, .68]	.31 [.04, .55]	.25 [-.03, .50]
12 Perspective on being drunk	.14 [-.17, .41]	.06 [-.25, .35]	-.01 [-.31, .29]	.16 [-.14, .44]	.17 [-.12, .45]
Means (*SD*)	20.2 (20.5)	1.6 (.9)	4.0 (.9)	9.5 (4.9)	1.8 (.6)

	6	7	8	9	10	11	12
	-						
	.67 [.49, .80]	-					
	.34 [.07, .56]	.34 [.08, .56]	-				
	.43 [.18, .63]	.33 [.06, .55]	.56 [.34, .72]	-			
	.19 [-.09, .45]	.19 [-.10, .44]	.11 [-.18, .37]	.16 [-.13, .42]	-		
	.25 [-.03, .50]	.19 [-.09, .45]	.23 [-.05, .48]	.34 [.06, .56]	.55 [.31, .72]	-	
	.44 [.16, .65]	.38 [.10, .61]	.12 [-.18, .40]	-.11 [-.39, .20]	.01 [-.29, .30]	-.24 [-.51, .06]	-
	2.3 (.9)	2.7 (1.0)	1.2 (.4)	1.6 (.7)	6.0 (1.3)	26.6 (13.3)	.7 (.4)

Surprisingly, there was an overall lack of correlation between participants' actual consumption of alcohol and the established *trait* measures of drinking behavior, and also with representations in terms of social context.

Discussion

Regarding the representations of alcoholic beverages, the results of this study were highly similar to those of Study 1. The representations of all beverages were strongly related to their consumption, and especially for soft-drinks. More specifically, the beverages were largely represented in terms of sensory experiences of drinking, drinking context, and immediate positive consequences of consumption. We again found differences in these representations between beverages. Soft-drinks were more represented in terms of the sensory experiences of consumption than the alcoholic beverages and water. Furthermore, as in Study 1, alcoholic beverages were more represented in terms of the social context of consumption than the other beverages. This representation in terms of social context was more pronounced in the bar environment than in the laboratory environment from Study 1.

In Study 2, the representation in terms of social context was only positively associated with current craving for an alcohol beverage, and was unexpectedly negatively associated with uncontrollability over alcohol-related thoughts. In addition, there was a marginal negative association with the AUDIT score and a measure of drinking for coping motives, which was also unexpected. Furthermore, the actual number of alcoholic beverages consumed in the bar was only associated with current alcohol craving and with drinking for coping motives, and not with any of the other established measures of drinking. This lack of association between alcohol-related measures and the actual consumption of alcohol is not in line with previous work on drinking behavior, including Study 1 of the current paper, which typically finds positive associations between these measures (e.g. Danner, Aarts, & de Vries, 2008; Kuntsche, Knibbe, Gmel, & Engels, 2005; Saunders, Aasland, Babor, de la Fuenta, & Grant, 1993). Assessing drinking behavior in a bar might be suboptimal for studying predictors of drinking behavior and the motivation to drink. More specifically, people typically go to a bar to drink alcohol, and hence the decision to drink might already have been made before participants entered the bar. We further address this potential limitation in the general discussion.

General Discussion

In two studies, we examined people's idiosyncratic representations of alcoholic beverages using a property generation task in a university laboratory environment (Study 1) and in a local bar (Study 2). Across studies, participants primarily represented alcoholic beverages in terms of the sensory experiences, context, and immediate positive

consequences of drinking the beverages. In contrast, the caloric and other unhealthy aspects of frequently consumed alcoholic beverages did not seem salient in people's representations. In a more detailed examination, we found that frequently consumed alcoholic beverages were especially strongly represented in terms of the *social* context of consumption (e.g. "with friends").

In addition, Study 1, examining a student sample, revealed a small but consistent positive association between the social context representation of alcohol and measures of alcohol craving and actual drinking. This finding is in line with much earlier research, which has shown that people drink in social contexts (Cooper, 1994; Kuntsche, Knibbe, Gmel, & Engels, 2005; Kuntsche & Kuntsche, 2009). Previous research largely focused on people's motives to drink to make social interactions more enjoyable. Our results on representations add to this literature by suggesting that the social context itself, irrespective of the outcome expectancies of drinking in the social domain, may contribute to the motivation to drink alcohol. In sum, Study 1 suggests that alcoholic beverages are strongly represented in terms of the social context of their consumption, and that representations are associated with drinking behavior. This conclusion resonates well with habit research (Sheeran, Aarts, Custers, Rivis, Webb, & Cooke, 2005), showing that social context is an important aspect of drinking alcoholic beverages among student participants.

In Study 2, the established *trait* measures of drinking behavior such as the AUDIT were not correlated with the actual consumption of alcohol in the bar. This is surprising, because these measures are considered good predictors of drinking behavior. Lack of this basic correlation between predictors of drinking and actual drinking behavior in this study might point to a low validity of these measures in the current study. The fact that other hypothesized correlations were absent in this study may therefore not be informative. In addition, when examining correlations with social context representations, some of the correlations were in opposite directions relative to the findings from Study 1. These results may be explained by the different demographics and characteristics of this non-student sample, or by low validity of the established measures in the current study. Furthermore, our participants likely attended the bar in order to drink, thus constituting a specific subsample of people. This might have led to the limited variance of only 5 participants not consuming any alcoholic beverage. In hindsight, it might have been better to conduct this study in a naturalistic drinking environment that also attracts non-drinkers, such as a cinema. Although few conclusions about craving and drinking behavior can be drawn from Study 2, the results concerning the content of people's representations of alcoholic beverages are highly consistent with Study 1. Specifically, they show that alcoholic beverages are uniquely represented in terms of the social context of consumption.

Implications and future research

The representations that people form during their lifetime play a key role in driving their behavior (Ackerman, Nocera, & Bargh, 2010). Therefore, obtaining systematic insight into their content is vital to advance our understanding of drinking behavior. For instance, future research might look into the link between representations and implicit attitudes, and what content in a representation leads to a positive attitude towards alcohol and to impulsive drinking (Rooke et al., 2008, Stacy & Wiers, 2009). Similarly, alcohol priming research might benefit from increased insight into alcohol representations. Here, activating alcohol-related representations (e.g. "buzzed", "sexy") has been found to increase alcohol consumption (Hill & Paynter, 1992; Stein, Goldman, & Del Boca, 2000; Weingardt et al., 1996). The replicability of these so-called social priming effects has been called into question in recent years (for a review on this issue, see Cesario, 2014). It might be the case that such priming effects become more robust and reliable if the primes are tailored to an individual's alcohol representation. For instance, if participants do not represent alcohol in terms of features like "sexy", no priming effects on alcohol consumption are to be expected when they are exposed to the word "sexy". The property generation task offers a way to provide tailored prime concepts to participants, thereby potentially allowing for more reliable priming effects.

In a similar vein, interventions to reduce drinking are most effective when tailored to the individual (Krebs, Prochaska, & Rossi, 2010; Ringold, 2002). For instance, individuals who represent alcohol in terms of the social context of consumption might benefit more from an intervention that targets social norms or peer resistance than from education on the long-term health risks of drinking. However, when the long-term negative health consequences of drinking are not particularly salient, such as in our samples, the effectiveness of an intervention to reduce drinking might benefit from including education on weight and other health-related consequences of drinking. The property generation task might be a useful tool to tailor interventions by first assessing peoples' representations of alcoholic beverages. This task may thus supplement explicit motive questionnaires and interview methods in this regard, as property generation can be administered quickly and at low cost. Furthermore, the property generation task does not trigger participants to consciously reflect on what makes them drink. Considering that explicit measures of motivation or attitudes tap into different processes than implicit measures such as the property generation task (Nosek, Hawkins, & Frazier, 2011; Thrash, Maruskin, & Martin, 2012), it would be useful to further study whether the property generation task predicts long-term drinking outcomes over and above the current explicit measures of drinking motives.

Conclusion

The focus of this article has been on the representations of alcoholic beverages and the link with their consumption, but the property generation task as a method can also be relevant in the domain of eating. A recent study with the property generation task for instance found that palatable foods are strongly represented in terms of their consumption, and consumption representations were correlated with the desire to eat (Papies, 2013). While the studies reported here are only a first, preliminary application of this task to understanding alcohol representations, we hope that they inspire further work to fully understand the regulation of appetite, such as of eating and drinking behavior.

Footnotes

[1] Due to a programming error, 32 participants received only two of their three selected beverages per beverage category during the task. Including this as a between-subjects factor did not have an effect on the results, $F < 1$.

CHAPTER 4

Empirical investigation of simulations and appetitive reactivity

This chapter is based on:

Keesman M, Aarts H, Vermeent S, Häfner M, Papies EK (2016). Consumption simulations induce salivation to food cues. *PLoS ONE 11(11)*: e0165449. https://doi.org/10.1371/journal.pone.0165449

Author contributions:

MK and SV designed Experiment 1, and MK, EKP, MH, and HA designed Experiment 2; SV conducted the experiments; MK analyzed the data; MK drafted the manuscript and revised it with EKP; SV, MH, and HA provided feedback for further revisions. All authors approved the final version

Introduction

Seeing a food such as chips can be enough to make your mouth water. Much research supports this link between food cues and increases in salivation (for reviews, see Spence, 2011; O. W. Wooley & Wooley, 1981). The explanations of how food cues lead to salivation typically relate to classical conditioning (O. W. Wooley & Wooley, 1981): Much like Pavlov's dog, people associate the smell of chips with the salivation produced in response to eating them. Later, the smell of chips produces a salivary response, even in the absence of actual consumption. However, salivation is stronger under certain circumstances compared to others. For instance, food cues induce more salivation when the food is liked more (Rogers & Hill, 1989; White, 1978). Unrestrained eaters salivate more to food cues than do restrained eaters (i.e. chronic dieters; Nederkoorn & Jansen, 2002). Furthermore, hunger tends to increase salivation to food cues (Finch, 1938; S. C. Wooley & Wooley, 1973), although this relationship is not entirely clear (Christensen & Navazesh, 1984). Imagining a favorite food also increases salivation without any sensory exposure, especially when participants have vivid mental imagery (e.g. White, 1978). In summary, individuals seem to have especially strong salivary responses to food cues when the food is attractive. This suggests that the relation between food cues and salivation is more complex than a mere stimulus-response link.

In the current paper, we examine whether consumption simulations induce salivary responses to food cues. Specifically, we suggest that food cues trigger reenactments of earlier eating experiences, especially when the food is attractive, which then induce salivation. We refer to such reenactments as *simulations* (Barsalou, 2002; Hesslow, 2002). Figure 1 gives an overview of this account of salivary responses to food cues, which is derived from grounded cognition (Barsalou, 2008). This grounded account of salivation might also function to more generally predict and explain the effects of rewarding stimuli on appetitive responses. The current research, however, was designed to examine this in the context of salivation to food cues.

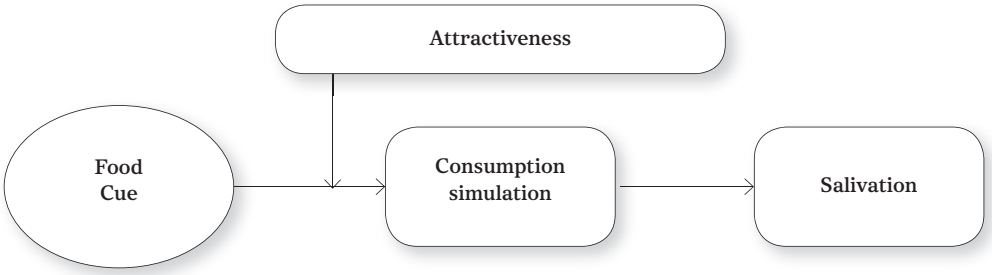

Figure 1.

Overview of our grounded cognition account of salivation to food cues

Salivation from the perspective of grounded cognition

Adopting a grounded cognition perspective, food cues trigger consumption simulations (Papies & Barsalou, 2015). This process of eliciting simulations is largely in line with models of associative networks (e.g. Smith, 1998): Earlier eating experiences are stored as representations in memory, and when any property of such a representation gets activated, this may reactivate associated features through pattern completion inferences (Barsalou, 2009; Holyoak, Novick, & Melz, 1994). A representation that best fits the current situation gets activated (Clark, 2013). As food experiences typically involve their consumption, food cues are therefore likely to elicit simulations of consumption. Seeing chips, for instance, may trigger simulations of their salty taste and the enjoyment of eating them (Papies, 2013). These simulations usually occur automatically and unconsciously, but they can be facilitated when people are induced to actively engage in or focus attention on them (Holland, Hendriks, & Aarts, 2005). A recent review of fMRI research on the neural processes underlying food perception and food consumption corroborates the notion that food cues trigger simulations of earlier eating experiences (Chen, Papies, & Barsalou, 2016). In these experiments, participants consumed a food in the fMRI scanner, or they were presented with a food word or picture. The results showed that the activated brain areas were similar for eating and perceiving a food. Both, for instance, activated taste and reward areas. Similar neural processes are thus active for both eating and perceiving food. This offers additional evidence that simply perceiving a food cue triggers simulations of earlier eating experiences.

Importantly, food cues are especially likely to trigger simulations of consumption when the food is considered attractive (Papies, 2013; Papies & Barsalou, 2015). A food may be considered attractive when the features related to consuming it are salient and rewarding, such as a pleasant taste or texture, or the positive affect of eating with friends. Similarly, when hungry, sensory and reward experiences of eating are amplified (Berridge, 1991; Seibt, Häfner, & Deutsch, 2007), which makes the food seem more attractive. These consumption experiences are stored in the representations of the food, and when subsequently cued with the food, they are *reenacted* as simulations. Both fMRI and behavioral research corroborate that attractive foods trigger more consumption-related simulations than neutral foods (Chen et al., 2016; Frank et al., 2010). Furthermore, consumption simulations are modulated by situational factors and goals, such that they are increased when hungry and decreased when a person holds a dieting goal that precludes consumption (Chen et al., 2016; Papies, 2013). Taken together, this evidence clearly supports the perspective that food cues especially induce simulations of consumption when the food is considered attractive.

When actually eating a food, the body produces a salivary response (de Almeida, Grégio, Machado, de Lima, & Azevedo, 2008; Kaplan & Baum, 1993). We suggest that

simulations of eating a food produce salivary responses similar to when a food is actually being eaten. This produced saliva is useful for chewing, swallowing, and digesting food (Kaplan & Baum, 1993). Saliva has an additional function for sour food, as it protects the digestive system by diluting harmful acids that may for instance cause dental erosion (Buzalaf, Hannas, & Kato, 2012; Kaplan & Baum, 1993). Accordingly, sourness of a food increases salivation (Watanabe & Dawes, 1988). Salivation thus facilitates the consumption of a food. Similarly, when simulations of consumption induce salivation, the body effectively prepares for and facilitates upcoming consumption of the food.

With this process of simulation, the grounded model of salivation to food cues can be used to explain the modulating effects of food properties, situational factors, and goals, on salivation that were described above. For example, we expect attractive compared to neutral foods to trigger increased simulations of consumption, which subsequently induce increased salivation. Furthermore, simulations are less likely to be triggered if an individual is trying to diet, when satiated, or when suffering from anorexia nervosa (Chen et al., 2016; Papies & Barsalou, 2015). Our account predicts that these conditions therefore reduce salivary responses. Indeed, individuals suffering from anorexia nervosa salivate less to food cues than a control group (LeGoff, Leichner, & Spigelman, 1988). Consumption simulations might similarly explain and predict other embodied reactions to food cues. One such reaction is the release of the hormone ghrelin, which increases appetite and prepares the body to eat by triggering gastric contractions that aid digestion (Inui et al., 2004; Schmid et al., 2005; Wren et al., 2001). Parallel to the expected increase in salivation for attractive compared to neutral food in the current research, ghrelin is increased when participants are cued with an indulgent compared to healthy milkshake (Crum, Corbin, Brownell, & Salovey, 2011). This suggests that ghrelin is induced by a more complex psychological process than a direct stimulus-response link. We suggest the mechanism is similar to that of salivation: food cues trigger simulations of eating the food, which then induce the release of ghrelin. Simulations then generally work to prepare the body to eat, not just by inducing salivation, but also leading to other bodily responses reactions, such as by releasing ghrelin and inducing an approach impulse to pick up the food. Importantly, if this is the case, the grounded model with simulation as its central mechanism could be used to better predict appetitive responses to food cues more generally.

Overview of the present chapter

In the present chapter, we systematically tested whether consumption simulations induce salivation, and thus whether the link between food cues and salivation is more complex than a mere direct stimulus-response link. We assessed salivation to an attractive food, a neutral food, a sour food, and a non-food control object. In previous

experiments examining salivation in response to food cues, researchers often instructed participants to simulate eating the food (Hardman, Scott, Field, & Jones, 2014; Jansen, Stegerman, Roefs, Nederkoorn, & Havermans, 2010; Rogers & Hill, 1989; O. W. Wooley, Wooley, & Woods, 1975). Participants have been instructed, for instance, to "imagine as vividly as (you can) that (you are) actually eating the food", "imagine its taste and its texture in your mouth", and "give in to the feelings the pictures elicit." As a proof of concept of our methodology, in our Experiment 1, we also instructed participants to simulate consuming any object that they would be exposed to. The salivary responses were tested in a within-participants design to increase statistical power, as salivary responses are highly stable within individuals (Neyraud, Palicki, Schwartz, Nicklaus, & Feron, 2012; Sánchez-Pérez et al., 2015). We hypothesized that more saliva would be induced for the neutral food compared to the non-food control object, and more saliva for the attractive compared to neutral food. We further tested the hypothesis that sour food leads to the most salivation.

Experiment 2 took our test one step further by examining whether simulations of consumption induce salivation in response to food cues. The same objects were included as in Experiment 1. This time, half of participants were instructed to simulate consuming the presented objects, and the other half of participants were not. This allowed us to directly test whether simulating consumption increased salivation. Furthermore, we included a measure of consumption simulations and of desire to eat. As in Experiment 1, we hypothesized that more saliva would be induced in response to the foods than the non-food control object, especially when they were attractive or sour. Importantly, we hypothesized that salivation for the attractive and sour foods would be especially increased when participants simulated their consumption. For the attractive food, we furthermore expected to find a correlation between salivation and desire to eat, as both may indicate reactivity to food cues (Jansen, 1998; Jansen et al., 2010; Nederkoorn, Smulders, & Jansen, 1999).

Experiment 1

Methods

Design and participants

We recruited 20 participants (5 males; age M = 20.96, SD = 2.26). We determined this sample size with an a priori power analysis with α at .05, and 95% power to detect the difference in salivation during food exposure compared to salivation at baseline as reported by Hardman and colleagues (2014). Participants could only sign up for participation if they did not smoke, if they liked chips (the selected attractive food), and if they agreed not to eat one hour before participation. Only non-smokers were recruited as smoking decreases salivary flow (Rad, Kakoie, Niliye Brojeni, & Pourdamghan, 2010; Trudgill, Smith, Kershaw, & Riley, 1998). We used a within-participants design with four types of objects (attractive food, neutral food, sour food, non-food control object) and salivation as the dependent variable.

Materials

As stimulus materials, we used a small bag of chips (attractive food), a slice of bread with cheese (neutral food; typical Dutch breakfast food), a lemon slice (sour food), and a block of wood (non-food control object; Naumann, Trentowska, & Svaldi, 2013). Each participant received a new bag of chips, which was opened and put in a bowl in front of the participants. A fresh slice of lemon was cut in front of each participant, and was then put on a plate. During the experiment, participants did not eat any of the items.

Simulation instructions

Participants were instructed to simulate eating each of the objects as follows: "I want you to focus on the object as much as possible. Use the entire minute to focus on the following: Pick up the object. How does it feel? How does the object smell? How would the object taste? What would it be like to have this object in your mouth?" (Hardman et al., 2014).

Saliva collection

For the collection of saliva, we used plastic cups that were marked and weighed using a 0.01-gram precision scale. Before collection started, we instructed participants to swallow. Then, we instructed them to keep their lips closed, to keep their tongue unmoved, and to refrain from swallowing for one minute. After one minute of stimulus exposure, participants collected their saliva and spit it out in the plastic cup, which was subsequently weighed by the experimenter. We instructed participants to not eat any of the items during the experiment, but they could eat it at a later time if they wished.

Procedure

Participants read and signed the informed consent form, and were asked to rinse their mouth with a cup of water. Then, they reported their current hunger and thirst. The experimenter told participants that they would be exposed to various objects and gave them the simulation instruction. Then, the saliva collection procedure was explained to them. To probe for understanding, participants were asked to repeat what was explained to them.

Participants were first exposed to the non-food control object, and a saliva sample was taken. A 3 minute break followed during which participants could read chapter one of the popular novel "The Hobbit" (Tolkien, 2001). This procedure was then repeated for the three foods, to which each participant was exposed to in random order. After the saliva collection for all items, participants rated each food on tastiness and frequency of consumption. This was done on scales from 1 (not at all tasty/never, respectively) to 7 (very tasty/very often, respectively). See Figure 2 for an overview of the procedure.

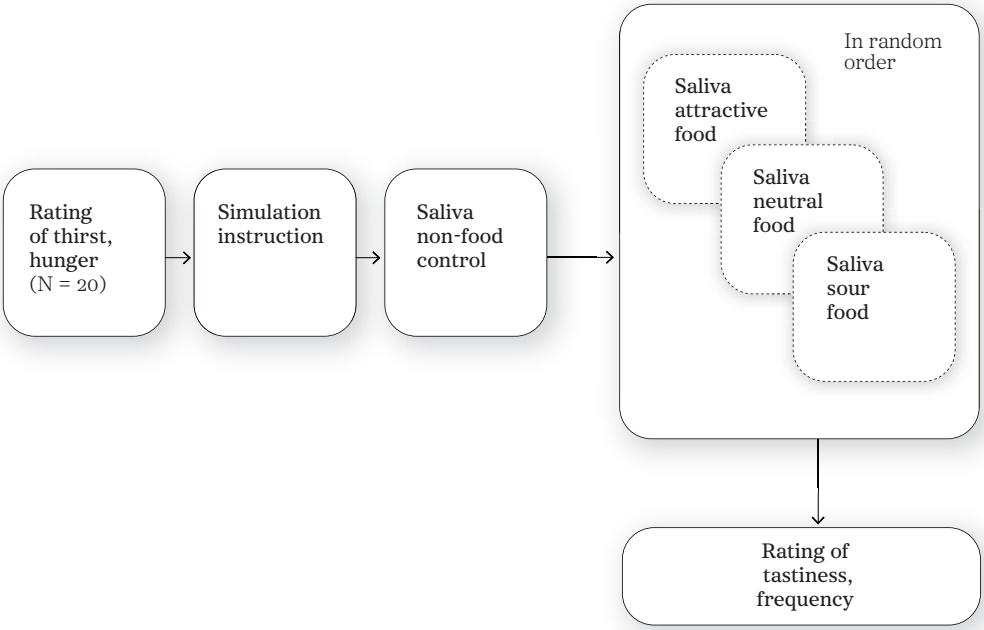

Figure 2.

Overview of the procedure of Experiment 1

Results

Descriptive statistics

Participants had a healthy BMI of 21.47 (*SD* = 2.49). Participants rated their hunger to be around the midpoint of the scale, at 4.05 (*SD* = 1.32).

Outlier removal

We considered data points that differed by more than 3 standard deviations from the mean as outliers. In this Experiment, there were no outliers.

Manipulation check

The attractive food (M = 5.80, SD = .83) was considered tastier than the neutral food (M = 3.90, SD = 1.68; $t(19) = 4.20$, $p < .001$) and the sour food (M = 4.25, SD = 1.68; $t(19) = 3.28$, $p = .004$). This indicates that our attractiveness manipulation was successful.

Main analyses

In line with our hypotheses, foods induced more salivation than the non-food control object, especially when attractive or sour, as can be seen in Figure 3. Paired t-tests indicated that there was significantly more salivation for the neutral food than for the non-food control object, $t(19) = 3.73$, $p = .001$, $d = .83$ (with 95% CI .31,1.33).

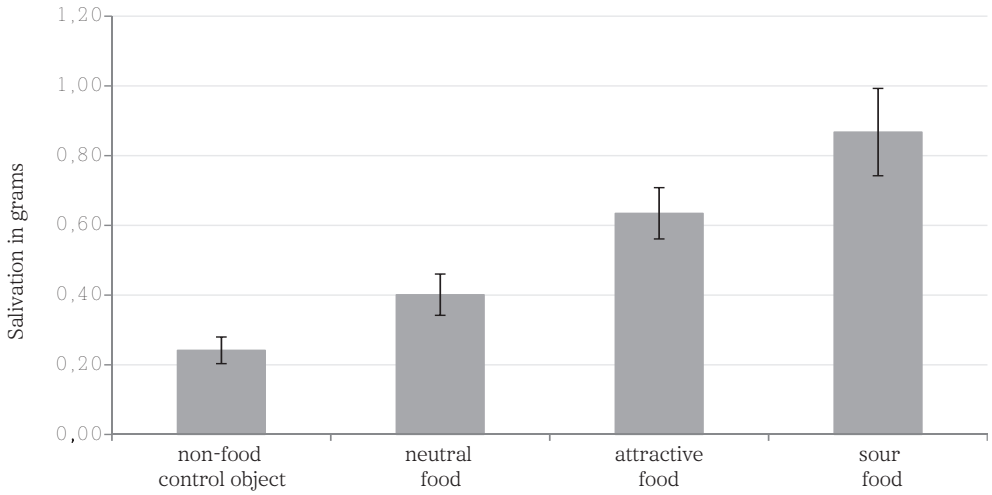

Figure 3.

Salivation in response to stimulus exposure and simulating its consumption in Experiment 1. Different letters indicate significant differences between objects, p < .05. Error bars represent standard errors from the mean.

Furthermore, more saliva was produced for the attractive than for the neutral food, $t(19) = 5.74$, $p < .001$, $d = 1.29$ (with 95% CI .68,1.87). More saliva was also induced for the sour compared to attractive food, $t(19) = 2.51$, $p = .021$, $d = .56$ (with 95% CI .08, 1.02). In sum, foods triggered salivary responses, especially when the food was attractive or sour, and the sizes of these effects were large.

There were no main or interaction effects of order, all $F < 1.62$, $p > .16$.

Further analyses

There were no main or interaction effects of gender or of self-reports of hunger on salivation to the foods (neutral, attractive, sour), all $F < 1$.

Discussion

The results confirmed our hypotheses that people salivate more to foods than to a non-food control object, especially when they are attractive or sour. The finding that more saliva was induced for the sour compared to neutral food replicates other previous experiments (Nederkoorn et al., 1999; Watanabe & Dawes, 1988). Although the effect of food attractiveness on increased salivation has not been examined often, our findings do replicate this limited earlier work (Rogers & Hill, 1989; White, 1978). The effect of food attractiveness on increased salivation cannot be explained by mere stimulus-response links, but fits our grounded model, with simulation as the process that induces salivation.

Experiment 2

Experiment 2 was designed to examine whether consumption simulations induce salivation to food cues. The procedure was largely similar as for Experiment 1, but now half of participants were instructed to simulate eating each item, and half were instructed to merely look at them. This allowed us to directly test the effect of simulating consumption on salivation to food cues. Additionally, after measuring salivation as in Experiment 1, participants rated their simulations and desire to eat for each object separately. We again hypothesized that food cues would increase salivation, especially when the food was attractive or sour. Importantly, we hypothesized the instruction to simulate to increase the effect of object type on salivation, relative to the mere exposure instruction. We further expected salivation and desire to eat to be correlated for the attractive food.

Methods

Design and participants

We recruited 60 participants (17 male; mean age = 21.17, *SD* = 2.29). An a priori power analysis with α at .05 and 95% power indicated that a sample size of 11 would be required to detect the difference in salivation between the attractive and neutral food from Experiment 1. As the effect sizes for the mere exposure condition were unknown, we chose to collect data from 30 participants per group, and thus from 60 in total. This allowed us to detect an effect size of d = .68, about half the effect size we found in Experiment 1 for the difference in salivation to the attractive compared to neutral food. Again, participants could only sign up for participation if they had not participated in Experiment 1, did not smoke, liked chips (the selected attractive food), and if they agreed not to eat one hour before participation. The experiment had a 2 (condition: instructed simulation, mere exposure; between participants, with random assignment) x 4 (object type: attractive food, neutral food, sour food, non-food control object; within participants) mixed design with salivation as the dependent variable.

Conditions

Participants in the instructed simulation condition received the instruction to simulate eating each of the presented objects as in Experiment 1. Participants in the mere exposure condition received the instruction to "focus on the object for one minute. I will ask you some questions about it later". Thus, no mention was made of simulation, consumption, or touching any of the items.

Measure of simulations

For each item, participants reported the extent to which they had experienced simulations related to food consumption. This was done using 5 statements to which participants responded on a scale from 1 (not at all) to 10 (definitely; "I imagined that I was eating the object", "It was as if I could really taste the object", "It was as if I could really feel the texture of the object in my mouth", "I imagined how it would be to eat the object", "I imagined how eating this object would make me feel"; based on Tiggemann & Kemps, 2005). A measure of simulations was created using the average score of the 5 items, $\alpha > .84$ for each of the foods.

Desire to eat

For each item, participants were asked to respond to the statement "I would have liked to eat (the item)" on a scale from 0 (not at all) to 10 (very much).

Concern for dieting

To assess concern for dieting, a 6-item subscale of the restraint scale with statements such as "I diet...." was administered (Herman & Polivy, 1980). The response options ranged from 0 (never) to 3 (always) and 0 (not at all) to 4 (strongly), α = .76.

Procedure

The experiment largely followed the procedure of Experiment 1; see Figure 4 for an overview. First, ratings of participants' current hunger and thirst were obtained as in Experiment 1. The experimenter then told participants that they would be exposed to various objects. Then, participants received the simulation or mere exposure instruction. Salivation was assessed as in Experiment 1, first for the non-food control object, and then in random order for each of the three foods. After saliva collection was finished, simulation ratings were obtained for each object, and then ratings of desire to eat. As in Experiment 1, participants rated the tastiness of each food, but also rated the foods on other properties such as sourness and crunchiness. This was done on scales from 1 (not at all) to 7 (very much). Then, participants completed the concern for dieting scale. Finally, all participants were thanked for their participation and received remuneration.

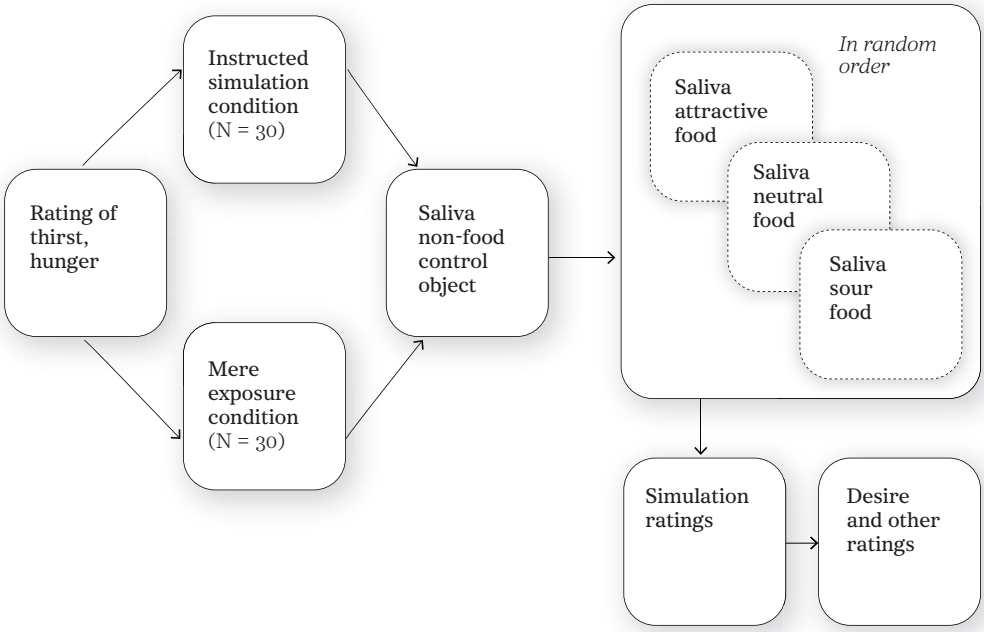

Figure 4.

Overview of the procedure of Experiment 2

Results

Descriptive statistics

Table 1 displays the descriptive statistics, showing that participants had a healthy BMI, low concern for dieting, and medium levels of hunger.

Outlier removal

We considered data points that differed by more than 3 standard deviations from the mean as outliers, and did not include them in our analyses. Outlier removal did not influence our main results. Two participants had outliers for the measures of salivation and simulation, for one participant there was an outlier for desire to eat.

Manipulation check

The attractive food (M = 5.78, SD = 1.62) was considered tastier than the neutral food (M = 4.28, SD = 1.34; $t(59)$= 6.12, $p < .001$) and the sour food (M = 3.82, SD = 1.63; $t(59)$ = 6.67, $p < .001$). Furthermore, the sour food (M = 6.22, SD = .94) was considered more sour than the neutral food (M = 1.30, SD = .74; $t(59)$ = 34.33, $p < .001$) and the attractive food (M = 1.23, SD = .72; $t(59)$ = 34.71, $p < .001$). These analyses suggest that our attractiveness and sourness manipulations were successful.

Importantly, participants in the instructed simulation condition reported more consumption simulations than those in the mere exposure condition, $F(1,56) = 31.93$, $p < .001$, $\eta p^2 = .36$. Furthermore, in the absence of explicit simulation instructions, participants reported increased simulation ratings for the attractive food compared to the other foods, all within participant contrasts, $F(1,27) > 12.05$, $p < .003$, $\eta p^2 > .30$. These results indicate that our manipulation of instructed simulation was successful. Additionally, the attractive food triggered the most consumption simulations. See Figure 5 for an overview of the simulation ratings.

Table 1.

Descriptive statistics of the participants in Experiment 2, by condition.

	Instructed simulation *N = 30*	**Mere exposure** *N = 30*	**Differences**
BMI	M = 21.40 (SD = 2.20)	M = 21.27 (SD = 1.92)	$t < 1$, p = .80
Concern for dieting (range: 0 - 20)	M = 6.63 (SD = 3.08)	M = 5.90 (SD = 3.40)	$t < 1$, p = .38
Hunger (range: 1 - 7)	M = 4.03 (SD = 1.35)	M = 4.03 (SD = 1.38)	$t < 1$, p = .99

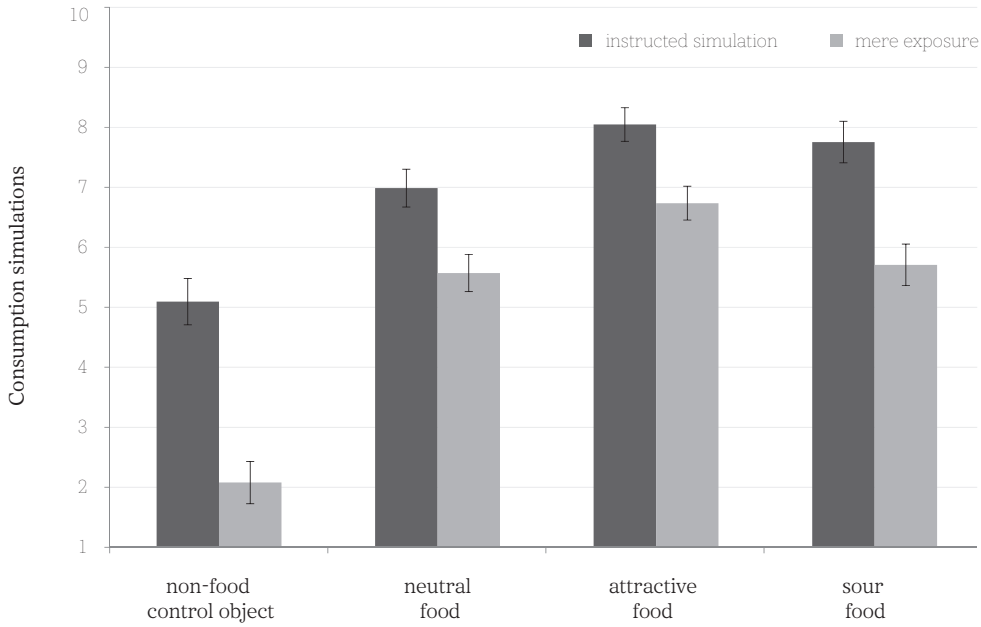

Figure 5.

Simulation in response to stimulus exposure, presented with standard errors.

Main analyses

We replicated our findings from Experiment 1 that foods induce more salivation than a non-food control object, especially when attractive or sour. Participants in the instructed simulation condition salivated significantly more to the neutral food than to the non-food control object, $t(29) = 4.69$, $p < .001$, $d = .86$ (with 95% CI .43, 1.27). More saliva was also produced for the attractive than for the neutral food, $t(29) = 6.18$, $p < .001$, $d = 1.13$ (with 95% CI .66, 1.58), and more for the sour than attractive food, $t(29) = 2.25$, $p = .032$, $d = .41$ (with 95% CI .03, 78). The same pattern of results was found in the mere exposure condition. Participants salivated more to the neutral food than the non-food control object, $t(27) = 4.29$, $p < .001$, $d = .81$ (with 95% CI .38, 1.23).

More saliva was also produced for the attractive than for the neutral food, $t(28) = 3.04$, $p = .005$, $d = .53$ (with 95% CI .13, .92), and more for the sour than attractive food $t(28) = 2.90$, $p = .007$, $d = .58$ (with 95% CI .17, 98). In sum, foods triggered salivary responses, especially when the food was attractive or sour. An overview of these findings can be seen in Figure 6.

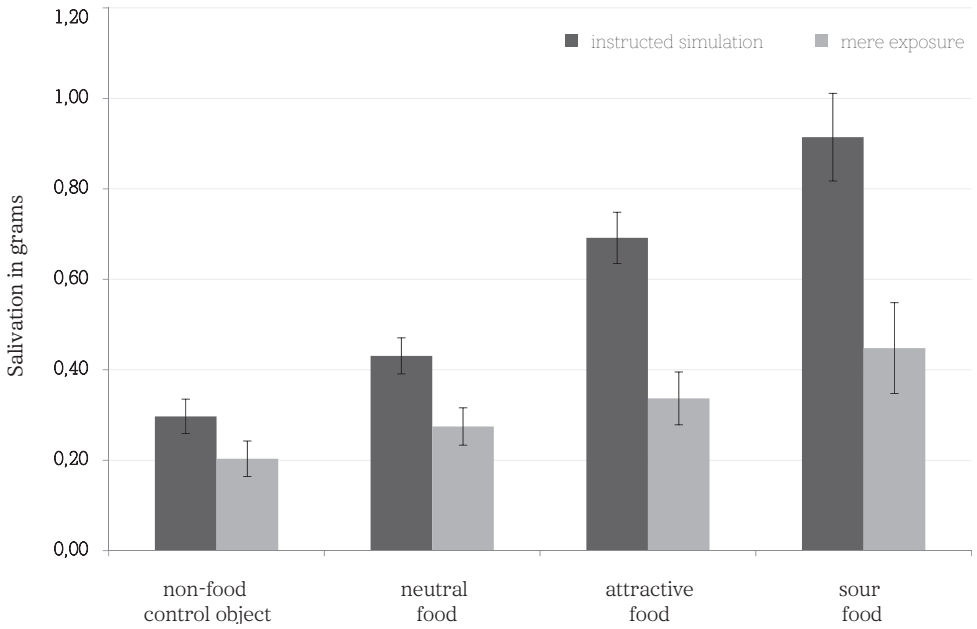

Figure 6.

Salivation in response to stimulus exposure and simulating its consumption, presented with standard errors.

Importantly, for attractive and for sour food compared to neutral food, salivation was especially increased when participants were instructed to simulate consumption. This was confirmed by the predicted interaction of condition with object type, $F(3,168) = 8.27$, $p < .001$, $\eta p^2 = .13$. With unequal variance t-tests, we found the instruction to simulate consumption to increase salivation for the attractive food, $t(46.32) = 3.97$, $p < .001$, $d = 1.03$ with 95% CI [.48, 1.58], the neutral food, $t(52.06) = 2.43$, $p = .019$, $d = .63$ (with 95% CI .10, 1.15), and the sour food, $t(44.08) = 2.95$, $p = .005$, $d = .76$ (with 95% CI .23, 1.29), but not for the non-food control object, $t(57) = 1.27$, $p = .21$, $d = .33$ (with 95% CI -.19, .84). Thus, the instruction to simulate increased salivation, and it modulated the effect of object type on salivary responses such that attractive and sour food especially increased salivation compared to neutral food when simulating its consumption.

As in Experiment 1, there were no main or interaction effects of order on salivation, all $F < 1$.

Finally, salivation and the desire to eat were correlated for the attractive food, $r(54) = .35$, $p = .008$, but not for the neutral and sour food, respectively $r(54) = .16$, $p = .23$, and $r(54) = .16$, $p = .24$. When computing these correlations, we controlled for salivation for the non-food control object.

Further analyses

Participants experienced more desire to eat for the attractive food than for the neutral food, sour food, and non-food control object, all these contrasts, $F(1,55) > 34.88$, $p < .001$, $\eta p^2 > .38$. There was no main effect of condition on the variable assessing desire to eat, $F = 1.28$, $p = .26$, but there was an interaction effect of condition with object type, $F(3,165) = 4.02$, $p = .009$, $\eta p^2 = .07$. With unequal variance t-tests, we found the instruction to simulate consumption to somewhat increase the desire to eat the attractive food, $t(49.70) = 1.79$, $p = .080$, $d = .45$ (with 95% CI -.06, .97). The instruction to simulate further increased the desire to eat the sour food $t(58) = 2.09$, $p = .041$, $d = .54$ with 95% CI (.02, 1.05), and somewhat increased the reported desire to eat the non-food control object, $t(30.01) = 1.86$, $p = .072$, $d = .44$ (with 95% CI -.04, 1.01). However, it somewhat decreased the desire to eat the neutral food, $t(52.85) = -1.78$, $p = .080$, $d = -.46$ (with 95% CI -.97, .06). An overview of these findings can be found in Figure 7.

There was no main effect of hunger on salivation, nor did hunger interact with condition or object type, all $F < 1$.

There was also no main effect of concern for dieting on salivation, nor did concern for dieting interact with condition or object type, all $F < 1$.

There was a main effect of gender on overall salivation, such that men salivated significantly more ($M = .57$, $SE = .08$) than women ($M = .40$, $SE = .05$), $F(1,37) = 4.52$, $p = .040$, $\eta p^2 = .11$. However, gender did not interact with object type or condition, or their interaction, all $F < 1.3$, $p > .27$.

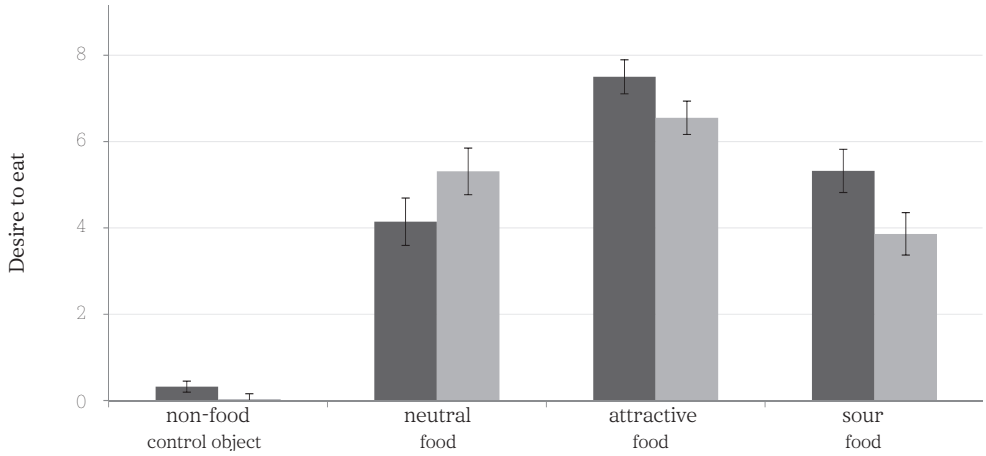

Figure 7.

Desire to eat by object type and condition in Experiment 2, error bars represent standard errors from the mean.

Discussion

Replicating Experiment 1, the findings of Experiment 2 showed that foods led to stronger salivary responses than a non-food control object. Salivary responses were further increased for attractive and sour food. Importantly, these effects of object type were stronger when participants were instructed to simulate consumption. Instructed simulation further increased salivation in response to the foods, but not to the non-food control object. Salivation to the attractive food was also associated with the desire to eat it. The main findings confirm our account that consumption simulations play a crucial role in inducing salivary responses to food cues.

The instruction to simulate seemed to increase the desire to eat the attractive and sour food and to decrease the desire to eat the neutral food, but no strong conclusions can be drawn from these results. More conclusive evidence regarding the effect of a simulation manipulation on desire could be obtained in an experiment with increased statistical power, and by assessing desire directly after stimulus exposure instead of at the end of the experiment. We found no effect of concern for dieting on salivation, which is in line with some previous studies (Rogers & Hill, 1989), but differs from others (Nederkoorn & Jansen, 2002; Klajner, Herman, Polivy, & Chhabra, 1981). The absence of a moderating effect of concern for dieting may be due to participants' generally low concern for dieting.

General Discussion

In the present chapter, we report evidence for a grounded account of salivation to food cues, suggesting a crucial role of consumption simulations for inducing salivation. In both Experiment 1 and 2, foods increased salivation compared to a non-food control object, especially when the food was attractive or sour. Importantly, in Experiment 2, attractive and sour foods especially increased salivation when participants were instructed to simulate consumption. Overall, the instruction to simulate increased salivation to the foods compared to the mere exposure instruction. Salivation to the attractive food was additionally associated with the desire to eat it. The results thus show that simulations of consumption increase salivary responses to food cues.

Simulation is a basic psychological process (Barsalou, 2009), and we expect simulations of consumption to trigger appetitive responses to rewarding stimuli in various domains, such as alcohol consumption, sex, and smoking (Barsalou & Papies, 2015). In line with this, a recent meta-analysis suggests that similar brain regions are active when cued with food and cigarettes, compared to neutral stimuli (Tang, Fellows, Small, & Dagher, 2012). This suggests that food and cigarette cues induce similar psychological processes, such that both induce simulations of consumption. Furthermore, an fMRI study found that alcohol cues induce reward simulations, and that these were associated

with craving in individuals that are addicted to alcohol (Myrick, Anton, Li, Henderson, Drobes, & Voronin, 2003). More research is needed, however, to confirm whether consumption simulations induce such appetitive responses. A comprehensive framework of how appetitive responses are induced, such as the presented grounded framework, contributes to better understanding and predicting when appetitive responses arise.

If simulations of consumption work to trigger appetitive responses more generally, interventions to reduce undesired appetitive responses could be made more effective by targeting these simulations. This is because interventions are most effective when they prevent appetitive motivation rather than when they help resisting a current appetitive motivation (Marteau, Hollands, & Fletcher, 2012). For instance, not eating chips or not smoking a cigarette is easier when no appetitive motivation arises in the first place than when this motivation needs to be controlled and resisted. An experience sampling study on temptations portrays the magnitude of this issue (Hofmann, Baumeister, Förster, & Vohs, 2012). Participants in this study were prompted 7 times per day, for 7 consecutive days, to respond to questions of whether they currently experienced temptations. On 76.6% of these prompts, participants indicated to currently experience or to have recently experienced an appetitive motivation, such as for food, for cigarettes, or to use social media. Importantly, participants enacted on 48% of these temptations, which could be predicted from the strength of their reported appetitive motivation. As we suggest that simulations of consumption induce appetitive responses, modulating these simulations is an important starting point for interventions. The priming of health goals is one approach to reduce simulations of consumption (Chen et al., 2016), which then subsequently prevents the appetitive behavior (Papies, 2016; Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014). Another approach is to reduce reactivity to simulations of consumption using a mind-tool such as the decentering component of mindfulness (see also Chapter 2 and Chapter 5). Overall, the grounded framework may be a useful starting point for the development of interventions to prevent undesired appetitive responses (see also Papies, 2016).

As a final note, it is important to stress that in psychological research, salivation to food is often taken as a proxy for desire to eat, where both indicate reactivity to food cues (Jansen, 1998; Jansen et al., 2010; Nederkoorn et al., 1999). However, research does not consistently find an association between salivation and this desire to eat the food (Nederkoorn & Jansen, 2002; Nederkoorn, Smulders, & Jansen, 2000; Van Gucht et al., 2008). Our finding suggests that there may indeed be an association between salivation and desire to eat. Such an association might be explained from the perspective of grounded cognition, which suggests consumption simulations induce desire to eat (Papies & Barsalou, 2015), as well as salivation to food cues. Furthermore, to the extent that people are consciously aware of their salivary responses to food cues, they may infer that they want to eat it, which may

increase their subjective experience of desire (Lindquist & Barrett, 2012). Accordingly, the association between desire to eat and salivation fits with grounded cognition and psychological construction.

A limitation of the current research is that we could not disentangle the visual and olfactory sources that contributed to the difference in salivation between each of the foods. Furthermore, we only obtained one saliva sample for each type of food, which precludes us from generalizing this research to other foods. This is common in research on salivation to food cues, however, with many studies having only assessed salivation at baseline (without any objects) and to one food item. One reason for researchers to obtain only a limited number of saliva samples might be that salivation might be decreased when obtaining many such samples. This might be especially likely when using the standard method of obtaining saliva samples of using up to three cotton rolls to absorb the saliva in a participant's mouth. These cotton rolls might leave a dry mouth, and participants might also find it a somewhat aversive experience, which could then lead to decreased salivation on subsequent trials. Using the spitting method, however, we showed that it is possible to obtain at least four saliva samples without order effects. Furthermore, we included a non-food object as a control stimulus, similar to Naumann and colleagues (2013), which is important, but not yet a standard procedure in research on salivation to food cues. Future research could therefore benefit from the paradigm designed here with a control stimulus and the spitting method to obtain saliva samples.

Conclusion

To conclude, the present study examined motivated consummatory responses to food cues, and demonstrated that salivary responses are increased when people simulate the consumption of food that benefits from such responses. The role of simulations in consummatory behavior of food has been largely neglected so far as a potential source for under- and overregulation of eating behavior. We therefore hope that the present analysis might offer an interesting and fruitful avenue for further research in this important health domain.

CHAPTER 5

Empirical investigation of decentering during imagery

The decentering component of mindfulness reduces reactivity to mental imagery

This chapter is based on:

Keesman, M., Aarts, H., Häfner, M., & Papies, E. K. (2017).
The decentering component of mindfulness reduces reactivity to mental imagery.
Unpublished manuscript.

Author contributions:

MK and EKP designed the experiments with feedback from MH and HA;
MK or research assistants conducted the experiments; MK analyzed the data;
MK drafted the manuscript and revised it with MH and HA; EKP provided feedback for further revisions
All authors approved the final version.

Introduction

In a world of abundance, the regulation of behavior is key for well-being (Carver & Scheier, 2001). One cognitive process that facilitates this is mental imagery, i.e. thoughts expressed as a seemingly real experience of a past or potential future situation (Taylor, Pham, Rivkin, & Armor, 1998). Mental imagery facilitates the regulation of behavior by enabling one to prepare for and motivate action in the imagined situation (Barsalou, 2009; Niedenthal, 2007; Taylor et al., 1998). For instance, when imagining a bad review for a paper, this may trigger the motivation to work harder. Or when imagining the consumption of a food, this induces salivation even before the food reaches the mouth, thus preparing for its consumption (see Chapter 4 for a detailed discussion). Imagery can thus facilitate behavior regulation by motivating and preparing for action.

Imagery can also hinder behavior regulation, however, by inducing states that are at odds with someone's aims of behavior regulation. Imagery of a bad review for a paper might for instance induce a fear response that leaves someone unable to stop working, or that makes it difficult to fall asleep at night. Furthermore, rewarding imagery of consumption might induce the motivation to consume high-caloric snacks, alcohol, or cigarettes (May, Kavanagh, & Andrade, 2015; Papies & Barsalou, 2015). Indeed, much research shows that continuously elaborating on unpleasant or rewarding imagery is associated with psychopathologies such as depression and binge eating (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). While mental imagery can thus be a useful tool to enhance well-being through the regulation of behavior, it may also trigger reactivity that impedes it. Therefore, it is vital to conduct research on psychological interventions to reduce this undesired reactivity stemming from mental imagery.

In the research reported in the present chapter, we examined the role of the decentering component of mindfulness for reducing reactivity to mental imagery i.e. the insight that thoughts and other experiences are impermanent, rather than permanent or reflecting an objective reality (Bishop et al., 2004; Dreyfus, 2011; see also Hölzel et al., 2011; Tang, Hölzel, & Posner, 2015). Mindfulness-based interventions have become popular as a way to reduce reactivity, and they have been successfully implemented to reduce anxiety, depression, and unhealthy eating (for meta-analyses, see Hofmann, Sawyer, Witt, & Oh, 2010; Katterman, Kleinman, Hood, Nackers, & Corsica, 2014). However, one important question that requires an answer is how mindfulness exactly affects the mental imagery that plays a role in triggering undesired reactivity. As one example, the body-scan, which is a typical mindfulness-based exercise, has been found to reduce mental imagery (May, Andrade, Batey, Berry, & Kavanagh, 2010), because it taxes working memory (van den Hout et al., 2011). Furthermore, people high in trait mindfulness have decreased intrusive imagery, are better able to stop their imagery, and can distract themselves from it (Ostafin, Kassman, & Wessel, 2013). These findings

using a broad mindfulness-based exercise and mindfulness questionnaire thus suggest that mindfulness prevents undesired reactivity by reducing mental imagery. Here, we suggest that mindfulness can also reduce reactivity to mental imagery and other forms of thought while these are active in one's mind.

To better understand how mindfulness works, previous research has started testing the role of the specific components of mindfulness, such as decentering. Among experienced meditators, as well as after completing a mindfulness-based intervention, decentering is often measured using questionnaires, and it is found to be correlated with reduced negative affective reactivity, such as pain, anxiety, and depression (Fresco et al., 2007; Hoge et al., 2014; Lau et al., 2006; Shoham , Goldstein, Oren, Spivak, & Bernstein, 2017). Similarly, decentering is associated with reduced cravings for food (Papies, Winckel, & Keesman, 2016; see also Chapter 6). To directly examine the causal role of decentering in reducing reactivity, a brief decentering instruction was recently developed to teach participants about the insight that thoughts are merely impermanent events. Participants engaging in decentering, relative to control participants, had reduced impulses to grab food (Papies, Barsalou, & Custers, 2012), and consume fewer unhealthy snacks at home and in the university cafeteria (Jenkins & Tapper, 2014; Moffitt, Brinkworth, Noakes, & Mohr, 2012; Papies, Pronk, Keesman, & Barsalou, 2015). The decentering component of mindfulness thus seems to play a key role in reducing reactivity to unpleasant stimuli (Bernstein et al., 2015), and to rewarding stimuli (for an overview, see Chapter 2).

One way through which mindfulness might work is by reducing imagery, for example by inducing distraction or suppression of one's thoughts, or by taxing working memory (see e.g. Tapper, 2017; van den Hout et al., 2011). However, it has also been suggested that engaging in decentering reduces reactivity to imagery while this is kept active in mind, such that this imagery becomes less compelling by applying decentering (Chiesa, Anselmi, & Serretti, 2014; Chapter 2). Yet, earlier research on trait decentering or decentering inductions does not allow us to disentangle whether decentering reduces imagery, or whether it reduces reactivity to imagery (e.g. Hoge et al., 2014; Papies et al., 2012, 2015). The current research was therefore designed to examine whether decentering can also reduce reactivity to mental imagery and other forms of thought. We systematically examined this aspect of decentering by instructing all participants to sustain their attention on the mental imagery induced by a stimulus, thus precluding suppression or distraction. We hypothesized that participants would display reduced reactivity to an imagined unpleasant event or appetizing food when they also engaged in decentering, compared to control participants who did not apply decentering to their imagery.

The current research

To systematically test the hypothesis that decentering reduces reactivity to mental imagery, we conducted four experiments, including one replication experiment. In Experiment 1a and in the replication Experiment 1b, we tested the hypothesis that decentering reduces reactivity to imagery of an unpleasant experience. All participants were instructed to vividly imagine an unpleasant autobiographic experience. In addition, decentering participants were instructed to apply a decentering perspective to this imagery, and control participants were instructed to apply an immersed perspective to this imagery. The immersion instruction – and the decentering instruction to observe the imagery – ensured that participants would keep their imagery active, and not suppress it, or distract themselves from it. In Experiment 2, we applied this approach to test the hypothesis that decentering reduces reactivity to rewarding imagery of an attractive food. In Experiment 3, we extended this toward an implicit measure of reactivity toward attractive food, namely the amount of salivation. Furthermore, control participants were now only exposed to the food, without receiving any further instruction such as about immersion.

In each experiment, we provided participants with a brief 3-minute decentering instruction (see also Jenkins & Tapper, 2014; Papies et al., 2015). This approach is far removed from teaching mindfulness through extensive meditative practice within an Buddhist ethical framework (Chadha, 2015; Grossman & Van Dam, 2011; Murphy, 2016). To answer the current hypothesis, however, this approach was preferred as it provides a test of decentering under tightly controlled conditions. As an example, it rules out any influence from other mindfulness or meditation-related aspects such as acceptance or compassion (Alberts, Thewissen, & Middelweerd, 2013; Hofmann, Grossman, & Hinton, 2011), or from sample characteristics such as an individual's previous meditation practice (Creswell, Myers, Cole, & Irwin, 2009). Furthermore, manipulating decentering in an experimental design, rather than measuring it in a correlational study, allows us to draw causal inferences about the mechanisms and effects of decentering with respect to mental imagery.

Experiment 1a

Experiment 1a was designed to test the hypothesis that engaging in decentering reduces negative affective reactivity to imagery of an unpleasant event. The experiment consisted of two sessions which were administered in a counterbalanced order. In one session, participants imagined an unpleasant autobiographic experience and engaged in immersion, and in the other session, participants imagined this same experience and engaged in decentering. Thus, participants were always instructed to imagine the unpleasant experience in detail, and results can thus not be explained by a suppression or distraction account. Furthermore, participants imagined the same autobiographical experience in both sessions to keep the content of the mental imagery as similar as possible. To rule out carry-over effects of the decentering manipulation, the order of the sessions was counter-balanced, and participants were randomly assigned to an order. Taken together, this was a highly controlled design to test whether decentering reduces reactivity to imagery of an unpleasant experience.

Methods

Design and participants

Affective reactivity to the mental imagery of an unpleasant autobiographic event was examined in a 2 (instruction: mental imagery + immersion vs. mental imagery + decentering; within-participants) x 2 (order: first session mental imagery + immersion vs. first session mental imagery + decentering; between-participants) design with random assignment to order.

Twentyone participants completed both sessions of the experiment (8 males; age M = 21), and this sample size was based on a pilot study. On average, there were seven days between the two sessions. One additional participant completed the first but not the second session of the experiment and was therefore excluded from any analyses.

Materials

Instruction

The instructions for the decentering and control perspectives were of similar length and structure, took about 3 minutes, and were both based on a 12-minute decentering and immersion induction by Papies, Pronk, Keesman, & Barsalou (2015).

For mental imagery + decentering, participants were instructed to imagine an unpleasant autobiographic event and to observe their thoughts as transient mental events that arise and dissipate again. We provided an illustration of this perspective by comparing it to observing the stream of water in a waterfall. We told them not to resist this stream, and to not pretend that it does not exist, but rather to observe how

the stream passes by. Participants were instructed to become aware of all thoughts and reactions, and to observe these as passing events. To prevent demand effects due to participants' preconceived notions of mindfulness, no mention was made of mindfulness, acceptance, or meditation.

For mental imagery + immersion, participants were instructed to imagine an unpleasant autobiographic event and to immerse themselves into their thoughts about of the event as if it were happening right now. We compared it to thinking back of a funny even, that all aspects of the event can be recalled, and that this might even spontaneously trigger a smile. See Footnote 1 for the complete instructions.

Affect scale

Participants responded to "how did you feel after applying [name of instruction] to your own thoughts?" on three scales with different anchors, from 1 (very negative, very unpleasant, very bad) to 7 (very positive, very pleasant, very good). The scores were averaged to a mean affect score, which constituted the main dependent variable, Cronbach's α = .71.

Manipulation check

As a manipulation check, participants reported their decentering experiences on three items: "while applying [name of instruction] I saw myself as separate from my thoughts", "while applying [name of instruction] my thoughts felt very real (recoded)", and "sometimes you have thoughts and it feels as if what you are thinking about is really happening right now. While applying [name of instruction], to what extent did your thoughts feel like they were really happening right now? (recoded)". This was done on a scale from 1 (not at all applicable to me) to 7 (very applicable to me). The items were based on a decentering and awareness questionnaire (Papies, Winckel, & Keesman, 2016; see also Chapter 6). The scores were averaged to a mean decentering score, Cronbach's α = .68.

Vividness of mental imagery

We assessed vividness of thoughts with the items "in some cases thoughts are clear and include many details, in other cases they do not. While applying [name of instruction] my thoughts were very clear.", and "in some cases thoughts are clear and included many details, in other cases they do not. While applying [name of instruction] my thoughts included many details". Participants responded on a scale from 1 (not at all applicable to me) to 7 (very much applicable to me). The items were averaged to a mean vividness score, Cronbach's α = .71.

Imagery and decentering in daily life

Participants were asked "In daily life, do you experience your thoughts as [name of instruction]?" and responded on a scale from 1 ((almost) never) to 7 (very often).

Procedure

An overview of the procedure of Experiment 1a can be seen in Figure 1.The experiment was executed using Inquisit 4 software (2015), and instructions were provided to participants using a pre-recorded audio fragment, through noise-cancelling headphones. When no interaction was required, the experimenter sat out of sight behind a room partition. Before the start of the experiment, participants read and then signed an informed consent form. The experiment started by asking participants to write down a keyword of a past event that still negatively affects them today, when thinking back of that event. They were asked to summarize this event into three keywords. Then, participants received the mental imagery + decentering or mental imagery + immersion instruction. Participants were given the opportunity to ask questions to the experimenter, and then continued. Next, the keywords they had entered appeared on the screen to remind them of the autobiographic event selected. Participants were instructed to press the spacebar to indicate that they had started imagining the unpleasant experience, with or without engaging in decentering, depending on the condition. After 30 seconds, a sound signal informed participants that they could stop applying the instructions. Participants then responded to the affect scale and the other questionnaires. At the end of the experiment, participants relaxed for 5-minutes while listening to a music fragment of Delibes' Coppelia, which has been shown to uplift participants' moods (Västfjäll, 2002). This was included to neutralize any potentially negative mood-states of participants. Afterwards, participants scheduled their second session in the lab.

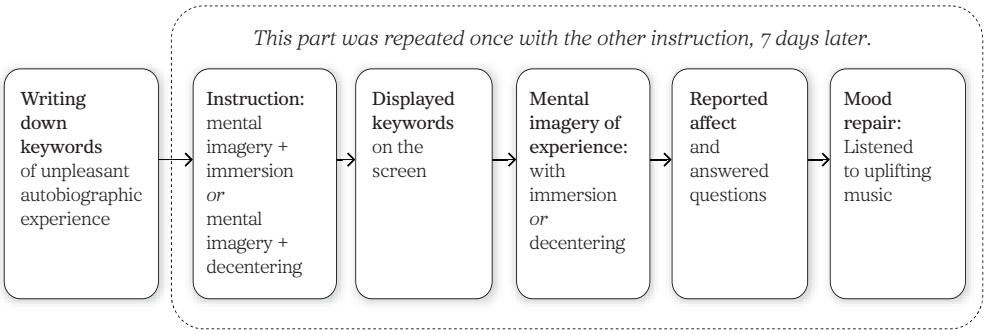

Figure 1.

Procedure of Experiment 1a.

During the second session, the procedure was repeated as in the first session, using the same keywords of the past event, but with the other instruction (mental imagery + decentering or mental imagery + immersion). At the end of the second session, additional questions were asked to get some insight into the original experience of the unpleasant event, such as: "how long ago did the situation of the memory take place?" and "how did you experience the situation of the memory when it took place?" (1-very negative to 7- very positive), "while you were participating in this research, did you think this research was about mindfulness? Yes or No." Some open-ended questions were added, but the answers were not formally analyzed: "what do you think this research was about?", "what results do you think I expect in this research?", "do you meditate, or have you ever taken part in a mindfulness course? Could you tell us a bit more about this?", "you participated in two parts of a scientific research on ways of relating to your thoughts. During this research, did you do your best to apply these instructed ways of relating to your thoughts?". Finally, participants were debriefed, thanked, and received a small remuneration.

Results

Analysis plan

For the statistical analyses, we used a Bayesian approach to ANOVA (see also Rouder, Morey, Speckman, & Province, 2012; Rouder, Morey, Verhagen, Swagman, & Wagenmakers, 2016). For ease of interpretation, we also reported a Cohen's *d* effect size with its 95% confidence interval for each of the hypothesis tests.

The analyses provided a Bayes Factor (BF), which is a graded measure of evidence for a specific hypothesis, with higher values indicating stronger evidence (for a review on the Bayes Factor, see Kass & Raftery, 1995). A BF can thus be in favor of a specified hypothesis, but it can also be in favor of the null hypothesis or favor neither. This is in contrast to a *p*-value in traditional frequentist statistics, which can only be used to reject the null-hypothesis. A $BF_{1,0}$ of 1 indicates equal support for both hypotheses, a $BF_{1,0}$ below 3.2 is considered uninformative or anecdotal evidence, and a $BF_{1,0}$ of 10 suggests that the observed data is 10 times more likely under the alternative compared to the null hypothesis. This is often considered "strong" evidence for the alternative hypothesis (Kass & Raftery, 1995). Statistical analyses were conducted in JASP (JASP Team, 2016), using JASP's default priors (as suggested by Rouder, Speckman, Sun, Morey, & Iverson, 2009; Wetzels, Raaijmakers, Jakab, & Wagenmakers, 2009). For a more detailed rationale for using a Bayesian approach to the statistical analyses, see Footnote 2 or Wagenmakers (2017).

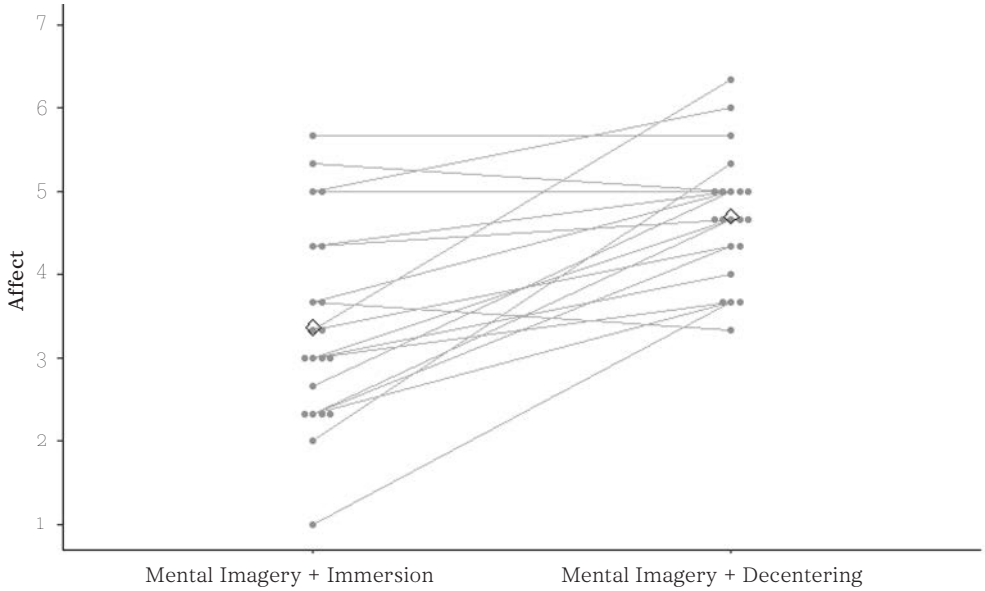

Figure 2.

The role of decentering for reducing negative affective reactivity to unpleasant imagery.

Each grey line represents one participant, with the dots indicating the experienced affect for mental imagery + immersion and mental imagery + decentering, ranging from [1]-very negative to [7]-very positive. The diamonds represent the mean affect scores.

Manipulation check

There was decisive evidence that a decentered perspective was induced for participants engaging in decentering (M = 4.78, SD = .99) relative to participants engaging in immersion during mental imagery (M = 3.59, SD = 1.12), $BF_{1,0}$ = 1886. There was no evidence for a main effect or interaction with order, both $BF_{1,0}$ < 1.78.

Descriptive statistics of the unpleasant event

The unpleasant events that participants imagined during the experiment took place 4.62 years ago on average (SD = 4.05; min = still ongoing, max = 15 years ago). When the event actually happened, participants experienced it as very negative, as indicated on an affect scale from 1 (very negative) to 7 (very positive), with M = 1.71 (SD = .72). Examples of keywords provided by participants were: “cancer, diagnosis, dad” and “broken jaw, hospital, study delay”.

Testing the effect of decentering on reactivity

There was decisive evidence for the hypothesis that during imagery of the unpleasant experience, engaging in decentering reduced negative affective reactivity relative to engaging in immersion, $BF_{1,0} = 2944$, and Cohen's $d = 1.23$ with 95% CI [.65, 1.79]. The mean affect values of each individual participant in both conditions are displayed in Figure 2. See Footnote 3 for a replication of this effect in Experiment 1b. There was no informative evidence suggestive of a main effect of order, $BF_{1,0} = .46$, or interaction with order, $BF_{1,0} = .68$.

Exploratory analyses

There was evidence suggesting that the vividness of people's imagery was increased when engaging in immersion ($M = 5.00$, $SD = 1.10$) relative to engaging in decentering ($M = 4.07$, $SD = 1.43$), $BF_{1,0} = 7.45$. There was no informative evidence suggestive of a main effect or interaction with order, respectively $BF_{1,0} = .0.49$ and $BF_{1,0} = .89$. To further explore the role of subjective decentering and subjective vividness of imagery on affective reactivity during the decentering sessions, we conducted a Bayesian regression analysis. There was some evidence suggesting subjective decentering predicted affective reactivity, $BF_{1,0} = 3.63$, but there was no such evidence for subjective vividness, $BF_{1,0} = 0.58$. To further explore whether subjective vividness of imagery could explain part of the effect that decentering reduced reactivity to mental imagery relative to immersion, we conducted a within-participant mediation analysis using MEMORE (Montaya & Hayes, in press). But, we found no evidence of subjective vividness mediating the effect of decentering on affective reactivity to mental imagery, $\beta = -.17$ with 95% CI [-.76, .12], as zero was included in the confidence interval.

In response to the question asking participants whether they thought the experiment was about mindfulness (yes/no), 11 participants answered yes. When adding this factor to the model of the main analyses, it did not change its conclusion.

Discussion

In sum, participants once imagined an unpleasant autobiographic experience while engaging in immersion, and once imagined the same experience while engaging in decentering. There was very strong evidence for the hypothesis that engaging in decentering reduced negative affective reactivity to unpleasant imagery. This effect was replicated in Experiment 1b, see Footnote 3. Although vividness of imagery was lower when participants engaged in decentering relative to immersion, vividness did not explain the effect of decentering on affective reactivity. The results indicate that decentering reduces affective reactivity to imagery, even when it is kept active in mind. An important question that remains is whether decentering also reduces reactivity to rewarding imagery, which was addressed next.

Experiment 2

Experiment 2 was designed to test the hypothesis that engaging in decentering reduces reactivity to rewarding imagery of food. Participants imagined an attractive yet unhealthy snack, or imagined the same snack while also engaging in decentering. Again, a within-participants design was used. This time, however, participants were tested in the same session rather than one week apart as in Experiment 1a, because food preferences are highly context–dependent (Meiselman, 2006). Furthermore, instead of using an automatized audio-fragment, a research assistant personally provided the instructions to each participant. Food cravings were measured as the dependent variable. Some open-ended questions followed afterwards, but these were not formally analyzed. Thus, the design was largely similar to that of Experiment 1a, but the target of the imagery and decentering was now an attractive food.

Methods

Design and participants

Food cravings in response to mental imagery of an attractive yet unhealthy snack were examined in a 2 (instruction: mental imagery + immersion vs. mental + decentering; within-participants) x 2 (order: first mental imagery + immersion vs. first mental imagery + decentering; between-participants) design with random assignment to order.

A sample of 30 participants completed the experiment (6 males; age M = 22; BMI M = 21). To prevent participants from entering the experiment completely satiated, we asked them to refrain from eating for one hour before participation in the experiment. All participants indicated to have complied with this request.

Materials

Craving scale.

We assessed participants' cravings with four questions: "How strong is your craving for this food product at this moment?", "At this moment, how strong is your desire to eat this food product?", "How difficult would it be for you to resist this food product if it was right in front of you?", "How attractive is this food product for you, right now, at this moment?". The participants responded to these questions on a Visual Analog Scale scale from 0 (respectively: no craving at all, no desire at all, not at all difficult, not at all attractive,) to 10 (respectively: very strong craving, very strong desire, very difficult, very attractive). We computed an average craving score to be used as outcome variable, Cronbach's α = 91.

Procedure

See Figure 3 for an overview of the procedure. After providing informed consent, participants were asked to write down a snack they liked a lot, but of which they knew they should reduce their intake. Participants then received the mental imagery + immersion or mental imagery + decentering instruction. Thus, they were instructed to imagine the food product and engage with this imagery, or to also engage in decentering towards this mental imagery. If participants had no further questions, they could start. After 1 minute, the experimenter indicated that they could stop. Participants then responded to the craving scale. Afterwards, they responded to three open questions: "what thoughts did you have in response to the food product, during the exercise?", "how did you experience these thoughts during the exercise, and how did you feel?", and "what did you exactly do while adopting the perspective towards your thoughts?". Participants then indicated to whether engaging in mental imagery or in mental imagery with decentering is similar to how they normally relate to their thoughts, on a VAS scale from 0 (not at all similar) to 10 (very similar).

To prevent carryover of the instructions from the first part to the second part of the experiment, participants listened to a five-minute audio fragment of the Lion King 2: Simba's Pride (Rooney & LaDuca, 1998). Participants then received the other instruction (mental imagery or mental imagery + decentering), followed by and the same procedure as before. Thus, similar to Experiment 1a, all participants saw the same keywords and imagined the same food in both conditions. At the end of the experiment, we assessed concern for dieting (Herman & Polivy, 1980), and we assessed current hunger ("How hungry are you at this moment?") on a VAS scale from 0 (not hungry at all) to 100 (very hungry).

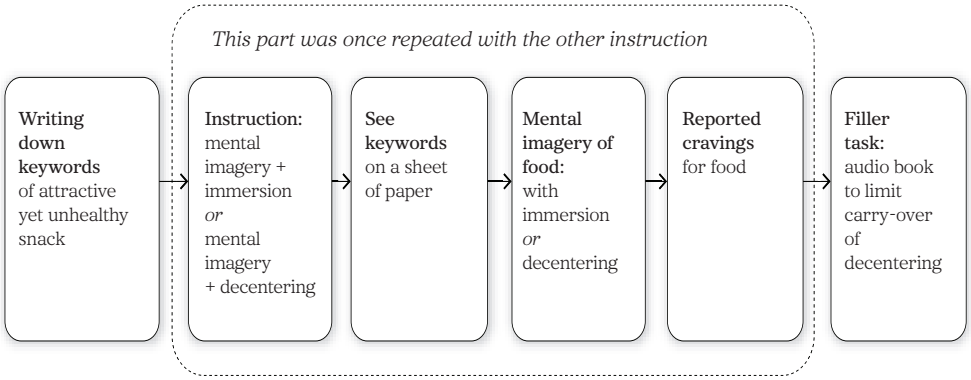

Figure 3.

Procedure of Experiment 2.

Results

Testing the effects of decentering on appetitive reactivity

There was decisive evidence for the hypothesis that engaging in decentering reduced reactivity to mental imagery of an attractive yet unhealthy snack, $BF_{1,0}$ = 111, Cohen's *d* = .79 with 95% CI [.38, 1.20], see Figure 4. There was no evidence suggestive of a main effect of order, $BF_{1,0}$ = .55, or interaction of instruction with order, $BF_{1,0}$ = .63.

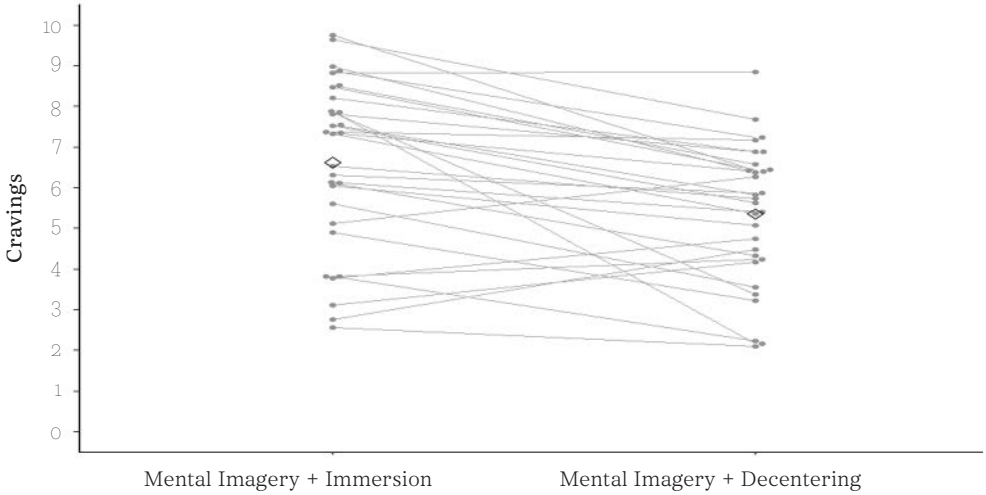

Figure 4.

The role of decentering for reducing cravings to rewarding imagery of consumption.

Each grey line represents one participant, with the dots indicating the experienced craving for mental imagery + immersion and mental imagery + decentering, ranging from [0]-no cravings at all to [10]-very strong cravings. The diamonds represent the mean craving scores.

Discussion

In sum, participants once imagined an attractive yet unhealthy snack while engaging in immersion, and once while engaging in decentering. There was decisive evidence for the hypothesis that engaging in decentering reduces food cravings in response to rewarding imagery of consumption. This is in line with the findings from Experiment 1a and the replication Experiment 1b. As rewarding imagery of consumption plays an important role in driving actual consumption (Kavanagh, Andrade, & May, 2005; May et al., 2015; Papies & Barsalou, 2015), it is useful to have such a brief training available to prevent this imagery from inducing cravings. Furthermore, the effects of decentering on reactivity from rewarding imagery are unlikely to be limited to the domain of food, and might also be used in other domains such as smoking and drinking.

Experiment 3

This experiment built further on the finding from Experiment 2 that engaging in decentering reduces reactivity to rewarding imagery of eating, and improved the research design in three important ways. First, instead of just working with imagery of an attractive snack, we now actually exposed participants to an attractive snack: a bowl of crisps. Second, we used salivation as a physiological measure of appetitive reactivity, rather than using self-report measures of reactivity as in Experiment 1a, 1b, and 2. Assessing salivation is more robust to demand characteristics, making it unlikely that any effects of decentering are due to participants responding in a socially desirable manner. Third, instead of having an immersion instruction as control, participants were now just exposed to the food without any further instructions. Any effects on the dependent variable could thus only be attributed to decentering. This thereby excludes the possibility of the effects being driven by the participants engaging in immersion. We used a between-participants design in Experiment 3, as carry-over effects of decentering might be more likely with exposure as a control condition where participants receive no detailed instructions on how to process the food stimulus and might therefore be more likely to keep applying the instructions from the other condition. Furthermore, at the end of the experiment, participants self-reported their mental imagery of consumption. This allowed us to compare amount of imagery between participants who were only exposed to the food and those who also engaged in decentering.

Earlier research on salivation to food cues found that imagery of consumption increases salivation (Chapter 4; White, 1978). Furthermore, this research suggests that participants spontaneously imagine consumption to food cues, especially when the food is attractive (Chapter 4). We included both a neutral and attractive food in the current research, and expected that the attractive food would elicit more imagery of consumption than the neutral food, which could then be targeted using decentering.

We expected reduced salivation to the attractive food for participants engaging in decentering relative to the control participants. Furthermore, we expected that the attractive food would elicit mental imagery of consumption for both the exposure and decentering participants. Evidence of no difference in mental imagery would then provide further support for the thesis that decentering works by reducing reactivity to mental imagery, rather than working by reducing mental imagery.

Methods

Design and participants

Salivation was examined in a 2 (instruction: exposure vs. exposure + decentering; between-participants) x 2 (food type: attractive vs. neutral; within-participants) x 2

(order: attractive food first vs. neutral food first; between-participants) design with random assignment to conditions.

A sample of 60 participants completed the experiment (17 males; age M = 22, BMI M = 21). This sample size was based on the second experiment of Chapter 4, since the same procedure was used. During recruitment, participants were told that they could only sign up for participation if they liked crisps. Furthermore, all participants had to agree to not eat for one hour before participation. This was to ensure that participants were not fully satiated when starting the experiment, and to reduce the amount of food residue in their mouths.

Materials

Instruction for measuring salivation.

Participants were given an instruction on the measure of salivation based on Keesman and colleagues (2016). They were told that they would get to see three objects, each for one minute. Before seeing an object, they would be asked to swallow all the saliva in their mouth. Then, when seeing the object, they were asked to focus their gaze on it, to keep their lips closed, to not move their tongue, and to not swallow any more saliva. They were told that the experimenter would inform them once one minute had passed, and that they should collect all the saliva in their mouth during that minute and then spit it out in a cup. After spitting in the cup, participants had a three-minute break before the experiment continued. During this break, they could read the short story "The Last Question" by Isaac Asimov (1956). Participants were asked to remain silent during this break. To check whether participants understood the saliva procedure, they were asked to repeat the instruction to the experimenter.

Salivation amount

The cups were pre-weighed using a precision scale that could measure differences of 0.01 gram. When the saliva was in the cup, it was weighed again. The amount of saliva was calculated by subtracting the pre-spitting weight from the post-spitting weight.

Questionnaire assessing imagery about consumption

To assess whether participants imagined eating the foods, participants responded to a mental imagery of consumption questionnaire consisting of 5 items (e.g. "I imagined how it would be to eat [the specific food]"; see also Keesman et al., 2016; Tiggemann & Kemps, 2005). Participants responded to two versions of the questionnaire, one for the neutral food, and one for the attractive food, on scales from 1 (not at all) to 10 (very much), both Cronbach's $\alpha \geq .87$

Manipulation check

To assess decentering experiences, participants responded to an adapted version of the food-specific decentering questionnaire (e.g. "I considered my thoughts about [the specific food] as transient events in my mind"; Keesman et al., unpublished manuscript; Papies et al., 2016). Participants responded to two versions of the questionnaire, one for the neutral food, and one for the attractive food, on scales from 1 (not at all) to 10 (completely true), both Cronbach's $\alpha \geq .70$.

Food desire and attractiveness.

Participants indicated whether they would have liked to eat the neutral and attractive food, both on a scale from 1 (not at all) to 10 (very much). Furthermore, participants were asked whether they liked the neutral and attractive food, both on a scale from 1 (not at all) to 10 (completely true). We computed an average attractiveness score for the neutral food and for the attractive food, both Cronbach's $\alpha \geq .68$.

Additional questions

Participants were asked "what results do you think we expect to find in this research?" Then, they were asked "while participating in this research, did you think the research was about mindfulness? Yes or No." I then asked participants "how much experience do you have with mindfulness or other meditation techniques?", "how skilled do you judge yourself in terms of applying these meditation techniques?", and "how often do you apply meditation techniques?", all on scales from 1 (respectively: no experience, not at all skilled, never) to 10 (respectively: a lot of experience, completely true, very often).

Procedure

For an overview of the procedure of Experiment 3, see Figure 5. Before the experiment started, participants were asked to rinse their mouth using a cup of water. The experiment then started with participants answering the questions "how hungry are you at this moment?" and "how thirsty are you at this moment?", on scales from 1 (not at all hungry/thirsty) to 10 (very hungry/thirsty). Participants then received an instruction on the saliva measure, and a baseline measure of salivation was then taken with a non-food control object (small block of wood) using the abovementioned salivation procedure. Exposure participants received no additional instructions. Decentering participants received a decentering instruction and they were instructed to engage in decentering towards any imagery elicited by the objects presented to them. In contrast to Experiments 1a, 1b, and 2, participants were now not explicitly instructed to imagine a food or an experience. After the instructions, participants were exposed to either the neutral food (bread with cheese) or the attractive yet unhealthy food (bowl of crisps).

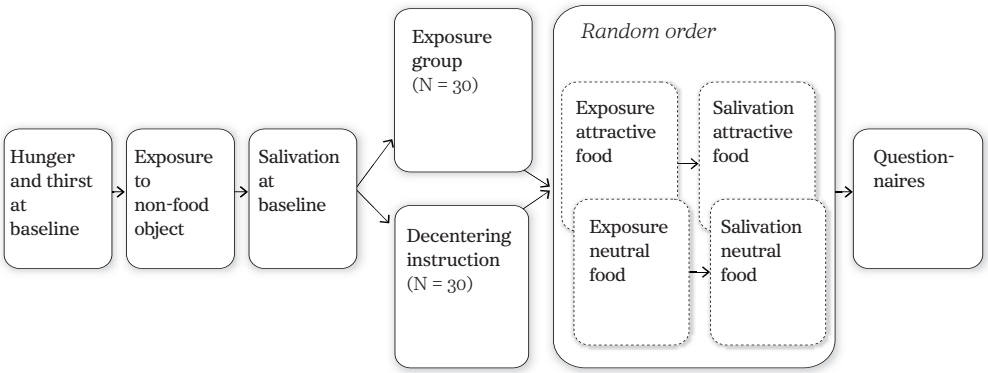

Figure 5.

Procedure of Experiment 3.

A new bag of crisps was used for each participant, and was opened and emptied into a bowl in front of the participant. After the measure of salivation was taken, decentering participants were reminded of the decentering instructions, and all participants were then exposed to the other food. After the measures of salivation had been taken for all three objects, participants completed several questionnaires.

Results

Manipulation check

There was strong evidence suggesting that decentering participants had adopted a decentering perspective (for the attractive food, $M = 6.71$, $SD = 1.48$, and for the neutral food, $M = 7.35$, $SD = .97$) relative to exposure participants (for the attractive food, $M = 5.88$, $SD = .97$, and for the neutral food, $M = 6.40$, $SD = 1.34$, respectively), $BF_{1,0} = 12.88$. There was also strong evidence for participants adopting a more decentered perspective towards the neutral food than towards the attractive food, $BF_{1,0} = 13.63$, all other $BF_{1,0} < 1.68$.

Participants found the attractive food more attractive ($M = 7.79$, $SD = 1.73$) than the neutral food ($M = 5.85$, $SD = 2.53$), $BF_{1,0} = 10762$, with no main or interaction effects of instruction, or order of exposure, all $BF_{1,0} < .33$.

Testing the role of decentering for reducing salivation to food

Baseline differences

There was anecdotal evidence suggesting that decentering participants salivated less at baseline ($M = .20$, $SD = .16$), than exposure participants ($M = .31$, $SD = .18$), $BF_{1,0} = 2.99$. Therefore, we controlled for baseline salivation in the main analysis. To this end, the residuals of salivation were computed and are presented in Figure 6.

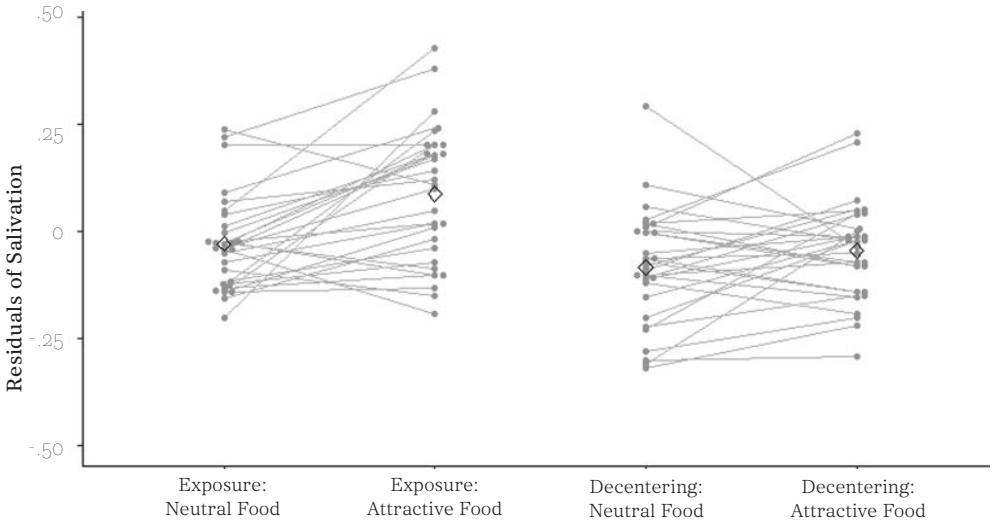

Figure 6.

The role of decentering for reducing salivation to food.

Each grey line represents one participant, with the dots indicating salivation controlled for baseline, for the neutral and the attractive food, for exposure or decentering participants. The diamonds represent the mean salivation scores.

Outlier removal

Following Keesman and colleagues (2016), on which the salivation paradigm was based, we considered data points that differed by more than 3 standard deviations from the mean as outliers, and did not include them in the analyses. There was one outlier each for salivation to the neutral and to the attractive food. Outlier removal did not influence the main conclusions.

Main analyses

Simple main effects confirmed the main hypothesis that decentering participants salivated less to the attractive food than exposure participants, $BF_{1,0} = 9.00$, Cohen's $d = .78$, 95% CI [.25, 1.31], see Figure 6. There was no evidence for an effect of order $BF_{1,0} = .66$, or for an interaction of order with instruction, $BF_{1,0} = 1.74$

Overall, participants salivated more to the attractive food than to the neutral food, $BF_{1,0} = 266.58$, and decentering participants salivated less than exposure participants, $BF_{1,0} = 19.127$. There was anecdotal evidence for the effect of instruction being qualified by food type, $BF_{1,0} = 3.38$, and no evidence for other main or interaction effects, all other $BF_{1,0} < 1.50$.

The simple main effects were also tested for the neutral food. There was no

informative evidence for or against an effect of decentering instruction on salivation to the neutral food, $BF_{1,0}$ = .91, Cohen's *d* = .51, 95% CI [-.01, 1.03]. There was no evidence for an effect of order $BF_{1,0}$ = .22, or for an interaction of order with instruction, BF1,0 = .18

Examining mental imagery about consumption.

The evidence strongly suggested that participants imagined consumption more when exposed to the attractive food (for exposure *M* = 6.13, *SD* = 1.70, for decentering *M* = 5.56, *SD* = 2.63) than when exposed to the neutral food (for exposure *M* = 4.83, *SD* = 1.76, for decentering *M* = 4.95), $BF_{1,0}$ = 1341. There was no informative evidence suggestive of a main effect or interaction with instruction or order of presentation, all $BF_{1,0}$ < 1.52. Simple effects analyses showed that there was some evidence for the null hypothesis of no difference in amount of mental imagery about consumption between decentering and exposure participants, for both the attractive food, $BF_{1,0}$ = .28, and the neutral food, $BF_{1,0}$ = .21. These findings suggest that amount of imagery about consumption was comparable for decentering and control participants.

Exploratory analyses

To the question asking participants whether they thought the experiment was about mindfulness (yes/no), 2 responses were missing. In the decentering condition, 15 out of 28 participants thought the research was about mindfulness, and in the exposure condition, 3 out of 30 participants thought the research was about mindfulness. Adding this as a factor to the model did not change the conclusions.

Discussion

Participants in this experiment were exposed to an attractive yet unhealthy food, or they also engaged in decentering. Exposure participants spontaneously imagined eating the food, which is in line with earlier findings (see e.g. Chapter 4). Moreover, decentering participants also did this, and there was evidence of no difference in amount of imagery about eating between the decentering and exposure participants. This suggests that decentering participants did not reduce their imagery through – for instance – suppression or distraction. Importantly, and in line with the hypothesis, the attractive food induced less salivation when participants engaged in decentering. The effects are unlikely to be caused by social desirability, as salivation is difficult to consciously control. Furthermore, the effects are unlikely to be driven by the control participants, as these were just exposed to the foods rather than receiving an instruction to immerse in their imagery of consumption. The findings of Experiment 3 thereby provide strong additional support to the findings from Experiment 1a, 1b, and 2, that decentering works by reducing reactivity to mental imagery.

General Discussion

The research of the present chapter examined whether decentering causes reduced reactivity to mental imagery, which is crucial for understanding how the decentering component of mindfulness exactly works. Therefore, we instructed our participants to engage in decentering in four experiments, including one replication experiment. In Experiment 1a and the replication Experiment 1b, all participants imagined an unpleasant event. When participants also engaged in decentering, they experienced much less negative affect compared to participants who also engaged in immersion. This effect was conceptually replicated in Experiment 2, in the domain of reward, where all participants imagined an attractive food. When participants also engaged in decentering, they experienced much fewer cravings to eat than participants who also engaged in immersion. In Experiment 3, participants were exposed to an attractive food, and half also engaged in decentering towards any imagery elicited by the food. Importantly, the food induced the same amount of imagery in decentering participants as in participants who were just exposed to the food. However, decentering participants salivated much less in response to food exposure, again suggesting that decentering participants experienced reduced reactivity. In sum, four experiments show that decentering works by reducing reactivity to mental imagery, even when this imagery is kept active in mind.

These results are in line with the notion that decentering entails the observing of imagery for what it really is, impermanent in nature, without altering its content, suppressing it, or distraction from it (Bernstein et al., 2015; Chiesa et al., 2014; Dreyfus, 2011; Keesman et al., 2017). At the same time, the findings may seem at odds with earlier research on mindfulness. For instance, mindfulness-based practices such as the body scan reduce reactivity by reducing mental imagery (May et al., 2010), and trait mindfulness is also associated with reduced imagery of alcohol (Ostafin et al., 2013). This discrepancy in findings can be explained by their focus on mindfulness more generally. Broad mindfulness-based practices often involve the regulation of attention, such as maintaining awareness on the breath or on bodily sensations (Malinowski, 2013; Mrazek, Smallwood, & Schooler, 2012). This can be distracting from imagery, and thus reduce it. These mindfulness-based practices related to the regulation of attention also tax working memory, which could further contribute to reducing mental imagery (Tapper, 2017; van den Hout et al., 2011). In contrast, the current research deconstructed these mindfulness-based practices to a brief decentering instruction that allowed us to precisely examine the cognitive mechanism of decentering, without interference from the attention regulation component of mindfulness. To be able to make stronger claims about distraction or working memory taxation during decentering, it would be interesting to add measures of distraction and of working memory taxation in future research. Nevertheless, this approach allowed us to examine and find evidence for the hypothesis that decentering directly reduces reactivity

to mental imagery, even when this imagery is kept active in mind.

Previous research on a psychological tool referred to as cognitive distancing has shown similar reductions in reactivity to imagery as decentering, such as when analyzing a past, distressing event from a "why did this happen" perspective (Kross & Ayduk, 2011; Kross, Ayduk, & Mischel, 2005). However, cognitive distancing does not reduce reactivity to concrete imagery, such as in the current research, i.e. when mentally imagining an attractive snack, or when imagining an unpleasant autobiographic experience (Kross & Ayduk, 2011; Kross et al., 2005). Decentering thus adds to the available psychological tools by being able to diminish reactivity to these types of imagery. This is important, as by reducing the influence of short-term affective reactivity on behavior, decentering allows people to guide their behavior with their long-term intentions, such as that of eating healthily or getting enough sleep. A further benefit of decentering is that it can be taught through a relatively brief instruction. In addition, it seems that people can engage in decentering towards any stimulus, in any situations. In other words, people can use the insight of decentering at the moment a thought or mental imagery arises. Decentering might thereby be a valuable complement to interventions that aim to increase people's ability to regulate their behavior.

Future directions

Much research already shows beneficial effects of mindfulness-based interventions (for meta-analyses, see Hofmann et al., 2010; Katterman et al., 2014; Khoury, Lecomte, Gaudiano, & Paquin, 2013; Oikonomou, Arvanitis, & Sokolove, 2016), and of acceptance and commitment therapy (ACT; Hayes, Strosahl, & Wilson, 2011) on affective reactivity and cravings. In addition, research suggests that these beneficial effects occur because the participants engage in decentering (Fresco et al., 2007; Grant et al., 2011; Hoge et al., 2014; Keesman et al., 2017; Papies et al., 2016; Shoham et al., 2017). To examine this more systematically, we experimentally manipulated decentering, and indeed found that engaging in decentering reduces reactivity to mental imagery. This supports the use of mindfulness-based interventions to enhance behavior regulation. As the current research only measured the short-term effects of a decentering training, it would be interesting to examine the potential for long-term effects, such as how long people can continue using decentering after receiving this brief training, or how the long-term application of decentering can be facilitated.

Given the strong effects of the brief decentering instruction in the current research, it would be interesting to examine the value of adding the decentering instruction to existing lifestyle interventions that do not yet include a form of mindfulness. The brevity of the instruction makes it suitable to those who lead a busy life. Furthermore, this decentering instruction does not require formal meditation, which may make it an appealing alternative to more traditional mindfulness-based tools, at least to those who

might be hesitant to try meditation. Before a form of this brief decentering instruction is ready to complement an existing intervention, however, it is vital to first examine how people can best engage in decentering in daily life. As decentering targets imagery, it would for instance be interesting to know if tools that increase awareness of imagery, such as keeping a thought-journal, facilitate the adoption of decentering in daily life.

One important limitation of the work reported in this chapter is that the participant sample of the current research primarily consisted of healthy university students. Therefore, the results are only meaningful with respect to preventative interventions, or interventions in non-clinical samples, but not with respect to psychopathologies. It would be interesting to extend this research on decentering to subgroups of the population who are sensitive to experiencing dysfunctional unpleasant or rewarding imagery, such as those who are phobic, obese, or addicted to a substance. Given the previous research showing associations between decentering and improved functioning in depressed and addicted samples (Brewer, Elwafi, & Davis, 2012; Hofmann et al., 2010), there seems much potential for a direct decentering training. Furthermore, it would be interesting to know how effects of the brief decentering instruction compare between a meditation-naïve sample and experienced meditators. Experienced meditators are trained to become aware and maintain awareness on their imagery, and are trained to engage in decentering. As such, they might show stronger reductions in reactivity when instructed to engage in decentering, relative to meditation-naïve participants.

Conclusion

We systematically examined the role of the decentering component of mindfulness for reducing reactivity to mental imagery of unpleasant past experiences and of attractive yet unhealthy foods. The results of four experiments, including one replication, suggest that engaging in decentering is useful for reducing reactivity to mental imagery. Furthermore, in these meditation-naïve samples, decentering seemed to work by observing the mental imagery as impermanent, rather than by reducing this imagery through suppression or distraction. Overall, this research supports the use of decentering as a tool to reduce reactivity from both unpleasant and rewarding imagery. As people's behavior will be less influenced by short-term affective reactivity, this might leave people room to act in line with their long-term intentions or regulation goals, such as eating healthily or being kind towards others.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Footnotes

[1] *Decentering instruction (in Dutch)*

"Straks zal je (opnieuw) een manier om met je gedachtes om te gaan uitgelegd krijgen. Deze manier om met je gedachtes om te gaan zal je dan (opnieuw) toepassen op de gedachtes die je hebt bij jouw opgeschreven herinnering.

De uitleg over deze manier van met je gedachtes om te gaan zal nu beginnen. Als je op deze manier met je gedachtes omgaat, dan probeer je om je gedachtes te zien als mentale gebeurtenissen die ook weer voorbijgaan. Om dit te illustreren zal ik een metafoor van een waterval gebruiken.

Probeer je even een waterval voor te stellen. De constante stroom aan water is je gedachtegang. Dit houdt niet op, en gaat constant door, en het water kan je ook gemakkelijk mee naar beneden sleuren als je erin terecht komt. Probeer hier geen weerstand tegen de stroming te bieden, en probeer ook niet te doen alsof de waterval niet bestaat. Maar ga eens achter de waterval staan. Op die manier kan je gewoon kijken naar al het water dat voorbij komt. Zo kun je dus ook met je gedachtes omgaan. Observeer de gedachtes die je hebt, en zie hoe ze opkomen en voorbijgaan."

"Ik wil je graag vragen om deze manier van omgaan met je gedachtes straks toe te passen op de herinnering die je eerder hebt opgeschreven. Maar hoe kun je dit het beste doen? Als je bijvoorbeeld terugdenkt aan de gebeurtenis, of een bepaalde emotie ervaart, wees dan bewust van de aspecten van die gebeurtenis, maar blijf ook bewust van waar je je nu bevindt (op een stoel in deze kamer). Probeer de gedachtes, fysieke reacties, en emoties ie bij je opkomen op te merken, maar realiseer je dat het gewoon maar mentale gebeurtenissen zijn. Het zijn maar voorbijgaande verschijnselen die je hersenen produceren. En omdat dit zo is, hoef je er ook niets mee te doen, deze gedachtes gaan altijd uit zichzelf gewoon weer weg. Dus net als bij het water in de waterval, observeer gewoon hoe je gedachtes voorbij stromen. Sommige gedachtes kunnen confronteren zijn, maar probeer ze niet te onderdrukken of te vermijden. Merk op hoe ze opkomen en weer verdwijnen. Net als dat je niet hoeft te reageren op een paar druppels water, zo hoeft dat ook niet bij deze gedachtes. Als je deze manier van met je gedachtes omgaan toepast, dan zal je misschien alsnog soms even worden meegesleept in je gedachtes. Dit gebeurt soms gewoon en is eigenlijk heel natuurlijk. Zodra je dat merkt, laat het dan los omdat het maar een mentale gebeurtenis is, en probeer dan weer dit perspectief aan te nemen waar je observeert hoe je gedachtes opkomen en weer verdwijnen. Is het duidelijk wat ik bedoel met deze manier van je gedachtes beschouwen als voorbijgaande mentale gebeurtenissen?"

"Straks gaan we hiermee een korte oefening doen van 30 seconden. Je krijgt dan (weer) de kernwoorden te zien van de herinnering die je eerder hebt opgeschreven. Ik wil je dan vragen om deze herinnering voor de geest te halen. Als je dat hebt gedaan, mag je met de oefening beginnen. Probeer dan alle gedachtes en reacties die je bij je herinnering hebt te zien als voorbijgaand, dus als mentale gebeurtenissen die opkomen en weer verdwijnen. Terwijl je dit doet kan het helpen om je bewust te blijven van de situatie waarin je nu bent, voel hiervoor bijvoorbeeld je lichaam op de stoel zitten en voel hoe je voeten op de vloer staan. Heb je nog vragen over deze oefening?"

"Hier zijn (weer) jouw 3 kernwoorden die je had bij je herinnering. Begin nu gelijk met de oefening.

Immersion instruction (in Dutch)

"Straks zal je (opnieuw) een manier om met je gedachtes om te gaan uitgelegd krijgen. Deze manier om met je gedachtes om te gaan zal je dan (opnieuw) toepassen op de gedachtes die je hebt bij jouw opgeschreven herinnering."

"De uitleg over deze manier van met je gedachtes om te gaan zal nu beginnen. Als je op deze manier met je gedachtes omgaat, dan probeer je om helemaal op te gaan in je gedachtes. Om dit te illustreren zal ik een voorbeeld van een grappige herinnering gebruiken."

"Bijvoorbeeld, als je op straat loopt en aan iets leuks of grappigs terugdenkt, dan begin je vaak spontaan te glimlachen. Het is net of je er echt bent, alsof het nu gebeurt, en alle gedachtes en ervaringen van toen stel je je dan ook heel levendig voor. Ook lichamelijk kan dit heel sterk terugkomen, zoals met die glimlach."

"Ik wil je nu graag vragen om deze manier van omgaan met je gedachtes toe te passen op de herinnering die je eerder hebt opgeschreven. Maar hoe kun je dit het beste doen? Probeer je heel levendig de gebeurtenis voor te stellen. Ga hiervoor terug in de tijd en herleef deze ervaring. Denk dus bijvoorbeeld terug aan waar je was, hoe iedereen keek, wat er werd gezegd, wat je dacht, en wat je voelde in je lichaam. Ervaar dus alle emoties, gedachtes, en hoe het voelt in je lichaam, alsof het nu echt gebeurt. Is het duidelijk wat ik bedoel met deze manier van in je gedachtes opgaan?"

"Straks gaan we hiermee een korte oefening doen van 30 seconden. Je krijgt dan (weer) de kernwoorden te zien van de herinnering die je eerder hebt opgeschreven. Ik wil je dan vragen om deze herinnering voor de geest te halen. Als je dat hebt gedaan mag je met de oefening beginnen. Probeer dan helemaal op te gaan in alle gedachtes en reacties die je bij je herinnering hebt, dus stel ze je heel levendig voor alsof ze nu echt gebeuren. Heb je nog vragen over deze oefening?"

"Hier zijn (weer) jouw 3 kernwoorden die je had bij je herinnering. Begin nu gelijk met de oefening."

[2] In psychological research, frequentist approaches to data-analysis using the *p*-value are dominant, but Bayesian approaches have some advantages (see e.g. Wagenmakers et al., 2017). First, in calculating the Bayes Factor, account is taken of what is expected under the null and the alternative hypothesis. In calculating a *p*-value, only the extremeness of the data under the null is considered. Data that are unlikely under the null hypothesis, however, may just as well be unlikely under the alternative hypothesis, and can therefore be uninformative. A p value above .05 does not indicate evidence in favor of the null, also not when statistical power is high, whereas a BF < 1/3 indicates evidence in favor of the null hypothesis. A recalculation of intervention studies in *Addiction* shows why this distinction is important, only in $1/5^{th}$ of reviewed non-significant findings was the conclusion of 'no difference between treatment and control' appropriate, as most results were inconclusive (Beard, Dienes, Muirhead, & West, 2016). Furthermore, the meaning of the Bayes Factor is clear, the higher the BF, the more evidence for a hypothesis, regardless of sample size. A *p*-value, on the other hand, can be quite ambiguous. For instance, does an experiment with N = 10 participants and p = .023 provide equally strong evidence against the null-hypothesis as when an experiment with N = 200 participants and p

= .023? This example turns more ambiguous with the knowledge that the *p*-value typically decreases as the number of observations grows larger (Wagenmakers, 2007). As a last point, the Bayes Factor is not affected by researcher intentions, such as optional stopping and multiple testing, but the *p*-value is (Wagenmakers et al., 2017).

3 Expiriment 1b

We conducted Experiment 1b (N = 22, 4 males) using the same 2 (instruction: mental imagery, mental imagery + decentering; within-participants) x 2 (order: first session simulation, first session decentering; between-participants) design, with random assignment to conditions, and with affective reactivity as dependent variable. The major difference with Experiment 1a was that the instructions in Experiment 1b were provided by the experimenter, rather than in automatized manner through headphones. The results again showed very strong evidence for the hypothesis that engaging in decentering reduces negative affective reactivity to unpleasant imagery, $BF_{1,0}$ > 1 495 000, Cohen's *d* = 1.50 with 95% CI[.87, 2.10]. There was little informative evidence for or against a main effect of order, $BF_{1,0}$ = .45, or for an interaction effect of order and instruction, $BF_{1,0}$ = .72. This experiment thereby replicates the results from Experiment 1a, showing that decentering reduces negative affective reactivity to mental imagery of unpleasant events.

CHAPTER 6

Empirical investigation of decentering among meditators

Meditation is associated with increased resilience to unpleasant experiences and decreased cravings for food: The role of decentering

Based on:

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Author contributions:

MK designed the study; MK analyzed the data; MK drafted the manuscript and revised it with EKP; MH and HA provided feedback for further revisions. All authors approved the final version.

Introduction

Meditation and mindfulness-based interventions have been shown to effectively reduce negative mental states, such as stress and cravings (Alberts, Thewissen, & Raes, 2012; Hofmann, Sawyer, Witt, & Oh, 2010; Kabat-Zinn, 1982). They are therefore increasingly implemented in clinical practice, such as for the treatment of anxiety and depression (for a meta-analysis, see Hofmann et al., 2010). Mindfulness-based interventions are also increasingly used in non-clinical settings, such as for reducing unhealthy eating and smoking (for meta-analyses, see Katterman, Kleinman, Hood, Nackers, & Corsica, 2014; Oikonomou, Arvanitis, & Sokolove, 2016). Despite the growing evidence for the effectiveness of meditation and mindfulness-based interventions, only little is known about the exact underlying psychological mechanisms. A better understanding of these mechanisms is, however, crucial in facilitating the tailoring of meditation and mindfulness-based interventions to more effectively increase health and well-being.

We consider mindfulness to be a mental skill that can be developed through, amongst others, meditative practice, or through mindfulness-based interventions, which typically include substantial meditative practice. One important facet of both mindfulness and meditative practice that is recognized by psychologists and contemplatives alike is decentering (Bishop et al., 2004; Bodhi, 2011; Dreyfus, 2011; Hölzel et al., 2011; Tang, Hölzel, & Posner, 2015). Decentering can be defined as a metacognitive insight of one's experiences as impermanent, and as not necessarily accurate reflections of reality (Bishop et al., 2004; Safran & Segal, 1990). This perspective of decentering can be developed throughmeditative practice (Dreyfus, 2011; Dunne, 2015; Grossman & Van Dam, 2011; Williams & Tribe, 2000). For instance, by engaging in meditation, a person may gradually come to realize that many of one's experiences – such as sensory experiences, ruminative thoughts, and feelings of desire – are in essence no more than impermanent constructions that arise and also dissipate again. Even though many of these experiences typically occur non-consciously, it is possible to become aware of them and observe them as transient events. This way, they become less self-relevant and have less impact (Lebois et al., 2015).

Some research suggests that the adoption of a decentering perspective plays an important role in explaining the effects of meditation and mindfulness-based interventions in reducing depression and anxiety (Fresco et al., 2007; Hoge et al., 2014; Lau et al., 2006; for an extensive review of decentering in this domain, see Bernstein et al. 2015). In addition, experimental studies among non-meditators have shown that brief decentering inductions can also reduce craving for food (Jenkins & Tapper, 2014; Lacaille et al., 2014; Papies, Barsalou, & Custers, 2012; Papies, Pronk, Keesman, & Barsalou, 2015; Papies, van Winckel, & Keesman, 2016).Research still has to establish whether brief decentering inductions among non-meditators lead to a similar quality of decentering

as among experienced meditators.However, both sets of findings on the effects of decentering are in line with Buddhist teachings, which have informed much of the current research on meditation and mindfulness. These suggest that both our aversion to negative experiences and our craving for positive experiences are "root causes" of suffering (Teasdale & Chaskalson, 2011). Importantly, Buddhist contemplative practice such as meditation is believed to facilitate the relief of aversion and craving through increased adoption of a decentering perspective. This suggests that decentering may be similarly important for explaining the effects of meditation on craving as on dealing with negative experiences. In the current research, we therefore examined whether decentering underlies the beneficial effects of meditation in relation to both unpleasant and pleasant experiences.

When applying the perspective of decentering, bodily and mental experiences are observed as impermanent events that come up but also disappear again (Farb et al., 2007; Hadash, Segev, Tanay, Goldstein, & Bernstein, 2016; Lebois et al., 2015). This typically results in reduced identification with one's experiences as being part of an enduring or future self, and in reduced cognitive elaboration on these experiences (Dreyfus, 2011; Teasdale & Chaskalson, 2011). When observing an affectively laden experience from this decentering perspective, it therefore becomes less compelling, and is less likely to induce a strong affective response (Hadash et al., 2016). In other words, decentering does not change the content of an experience, but rather allows for observing an experience as it really is, and without immediate reactivity. For example, thinking about an upcoming job interview and ruminating about what could go wrong might normally lead to feeling stressed. Such thoughts can also be observed for what they are, however, being transient mental events that do not necessarily reflect reality, and which naturally arise and dissipate. This perspective will decrease further elaboration on these thoughts, and thus curb the development of stress and anxiety. The nature of decentering thus allows for staying with the current reality, and to stay focused on the present, rather than getting immersed in an imagined or even feared future reality. It can be adaptive to adopt this perspective as a regulation strategy, such as when preparing for a job interview, because it could reduce the extent to which unpleasant and pleasant experiences induce undesired or unhealthy affective responses.

A recent fMRI study elegantly shows the role of decentering in how Zen meditators and non-meditators respond to painful stimulations (Grant, Courtemanche, & Rainville, 2011). In this study, the meditators were explicitly instructed not to meditate. Any differences between groups therefore reflect a learning experience through meditation, rather than being caused by being in a meditative state. While pain was induced in participants using heat stimulation on the skin, the meditators were more resilient to this heat than non-meditators, as a higher temperature was required for the heat to become painful. The meditators also showed increased activity in brain areas associated

with sensory and pain processing in comparison to the non-meditators, suggesting that they were highly aware of the heat stimulation. Importantly, and in line with a decentering account, resilience to the heat stimulation was associated with a decoupling of activity in these sensory areas from activations in prefrontal cognitive-evaluative and self-processing areas. Thus, these results suggest that despite being more aware of the unpleasant experience, meditators had a weaker affective pain response than the non-meditators due to decreased elaborative and self-referential processing.

In the domain of craving, in contrast to the domain of negative affect, it is much less clear which psychological processes underlie the effects of meditation. Moreover, little research has been conducted on the role of decentering with regard to pleasant, rewarding experiences, for example eating tasty but unhealthy food.In a small number of studies on decentering in this domain, non-meditators were instructed how to apply the decentering perspective in response to tempting foods (Jenkins & Tapper, 2014; Lacaille et al., 2014 Papies et al., 2012, 2015). Observing one's thoughts about pleasant, reward-related, experiences as fleeting mental events was expected to decrease how likely they were to induce craving. Indeed, participants who applied decentering had decreased approach impulses and reduced craving to eat the food (Lacaille et al., 2014; Papies et al., 2012, 2015). Furthermore, decentering reduced unhealthy snacking compared to a control group (Jenkins & Tapper, 2014; Moffit, Brinkworth, Noakes, & Mohr, 2012). One additional small-scale study (N = 33) among active meditators examined the effects of lifetime meditation experience and decentering on the experience of food cravings in daily life (Papies, van Winckel, & Keesman, 2016). Results showed that decentering from food-related thoughts was associated with reduced food cravings, especially among meditators with relatively little meditation experience. These studies suggest that decentering plays an important role in reducing craving for pleasant experiences, such as eating tempting foods. It remains unknown, however, if decentering also underlies the beneficial effects of meditation for reducing cravings.

A construct related to decentering is awareness of experiences. Applying the decentering perspective that a specific experience is impermanent in nature also implies an awareness of this experience in the first place. In addition, awareness and decentering can both be developed through meditation. This is confirmed by fMRI research (Grant et al., 2011) and research using self-report measures (Brown & Ryan, 2003), establishing that awareness of experiences is increased in meditators. Importantly, research has also found that awareness of experiences is associated with various measures of well-being, such as increased self-esteem, increased autonomy, and decreased depressive symptoms (Brown & Ryan, 2003). To test the unique, beneficial effects of decentering, then, it is important to also take into account the effects of awareness of unpleasant and pleasant experiences.

The present study

For the research report in this chapter, we recruited experienced meditators to examine whether decentering underlies the benefits of meditation for reducing affective reactivity towards both unpleasant and pleasant experiences. For the domain of negative affect, we hypothesized that lifetime meditation experience would be associated with increased resilience to unpleasant experiences. We further expected meditation to be associated with the extent to which participants apply the decentering perspective to their experiences in daily life, and that meditators would therefore be better able to cope with unpleasant experiences. For the domain of positive, reward-related experiences, we hypothesized that lifetime meditation experience would be associated with reduced food cravings, and that applying the decentering perspective to experiences in daily life would underlie this effect. In addition, we expected that lifetime meditation experience be associated with increased awareness of one's thoughts (e.g. Grant et al., 2011), but that this in itself would not lead to increased resilience or decreased food cravings. By including both decentering and awareness in the mediation model, we could assess the effects of meditation experience that are unique to decentering.

Methods

Participants

Eighty-seven meditation practitioners were recruited from meditation communities in the Netherlands for participation in this study. We aimed to recruit a convenience sample of 100 meditation practitioners which seemed sufficient for conducting a mediational regression analysis with 3 predictors. Due to time constraints, we could only recruit 87 participants.

Materials

Meditation experience questionnaire

Participants indicated how many days per week they practiced meditation, how many minutes per day they practiced meditation, and for how many years they had practiced meditation at this frequency. If participants indicated having previously practiced meditation at a different frequency, these same questions were repeated for that frequency of practice. Then, participants were asked in how many meditation retreats they had participated, and how many hours they had meditated during those retreats. Based on participants' answers to these questions, we estimated their lifetime meditation experience in hours (Hasenkamp & Barsalou, 2012).[1]

In addition, participants were asked to answer the questions "what type of meditation do you normally practice?", "what do you do during your practice of meditation?" and "what do you experience during your practice of meditation?".

Decentering and awareness questionnaire

We adapted the brief food-specific decentering and awareness questionnaire into a general decentering and awareness questionnaire (Papies et al., 2016). The questionnaire had eight decentering items (e.g. "I consider my thoughts to be transient mental events", "When I have thoughts, I notice how they come and go", "The thoughts that I have are very intense (recode)", "My thoughts feel very real (recode)", "My thoughts elicit strong reactions (recode)", "I can distance myself from my thoughts", "I am able to separate myself from my thoughts"), but due to a programming error, one decentering item was not recorded ("I get lost in my thoughts (recode)"). The questionnaire further included three awareness items ("I notice what thoughts I have", "I notice how I react to my thoughts", "I notice how I react to various circumstances and situations"). Participants responded on a scale from 1 ("does not apply to me at all") to 7 ("applies to me very much").

Resilience to unpleasant events

We measured the ability to recover from unpleasant life experiences with the extensively used 6-item Brief Resilience Scale (Smith et al., 2008). This scale has good internal consistency and test-retest reliability, and is also predictive of health outcomes such as perceived stress and physical well-being. Participants responded on a Likert scale from 1 (strongly disagree) to 5 (strongly agree) to statements such as "I tend to bounce back quickly after hard times" (recoded).

Trait food craving

We assessed craving for food using the 5-item Conceptual Craving Scale (Hill, Weaver, & Blundell, 1991), which has been found to correlate with more extensive measures of craving (e.g. White, Whisenhunt, Williamson, Greenway, & Netemeyer, 2002). Participants respond on a Likert scale from 1 (never) to 5 (always) on questions such as "How often do you experience strong urges to eat particular types of food?".

Procedure

Participants were recruited using flyers at local meditation communities. The people who indicated that they wanted to participate received a link to the online questionnaire by email. The questionnaire was entirely in Dutch. First, informed consent was obtained from all participants. Then, participants filled out the lifetime meditation experience questionnaire. Then, participants completed the decentering and awareness questionnaire, followed by the resilience and food craving scales. Finally, participants answered a number of demographic questions and were given the opportunity to enter a lottery to win one out of three €20 vouchers. Some additional questions were included at the end of the questionnaire to select meditators for a separate interview study (not reported in this chapter).

Results

Descriptives

The descriptive statistics, internal consistency of the measures, and the correlations between each of the measures can be found in Table 1.

One participant had 29,578 hours of meditation experience, partially due to 10 full years of retreat experience. Because this strongly deviated from the mean and influenced the results, we excluded this participant from the analyses. The remaining participants had, on average, 725 hours of meditation experience (*SD* = 1117).Participants practiced meditation in various styles, from different contemplative traditions. Participants often reported that they practiced multiple of these styles of meditation, as is common in Western practitioners, e.g. "Vipassana (school of Goenka) and Zen (school of Rinsai)" or "Shamatha and Vajrayana from the Nyingma tradition".

Table 1.

Descriptive statistics, internal consistency, and the correlations between the used measures.

Measure		*M*	*SD*	Cronbach's *α*	1	2	3	4	5	6	7
1.	Age *In years*	40	12		-	-.15	.15	.21†	-.22*	.06	.01
2.	Sex	34 males				-	-.14	.06	.14	-.12	.10
3.	Lifetime meditation experience *In hours*	725	1117				-	.21†	-.29**	.22*	.27*
4.	Resilience to unpleasant events *Scale 1 - 5*	3.6	.7	.78				-	-.27*	.54**	.18
5.	Craving for food *Scale 1 - 5*	2.9	.8	.81					-	-.24*	.02
6.	Decentering *Scale 1 - 7*	4.6	.9	.79						-	.28**
7.	Awareness *Scale 1 - 7*	5.6	.9	.78							-

$^{\dagger}p < .10$, $^{*}p < .05$, $^{**}p < .01$ (two-tailed).

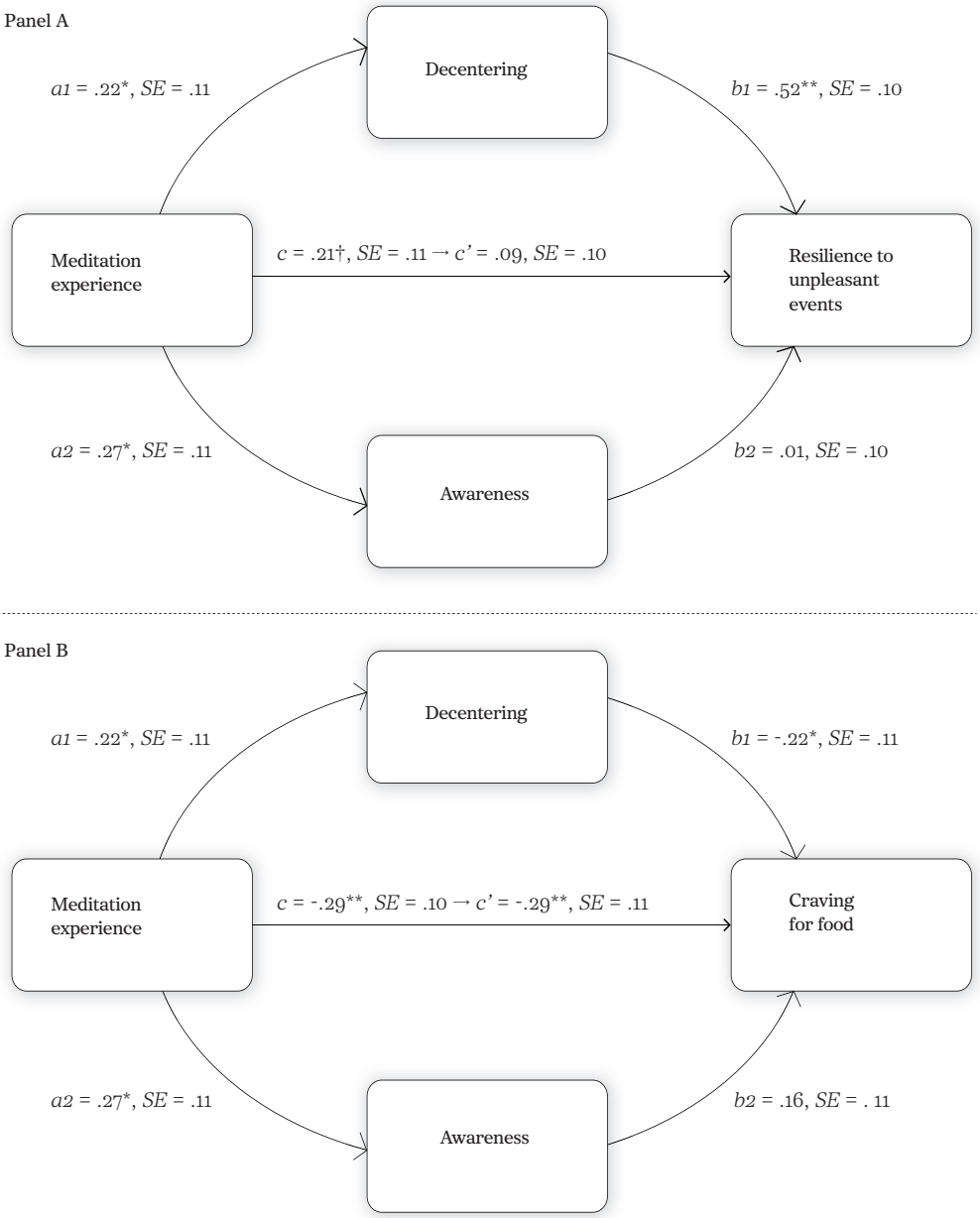


Figure 1.

The mediation model illustrating that meditation experience was associated with resilience to unpleasant events (panel A) and decreased food craving (panel B), and that this was mediated by decentering for both resilience, β = .12, *SE* = .04, and food craving, β = -.05, *SE* = .02. Standardized regression coefficients are reported, †p < .10, *p < .05, **p < .01

Main analyses

Our hypotheses were tested with the non-parametric bootstrapping approach to regression and mediation using the PROCESS macro (Hayes, 2013). Tests used 5,000 bias-corrected bootstrap samples.

Figure 1 (page 127) provides an overview of the results, with all effects being reported with standardized regression coefficients. As predicted, meditation experience slightly and positively predicted resilience (panel A), and negatively predicted food cravings (panel B). As further hypothesized, meditation experience also significantly predicted both decentering and awareness. Decentering positively predicted resilience, and negatively predicted craving, which was also in line with our hypotheses. Importantly, mediation analyses showed that the effect of meditation experience on resilience operated indirectly through decentering, β = .12, 95% CI [.05, .20], and this was also the case for craving, β = -.05, 95% CI [-.10, -.01]. Awareness, on the other hand, did not predict resilience or craving. We also found no evidence of the effects of meditation experience on resilience and craving being mediated by awareness, since zero was included in both confidence intervals, 95% CI [-.04, .05] and 95% CI [-.01, .12], respectively.

While age was positively correlated with resilience and negatively correlated with cravings, controlling for age in the analyses did not change the results.

General Discussion

We examined the role of decentering as a psychological mechanism underlying the potential effects of meditation on resilience to unpleasant events and on cravings for food. We found that lifetime meditation experience was associated with increased resilience to stressful events and with decreased food cravings. Meditation experience was furthermore associated with the extent to which meditators adopt a decentering perspective in daily life, and with awareness of thoughts. However, only decentering, and not awareness, was found to underlie the effects of lifetime meditation experience on resilience and cravings. Our findings provide direct evidence for the notion that decentering plays a key role in the beneficial effects of meditation, in the face of both unpleasant *and* pleasant experiences.

These results corroborate earlier research, which showed that meditators were more resilient to painful stimulations, and that brief decentering instructions to non-meditators reduced cravings for food. Altogether, it seems that decentering plays an important role in developing equanimity (Dreyfus, 2011; Dunne, 2011; Grabovac, Lau, & Willett, 2011; Kuan, 2012; Monteiro, Musten, & Compson, 2014). Equanimity is an "even-minded mental state or dispositional tendency toward all experiences or objects, regardless of their affective valence (pleasant, unpleasant, or neutral) or source" (Desbordes et al., 2015). In the current research, equanimity is reflected by increased resilience to

stressful events, in the sense that one quickly recovers in the face of unpleasant experiences that might trigger negative affective reactivity. Furthermore, decreased cravings reflects equanimity in the sense of remaining even-minded towards the prospect of having a rewarding experience (Desbordes et al., 2015; Hadash et al., 2016). Increased equanimity may be adaptive as it provides the opportunity for responding in a reflective manner in line with long-term goals, rather than responding impulsively, based on the current affective state (Ostafin, Bauer, & Myxter, 2012; Papies et al, 2015).

Most people may not have the knowledge that the insights and skills developed through meditation may be beneficial for dealing with unpleasant and pleasant experiences alike, or otherwise, how to effectively use them. Indeed, Papies et al. (2016), who assessed the association of practitioners' tendency to apply decentering specifically to their thoughts about food, found stronger correlations with food cravings than the current study, which measured associations with the tendency to apply decentering in general. To facilitate the application of decentering in diverse domains (for example stress, anxiety, alcohol, smoking) it might be important to make meditators aware that the insights obtained in their practice can be applied to these domains, and to stimulate training with regard to specific cues and situations that trigger, for example, stress or cravings (see also Papies, 2017).

In the current research, we have focused on decentering, as this facet of mindfulness is underrepresented in contemporary meditation research so far, especially in the domain of reward and craving. With this narrow focus of our research, however, we did not assess other important skills and perspectives that are developed through meditation, such as attention regulation and concentration (Jha, Krompinger, & Baime, 2007; Mrazek, Smallwood, & Schooler, 2012), and loving-kindness and compassion (Hofmann, Grossman, & Hinton, 2011). Ideally, in the study of meditation and mindfulness-based practices, all main skills and insights that are obtained through such practices should be taken into account, as well as the ethical framework of its respective contemplative tradition (Grossman, 2015). Our focused approach has benefits, however, as it allowed us to test the unique effects of decentering.

A potential limitation of this research is that we only used self-report measures. Participants could therefore adjust their responses to their personal hypotheses about how meditation works, or to what they think the researchers expected (see also, Grossman & Van Dam, 2011). These potential biasing effects of using self-report measures, however, may be limited in the current study, as all participants had meditation experience and should thus exhibit a similar bias. Furthermore, there currently is no other way of assessing decentering than doing this by self-report. Important next steps for research would be to provide additional validation for the decentering questionnaire, and to find other ways of assessing decentering.

A further limitation of our research is that we only measured lifetime meditation hours, rather than other forms of learning about decentering. As decentering is based on insight, (Dreyfus, 2011; Kuan, 2012), it might also be developed through instructions and contemplative discourse, which we did not measure. Future research might attempt to study the development of decentering from more varied sources. In relation to this, it would be worthwhile for future research to explore how decentering as adopted by experienced meditators compares to decentering as adopted by novices or non-meditators.

Finally, we used a cross-sectional dataset to draw conclusions about mediation, which could provide biased estimates (Cole & Maxwell, 2003; Maxwell & Cole, 2007). To test mediation, well-powered longitudinal experiments with random assignment to conditions would provide the most accurate estimates, and moving towards such designs is certainly the way forward. Yet, given constraints on participant time and researcher resources and our desire to learn to most about decentering, we still decided to collect this cross-sectional dataset and try to learn the most from it using the statistical tools available that were available to us (Hayes, 2013). In addition, our specific hypotheses were based on theory and findings from carefully controlled experimental research. Thus, these results make a valuable contribution to understanding the psychological processes underlying the beneficial effects of meditation.Given the mere correlational nature of our data, alternative interpretations are certainly possible, such that people with more awareness of their thoughts are more likely to start meditating, or that having increased resilience to stressful events makes it easier to regard one's thoughts as fleeting mental events. However, we consider these directions of the associations to be less likely than the theory-based interpretation of the findings offered here, namely that meditation increases the extent to which decentering is applied in daily life, which increases resilience and reduces cravings.

Conclusion

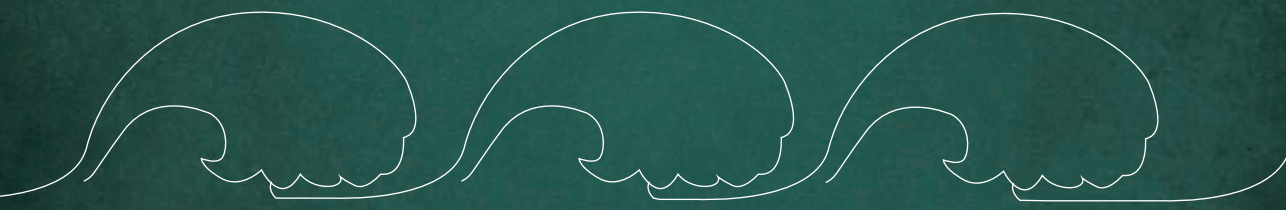
This study underscores the importance of decentering for coping with unpleasant and pleasant thoughts. Decentering is the insight that upcoming (potentially troubling) thoughts and experiences are transient mental events, rather than permanent and necessarily accurate reflections of reality. We found the extent to which meditators apply decentering in daily life to underlie the beneficial effects of meditation on resilience to unpleasant events, and on reduced food cravings in daily life. Understanding exactly how decentering works may improve the efficiency and effectiveness of teaching it. This is important as the results suggest that adopting a decentering perspective provides benefits to meditators' health and well-being.

Footnotes

[1] During a separate interview study, four participants gave a more detailed estimation of their lifetime meditation hours. These numbers were used for the analyses, but this did not influence the results.

PART III

The end matter



SAMENVATTING

Summary in Dutch

Het observeren van de geest in plaats van erop te reageren: Hoe mindfulness mensen in staat stelt om gezonder te leven

De menselijke geest is buitengewoon.Het stelt ons in staat om potentiele toekomstige scenario's in te beelden, actieplannen te maken, en effectief te handelen in complexe sociale situaties. Zonder de menselijke geest zou er geen kunst, wetenschap, of beschaving zijn. En hoewel de menselijke geest vele voordelen met zich meebrengt, kan het ook onnodig lijden veroorzaken. Een herinnering of ingebeeld toekomstscenario met negatieve lading kan bijvoorbeeld angst, verdriet, of boosheid veroorzaken. Daardoor kan het zijn dat iemand met een oorlogsverleden niet geniet van siervuurwerk, maar juist angst ervaart door de harde knallen. Aan de andere kant kan een herinnering of ingebeeld toekomstscenario met positieve lading juist verlangen veroorzaken. Hierdoor kan het ondanks alle goede voornemens lastig zijn om toch af te blijven van die lekkere snack, sigaret, of alcoholische versnapering: zelfs wanneer we dat niet willen kan de geest dus invloed uitoefenen.

Wetende dat de menselijke geest niet alleen positieve kwaliteiten met zich meebrengt zijn er in verschillende beschavingen methodieken ontwikkeld om de kwaliteiten van de geest die zij onwenselijk vinden te verminderen, en de kwaliteiten die zij wenselijk vinden te bevorderen. Een vorm van een methodiek uit het Boeddhisme is enorm populair geworden in de Westerse wereld, en wordt *mindfulness* genoemd: i.e. "bewustzijn door het richten van aandacht, doelbewust, in het huidige moment, en zonder oordeel" (Kabat-Zinn, 1982, 1994). Mensen beginnen vaak met het leren van mindfulness in gestandaardiseerde cursussen met 8 wekelijkse groepsbijeenkomsten, waar zij ook worden gevraagd om 45 minuten per dag te mediteren ("MBSR Standards of Practice," 2014). Veel onderzoek toont ook aan dat deelname aan zo'n cursus leidt tot een vermindering van angst en depressie, en minder gebruik van genotsmiddelen (Hofmann, Sawyer, Witt, & Oh, 2010; Oikonomou, Arvanitis, & Sokolove, 2016), als mensen ook echt mediteren (Creswell, Myers, Cole, & Irwin, 2009; Rosenzweig et al., 2010). Er is echter minder bekend over hoe mindfulness nou precies werkt. Gaat het om ontspanning, het vermijden van problemen door de aandacht te focussen op het huidige moment, of doet mindfulness iets anders met de geest? Het hoofddoel van mijn onderzoeksproject was het heel nauwkeurig in kaart brengen van het psychologische mechanisme waarmee mindfulness reactiviteit verminderd.

Achtergrond

In mijn promotieonderzoek heb ik mij voornamelijk gericht op het consumptiedomein, omdat overconsumptie een steeds groter maatschappelijk probleem wordt en het lijkt dat de geest een belangrijke rol in speelt bij consumptie. Ter illustratie, 52% van de Westerse bevolking heeft overgewicht, 19% is obees, en deze percentages lopen nog steeds op (Organisation for Economic Co-operation and Development, 2015). Wat mij altijd heeft gefascineerd is dat deze mensen vaak wel gezonder willen leven (Fagan, Diamond, Myers, & Gill, 2008), maar dat het de meerderheid van deze mensen op de lange termijn toch niet lukt (Mann et al., 2007). Er moeten dus methodieken worden ontwikkeld die deze mensen in hun kracht stellen om dit wel te doen. Wat zou er bijvoorbeeld gebeuren er als er minder reactiviteit in de geest zou worden uitgelokt – zoals dat er minder verlangen naar een ongezond product wordt ervaren? Met minder verlangen voor de ongezonde optie wordt het misschien wel makkelijker de voornemens om gezonder te leven op te volgen. Het begrijpen van de rol van de geest omtrent reactiviteit naar consumptieproducten is dus een belangrijk thema om gezondheid te bevorderen, en staat daarom ook centraal in dit proefschrift. In mijn promotieonderzoek onderzocht ik eerst de rol van de geest bij het veroorzaken van reactiviteit, en daarna onderzocht ik de actieve component van mindfulness die daar verandering in zou kunnen brengen.

De geest oefent invloed uit op gezondheidsgedragingen

Om mensen de kracht te kunnen geven om een gezonder leven te leiden, moeten we eerst goed begrijpen waar gedrag vandaan komt. Inzichten uit psychologisch onderzoek suggereren bijvoorbeeld dat menselijke gedrag niet alleen voortkomt uit rationeel denken en voornemens om lange-termijn doelen te behalen, i.e. *"homo economicus"*, maar dat andere processen van de geest menselijk gedrag ook kunnen beïnvloeden (Bargh & Ferguson, 2000; Evans, 2008; W. Hofmann, Friese, & Wiers, 2008; Strack & Deutsch, 2004; Stroebe, van Koningsbruggen, Papies, & Aarts, 2013). Verlangens om te eten zijn bijvoorbeeld een belangrijke voorspeller van consumptie en gewichtstoename (Boswell & Kober, 2016). Gewoontes voorspellen eetgedrag beter dan voornemens (Albery, Collins, Moss, Frings, & Spada, 2015; Danner, Aarts, & de Vries, 2008), en bij het zien van aantrekkelijk voedsel worden bijvoorbeeld impulsen opgestart om dit voedsel te pakken (Papies, Barsalou, & Custers, 2012), vooral bij honger (Seibt, Häfner, & Deutsch, 2007). Om mensen in hun kracht te stellen gezonder te leven moet er dus goed rekening worden gehouden met deze aspecten van de geest die ongewenste reactiviteit kunnen veroorzaken (zie Marteau, Hollands, & Fletcher, 2012; Sheeran et al., 2016; Sheeran, Gollwitzer, & Bargh, 2013). In andere woorden, om mensen een betere kans te geven om hun naar hun voornemens te handelen, moeten we manieren vinden om hun reactiviteit naar ongezonde consumptieproducten te verminderen (W. Hofmann et al., 2008; Stroebe et al., 2013).

Eerdere ervaringen zijn als representaties opgeslagen in het geheugen

Om ongewenste reactiviteit van de geest zo goed mogelijk te kunnen verminderen is het essentieel om de oorsprong hiervan goed te begrijpen, en in Hoofdstuk 2 van dit proefschrift wordt onderzoek naar deze processen in het voedseldomein uitgebreid beschreven. In het algemeen neemt veel onderzoek naar gedragsverandering aan dat representaties, i.e. opslagstructuren van informatie over de wereld (Barsalou, 2008), een belangrijke rol spelen bij het veroorzaken van reactiviteit (W. Hofmann et al., 2008; Jones, Corbin, & Fromme, 2001; Papies & Barsalou, 2015; Smith, 1998; Stacy & Wiers, 2010). Deze representaties komen voort uit eerdere ervaringen met de wereld (zoals het eten van chips), waarin de eigenschappen van deze ervaringen gekoppeld worden opgeslagen in het geheugen (zoals "zout", "geel", "belonend", "TV kijken"; Papies, 2013). Als vergelijkbare ervaringen vaker voorkomen, dan worden deze eigenschappen steeds sterker met elkaar gekoppeld in het geheugen (Barsalou, 2008; Niedenthal, 2007). Deze informatie kan dan worden gebruikt om gedrag te motiveren: wanneer iemand chocola representeert als iets dat verdriet wegneemt, dan zal deze persoon waarschijnlijk chocola willen eten bij verdriet. Onderzoek van Sheeran en collega's (2005) laat zien dat representaties ook een belangrijke rol spelen bij het opstarten van gewoontegedragingen.

Hoewel onderzoek overtuigend laat zien dat representaties een belangrijke rol spelen bij het veroorzaken van gedrag, is er eigenlijk maar weinig bekend over wat er allemaal is opgeslagen in mensen hun representaties, of hoe dat gemeten kan worden. Om beter te voorspellen hoe iemand zich zal gaan gedragen, en om reactiviteit tegen te gaan, is het echter essentieel om inzicht te hebben in mensen hun representaties van ongezonde producten.

In Hoofdstuk 3 van dit proefschrift wordt onderzoek gerapporteerd met de eigenschappentaak als methode om representaties systematisch in kaart te brengen. Deze taak wordt dan toegepast om representaties van energierijke drankjes in kaart te brengen. Eén onderzoek was uitgevoerd op de universiteit, en een ander onderzoek was uitgevoerd op weekendavonden in twee cafés. Deelnemers gaven aan welke drankjes zij vaak consumeerden, en welke niet, en rapporteerden daarna de eigenschappen van deze alcoholische en suikerhoudende drankjes, en water. Per drankje werden dan alle gerapporteerde eigenschappen systematisch gecategoriseerd aan de hand van een uitgebreid coderingsschema. De eigenschap “zoet” werd bijvoorbeeld gecategoriseerd als “smaak”, wat valt onder “sensorische ervaring”, wat weer valt onder “consumptie situatie”. Na de eigenschappentaak beantwoordden deelnemers vragenlijsten over alcoholgebruik en over verlangens om te drinken. Uit de resultaten bleek dat alle energierijke drankjes sterk werden gerepresenteerd in termen van het consumeren daarvan. Als deze categorie gedetailleerd werd bekeken, dan bleken alcoholische drankjes, suikerhoudende drankjes, en het water, allen sterk gerepresenteerd in termen van de sensorische ervaringen (zoals “zoet”) en positieve uitkomsten (zoals “zorgt voor plezier”, “genieten”) van het opdrinken. Ook bleek uit de resultaten dat alcoholische drankjes die deelnemers vaak dronken sterk gerepresenteerd werden in termen van de sociale context van consumptie (zoals “met vrienden”), in verhouding tot suikerhoudende drankjes, water, en alcoholische drankjes waarvan deelnemers aangaven deze niet vaak te drinken. In het eerste onderzoek bleek het representeren van alcoholische drankjes in termen van de sociale context van consumptie ook voorspellend voor alcoholkeuzes en verlangen om te drinken. Het gebruik van deze eigenschappentaak kan een nuttige methodiek zijn om toegang te krijgen tot mensen hun representaties van consumptieproducten, zoals energierijke drankjes. In Hoofdstuk 3 volgt een discussie over het toepassen van deze methode om meer te leren over welke informatie mogelijk actief zal worden in de menselijke geest, wat zal helpen bij het personaliseren van onderzoek en interventies om mensen in hun kracht te stellen de gezonde keuze te maken.

Hoe representaties als simulaties actief kunnen worden in de geest – en daarna gedrag kunnen beïnvloeden

Als een situatie overeenkomt met de eigenschappen in een opgeslagen representatie (bijvoorbeeld wanneer je televisie kijkt en chips ziet), dan worden de in representaties gekoppelde eigenschappen geactiveerd als simulaties (zoals "zout", "belonend", "knapperig"; Barsalou, 2003, 2009, 2015; J. Chen, Papies, & Barsalou, 2016; Niedenthal, 2007). Dat wil zeggen dat de verzameling aan eerdere situaties opnieuw wordt ervaren. Dit houdt dus ook in dat het bij eigenschappen die in grote mate aan elkaar zijn gekoppeld in representaties waarschijnlijker wordt dat deze ook samen worden gesimuleerd. Dus als mensen in het verleden veel ongezonde producten hebben geconsumeerd, dan maakt dat het waarschijnlijk dat zij in specifieke situaties consumptie meer zullen simuleren (May et al., 2015; Papies & Barsalou, 2015). Dit proces van simulatie verloopt automatisch en kan grotendeels onbewust gebeuren, maar kan ook bewust worden in de vorm van mentale beelden (May, Kavanagh, & Andrade, 2015; Papies & Barsalou, 2015). Er kan dus veel activiteit in de geest plaatsvinden, en dit is veelal afhankelijk van de huidige situatie en eerdere ervaringen in vergelijkbare situaties.

Bevindingen uit eerder onderzoek suggereren dat simulaties en mentale beelden over consumptie ook reactiviteit kunnen veroorzaken (May et al., 2015; Papies & Barsalou, 2015). Onderzoek heeft bijvoorbeeld aangetoond dat mensen die bij het zien van voedsel meer de consumptie daarvan simuleren, in de loop van de tijd ook meer kilo's aankomen, in verhouding tot mensen die consumptie in mindere mate simuleren (Stice, Yokum, Bohon, Marti, & Smolen, 2010; Stice, Yokum, Burger, Epstein, & Small, 2011). Het blijft echter onduidelijk of simulatie een bijverschijnsel is, of dat simulatie ook daadwerkelijk reactiviteit zoals verlangen of eetgedrag veroorzaakt. De beste manier om de rol van simulaties bij het veroorzaken van reactiviteit te toetsen is door middel van een experiment met een objectieve maat die mensen niet of nauwelijks zelf bewust kunnen beïnvloeden. Dat is precies de aanpak van het onderzoek dat in Hoofdstuk 4 is gerapporteerd.

Het doel van het onderzoek in Hoofdstuk 4 was om de rol van de geest bij het veroorzaken van reactiviteit in kaart te brengen. Specifiek werd onderzocht of de simulatie van consumptie de aanmaak van speeksel verhoogt, als voedsel wordt waargenomen. In de wetenschappelijke literatuur wordt namelijk nog vaak aangenomen dat het waarnemen van voedsel direct leidt tot de aanmaak van speeksel, zonder duidelijke rol voor de geest. Echter, het lijkt erop dat er bij het waarnemen van aantrekkelijk voedsel meer speeksel wordt aangemaakt dan voor neutraal voedsel, wat aangeeft dat de geest hier toch een belangrijke rol in kan spelen. De hypothese voor dit onderzoek was dat het simuleren van consumptie bij het zien van voedsel zouden leiden tot de aanmaak van meer speeksel, en vooral als dit aantrekkelijk voedsel zou zijn. Het aanmaken van

speeksel zou het lichaam dan in feite voorbereiden op het consumeren van dit gesimuleerde voedsel. In twee experimenten werden deelnemers blootgesteld aan een lekker, een neutraal, en een zuur voedsel, en een niet-voedsel controle object. In Experiment 1 kregen alle deelnemers de instructie om bij elk object het consumeren daarvan te simuleren. In Experiment 2 kreeg de ene helft van de deelnemers deze simulatie instructie wel, en de andere helft van de deelnemers kreeg deze simulatie instructie niet. In beide experimenten werden de deelnemers blootgesteld aan alle objecten, één per keer, waarna we de speekselhoeveelheid registreerden. Zoals verwacht registreerden we meer speeksel voor de voedselobjecten dan bij het niet-voedsel controle object, en vooral als het voedsel aantrekkelijk of zuur was. We registreerden ook meer speeksel bij de deelnemers de instructie om te simuleren hadden ontvangen, en dit was vooral het geval voor het aantrekkelijke en het zure voedsel. Deze bevindingen suggereren dat de geest, middels het simuleren van consumptie, een belangrijke rol speelt bij de aanmaak van speeksel na het zien van voedsel. In Hoofdstuk 4 van dit proefschrift wordt de rol van de geest bij het induceren van andere consumptie-gerelateerde processen verder bediscussieerd.

Hoe kan mindfulness mensen in hun kracht stellen om gezonder te leven?

Aangezien de geest via simulatie een belangrijke rol speelt bij het veroorzaken van reactiviteit naar ongezonde producten, is het belangrijk om specifiek dit aspect van de geest aan te pakken om mensen beter in hun kracht te stellen om gezonder te leven. Op basis van inzichten uit het Boeddhisme werd verwacht dat specifiek de *decentering* component van mindfulness een belangrijke rol zou kunnen spelen bij het verminderen van reactiviteit (Dreyfus, 2011). Decentering is het meta-cognitieve inzicht dat wat zich in de geest afspeelt niet permanent is, en ook niet noodzakelijk een accurate reflectie van een objectieve werkelijkheid weergeeft (Bishop et al., 2004; Dreyfus, 2011; Teasdale & Chaskalson, 2011). Dus als iemand een decentering perspectief aanneemt, dan wordt alles wat de geest fabriceert geobserveerd als voorbijgaande gebeurtenissen, waardoor dit minder overtuigend wordt. Als gevolg zou de geest dan minder reactiviteit teweeg kunnen brengen. Neem bijvoorbeeld iemand die bij thuiskomst na een lange werkdag neerploft op de bank, en de TV aanzet. Als deze persoon vaak chips eet in deze situatie, dan zal die situatie nu simulatie van het consumeren van chips aanwakkeren. Deze simulatie kan bijvoorbeeld bestaan uit het oppakken van de chips, de smaak, en het positieve gevoel dat het opeten geeft. Dit proces van simulatie kan dan allerlei vormen van reactiviteit veroorzaken, zoals bewuste gedachtes over het eten van chips, en een sterk verlangen om dit ook daadwerkelijk te gaan doen. Het blijven simuleren van consumptie zet deze reactiviteit nog sterker aan, wat er uiteindelijk toe kan leiden dat deze persoon opstaat om een zak chips te pakken. Echter, als deze persoon een decentering perspectief

had aangenomen, dan zouden deze fabricaties van de geest geobserveerd worden als voorbijgaande gebeurtenissen in de geest, waardoor ze minder overtuigend zouden worden. Als resultaat zou er dan minder reactiviteit worden aangewakkerd, wat de kans op handelen naar wat er zich in de geest afspeelt zou verkleinen. Op deze manier zou de decentering component van mindfulness een belangrijke rol kunnen spelen bij het verminderen van reactiviteit op de geest, wat mensen uiteindelijk beter in hun kracht zou kunnen stellen om gezonder te leven.

In Hoofdstuk 5 van dit proefschrift wordt onderzoek gerapporteerd over of de decentering component van mindfulness reactiviteit zou verminderen als er beelden met een positieve of negatieve lading actief zouden zijn in de geest. Om dit te onderzoeken ontvingen deelnemers een korte decentering instructie, waarin ze werden gevraagd om hun gedachtes te observeren als voorbijgaand, als gebeurtenissen in de geest die opkomen en vanzelf ook weer verdwijnen. In Experiment 1 en in een replicatie-experiment beeldden deelnemers een vervelende autobiografische gebeurtenis in. Deelnemers rapporteerden dat dit inbeelden leidde tot een sterk negatief gevoel, tenzij ze een decentering perspectief aannamen, wat dit negatieve gevoel sterk verminderde. In Experiment 2 beeldden deelnemers een voor hun aantrekkelijke maar ongezonde snack in. Deelnemers rapporteerden dat dit inbeelden leidde tot een sterk verlangen om deze snack te eten, tenzij ze een decentering perspectief aannamen, wat dit verlangen sterk verminderde. In Experiment 3 ontving de helft van de deelnemers een decentering instructie, en de andere helft van de deelnemers ontving deze niet. Er werd dan steeds een aantrekkelijke snack voor deelnemers neergezet, en de hoeveelheid aangemaakt speeksel werd dan geregistreerd net als in het onderzoek van Hoofdstuk 4. Speekselhoeveelheid werd hier weer gebruikt als objectieve maat van reactiviteit, die maar moeilijk bewust te beïnvloeden is door de deelnemer. Daarnaast vroegen we deelnemers te rapporten in hoeverre ze het eten van het product inbeeldden. Uit de resultaten bleek dat de mate van het inbeelden van consumeren niet verschilde tussen de decentering en controle deelnemers. Echter, deelnemers die geïnstrueerd waren om een decentering perspectief aan te nemen maakten veel minder speeksel aan dan de deelnemers die deze decentering instructie niet hadden ontvangen. Het geheel van deze experimenten toont dus aan dat decentering reactiviteit vermindert, zelfs wanneer beelden met een positieve of negatieve lading actief zijn in de geest. Dus, zonder te beelden in de geest te onderdrukken werd de reactiviteit daarop toch verminderd. In Hoofdstuk 5 wordt het mechanisme van decentering om de reactiviteit naar mentale beelden te verminderen verder bediscussieerd

Aangezien het aanleren van mindfulness typisch via meditatie gebeurd, richtte het onderzoek van Hoofdstuk 6 zich ook op dit aspect van decentering en reactiviteit. Er werd hier onderzocht of het aannemen van een decentering perspectief kan verklaren waarom meditatie ervoor zorgt dat mensen minder verlangens ervaren en adaptief

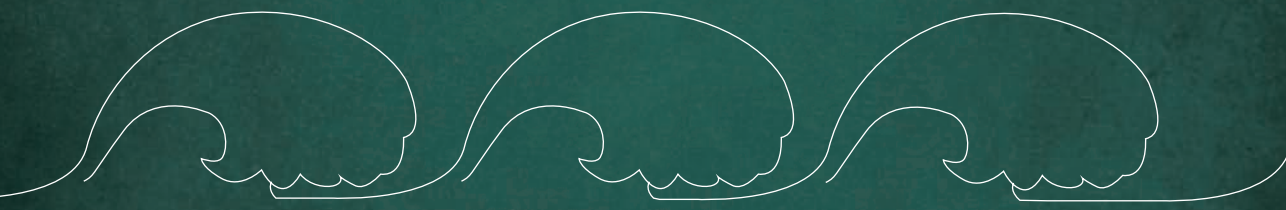
kunnen omgaan met stressvolle gebeurtenissen. Vooral in het domein van consumptie en verlangens viel hier nog veel over te leren. Deelnemers aan dit onderzoek rapporteerden heel systematisch hun totale meditatie ervaring in uren, de mate waarin zij in het dagelijks leven bewust zijn van hun gedachtes, en de mate waarin zij in het dagelijks leven een decentering perspectief aannemen. Voor de uitkomstmaten rapporteerden deelnemers de mate waarin zij terug konden veren na stressvolle gebeurtenissen, en de mate waarin zij voedselverlangens ervaren in het dagelijks leven. Uit de resultaten bleek dat de totale meditatietijd samenhing met het terugveren na stressvolle gebeurtenissen, en met verminderd verlangen voor voedsel. Een belangrijk aspect van de resultaten was dat het aannemen van een decentering perspectief in het dagelijks leven een belangrijke rol speelde in het verklaren van de bovenstaande effecten. Enkel bewustzijn van de gedachtes, aan de andere kant, hing niet samen met verminderde verlangens of goed kunnen terugveren na stressvolle gebeurtenissen. In andere woorden, door te mediteren nemen mensen in grotere mate een decentering perspectief aan, en daardoor kunnen zij beter omgaan met stressvolle omstandigheden, en ervaren zij minder voedselverlangens in het dagelijks leven. Ook de resultaten van dit onderzoek suggereren dus dat het aannemen van een decentering perspectief een belangrijke rol speelt in het verminderen van reactiviteit. In Hoofdstuk 6 van dit proefschrift wordt deze rol van decentering bij het verklaren van de effecten van meditatie verder uitgelicht.

Conclusie

Dit proefschrift richtte zich op de rol van de geest bij het veroorzaken van ongewenste reactiviteit, en hoe mindfulness dit tegen zou kunnen gaan. Het eerste deel van het onderzoek richtte zich daarbij op het systematisch in kaart brengen van de inhoud van representaties die bijdragen aan wat er zich in de menselijke geest afspeelt. Daarna volgden twee experimenten die bevestigden dat de geest een belangrijke rol speelt bij het aanwakkeren van reactiviteit, en specifiek dat de simulatie van consumptie de aanmaak van speeksel bevordert bij de waarneming van voedsel. Het tweede deel van het onderzoek richtte zich op het systematisch in kaart brengen van het psychologische mechanisme van mindfulness dat zulke reactiviteit zou kunnen verminderen. Hieruit bleek dat de decentering component van mindfulness, i.e. het meta-cognitieve inzicht dat ervaringen van voorbijgaande aard zijn, een belangrijke rol kan spelen bij het verminderen van reactiviteit. In experimenteel en cross-sectioneel onderzoek leidde decentering tot minder verlangens, minder speekselaanmaak, en minder negatieve gevoelens. Hieruit blijkt dus dat het aannemen van een decentering perspectief reactiviteit kan verminderen.

Voor dit onderzoek is decentering als actieve component van mindfulness heel systematisch in kaart gebracht. Door deze actieve component goed te begrijpen kan decentering ook heel precies aan deelnemers worden aangeboden, en zijn deelnemers in staat

om decentering toe te passen na een instructie van slechts 3 tot 5 minuten. Om deze actieve component van mindfulness te onderzoeken, en hier korte-termijn effecten mee te bereiken, is het dus ook niet nodig om deelnemers een uitgebreide mindfulness-cursus te laten volgen. Dit maakt decentering een stuk toegankelijker voor gebruik in vervolg-onderzoek. Een belangrijke vraag is daarbij hoe decentering kan worden ingezet als methodiek om een gezonde leefstijl te bevorderen. Hoewel het voor dit proefschrift niet is onderzocht, wordt op basis van psychologische modellen verwacht dat verminderde reactiviteit naar ongezonde producten zorgt voor meer ruimte om te handelen naar voornemens, zoals om gezonder te leven (Hofmann et al., 2008). Er is dus veel reden voor vervolgonderzoek naar het toepassen van decentering, want het kan mensen vast helpen om de geest te observeren in plaats van er direct op te reageren.



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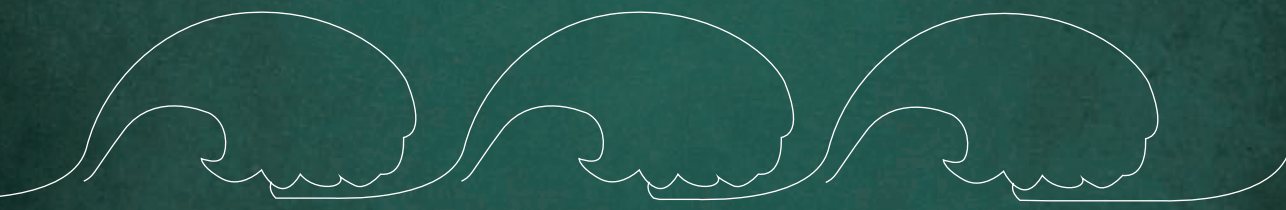

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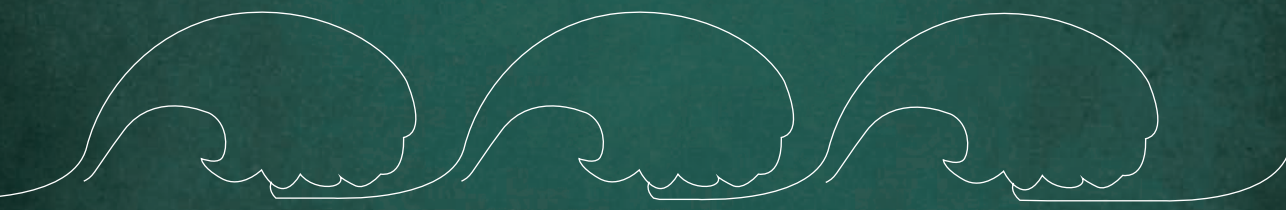
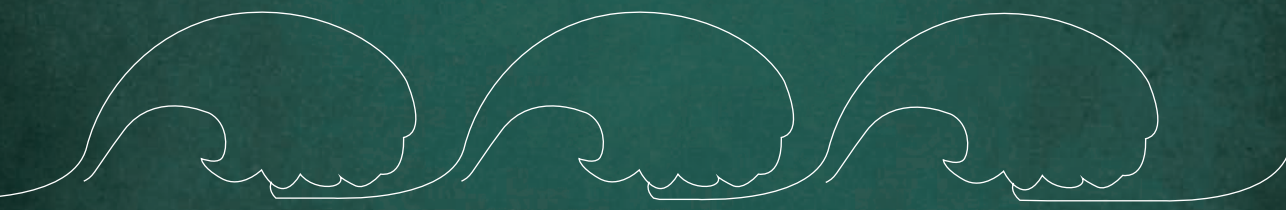


MIKE KEESMAN

Curriculum vitae

Mike Keesman was born in the Netherlands on the 11th of January, 1990. He started his undergraduate education in 2008, at University College Utrecht. There, he majored in Social Sciences, primarily focusing on psychology and economics. In addition, he minored in China studies, for which he studied at Xiamen University for one semester. After graduating in 2011 (with honors), he started with a research master which especially focused on the social and health-related aspects of behavioral regulation. He graduated in 2013 (cum laude). Afterwards, he started his PhD project under the supervision of Esther K. Papies, Michael Häfner, and Henk Aarts, which led to this dissertation. In 2017, Mike started as a postdoctoral researcher at Leiden University, on the BENEFIT project.



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"You can't stop the waves but you can learn to surf"

Jon Kabat-Zinn