On the Instigation of Implicit Motivation:

How Deprivation and Positive Affect Cause Motivated Behavior

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Cover Design:
Fluid deprivation by Vladimir & Piotr

Cover Photography:
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Printed by: Ipskamp Drukkers BV, Enschede

ISBN: 978-90-76269-76-4

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How Deprivation and Positive Affect Cause Motivated Behavior

Over de Totstandkoming van Impliciete Motivatie:

Hoe Deprivatie en Positief Affect Gemotiveerd Gedrag Veroorzaken

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor

aan de Universiteit Utrecht

op gezag van de rector magnificus, prof. dr. J. C. Stoof

ingevolge het besluit van het college van promoties,

in het openbaar te verdedigen op

vrijdag 19 juni 2009 des middags te 2.30 uur

door

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geboren op 14 november 1980, te Zwolle

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The research in this thesis was funded by the Dutch Organization for Scientific Research (NWO; grant 452-02-047).

Contents

Chapter 1

Introduction and Overview

This dissertation deals with the question how people become motivated to perform specific actions without much conscious thought. Studying human motivation is essential, as many -- if not all -- human behaviors are motivationally driven. For example, one may lose oneself in spending a lot of time searching the internet to find that one special book; skip lunch in order to finish a paper; or drink a glass of beer in one gulp. Behavioral scientists in general, and psychologists in particular aim to understand why human beings are motivated to behave the way they do and, more recently, whether such behavior can materialize in the absence of conscious awareness of the actual causes of behavior. Such understanding is not just of theoretical importance; it also helps to predict the occurrence of behavior and offers a potential tool for how to change it. For example, will a person who has been lonely for a while become motivated to visit a bar, and if so, under which conditions? And would such motivation originate from conscious intent, or could it also happen mindlessly? Or if one wants people to eat healthier foods, would it be better to promote healthy alternatives to their current foods to satisfy their appetite (a strategy that fast-food restaurants like McDonalds seem to adopt lately), or would it be better to devalue the current food choices, for example by providing people with pictures or slogans of negative consequences of eating unhealthy (a strategy used in smoking campaigns). The present dissertation aims to understand basic aspects of motivated behavior and thus may offer some answers to these type of questions.

In the search on the origin and control of human motivated behavior and the goals that we pursue in our daily lives, researchers often suggest that most of our behavior is ultimately the result of conscious deliberation (e.g., Bandura, 1986; Fishbein & Ajzen, 1975; Locke & Latham, 1990). Specifically, when we prepare and execute a behavior that we are motivated to engage in, we form an intention to perform that behavior on the basis of beliefs and values about social and personal outcomes that the behavior will produce. However, research over the last two decades casts strong doubts on this view. Based on the principle that executing an action (albeit relatively simple such as moving a finger or more complex such as earning money or visiting a friend) requires some sort of representation of that action to be accessible in mind, researchers also showed that *vice versa* rendering an action accessible (e.g., by priming the word “walking”) suffices to increase the execution of that action (e.g., Greenwald, 1970; Prinz, 1997).

More surprisingly and controversially perhaps, several lines of research provide evidence for the idea that rendering behavior representations accessible in mind can suffice to induce actual motivation to engage in the behavior given that the individual represents the behavior in terms of a desired state (e.g., making money, socializing). This occurs even if the behavior is rendered accessible outside conscious awareness (e.g., by means of subliminal priming; for overviews on such research on nonconscious goal pursuit, see Custers & Aarts, 2005a; Moskowitz, Li, & Kirk, 2004). To stretch this point even further, it has been proposed that when people are motivated to perform a specific behavior or attain a specific outcome, their mental system is

nonconsciously attuned to attaining the desired state. This could be materialized for example, by sustaining the representation of the behavior or outcome active over time, thereby increasing the probability to recognize and act on opportunities to attain the outcome, and by perceiving relevant objects in one's environment as being bigger, such that it becomes easier to attain one's goals. Thus, rather than being exclusively the domain of conscious processes, the motivation to perform a behavior or attain a goal can arise nonconsciously as well. And priming or the accessibility of the representation of behavior seems to play a crucial role in these processes.

However, although research on nonconscious goal pursuit has provided a valuable contribution to psychological science by showing that activating desirable behavior representations can instigate implicit motivation for such behaviors, it also brings up the question how people are able to determine whether a specific behavior is desirable or not outside conscious awareness. The importance of this question becomes especially clear considering that a single behavior representation may refer to a desired state at some, but not at other times. For example, if the representation of drinking soda is rendered mentally accessible after passing a Coca-Cola sign in the street, this may increase the motivation to drink more if one was already quite deprived of fluids (in which case drinking may be desirable) than when one did just drink a bottle of water before passing the sign (in which case drinking may be less desirable). Clearly, to understand how people determine the desirability of a specific behavior without conscious intervention, and when motivation will arise to engage in behavior, it is important to assess where motivation comes from in the first place.

In the literature, two main sources of motivation are distinguished. First, in the need literature it has been proposed that deprivation of resources that are crucial for one's well-being (such as food or social contact) influences the motivation for behaviors that are instrumental in reducing the state of deprivation (e.g., Murray, 1938; Pittman & Zeigler, 2007). This may come as no surprise: If one is deprived of food, one will become more motivated to eat. Second, behaviors may carry intrinsic motivational properties in themselves, because the mental representations of the behaviors have become associated with positive affect (e.g., Custers & Aarts, 2005; Damasio, 1994; Deci & Ryan, 2000). For example, one may be motivated to go bowling because one has positive past experiences with this activity. By taking these two sources of motivation – deprivation of crucial resources and a link between positive affect and a behavior representation – into account, then, one may get to the roots of how the nonconscious priming of behavior representations can create human agents that are able to experience and act on their motivation to engage in specific behaviors.

There are several studies that have examined the effects of motivated behavior as a result of priming, deprivation and positive affect. Somewhat surprisingly, however, so far studies on motivational products of priming, deprivation and positive affect have led relatively separate lives, as there is hardly any research that tested the role of these three key players in a single research program. For example, although the priming to behavior literature suggests that behavior representations have to be

mentally accessible for motivated behavior to occur (e.g., Bargh, 1990; Custers & Aarts, 2005a), theories on deprivation and needs usually do not explicitly take accessibility into account or even suggest that deprivation directly leads to motivated behavior without considering the enhanced accessibility of behavior representations to play a moderating role (see e.g., Fiske, 2004; Mook, 1996; Pittman & Zeigler, 2007). Furthermore, research on persuasion, evaluative conditioning and attitudes conceives of positive affect to play an important role in motivating people to perform the behavior at issue (e.g., De Houwer et al., 2001; Petty, Wegener, & Fabrigar, 1997). However, the contribution of such influence of positive affect on motivated behavior is rarely examined as a function of a state of deprivation. Accordingly, little is known about how the accessibility of behavior representations, deprivation of crucial resources, and an association between positive affect and a behavior representation work together in producing motivated behavior outside conscious awareness.

The current dissertation aims to provide a first step in obtaining insight into this matter. For this purpose I present a framework for the understanding and examination of motivated behavior resulting from the two basic sources of motivation, i.e., deprivation and positive affect, and the moderating role of behavior representations in the actual realization of motivated behavior. Next, a series of studies are presented that investigated key aspects of the framework. Specifically, it is tested (a) whether priming of behavior representations moderate the effects of deprivation on motivated behavior; (b) whether positive affect can turn people into a state of readiness for goal pursuit by examining how the establishment of a link between a behavior representation and positive affect causes objects relevant to perform the behavior to be perceived as being bigger; and (c) how deprivation and positive affect motivate behavior when they are both present. Below follows a more detailed overview of the chapters in the dissertation.

Overview of the Chapters

In Chapter 2 of this dissertation a theoretical framework is presented for understanding how motivated behavior results from deprivation of crucial resources or positive affect associated with behavior representations. Essentially, the framework proposes that the accessibility of the mental representation of a behavior is crucial for motivated behavior to occur, however that the actual motivation depends on the rewarding value of a behavior, which can be modulated by deprivation or result from an association of the behavior representation with positive affect. In the chapter, research from social-, cognitive-, health- and neuropsychology is reviewed to assess the role of behavior representations, deprivation, and positive affect in motivating behavior. Not only is the literature reviewed that underlies the proposed framework, an overview of studies that attest to the specific predictions of the framework is also presented (including the studies that will be presented in more detail in Chapters 3-5). Finally, it is discussed how the proposed view on motivated behavior may contribute to current as well as long-standing issues in the literature.

Chapter 3 deals with the question whether priming of behavior representations moderates the effects of deprivation on motivated behavior, by looking at the effects of subliminally priming the behavior of "drinking" under different levels of fluid deprivation. Study 3.1 tests the hypothesis that increases in fluid deprivation concur with increases in the motivation to drink, but only for participants who are subliminally primed with the mental representation of drinking. In addition, Study 3.2 tests whether subliminally priming the representation of "drinking" causes participants to actually drink more soda, but only when participants are relatively high deprived of fluids. In line with recent findings in research on nonconscious goal pursuit (see e.g., Custers & Aarts, 2005a; Moskowitz, Li, & Kirk, 2004), it is expected that motivation can increase even when participants are not consciously aware of the source of their motivation.

Chapter 4 tests whether nonconsciously motivated behaviors can result in a state of readiness for goal pursuit, in that objects instrumental in attaining a behavior for which one is motivated (e.g., a pencil in order to write) are perceived as being bigger. The idea that the perceived size of objects is contingent on the motivation to use them is not new (Bruner & Goodman, 1947), however there is no direct empirical evidence that being motivated for a behavior spontaneously accentuates the size of instrumental objects. In Study 4.1 this idea is tested for a behavior motivated by a state of deprivation, namely drinking. Specifically, it is tested how the motivation to drink (depending on fluid deprivation and the accessibility of the representation of drinking) affects the perceived size of a glass of water. Study 4.2 tests whether behaviors associated with positive affect also result in a state of readiness for goal pursuit and increase the perceived size of objects instrumental in performing those behaviors. It is expected that creating positive affect-motivated behaviors -- by co-activating neutral behavior representations (e.g., gardening) with positive affect -- increases the perceived size of objects instrumental in attaining those behaviors (e.g., a rake).

Chapter 5 focuses on the combined effects of deprivation and positive affect as sources of motivated behavior, by testing in a single research design how deprivation of fluids and an association between the representation of drinking and positive affect act upon the motivation to drink a glass of water. The first two studies test the hypothesis that the motivation to drink a glass of water (measured by participants' indicated motivation to drink and actual water consumption) depends on deprivation of fluids when the representation of drinking is not co-activated with positive affect, but that co-activating the representation of drinking with positive affect motivates behavior when deprivation is low. Study 5.3 tests whether the motivation to drink is affected if fluid deprivation becomes reduced without performing the behavior for which one is motivated by positive affect. It is expected that reducing fluid deprivation through eating a high-fluid content food (cucumber) diminishes the motivation to drink (i.e., water consumption) when drinking is deprivation-motivated, but remains high when positive affect-motivated.

Finally, I would like to note that each chapter of this dissertation is based on an article that has also been submitted to or published in a scientific journal. Therefore, each chapter can be read independently and the chapters can be read in any order. However, as the reader will notice, this also implies that there is some overlap between different parts of the dissertation.

Chapter 2

Unraveling the Motivational Yarn:
A Framework for Understanding Motivated Behavior Resulting From Deprivation and Positive Affect

Research suggests that the motivation to perform specific behaviors originates in the unconscious. This motivation springs from two basic sources: Deprivation of essential resources and positive affect attached to the specific behavior. There is little theoretical analysis and empirical research that addresses how these sources interact in producing motivation. Accordingly, we present a framework for the comprehension of motivated human behavior resulting from deprivation and positive affect. The framework consists of two essential components. First, it proposes that mental representations of behavior direct and motivate individuals to engage in behavior. Second, it suggests that a reward signal either emanating from deprivation or positive affect act upon behavior representations to produce motivated behavior. Thus, enhancing the accessibility of behavior representations can suffice to motivate behavior. We present several findings supporting the framework and discuss these findings in the context of nonconscious goal pursuit, needs and the distinction between liking and wanting.

This chapter is based on: Veltkamp, M., Aarts, H., & Custers, R. (2009). Unraveling the motivational yarn: Deprivation and positive affect as basic sources of motivated behavior. *Manuscript submitted for publication.*

"We can never, even by the strictest examination, get completely behind the secret springs of action" (Kant, 1785/2004, p.17).

Why do you want that piece of chocolate? What drives your neighbor to travel for five hours without much consideration just to meet a good friend? The common explanation for why human beings (and animals as well) are motivated to perform specific behaviors, is that they are deprived of something they need (e.g., Maslow, 1943; McDougall, 1908; Murray, 1938). Thus, people may be motivated to buy a box of chocolates because they are deprived of food and individuals who feel lonely may be pushed to seek contact with friends. However, although such a homeostatic principle may underlie the evolution and daily survival of most living organisms, humans can also be motivated in the absence of deprivation. This is vividly illustrated in a scene in Monty Python's "The Meaning of Life", where an obese man explodes after eating a chocolate following a copious meal. Rather than eating because one needs food, people may eat chocolate because they represent eating chocolate as a positive action they want to perform. Thus, it has been proposed that positive affect attached to behavior is another important source of motivation (e.g., Allport, 1937; Custers & Aarts, 2005a; Damasio, 1994). Whereas conscious reflective processes accompanying behavior may offer insight into the beliefs and values that people can share as possible motives for their behavior (e.g., Geen, 1995; Pittman, 1998), in principle, then, most of our behavior has deprivation-motivated or positive affect-motivated roots. The present paper focuses on these two sources of motivated behavior and the process underlying them.

Differentiating between the two sources of motivation is important and essential to advance our understanding of human behavior, and may help to improve attempts at changing and regulating behavior. However, the ability to determine the motivational sources of our behavior is, as discerned by Kant, not well developed (see also Nisbett & Wilson, 1977; Wegner, 2002), hence it may be difficult to tell whether our behavior is motivated by deprivation or positive affect or both. For example, the neighbor may infer that she is motivated to visit friends from the fact that she is willing to make a 5-hour drive in order to meet them, but it may be more difficult to assess whether the motivation to visit friends is caused by a deprivation of social contact or because visiting friends is perceived as something positive to do in itself. Or maybe she both feels lonely and enjoys the visits? Whereas the difficulty of tracing the sources of our own motivated behavior in daily life may be largely due to the nonconscious nature by which our behavior starts and unfolds, the psychological literature examining the basic sources of motivated behavior and their interplay seems to experience these difficulties as well.

The main reason for this may be that since the outset of psychological science (and even before that, see e.g., Aristotle, 330BC/1998) it has been assumed that the motivation for any behavior can in the end be traced back to a set of basic human needs (e.g., Fiske, 2004; Maslow, 1943; McClelland, 1951; McDougall, 1908; Murray,

1938; Pittman & Zeigler, 2007; Reiss, 2004; Sheldon, Elliot, Kim, & Kasser, 2001). Originally those needs were all assumed to be regulated by deprivation (Murray, 1938) in line with physiological needs (Cannon, 1932). However, because most research on human needs has mainly been interested in, if not absorbed by identifying the needs that can be considered to be universal, little attention has been given to a fine-grained analysis examining how deprivation of these needs produces motivated behavior. In fact, most research in this area suggests that needs differ in strength between individuals (e.g., need for achievement, closure or cognition; for overviews, see e.g., Kruglanski & Chun, 2008; Senko, Durik, & Harackiewicz, 2008; Thompson & Schlehofer, 2008). This does not only call into question whether they can be regarded to be basic human motivators and are controlled by deprivation, but also opens up the possibility that such needs actually refer to behaviors that are more positive to engage in for some people than for others (one person may enjoy achieving well more than another) and hence are affect-motivated.

Apart from differentiating between deprivation- and positive affect-motivated behaviors, it also seems a complicated enterprise to grasp how the two sources of motivation are related and how they interact in motivating behavior. An important reason for this is that previous work on this matter mainly has examined both sources separately. Accordingly, the question of how these two sources interact in motivating concrete behavior has hitherto received only little theoretical analysis and empirical attention.

The present paper aims to fill this gap by presenting a framework for the comprehension and examination of motivated human behavior. This framework consists of two essential components. First, it proposes that mental representations of behavior direct and motivate behavior. Second, the framework suggests that deprivation of crucial resources and positive affect act upon these representations to bring about actual motivation to engage in the behavior. In particular, the framework puts forward that motivated behavior results from the mere accessibility of the mental representation of that behavior, and that the rewarding value of the behavior is modulated by either positive affect attached to the behavior representation or deprivation. This way, people may become motivated to engage in a specific behavior without being aware of the actual motivational sources behind their behavior. In what follows we present research that speaks to this framework and details the relation between deprivation and positive affect in motivating behavior.

The Role of Behavior Representations in Motivated Behavior

In most contemporary theories of goal-directed behavior, it is assumed that the motivation to perform a specific behavior is the result of a deliberate decision or a person´s conscious intention to perform the behavior (e.g., Bandura, 1986; Deci & Ryan, 1985; Fishbein & Ajzen, 1975; Locke & Latham, 1990). In order to make such decisions and to be able to form intentions, people have to rely on mental representations of the behavior at issue (e.g., Goschke & Kuhl, 1993; Marsh, Hicks, &

Bink, 1998). That is, making decisions and forming intentions requires the utilization of mentally stored information for future use, in short, the ability to represent concrete actions, objects and their outcomes that are not present at the moment (e.g., Donald, 1997; Dretske, 1995; Prinz & Barsalou, 2000). Such mental representations do not only encompass semantic knowledge about a behavior, but also comprise the complete information necessary to actually perform the action (Prinz & Barsalou, 2000). In other words, behavior representations that are available in our repertoire are embedded in a connective network for perception, cognition and action. Thus, perceiving words referring to a behavior (such as painting) are expected to activate the semantic meaning of that word, but also the objects or tools associated with the behavior (e.g., Marsh et al., 1998; Tucker & Ellis, 1998), and the movements required to perform the behavior (represented in the motor areas of the brain; Glenberg & Kaschak, 2002; Pulvermüller, 2005; Zwaan & Taylor, 2006). In short, forming intentions to perform a specific behavior, which has been considered to be crucial for motivated behavior to occur, requires the representation of that behavior to be active (i.e., accessible).

Whereas conscious intentions have been shown to accompany the performance of motivated behavior, recently researchers have questioned whether such intentions are crucial for motivated behavior to occur. Already many years ago it has been proposed that activating behavior representations may suffice to get actual behavior going (Carpenter, 1874; James, 1890). This so-called principle of "ideomotor action" was summarized by William James as follows: "We … lay it down for certain that every [mental] representation of a movement awakens in some degree the actual movement which is its object" (1890, p. 526). Indeed, there is a growing amount of evidence showing that activating behavior representations outside conscious awareness (i.e., subliminal priming) does not only increase the tendency to perform a behavior as proposed by James (e.g., Chartrand & Bargh, 1999; Greenwald, 1970; Prinz, 1997), but can also increase the motivation to perform a behavior outside conscious awareness (for overviews of such nonconscious goal pursuit, see e.g., Custers & Aarts, 2005a; Moskowitz, Li, & Kirk, 2004; see also Aarts, Custers, & Marien, 2008a, for a differentiation between action preparation and motivation). More specifically, what this work on nonconscious sources of motivated behavior or goal pursuit has shown is that when a behavior is mentally represented as a desirable state (i.e., a goal; Fishbach & Ferguson, 2007; Gollwitzer & Moskowitz, 1996), merely rendering the representation accessible results in motivated concrete action to attain the goal without people necessarily being aware of their state of motivation and without consciously forming an intention.

By now, research has revealed several ways in which representations of desired behavioral states can become activated and induce motivation without conscious intervention. The first and most commonly used way in which a goal representation can be primed is by exposure to words that capture the representation itself (e.g., words such as "win", "strive", "achieve" and "master" prime the representation of "achievement", see Bargh, Gollwitzer, Chai, Barndollar, & Trotschel,

2001). However, recently it has been shown that goal representations can also be primed if one observes another person performing a specific behavior implying a given goal (e.g., Aarts, Gollwitzer, & Hassin, 2004; Dik & Aarts, 2007; Hassin, Aarts, & Ferguson, 2005; Loersch, Aarts, Payne, & Jefferis, 2008). But also thinking about a significant other (e.g., Fitzsimons & Bargh, 2003; Shah, 2003), smelling an object (e.g., scent of cleaning fluid; Holland, Hendriks, & Aarts, 2005; Holland, Veling, & Aarts, 2008), and perceiving a member of a stereotyped group (e.g., nurses; see Aarts et al., 2005) that is associated with a specific goal is capable of priming that goal in the person's mind. Thus, in daily life there are many social triggers that could activate mental representations of behavioral goals and hence increase the motivation for that behavior without conscious intervention.

Apart from examining the environmental cues that prime behavior representations and hence induce nonconscious motivated behavior, it is also important to understand how the enhanced accessibility of these representations act on our mental and behavior system in the absence of conscious awareness. The answer may already have been indicated by Kurt Lewin about 70 years ago, stating that "a strongly accented goal so transforms the situation that practically all objects acquire a reference to this goal" (p. 102, 1935). Indeed, the motivation to perform a behavior seems to tune the mental system towards engaging in that behavior, as research showed that (subliminal) priming of behavior representations (e.g., earning money) biases attention to objects (e.g., a wallet or coin) associated with the behavior (e.g., Aarts, Dijksterhuis, & de Vries, 2001; Ferguson & Bargh, 2004), increases the likelihood that objects and tasks are seen as an instrument to engage in the behavior (e.g., Balcetis & Dunning, 2006; Kay & Ross, 2003), and modulates conscious experiences of being motivated to perform the behavior (e.g., Custers & Aarts, 2005b; Fitzsimons & Bargh, 2003; Veltkamp, Aarts, & Custers, 2008a). Thus, the motivation to perform a specific behavior seems to bring the mental system in a state of readiness for goal pursuit, making it easier to attain one's goals.

Whereas priming the representation of a behavioral goal has been shown to tune higher cognitive processes in the service of performing goal-directed behavior, such priming effects may even occur on a more fundamental level. Specifically, a person's motivation to engage in behavior or to attain a goal has been proposed to affect basic perceptual processes. That is, perception has been conceptualized as a tool in the service of action and therefore objects instrumental in performing an action are expected to be spontaneously perceived to be bigger (Bruner, 1957). Accordingly, several studies have provided evidence for this functional size perception account by showing that the value of objects (e.g., coins) is positively related to the perceived size of these objects (for an overview, see e.g., Bruner & Postman, 1949). Although intriguing and groundbreaking, these early findings were heavily criticized because of poor methodology and potential confounds as to the relation between objective value and size (Eiser & Stroebe, 1972; Tajfel, 1957, 1959). Recent neuropsychological findings do suggest however, that top-down motivational information affects perception in

early visual processing areas (e.g., Bundesen, Habekost, & Kyllingsbaek, 2005; Desimone & Duncan, 1995; Serences & Yantis, 2006), indicating that motivational states can seize basic features of perception, even outside of conscious awareness.

In sum, representations of behavior are crucial in preparing and motivating behavior. Such representations can be triggered by a variety of environmental cues. Once activated, the representations are capable of modulating low-level perception processes as well as higher cognitive processes to facilitate the performance of the behavior and the attainment of goals. An important question emanating from this line of thought is how the human mental system is able to determine when a behavior is worth pursuing and when not in the absence of conscious awareness (see e.g., Aarts, Custers, & Veltkamp, 2008b; Bargh, 2006; Custers & Aarts, 2005a). That is, activating a behavior representation is not expected to result in motivation at all times, for all people and for all behaviors: A behavior may be highly desirable at one but not another occasion (e.g., one may be motivated to sleep when tired but not after waking up); or a behavior may be desirable to one person but not to another (e.g., visiting a gothic lifestyle event). It is proposed here that in order to motivate behavior, deprivation and positive affect act upon the mental representation of the behavior by providing a signal of whether the behavior is rewarding or desirable to engage in.

From Deprivation of Crucial Resources to Motivated Behavior

Deprivation is often conceived of as an important motivational source for behavior (e.g., Deci & Ryan, 2000; Fiske, 2004; Mook, 1996; Pittman & Zeigler, 2007). In general, the concept of deprivation refers to a lack of resources whose presence is required for an individual's well-being. Being deprived of such crucial resources is sometimes expressed in terms of having a need for the resource (need for fluid, need to belong; see e.g., Baumeister & Leary, 1995; Fiske, 2004; Pittman & Zeigler, 2007). Because the presence of such resources in an organism is required for optimal functioning, not reducing states of deprivation will eventually result in illness or even death. This makes deprivation a powerful motivator, resulting in obsessive thoughts and fantasizing about the lacking resources when deprivation becomes extremely high (e.g., Read, 1996; Wolf, 1958). Apart from acknowledging that deprivation is a fundamental source of motivation, however, it is important to grasp how deprivation increases the motivation for behaviors that reduce deprivation.

By far the most influential theory in explaining how deprivation results in motivated behavior is that of homeostasis. Homeostasis means that organisms are naturally inclined to maintain the amount of essential resources at a fixed level (Cannon, 1932; see also Cooper, 2008). Thus, declines in resources would automatically produce compensatory increases in motivation for behaviors functional in reducing deprivation and therefore restoring the balance. Although the concept of homeostasis was originally used to explain how bodily states of deprivation (food, fluid, oxygen) affect behavior, it was adopted in theorizing on psychological needs (Murray, 1938). In recent definitions of needs the idea that motivated behavior is

caused by a state of deprivation is still a central assumption (e.g., Baumeister & Leary, 1995; Deci & Ryan, 2000; Fiske, 2004), but especially in psychology needs have also been defined and operationalized differently. For example, the concepts of goals (Grouzet et al., 2005; Maslow, 1970), wants (Pittman & Zeigler, 2007) and desires (Maslow, 1970; Murray, 1938; Reiss, 2004) have all been used as synonyms for needs, although none of those concepts have to be dependent on deprivation. Furthermore, to test whether people have certain needs, researchers often do not look at the state of deprivation but instead ask individuals how much they need a resource (e.g., Aarts et al., 2004), how important certain events are for them (e.g., Reiss & Havercamp, 1998) or how satisfying it is to perform certain actions (e.g., Sheldon et al., 2001). These inconsistencies make it often unclear whether the concept of needs refers to resources regulated through homeostasis or something else altogether.

There seems to be consensus that the need to belong, referring to people's need for nonaversive interactions within already existing interpersonal relations, motivates behavior through this homeostatic principle (see e.g., Baumeister & Leary, 1995; Fiske, 2004; cf. the work on social contact and deprivation in the context of attachment, Bowlby, 1980; Harlow, 1958). However, there is disagreement concerning other social needs. For many social needs (e.g., need for achievement, autonomy, closure, cognition, competence, control and self-enhancement) it is unclear whether they motivate behavior through deprivation or not. Such needs are supposed to differ in strength between individuals, in that some people do and others do not or to a lesser degree have a specific need (see e.g., Pittman & Zeigler, 2007; Sheldon et al., 2001). For such needs, then, it is both tenable to propose that they depend on deprivation as that they depend on positive affect: deprivation may motivate behavior for such needs depending on how important a resource is to an individual (McClelland, 1951; Reiss, 2004), or individual differences in needs such as a need for achievement may reflect differences in how positive the act of achieving is for an individual (see e.g., Kruglanski & Chun, 2008; Senko et al., 2008; Thompson & Schlehofer, 2008). However, to understand how deprivation results in motivation from a homeostatic perspective -- which is the present purpose -- we will confine our analysis to resources for which it is clear that they are crucial for one's well-being (such as fluid, food or social contact).

Whereas the concept of needs may have underwent different meanings and ambiguities in a host of research programs, researchers that favored the classic view on deprivation and needs as part of a homeostatic principle have been quite informative in the effects that deprivation may have on individuals. That is, studies in which deprivation is conceptualized and operationalized in terms of lack of essential resources have shown that increases in for example fluid or food deprivation concur with increases in attention for objects instrumental in reducing deprivation (e.g., Jones, Bruce, Livingstone, & Reed, 2006; Mogg, Bradley, Hyare, & Lee, 1998), approach reactions towards instrumental objects (e.g., Raynor & Epstein, 2003; Seibt, Häfner, &

Deutsch, 2007) and actual amount of consumption (see e.g., Fitzsimons, 1972; Le Magnen, 1985).

The research on homeostatic behavior regulation alluded to above suggests that deprivation directly leads to motivated behavior. However, although a direct link between deprivation and behavior may fit well with the behaviorist's approach toward stimulus-response habits (e.g., Watson, 1925), such a homeostatic model may be too rigid and simplistic to explain all circumstances that can induce deprivation-motivated behaviors in both animals and humans (e.g., Berridge, 2004; Pinel, Assanand, & Lehman, 2000). Rather, motivated behavior seems to be based on the acquisition of knowledge about a link between a deprivation-reducing behavior (e.g., drinking) and deprivation (e.g., of fluid). Importantly, assuming that such knowledge usually derives from learning processes under conditions of deprivation, this suggests that deprivation motivates behavior via the mental representations of that behavior.

The idea that learning processes link deprivation to motivated behavior has a well-established theoretical and empirical tradition in psychological science. Early psychological theories already suggested that an organism has to learn through reinforcement that certain responses are functional in reducing deprivation while other responses are not (e.g., Hull, 1931). For instance, animal research (especially tested on rats) has shown that not being able to reduce fluid deprivation by means of drinking early in life (when only given access to lettuce to consume water) results in distorted drinking behavior following fluid deprivation later in life (Milgram, Krames, & Thompson, 1974; Milgram, 1979). Such findings support the idea that the link between fluid deprivation and the basic act of drinking as a deprivation-reducing behavior has to be learnt (or at least can be unlearned or rapidly replaced by another action).

According to incentive theory (Bindra, 1974; Bolles, 1972; Toates, 1986) animals as well as humans do not merely learn to associate deprivation (e.g., of fluid) with a particular behavior (e.g., drinking), but rather that performing a specific behavior is rewarding given that there is a state of deprivation. Thus, one may originally learn through trial-and-error that for example drinking is rewarding when deprived of fluids. Through reinforcement, then, eventually the link between the rewarding properties of the specific behavior under conditions of being deprived will be stored in memory. In other words, what incentive theory suggests is that deprivation increases the motivation for deprivation-reducing behaviors by modulating the rewarding properties of the mental representations of these behaviors, thus signaling that the behavior is worth pursuing. Supporting this idea, research has been shown that the rewarding value of objects instrumental in reducing deprivation becomes higher when high deprived (e.g., Cabanac, 1979; Ferguson & Bargh, 2004; Seibt et al., 2007) and diminishes again when deprivation decreases (Berridge, 2004; Cabanac, 1979; Gottfried, O'Doherty, & Dolan, 2003).

The notion that deprivation acts on, and modulates the rewarding value of the representation of a deprivation-reducing behavior suggests that this representation has to be mentally accessible to obtain effects on overt motivated behavior. However,

there is actually little empirical work testing this idea. In fact, most studies on deprivation seem to support a direct link between deprivation and motivated behavior (e.g., Drobes et al., 2001; McClelland & Atkinson, 1948; Mogg et al., 1998; Raynor & Epstein, 2003). It is important to note, however, that in studies that suggest a direct link participants are consciously aware of their state of deprivation, either because they are instructed to abstain from for example eating or drinking, or because they are asked questions about deprivation. Thus, the behavior of interest is rendered accessible to all participants, thereby confounding deprivation and accessibility of the representation of a deprivation-reducing behavior.

In one of the few studies manipulating deprivation and accessibility orthogonally, Strahan, Spencer and Zanna (2002) obtained an interaction effect between subliminally priming the representation of drinking and fluid deprivation on the amount of drinking: Deprived participants drank more during a taste test when primed with the concept of drinking, whereas non-deprived participants were not influenced by the primes. These priming effects showed up even though the representation of the behavior was already rendered accessible by explicitly asking participants several times about their state of deprivation before the dependent variable was assessed. Whereas conscious and nonconscious priming effects in motivated behavior have been demonstrated to occur independently (e.g., Bargh et al., 2001), participants' opportunity of explicitly reflecting on their deprivation and the behavior to reduce it before Strahan and colleagues (2002) assessed the dependent variable provides a challenge as to the meaning of the subliminal priming effects. In another recent study (Aarts et al., 2004), the interaction between deprivation (of income) and accessibility of a behavior representation (earning money) was investigated without making any reference to the behavior or the state of deprivation before the assessment of the dependent variable. Although the results of this study showed a similar interaction between deprivation and priming as the Strahan et al. (2002) study, deprivation was operationalized as the extent to which participants felt that they needed money, which could also be an indication of how positive they perceived the act of gaining money. Therefore, the findings may either represent an instance of deprivation-motivated behavior or of positive affect-motivated behavior.

To test the effects of accessibility of behavior representations in the relation between deprivation and motivation, Veltkamp, Aarts and Custers (2008a, 2008b) therefore focused on a resource that is obviously regulated through deprivation (fluid) and made sure that the mental representation of drinking behavior was not activated by anything other than a priming procedure in which the level of accessibility was unobtrusively manipulated. Hence, the amount of deprivation was measured at the end of the experimental session by asking people to indicate how deprived of fluids they were (in minutes). Veltkamp et al. (2008a, Study 1) found that an increase in fluid deprivation concurred with an increase in experienced motivation to drink, but only if the mental representation of drinking had been primed before. Veltkamp and colleagues (2008b) also examined the interplay of deprivation and accessibility on

basic perception. As mentioned earlier, there is suggestive, but not conclusive evidence that the motivation for a specific behavior can spontaneously increase the perceived size of objects that are instrumental in performing the behavior (e.g., Bruner & Goodman, 1947; Bundesen et al., 2005). Thus, by taking the functional size perception idea into the lab, Veltkamp et al. (2008b) tested whether fluid deprivation and behavior accessibility affected the perceived size of a glass of water. The results showed that a glass of water was only perceived to be bigger for participants who were relatively deprived and for whom the representation of drinking was mentally accessible, indicating that those participants were prepared to act upon their motivational state on a basic perceptual level.

A final study (Veltkamp et al., 2008a) extended these findings by manipulating fluid deprivation and showing that a relatively high state of deprivation caused an increase in actual drinking behavior, but only after the behavior representation had been primed. In the absence of fluid deprivation, priming did not increase the motivation to drink, indicating that the act of drinking does not have a rewarding value per se. Together, these studies show that, when deprived (of e.g., fluid or food), one may not become motivated to drink or eat until the representation of drinking or eating behavior itself has been primed by external cues, for example because one sees a soda vending-machine at the entrance of a building or perceives a McDonalds sign on the street. Note, however, that the studies discussed above mainly focus on mild rather than severe deprivation. However, under conditions of severe rather than mild deprivation, external priming may no longer be required. Specifically, under such rare conditions one may start to experience a dry mouth when fluid-deprived and an empty stomach when food-deprived (Mook, 1996; Rolls et al., 1980), rendering the relevant behavior representations accessible by themselves. Such internal cues may act as primes to action as well and can thus motivate behavior in the absence of external primes.

To recapitulate, deprivation motivates deprivation-reducing behavior by modulating the rewarding properties of the mental representation of that behavior. Specifically, because people learn throughout life that specific behaviors are rewarding to perform given a state of deprivation, being in a deprived state will eventually automatically alter the rewarding properties of behaviors and objects useful in reducing the deprivation (e.g., Berridge, 2001; Cabanac, 1979; Ferguson & Bargh, 2004; Seibt et al., 2007). However, the actual emergence of deprivation-motivated behavior requires the mental representation of the behavior to be mentally accessible, whether we are aware of it or not (Veltkamp et al., 2008a; 2008b).

Motivated Behavior in the Absence of Deprivation: The Case of Positive Affect

So far, we focused on how deprivation can motivate people to engage in behavior that reduces the deprivation. However, there are also behaviors in an individual's repertoire for which one is motivated to engage in because they seem to be positive to perform in themselves. For example, one may go for a stroll for no other reason than

for the joy of it. In such cases, the motivation to engage in a specific behavior does not seem to be contingent on a state of deprivation, but instead is driven by that the fact that the behavior is positive in itself. Thus, apart from deprivation, positive affect may be considered another source of motivation. This positivity signal to motivation can take different forms and arise from many sources. For example, one may anticipate the enjoyment of going out with friends; develop a rapid appetite for a Sushi-King meal when one learns that this meal is ordered by a good friend; or become more eager to earn some additional cash when one observes how someone is smiling upon making money by operating a slot machine. More generally, the motivation to engage in specific behaviors (e.g., socializing, eating sushi, earning money) can increase as a result of the co-activation of the representation of the behavior and positive affect.

The idea that positive affect is another important source of motivation to engage in behavior is supported by an abundance of research in several areas. For example, in the literature on persuasion (for overviews, see e.g., Chen & Chaiken, 1999; Petty, Wegener, & Fabrigar, 1997) it has been shown that creating more positive attitudes towards specific behaviors can increase the motivation (or intention) for these behaviors (e.g., showing celebrities driving environmentally friendly cars may increase the willingness to buy such cars). Such an attitude-behavior link can take place even in the absence of deprivation (see e.g., Shimp, Stuart, & Engle, 1991). In a related vein, research on operant conditioning showed that the motivation for a behavior can increase if performing that behavior has been followed by positive feedback in the past (e.g., a child consistently praised when riding a bike may become more motivated to go cycling; see e.g., Krosnick, Betz, Jussim, Lynn, & Stephens, 1992; Kuykendall & Keating, 1990). Furthermore, in the literature on self-determination it is explicitly stated that when all human needs are met, people will still be motivated to perform certain behaviors because they derive intrinsic motivation from performing these actions (Deci & Ryan, 1985; Deci & Ryan, 2000; cf. Berlyne, 1960). Although this intrinsic motivation may be expressed in many different ways (in terms of e.g., pleasure, joy, interest, curiosity or challenge), the common theme is that the behavior is attached to positive affect. Findings from different research areas, then, provide strong support for the idea that the positivity of a behavior can result in motivated behavior that is not contingent on deprivation states.

Previous research on the role of positive affect in motivated behavior suggests that people consciously take the rewarding value of a behavior into account before forming an intention or setting a goal to engage in the behavior (see e.g., Fishbein & Ajzen, 1975; Locke & Latham, 1990). However, there is no compelling reason to assume that positive affect can only motivate behavior consciously. Indeed, it is suggested that priming a behavior representation can produce motivation to perform that behavior in the absence of conscious awareness, but such nonconscious priming effects on motivated behavior are said to depend on whether the behavior is represented as a desired state (for overviews, see e.g., Custers & Aarts, 2005a; Moskowitz et al., 2004). It seems, then, that the mental system can process

information about the positivity of a behavior on an implicit level. Such implicit processing of affective information concurs with other research showing that affective processes can moderate decision making and behavior very fast and without reaching conscious awareness (e.g., Damasio, 1994; Dijksterhuis & Aarts, 2003; LeDoux, 1996).

Building on these findings, it has recently been proposed that motivated behavior can result from associations between behavior representations and positive affect (Aarts et al., 2008a; Custers & Aarts, 2005b), where positive affect is conceptualized in terms of valence assigned to an entity (cf. Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Zajonc, 1980), and not an emotion or mood state that people consciously experience (Isen & Diamond, 1989; Russell, 2003). Such an association is thought to act as a reward signal that can indicate -- without conscious awareness -- whether a behavior is worth to engage in and to pursue or not. An association between a behavior representation and positive affect can arise when a person performs the behavior in close temporal proximity of the activation of positive affective information. Furthermore, apart from directly performing the behavior, the representation of behavior may also be linked to positive affect by mere co-activation (e.g., when the perception of others performing the behavior is followed by a smile). In essence, any event that renders the representation of a specific behavior and positive affect active at (nearly) the same time should lead to the development of an association between the two (e.g., Aarts et al., 2008a; Custers & Aarts, 2005b) and act as a reward signal that is not conditional on a state of deprivation.

An important question emanating from this positive affect as implicit motivator perspective is how positive affect accompanying the activation of a behavior representation leads to an increase in motivation to engage in the behavior. In adopting a basic and direct approach to address this question, there is research to suggest that so-called “pleasure-centers” in the brain (mainly targeting the nucleus accumbens) are involved in the mechanism that turns positive affect into a motivator (see e.g., Shizgal, 1999). For example, rats performing an arbitrary behavior such as pressing a lever in a cage that is followed by positive affect (as the behavior activates the pleasure-center), become highly motivated to perform that behavior (Olds & Milner, 1954). Illustrative of the motivational strength of a behavior under such positive affective circumstances, it has been established that animals run uphill and leap over hurdles (Edmonds & Gallistel, 1974) and cross electrified grids (Olds, 1958) in order to engage in the behavior associated with positive affect. Importantly, such effects occur even in the absence of physiological deprivation states such as thirst or hunger (Shizgal, 1997). Extrapolating these findings to the realm of human motivated behavior suggests that linking a behavior representation to positive affect can increase a person’s motivation to engage in that behavior.

Recently, researchers have started to put this idea to the test. For example, in one study (Custers & Aarts, 2007a), participants were either subliminally primed or not with the behavior representation of socializing. Next, they performed a mouse-click task that, if sufficient time was left, was followed by a lottery in which they could win

tickets for a popular student party. Thus, working hard on the task was functional to be able to socialize. It was established that participants put more effort into the instrumental task when the behavior representation of "socializing" was primed, and that this effect was more pronounced for participants who represented the act of socializing as more positive (as assessed by the EAST, De Houwer, 2003). In a similar vein, Ferguson (2007) showed that priming the behavior representation of "treating people equal" caused participants to vote against cutting Medicare (a federal program that offers aid to specific minority groups) when they implicitly evaluated the representation of acting egalitarian to be more positive. Although these studies adopted an individual difference approach towards the associative strength between behavior and positive affect, and hence the findings are correlational in nature, they show that priming effects on motivated behavior are conditional on the positive valence of the behavior's representation.

If motivated behavior can spring from positive affect associated with behavior representations, then creating such associations in a lab environment should also result in affect-motivated behavior. This idea has recently been tested in a series of studies (Aarts et al., 2008a, 2008b; Custers & Aarts, 2005b; Veltkamp et al., 2008b) by co-activating behavior representations with positive information in an evaluative conditioning paradigm (De Houwer, Thomas, & Baeyens, 2001). More specifically, behaviors that participants perceived to be neutral (e.g., doing puzzles) were subliminally primed on a computer screen. This presentation was followed within a very short time-window (150-200 ms) by either positive affective information (words such as "friend" or "smile"; thus creating a behavior-positivity association) or neutral information. This pairing of behavior representations with positive affect resulted in increased subjective experienced motivation to perform these behaviors as well as working harder on a task that gives access to engage in the behavior (Custers & Aarts, 2005b). Further experimentation revealed that priming of the behavior representation causes participants to (covertly) prepare the execution of the behavior, while the attached positive affect turned this preparation into actual motivation as was shown by increased physical persistence in executing the behavior (Aarts et al., 2008a).

Another line of research tested the possibility whether the creation of a behavior-positive affect link can also modulate lower perceptual processes in the service of performing the behavior (Aarts et al., 2008b; Veltkamp et al., 2008b). To this aim, participants were unobtrusively presented with neutral behavior representations (e.g., doing puzzles) that were directly followed by positive or neutral affective stimuli, after which participants estimated the size of objects instrumental in performing the behavior (e.g., puzzle booklet). The results showed that establishing a link between a behavior representation and positive affect increased the perceived size of instrumental objects (Veltkamp et al., 2008b). These effects on perceived object size showed up immediately after the pairing of behavior representations with positive affect but after a delay as well (Aarts et al., 2008b). These findings suggest that creating a link between the representation of a behavior and positive affect motivates

people to engage in the behavior, which concurs with work on the effects of deprivation and accessibility of representations of deprivation-reducing behavior on size perception (Veltkamp et al., 2008b). Moreover, the fact that the effects of linking behavior to positive affect persisted over time strengthens the idea that the effects carry motivational properties (see e.g., Bargh et al., 2001; Förster, Liberman, & Friedman, 2007).

It is important to note that behaviors that are functional in reducing a state of deprivation (such as drinking) do not necessarily have rewarding value in the absence of deprivation (cf. Seibt et al., 2007). Hence, priming such behavior representations does not increase the motivation to engage in the behavior in the absence of deprivation (see Veltkamp et al., 2008a). This does not mean, however, that creating a link between a deprivation-reducing behavior and positive affect cannot motivate behavior. For instance, unobtrusively pairing the representation of drinking water with positive affective stimuli has been shown to increase the motivation to drink a glass of water in the absence of fluid deprivation (Veltkamp, Custers, & Aarts, 2009). This raises the question, then, of how such links between deprivation-reducing behaviors and positive affect and states of deprivation work together in their effects on motivating people to engage in a specific behavior, such as drinking a glass of water. This is the issue that we will turn to now.

The Crossroad of Deprivation and Positive Affect

Our framework and the reported studies suggest that the preparation and motivation of behavior requires the mental representation of the behavior to be active. Whether a behavior representation that becomes mentally accessible results in actual motivation depends on deprivation or its association with positive affect. Thus, when deprivation is absent, people can still be motivated to engage in deprivation-reducing behavior when the representation is attached to positive affect. An important issue that has been left untouched up to this point however, is how the two sources of motivated behavior work together. Do they have additive effects on motivation, in that the presence of both deprivation and positive affect results in stronger motivation than if only one of these sources is present? Or do they interact, such that the effects of one source of motivation depend on the absence or presence of the second one?

An argument for additive effects may rest on the idea that deprivation and positive affect operate as independent mechanisms. Such a view coincides with the distinction between “wanting” and “liking” recently addressed in the literature (Berridge & Robinson, 2003; Robinson & Berridge, 1993, 2000). Specifically, liking refers to the low level hedonic aspect of, for example, food, water or drugs, which is typically observed in facial responses to taste properties (e.g., a disgusting facial expression in the case of a bitter taste). However, liking does not determine the incentive value of such objects. The incentive value is reflected by wanting, which corresponds to the motivation to for example obtain food and engage in eating. Physiological evidence supporting the distinction between liking and wanting indicates

that different neurotransmitter systems mediate changes in hedonic and incentive value. The finding that opioid antagonists can block hedonic reactivity to foods, but do not suppress general energy intake is consistent with the assumption that the hedonic value of food (but not the incentive value) is mediated by the opioid neurotransmitter system (Berridge, 2001; Epstein, Truesdale, Wojcik, Paluch & Raynor, 2003; Robinson & Berridge, 2000). In contrast, the incentive value of food seems to be mediated by the dopaminergic system; dopamine antagonists reduce the incentive value of food, but do not alter hedonic reactivity (Epstein et al., 2003; Robinson & Berridge, 2000). Thus, liking and wanting are supposed to operate independent from each other and are expected to contribute to behavior in an additive way.

It is important to note however, that our conceptualization of positive affect does not pertain to the liking system, but rather to the wanting (motivation) system. Specifically, whereas Robinson and Berridge's (2000) ideas about liking speak to *sensory experiences of pleasure* (e.g., occurring when one eats chocolate), our notion about the role of positive affect in motivated behavior concerns the updating of behavior representations in memory and does not rely on such pleasure experiences per se. That is, positive affect can bypass the experience of pleasure and directly affects the overall utility of behavior representations that can be accessed in memory and guide decisions (Custers & Aarts, 2005b; Shizgal, 1999). Thus, just like a state of deprivation, positive affect acts on the representation of the behavior in motivating people to engage in the behavior. Supporting this idea, research suggests that behaviors that either are rewarding due to a state of deprivation (e.g., food) or to its association with positive affect (through operant conditioning) activate the mesolimbic dopamine system in the brain (e.g., Berridge, 2001; McFarland & Kalivas, 2003). This system is thought to be involved in motivational processes in that it encodes the rewarding value of behavior and modulates the effort one will invest in performing the behavior (Berridge & Robinson, 2003; see Berridge, 2007). Importantly, cues referring to such behaviors (i.e., primes) can activate that same system (Schultz, 1998; Berridge, 2007). Thus, when a person is primed with a specific behavior representation, the reward value of the behavior -- which can be either conditional on deprivation states or depend on the association between the behavior representation and positive affect -- will be encoded through one and the same mechanism.

The idea of one underlying mechanism that turns behavior representations into motivated behavior does not only concur with the finding that positive affect attached to behavior can motivate behavior in the absence of deprivation; it also suggests that if one source (e.g., deprivation) motivates behavior, the second source (e.g., positive affect) may not add much to the motivational equation, as the presence of a single source already gives input or a signal that a behavior is rewarding to perform and thus instigates motivated behavior. Specifically, whereas deprivation is thought to typically motivate behavior by providing a rewarding signal to engage in the behavior, positive affect will offer such a rewarding signal and motivate behavior in the absence of deprivation. Circumstantial evidence for this idea comes from animal

research. For example, the amount of consumed fluid in nondeprived rats has been shown to be positively related to the strength of the rewarding property of the fluid (operationalized as the percentage of sucrose added to it), while overall fluid consumption is high when deprived (Mook & Cseh, 1981; see Mook, 1996). In addition, the influence of food preferences on consumption in animals seems to be inversely correlated with deprivation (Barbano & Cador, 2006; Rudski, Billington, & Levine, 1994). Assuming that preferences are based on affective processes, these studies suggest that deprivation and positive affect associated with behavior can interact in their effects on the motivation to engage in behavior.

Although it has been acknowledged that motivation can arise from different sources such as states of deprivation or cues associated with positive affect (Berridge & Robinson, 2003; Berridge, 2007; Shizgal, 1997, 1999), in a recent set of studies we empirically examined the effects of these motivational sources more directly in a single research design (Veltkamp et al., 2009). Specifically, we tested how deprivation and positive affect influenced the motivation to drink, as drinking is effective to reduce fluid deprivation but can in principle also be positive affect-motivated. In our studies, the mental representation of drinking water was unobtrusively paired with either positive or neutral affective information, using the same co-activation procedure as in earlier research (Aarts et al., 2008a; Custers & Aarts, 2005b; Veltkamp et al., 2008b). In a first study the effects of this co-activation procedure and participants' self-reported level of deprivation in minutes were tested on participants' (subjectively reported) experienced motivation to drink. In a second study, the state of fluid deprivation was manipulated and effects on actual water consumption were tested. The results of this study showed that deprivation and positive affect interacted, in that fluid deprivation increased the motivation to drink, but that a pairing with positive affect motivated behavior when deprivation was low or absent.

The findings presented above show that the motivation to perform a behavior can be caused by a state of deprivation, but if such a deprivation is absent motivated behavior can result from an association between a behavior and positive affect. These findings concur with earlier work proposing that the association between behavior and positive affect creates a goal to engage in the behavior that may remain active until that goal is attained (Aarts et al., 2008b; Custers & Aarts, 2005a). In other words, the effects of the association between drinking water and positive affect pertains to the specific goal of drinking water, while the effects of fluid deprivation may also be prone to opportunities that are not part of the instrumental repertoire of these needs (i.e., drinking water), yet capable of reducing the current state of deprivation (Milgram et al., 1974; Milgram, 1979). Accordingly, eating food with high fluid content may reduce the deprivation of fluid and the motivation to drink water as well. This very same act of eating should not reduce the motivation to drink arising from the established link between drinking and positive affect, as this positive affect-motivated source can encourage people to drink in the absence of deprivation. Indeed, it is known that people have a tendency to consume more than they need (Pinel et al., 2000; Rolls,

Rolls, Rowe, & Sweeney, 1981), suggesting that, at least in the domain of drinking and eating, positive affect attached to behavior can act as a motivator even when basic needs are satisfied and deprivation is absent.

To test this idea, we asked participants to abstain from drinking for at least two hours before participating in our experiment, thereby creating a relatively high level of fluid deprivation (Veltkamp et al., 2009; Study 3). Next, the act of drinking water was either co-activated with positive affect or not. Accordingly, at this point participants may be motivated to drink either because of fluid deprivation or of the nonconscious goal to drink water (due to its association with positive affect). However, the experiment then took a crucial twist. One half of the participants were allowed to eat a certain amount of a high fluid-content food item – i.e., a cucumber that contains 96% of water (Davidson, 1999) – whereas the other half were not. In the eating condition, then, participants were able to reduce their fluid deprivation accidentally through performing an action that is usually not considered to be instrumental in quenching thirst. Finally, participants were allowed to drink water *ad libitum* to allegedly prepare for an upcoming concentration test. It was found that eating cucumber reduced water intake when drinking was motivated only by deprivation, but cucumber consumption did not diminish water intake when drinking had been paired with positive affect. These findings show that motivation to drink water as a result of deprivation can cease to exist without executing the motivated behavior after deprivation has been reduced by eating a high fluid-content food item, while the motivation for that specific behavior remained intact after a link between drinking and positive affect had been established.

Taken together, then, these findings support the idea that motivation to engage in a specific behavior can emerge from two different sources, i.e., deprivation and positive affect, that modulate the rewarding value assigned to a behavior, but that both sources react differently to deprivation-reducing methods that do not pertain to the behavior at issue. That is, although we may reduce our deprivation of fluid by eating, the established link between the representation of drinking water and positive affect may operate as a desired state or goal that motivates us to engage in that specific behavior when the deprivation is reduced by other means. Therefore, deprivation and positive affect can lead to similar, but also to different effects on motivated behavior.

General Discussion

In this paper, we presented a framework for the comprehension and examination of motivated human behavior that arises from two basic sources, namely deprivation of crucial resources and an association between behavior representations and positive affect. Specifically, the framework holds that the accessibility of mental representations of behavior is crucial in preparing the execution of behavior. Furthermore, the framework suggests that the deprivation of crucial resources as part of a homeostatic principle modulates the rewarding value of the behavior

representation, and accordingly, turns the preparation into actual motivation to engage in the behavior. When deprivation is absent, however, an association of a behavior representation with positive affect can act as a reward signal and thus motivate behavior as well. We presented several findings that provided support for this framework of motivated behavior. The present analysis thus fosters a more clear distinction between different sources of motivation, by showing how deprivation and positive affect separately result in motivation for behavior and how these two sources interact in their effects on motivation.

In our framework, a crucial role is allocated to the mental representations of behavior. Activating behavior representations prepares people to initiate the corresponding overt behavior, even though these representations are activated outside of awareness - i.e. through subliminal priming (e.g., Aarts et al., 2008a; Pulvermüller, 2005). In doing so, our framework takes into account the most proximal determinant of behavior (e.g., Bargh, 1990). Most contemporary models of motivated goal-directed behavior do not explicitly explicate the role of behavior representations in determining people's motivation to engage in behavior (e.g., Bandura, 1986; Deci & Ryan, 1985; Fishbein & Ajzen, 1975; Locke & Latham, 1990). Rather, these models mainly aim to specify the conditions that cause people to consciously assess the desirability of behaviors or to consciously set and adopt goals to engage in the behaviors. Focusing instead on mental representations of behavior as the proximal determinant of motivated behavior fits within recent developments on nonconscious processes in motivated behavior, and as such may open new ways to understand and examine how deprivation and positive affect alters people's motivation to engage in behavior. We briefly discuss how the framework may contribute to current research that examines the sources and processes of human motivated behavior.

Sources of Motivation in Nonconscious Goal Pursuit

The idea that mere priming of behavior representations influences motivated behavior in the absence of awareness of the source of this influence concurs with recent developments in research on nonconscious goal pursuit (for overviews, see Custers & Aarts, 2005a; Moskowitz et al., 2004). Research in this area shows that (subliminally) priming a behavior representation (e.g., of helping) can induce motivation for that behavior outside of conscious awareness, depending on whether that behavior is represented as a desired state or not. The question of how people nonconsciously "know" whether the behavior is represented as a desired state, and hence, worth to engage in has led to intriguing speculation about the workings of the mind by introducing concepts such as automated will (Bargh et al., 2001), implicit volition (Moskowitz et al., 2004) or implicit intention (Wood, Quinn, & Kashy, 2002). However, such terms merely stretch the applicability of inherently conscious concepts to the unconscious level and are not clear about how the unconscious can perform operations that until recently were assumed to require consciousness. The present framework takes a somewhat different stance on the matter. That is, the framework specifies the sources (deprivation and positive affect) that render behaviors to be

represented as desired states, and thus can motivate people to engage in the behavior in the absence of awareness of the sources of their motivation. As such, our framework offers insight into the boundary conditions of priming effects on motivated behavior.

Furthermore, it is important to note that previous research on nonconscious goal pursuit suggests that priming a behavior representation associated with positive affect may cause that representation to operate as a goal that people want to attain (Bargh & Huang, in press; Custers & Aarts, 2005b; Fishbach & Ferguson, 2007). Conceptualizing nonconscious goals in terms of an association between a behavior representation and positive affect may have implications for the way people's motivation to engage in a behavior ceases after they have been able to perform the behavior. Specifically, one of the hallmarks of goals is that the cognitive and motivational processes supporting the goal maintain active until that goal is attained (Aarts, 2007; Förster et al., 2007; Goschke & Kuhl, 1993; Marsh et al., 1998). This suggests that the motivation for deprivation-reducing behaviors (e.g., drinking water) associated with positive affect does not depend on deprivation under these circumstances, but rather should reduce once that behavior is performed.

Whereas deprivation and positive affect may cause people to represent deprivation-reducing behavior in terms of a goal, it may be worthwhile to emphasize that goals are thought to come in two ways: Consummatory or continuous (Austin & Vancouver, 1996; Boldero & Francis, 2002). Consummatory goals are supposed to be no longer relevant for the organism once that goal is achieved. Consummatory goals thus seem to be part of a hierarchically ordered structure that are instrumental in reducing basic needs (cf. Kruglanski, Shah, Friedman, Chun, & Sleeth-Keppler, 2002; Shah & Kruglanski, 2003). However, continuous goals are more chronic and need to be maintained because external and internal factors tend to push the current state away from the desired state (see also Powers, 1973). Continuous goals may therefore be regulated by a homeostatic principle. Whereas the distinction between consummatory and continuous goals is rarely made in empirical work on nonconscious goal pursuit (but see e.g., Custers & Aarts, 2007b; Moskowitz et al., 2004), they bear some resemblance with the two sources of motivation put forth in the present paper. Accordingly, it would be interesting for future exploration to examine whether consummatory and continuous goals differ from the way deprivation and positive affect motivate human behavior, and whether and how they interact with these two main sources of motivation.

Deprivation and Positive Affect in the Context of Wanting and Liking

Earlier on we addressed another distinction between sources of motivation that has been recently proposed in the theoretical analysis of motivational processes of addiction, namely that between a liking system and wanting system (Berridge, 2001; Robinson & Berridge, 1993, 2000). Liking refers to the hedonic properties of, for example, food, water or drugs, which trigger hedonic reactivity or sensory experiences of pleasure. Wanting refers to the incentive value attributed to an object, and as such

motivates people to get or consume it. In other words, wanting is related to motivation, and liking is related to evaluation. In doing so, the present framework on deprivation and positive affect as basic sources of motivated behavior differs from that of the liking/wanting model, in the sense that our framework considers both deprivation and positive affect to be sources of the wanting (motivation) system rather than the liking (evaluation) system.

Because of its clear relevance for the understanding and examination of behaviors that may be sensitive to addictive processes, such as (over)eating behavior, the distinction between liking and wanting has been examined in recent studies. It is important to note, though, that these studies are not that strict in applying the liking/wanting distinction as proposed by Berridge and colleagues. That is, often the hedonic properties of, for example, food items are explained as if they were similar to the concept of liking (e.g., Blundell & Finlayson, 2004; Epstein et al., 2003) and hence would only influence the evaluation or sensory hedonic experiences of objects. This notion seems incompatible with research showing that attractive food cues do increase the amount of eating behavior (e.g., Fedoroff, Polivy, & Herman, 1997; Mela, 2006; see for a review Papies, Stroebe, & Aarts, 2008a). Such findings suggest that not mere liking, but actual wanting can be induced by the hedonic properties of objects (cf. Lowe & Butryn, 2007; Lowe & Levine, 2005).

The studies alluded to above, then, suggest that, what may look like a liking response to hedonic properties is in fact a motivational action in response to exposure of food items. Specifically, based on the present framework, it may be argued that attractive (palatable) objects (e.g., a chocolate) prime behaviors that are associated with positive affect (e.g., eating chocolate), thus increasing the motivation for that behavior. Supporting this idea, recent research suggests that the perception of attractive food activates the mental behavior representation of eating such attractive food and increases the motivation to eat it (Papies, Stroebe, & Aarts, 2007, 2008b).

In short, whereas the liking/wanting distinction shares potential overlap with the two sources of motivated behavior delineated in the present framework, we believe that addressing motivation in terms of deprivation and positive affect offers a complementary view on the emergence of human motivation. Specifically, our framework elucidates how motivated behavior may derive from a homeostatic mechanism which evolved to ensure quick recovery of a state of deprivation of essential resources, and an affective-motivational mechanism that relies on the acquired reward value or utility of the behavior as a result of its association with positive affect.

The Relation between Deprivation, Positive Affect and Needs

The present paper not only examined the crucial role of the accessibility of behavior representations in preparing overt behavior and effects of deprivation and positive affect in motivating behavior. It also sheds new light on how these two sources of motivation interact in producing people's motivation to engage in a specific behavior.

It is important to emphasize that most research on motivated behavior tends to conceptualize the sources of motivated behavior in terms of needs (e.g., Baumeister & Leary, 1995; Fiske, 2004; Maslow, 1943; McClelland, 1951; Murray, 1938; Sheldon et al., 2001). Although it is certainly a parsimonious strategy to use one concept for similar sources, the current framework suggests that it may matter to differentiate between deprivation and positive affect in understanding and examining the occurrence of motivated behavior. Thus, the motivation to engage in a specific behavior that is thought to result from social needs (such as a need for achievement, closure, cognition or safety) can be explained in terms of deprivation-motivated (in which case motivation should depend on underlying states of deprivation; Deci & Ryan, 2000; McClelland, 1951) or positive affect-motivated (in which case behaviors such as performing well on an anagram task or seeking closure in a social impression formation task are positive in itself; Kruglanski & Chun, 2008; Senko et al., 2008). Which of these two sources actually accounts for motivated behavior is not merely a recreational activity however, but potentially has important implications, as the effect of positive affect attached to behavior representations on motivated behavior was found to be dependent on the absence or presence of a state of deprivation (Veltkamp et al., 2009).

To further illustrate the importance of differentiating between deprivation and positive affect as sources of motivation, consider for example a teenager who spends a fortune on chat-boxes. She may be motivated to do so either because she is deprived of social contact and has a need to belong (Baumeister & Leary, 1995), or because she enjoys calling chat-boxes. In the first case, stimulating social contact (e.g., signing her up for soccer to interact with her peers) may reduce chat-box calling. However, this may not be true in the latter case. That is, our framework suggests that when a person is motivated to call chat-boxes because that behavior is associated with positive affect, offering the opportunity to engage in another deprivation (need to belong)-reducing behavior (e.g., soccer) does not necessarily decrease the motivation to engage in calling chat-boxes. However, the reverse may be true as well. Making chat-boxes less attractive may reduce chat-box calling but not the need for social contact, which may cause other detrimental behaviors to arise. In short, failing to correctly distinguishing between deprivation and positive affect as sources of motivated behavior may not only hamper theoretical research on motivation but can lead to bad decisions in daily life as well.

Finally, the current framework may provide a new perspective on the underlying mechanism of anticipatory consumption behavior. Anticipatory consumption refers to the notion that organisms can be motivated to perform deprivation-reducing behaviors such as drinking or eating in the absence of objective deprivation, in order to avoid a state of high deprivation and jeopardize one's well-being (e.g., Fitzsimons, 1972; Rolls & Rolls, 1982). For example, one may drink a glass of water before getting in the car to make a long journey, thus preventing one from getting thirsty while still driving. Recent models of motivation and behavior have

incorporated this idea of an individual's anticipation of aversive states to understand the different (emotional) responses that may emerge as a result of the presence or absence of positive and negative outcomes (see for an overview, Elliot, 2008).

Anticipatory consumption may be explained in terms of a homeostatic principle, as engagement in the behavior is aimed at preventing deprivation. However, the homeostatic principle in this specific instance fails to explain how motivated behavior can occur without an actual physical state of deprivation (for a similar argument, see Berridge, 2001). According to the present perspective, however, it may be that under specific circumstances (e.g., going to travel) deprivation-reducing behaviors (e.g., drinking a glass of water) have been learned to be rewarding to prevent a state of deprivation, such that context-dependent associations between representations of behavior and positive affect develop (cf. goal activation effects on implicit evaluation of goal-relevant actions and objects, Ferguson & Bargh, 2004). Hence, whenever these circumstances render the behavior representations mentally accessible, motivated behavior may arise, also in the absence of objective deprivation. However, because this proposed link between anticipatory consumption behavior and the positive affective source of motivation proposed in the present framework is rather speculative, it awaits further testing.

Concluding Remark

According to Immanuel Kant, it is a challenge, if not a mission impossible to get behind the secret springs of action. Recent advances in the science of motivation, cognition and behavior have opened new ways to explore this issue. Building on and extending these advances, we presented a framework aimed to unravel the apparent motivational yarn that underlies most of our behavior. Our approach allows to differentiate between two basic sources of human motivation: Deprivation of crucial resources and an association between behavior representations and positive affect. We presented several studies that provided support for the proposed role of deprivation and positive affect in motivated behavior. By focusing on the operation of these two motivational sources and the way they interact in their effects on the motivation to perform behavior, we hope that the current framework may further our understanding of human motivation and will provide a good starting point for further research on this matter.

Chapter 3

On the Emergence of Deprivation-reducing Behaviors: Subliminal Priming of Behavior Representations Turns Deprivation into Motivation

Building on recent research into the emergence of human motivation and goal pursuit in the absence of the conscious awareness of the source of this pursuit, the present article aimed to shed light on how states of deprivation (e.g., deprivation of fluid) actually produce the motivation and corresponding behavior that lifts the deprivation. Two studies established that when participants were relatively deprived of fluids, they experienced enhanced motivation to drink and consumed more fluid in an alleged tasting test, and these effects were more pronounced when the concept of drinking was rendered accessible by subliminal priming. These results suggest that specific motivational goal states and corresponding behaviors do not arise directly from deprivation per se, but that accessible goal-related cognitions play a role in this process. Implications for theory and research on deprivation and nonconscious goal pursuit are briefly discussed.

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

Human beings continuously need specific resources like fluid or food in order to remain healthy and even to survive. From time to time such resources will therefore have a profound impact on behavior. Specifically, the level of deprivation of essential resources is considered to directly influence motivation and behaviors directed at reducing the deprivation. For example, the more deprived of fluid a person gets, the more motivated to drink that person will become.

However, there is research to suggest that the relation between deprivation and motivation is not that straightforward. Recent studies show that people become more motivated to engage in specific behaviors when mental representations of the behavior are (supraliminally and subliminally) primed by environmental cues (for an overview, see Custers & Aarts, 2005a; Moskowitz, Li, & Kirk, 2004). These priming effects on motivated goal-directed behavior underscore the human ability to form, store and access specific knowledge representations in memory to promote effective behavior. One possible reason for these goal priming effects, however, is that people have learned that the primed behavior has positive consequences under certain conditions, and deprivation may typify such a condition. The motivation to engage in goal-directed behaviors and to obtain essential resources may thus result from an interplay between deprivation and accessible knowledge on a basic nonconscious level. The present paper aims to advance the idea that these two different potential sources may work in tandem to produce motivation and behavior. Specifically, we hypothesized that the effect of deprivation (e.g., of fluids) on the motivation to engage in behavior that lifts the deprivation (e.g., drinking) is moderated by the enhanced accessibility of the mental representations related to the behavior.

The idea that deprivation of primary resources affects motivation is well-studied. Classic theorists like Murray (1938) already considered time of deprivation as an important factor in motivation. More specifically, motivation was thought to depend on a cyclical process: the longer one state lasts (e.g., waking), the higher the deprivation of the other state will be (e.g., sleeping) and the more one wants to attain this other state. Several studies support the idea that deprivation influences motivation. For example, deprivation of crucial resources (e.g., fluid, food and even social resources such as money) has been found to influence the desire to obtain deprivation-reducing or goal-related objects (e.g. Drobes et al., 2001; Ferguson & Bargh, 2004; Raynor & Epstein, 2003; Seibt, Hafner, & Deutsch, 2007; Sherman, Rose, Koch, Presson, & Chassin, 2003), perception (McClelland & Atkinson, 1948), memory (Aarts, Dijksterhuis, & de Vries, 2001), attention (Jones, Bruce, Livingstone, & Reed, 2006; Lusher, Chandler, & Ball, 2004) and actual behavior (Campfield, Smith, Rosenbaum, & Hirsch, 1996; Raynor & Epstein, 2003).

However, although the studies alluded to above show strong effects of deprivation on measures of motivation, it is important to note that this influence may be confounded with accessibility of representations of behavior that lift the deprivation. That is, in most studies human participants are consciously aware of their state of deprivation and the goal to reduce it as a result of the explicit nature in which

deprivation is manipulated or measured before the motivation measure (dependent variable) is assessed. For example, in their seminal work on the projective expression of implicit needs, McClelland and Atkinson (1948) asked participants not to eat for a certain amount of time before the start of the experimental session. Upon entering the lab, it was checked whether participants had adhered to the food regime, and then exposed to an ostensibly subliminal perception task (they actually projected empty slides on a screen). By asking participants specific questions about the slides (e.g., "What kind of things are on the table displayed on the slide?"), McClelland and Atkinson showed that hungry participants were more likely to "see" eating-related objects than did non-hungry participants. Such manipulations of deprivation are very common in recent research as well. Although explicit instructions to abstain from eating or drinking indeed result in food or fluid deprivation, they also render the mental representation of the relevant behavior ("eating", "drinking") accessible. In a similar vein, some studies enhanced the mental accessibility of deprivation-reducing behavior by asking participants to explicitly rate their level of thirst or hunger before the dependent variables are assessed. Thus, whereas a large body of research indicates that deprivation affects motivation, it is not clear how these effects interact with enhanced accessibility of relevant behavior representations.

Early biological approaches to motivation already suggest that deprivation alone is often not enough to motivate behavior (e.g., Geen, 1995). In order to reduce deprivation, the organism has to know which behavior it desires to perform. Hull (1931), for instance, stated that apart from the tension that is created by the deprivation, which is the driving force behind motivation, the organism should learn through reinforcement which responses to which stimuli reduce the deprivation. This idea was further advanced by work on incentive learning. These theories grew out of several remarkable findings in different animal labs that shed new light on the role of reinforcement in learning processes following the s-r habit paradigm (Skinner, 1953; Watson, 1925). According to incentive theory (Bindra, 1974; Bolles, 1972; Toates, 1986), it is not so much the strength of the stimulus-behavior relation that is reinforced, but specific behaviors are rendered more desirable by the deprivation, as the behaviors predict positive consequences under this condition. For example, one may have learned that drinking is desirable whenever one is deprived of fluid. As modern research often conceptualizes such learning in terms of mental processes that involve the acquisition and activation of knowledge representations (e.g., Custers & Aarts, 2005b), these views on deprivation and motivation suggest that priming deprivation-relevant knowledge facilitates the influence of deprivation on motivational behavior. Accordingly, people who are deprived should be more motivated to engage in specific deprivation-reducing behaviors, but these effects are more likely to become manifest when the mental accessibility of these behaviors is enhanced.

There are a few recent studies that explored this interaction between deprivation and priming. Strahan, Spencer, and Zanna (2002; Study 3.1) asked their participants to abstain from drinking for three hours. When entering the lab,

participants were all checked on the fluid-abstinence criterion and explicitly rated their level of thirst. Next, all participants ate cookies, after which half of them were allowed to drink water (the non-deprived condition), the other half were not (deprived condition). Participants then again rated their thirst. Subsequently, the accessibility of the concept of drinking was experimentally enhanced by subliminally priming half of the participants with drinking-related words and the other half with non-words. Next, participants were again asked to rate their thirst, and finally, they were asked to taste from two beverages. Although the interaction effect between deprivation and priming was not significant, the results of this study suggested that deprived participants drank more during the taste test when primed with the concept of drinking, whereas non-deprived participants were not influenced by the primes. These findings are interesting, but also somewhat puzzling. Specifically, the subliminal priming effects on behavior ensued even though participants were made consciously aware of their deprivation of fluid and drinking goal by the explicit nature of the experimental set-up. Whereas conscious and nonconscious priming effects on motivation and goal pursuit have been demonstrated to occur independently (Bargh, Gollwitzer, Lee Chai, Barndollar, & Trötschel, 2001), the repeated opportunity of explicitly reflecting on the deprivation and deprication-reducing behavior before the assessment of the dependent variable provides a challenge as to the meaning of the subliminal priming effects.

A study by Aarts, Gollwitzer, and Hassin (2004; Study 1) may offer some clarity to this dispute. They investigated the effects of priming the concept of earning money and of deprivation of money independently by measuring deprivation after the dependent variable (thus ensuring them that they did not activate thoughts about the deprivation or behavior before the priming event). In this study, the concept of making money was rendered accessible by capitalizing on the assumption that participants nonconsciously inferred the concept during the observation of another person's goal-directed behavior. After this goal inference task, participants were told that the study was almost completed, but that they had to perform a mouse-click task. Crucially, participants were told that if enough time was left at the end of the session they would be able to engage in a lottery in which they could win money. Participants' pace of working on the mouse-click task served as a measure of motivation: the faster they worked on it, the stronger their motivation to get to the last part of the session, where they could earn money. The findings of this study revealed that priming of the concept "making money" resulted in more motivational behavior only when people were relatively more deprived of it.

Although suggestive, these findings are not conclusive as to the interaction between deprivation and accessibility of deprivation-reducing behavior. As Aarts and Hassin (2005) suggested, their results can be attributed to differences in goal inferences between low and high deprived persons: highly deprived people inferred the goal to make money more readily then people with low deprivation. As a result, the goal could have been more accessible for highly deprived participants. To exclude

this potential confound, in the present two studies we manipulated the mental accessibility of a deprivation-reducing behavior directly – i.e., by subliminally priming the concept of drinking – and compared the effects of this priming procedure with a measure of fluid deprivation on motivated activity. Moreover, we took care not to render the behavior concept accessible in any other way than through the priming manipulation. That is, until the dependent variables were assessed, people were not reminded of thirst and drinking. In doing so, we attempted to disentangle the effects of deprivation and accessibility on motivation and behavior. Specifically, in the first study we investigated the effects of deprivation and priming on participant's experienced motivation to drink, while the second study was designed to test effects on actual amount of drinking behavior.

Study 3.1

Study 3.1 examines the hypothesis that priming of deprivation-reducing behavior representations moderates the effects of deprivation on the experienced motivation to engage in the behavior. For this purpose, participants were either subliminally primed or not with the concept of drinking and indicated their experienced motivation to engage in drinking behavior. Following previous work (Mogg, Bradley, Hyare, & Lee, 1998; Seibt, et al., 2007), we measured deprivation of fluid by using a self-report method that asked participants to indicate the last time they had drunk (in minutes) before they showed up at the experimental session. To make sure that the deprivation measure did not prime thoughts about drinking and thirst by itself, deprivation was assessed after the experienced motivation measure. If the representation of drinking has to be rendered accessible for deprivation to affect motivation, as we hypothesized, being deprived of fluids would more likely lead to increased experienced motivation for participants primed with drinking concept.

Method

Participants and design. Seventy-six Dutch undergraduates participated in this study receiving 2 euros or course credits for their participation. They were randomly assigned to either a drink-prime or nondrink-prime condition. Deprivation of fluids was measured using a self-report method.

Procedure. Participants worked in separate cubicles in which the experiment was presented on a 100 Hz computer screen. All participants started with the subliminal priming task. Subsequently, participants' level of experienced motivation to drink was measured and then, after a filler task unrelated to the present study, the deprivation of fluid measure was taken. Finally, participants performed a task in which awareness of the primes was assessed.

Priming task. The first task was announced as a task on basic perception, allegedly assessing people's ability to distinguish stimuli (dots) from backgrounds varying in brightness. The task consisted of 60 trials (including 20 practice trials). During the practice trials the background was grey, and black during the experimental trials. Every trial started with a row of crosses as a pre-mask (1000 ms), followed by a

prime word (20 ms) and another row of crosses as a postmask (1000 ms), all presented at the center of the screen. In the drink-prime condition the words "drinking" and "thirst" were primed (20 times each), whereas in the nondrink-prime condition a random letter string served as a control prime. During the postmask, a dot could appear either above or below the row of crosses (10 ms). Participants had to count the number of dots (for a similar subliminal priming procedure, see Aarts et al., 2005; Custers & Aarts, 2005b).

Experienced motivation. As a measure of experienced motivation, participants had to respond to the questions "To what extent do you want to drink right now?" and "To what extent do you want to quench your thirst right now?" on a 9-point scale. The answers on these questions were averaged to obtain one measure of experienced motivation, $r = .78$, $p < .01$.

Deprivation measure. To assess the level of deprivation, participants were asked to report (in retrospect) how many minutes before the experimental session they had drunk for the last time (mean deprivation: 84 minutes). An ANOVA showed that the reported minutes of deprivation were not affected by priming, $F < 1$.

Subliminality check and debriefing. To assure that the primes were presented subliminally, that is, that the primes could not be consciously identified as meaningful words (Marcel, 1983), participants performed the priming task again at the end of the experimental session. This time, the task consisted of 40 trials. Again, every trial started with a row of crosses as a pre-mask (1000 ms), followed by a prime word (20 ms) and a row of crosses as a postmask (1000 ms), sometimes followed by a dot appearing either above or below the row of crosses (10 ms) which the participants had to count. The primes consisted of the words "drinking" and "thirst" (10 times each), and of random letter strings in the remaining 20 trials. However, the participants were told this time that every time they saw a row of crosses, there would appear an existing word or a nonword for a very brief period in between the row of crosses. Their task was to indicate after every trial whether a word or a nonword was presented. In a signal detection analysis we assessed whether participants were able to distinguish words from nonwords (d'). The results showed that d' ($M = -.02$, $SD = .38$) did not significantly deviate from zero, $t(73) = -.45$, $p = .66$, indicating that participants could not distinguish between words and nonwords and thus were not able to consciously see the primes. Finally, all participants were debriefed. The debriefing indicated that participants were not aware of the real purpose of the study.

Results and Discussion

To test our specific hypotheses, we conducted a regression analysis in which level of experienced motivation was predicted by deprivation and prime (nondrink-prime = 0, drinkprime = 1). To reduce multicollinearity bias, all variables were standardized before computing the cross-products (Dunlap & Kemery, 1987). Analysis revealed a significant main effect for deprivation, $\beta = .35$, $t(75) = 3.19$, $p < .01$, but not for prime, $\beta = .16$, $t(75) = 1.50$, $p = .14$. As expected, the results showed a significant

two-way interaction, β = .23, *t*(75) = 2.10, *p* = .04. Regression lines are presented in Figure 1. In support of the hypothesis, additional analysis revealed that the level of experienced motivation to drink increased as a function of deprivation in the drinkprime, β = .49, *t*(40) = 3.53, *p* < .01, but not in the nondrink-prime condition, β = .12, *t*(34) = 0.71, *p* = .49. Furthermore, we examined the effect of priming for participants who were high or low deprived (see Cohen, Cohen, West, & Aiken, 2003). When deprivation was high (1 SD above the mean), experienced motivation increased significantly as a function of priming, β = .39, *t*(75) = 2.55, *p* = .01. However, when deprivation was low priming did not affect experienced motivation (1 SD below the mean), β = -.07, *t*(75) = -0.44, *p* = .66. In short, when in a state of deprivation of fluid, our participants experienced enhanced motivation to engage in drinking behavior when they were subliminally primed with the concept of drinking.

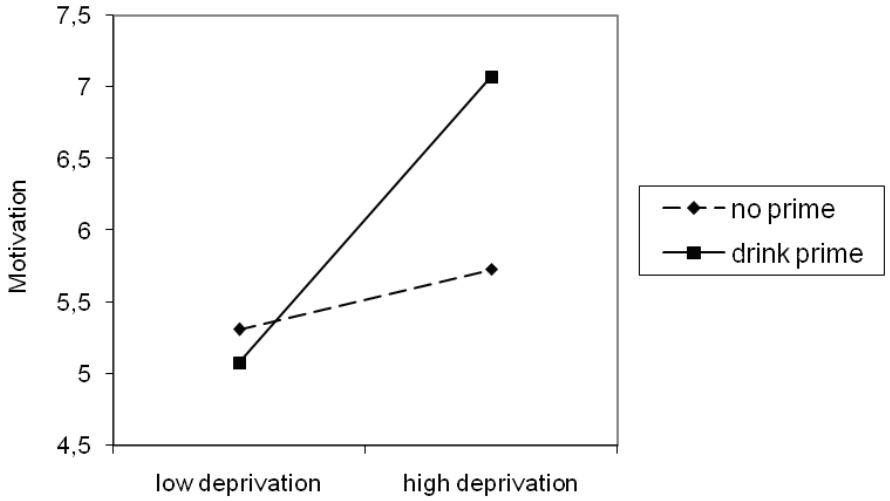

Figure 1: Experienced motivation to drink as a function of deprivation and prime.

Study 3.2

The goal of Study 3.2 was to replicate the moderating role of priming in deprivation on motivation that was found in Study 3.1 and to extend this finding in two important ways. First, a different deprivation measure was used, namely time of the day of participation. Instead of using a self-reported measure, we manipulated deprivation by making use of a more natural setting that allowed us to test participants at either one of two periods of the day (either before or after lunchtime). Based on previous work (e.g., Fitzsimons, 1972; Hulshof et al., 2004), we assumed that participants would be more deprived of fluid before than after lunch. Importantly, we took care that all participants remained ignorant about their level of deprivation during their participation.

Second, the present study was designed to extend the effects of experienced motivation in Study 3.1 to a behavior measure. Specifically, if deprivation and priming increases the experienced motivation to drink, then we should also be able to find effects on actual amount of drinking. To this end, we observed how much soda participants consumed in an alleged tasting task. Again, we expected that priming moderates the effects of deprivation. That is, we hypothesized that, in comparison to low deprived participants, high deprived participants will exhibit more deprivation-reducing behavior (drinking more soda), but that these differences are more pronounced when they are primed with the drinking concept.

Method

Participants and design. One hundred and one Dutch undergraduates were recruited for this study. The teaching time table for classes allowed us to run the study at two time periods of the day: between 10.30 am and 12.30 pm (before lunch, hence, high deprivation condition) or between 1.00 pm and 3.00 pm (after lunch, hence, low deprivation condition). All students had classes between 9.00 am and 10.30 am, and lunch break between 12.30 pm and 1.00 pm[3.1]. Participants received 2 euro for their participation. They were randomly assigned to a drinkprime or nondrink-prime condition.

Procedure and materials. Participants were recruited by means of a sign-up procedure. To conceal the real purpose of the study, the study was announced as an experiment on basic perception and judgment. Once the participants entered the lab, they were told they would first participate in the perception task, and that there would be a judgment task at the end of the session. The experiment was run in a room with two tables separated by a screen. There was a PC on the first table, while the experimenter was sitting behind the second table (which was not visible for participants). The participants were seated behind the PC where the first task was presented. This first task was a priming task, which was identical to Study 3.1. Next, participants were instructed to go to the experimenter to participate in an alleged unrelated study designed to gather stimulus materials for upcoming research on consumer behavior. The experimenter then presented a plate with two glasses of soda. To exclude the possibility that participants preferred one of the two sodas and that the sodas spontaneously evoked thoughts about thirst, we used sodas that in an unrelated pilot study were reported to be evaluative neutral and not associated with quenching thirst: Sprite and Cassis. The brand names were shown on the glasses. Participants were simply asked to choose one of the glasses and taste from it as much as they wanted. The dependent variable was the quantity of consumed soda measured in grams. There was no effect of priming and deprivation on choice of the drinks, F's < 1. Finally, participants were debriefed. Debriefing indicated that participants had not been aware of the primes and did not suspect a relation between the priming task and the taste test.

Results and Discussion

To test whether priming and deprivation had an effect on the quantity of consumed soda in grams, the quantity measure was subjected to a 2 (drinkprime or nondrink-prime) x 2 (deprivation: low or high) between participants ANOVA. The results showed a main effect of priming, $F(1,97) = 6.62$, $p = .01$, $\eta^2 = .06$, indicating that participants primed with drink words consumed more soda. The results also suggested a main effect of deprivation, but this was not significant, $F(1,97) = 1.79$, $p = .18$, $\eta^2 = .02$. However, the two-way interaction showed the expected prime by deprivation interaction effect, $F(1,97) = 4.46$, $p = .05$, $\eta^2 = .04$. Figure 2 presents consumed soda as a function of deprivation and prime.

Closer inspection of this interaction effect showed, in line with our hypothesis, that fluid consumption increased as a function of deprivation for participants primed with drink words, $F(1,99) = 3.47$, $p = .06$, $\eta^2 = .03$, but not for participants primed with non-drink words, $F<1$. Furthermore, priming of drinking-related words resulted in increased soda consumption for high deprived participants, $F(1,99) = 8.28$, $p < .01$, $\eta^2 = .08$. For low deprived participants, no prime effect was found, $F < 1$.

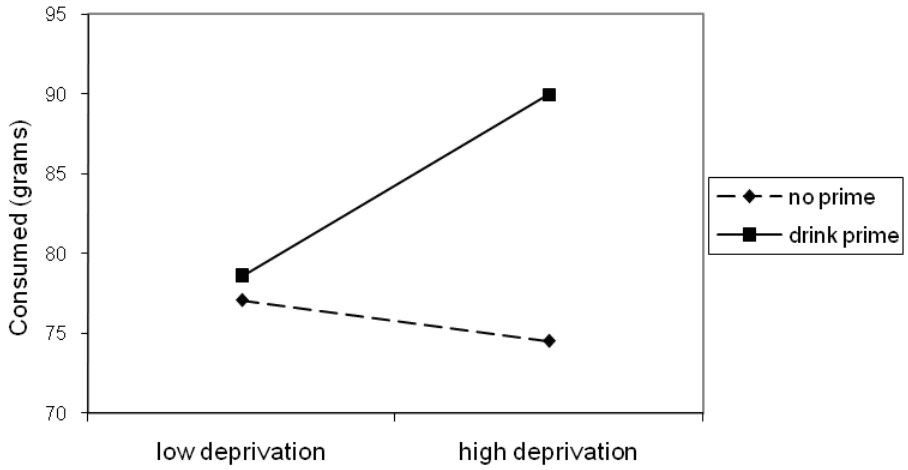

Figure 2: Quantity of drinking (in grams) as a function of deprivation and prime.

General Discussion

In two studies we investigated the role of deprivation and accessibility of representations of deprivation-reducing behavior in the motivation to engage in the behavior. The results of Study 3.1 showed that participants who were relatively more deprived of fluids experienced stronger motivation to drink, but only if the concept of drinking was rendered accessible in a subliminal priming task. Study 3.2 extended these effects by establishing that subliminal priming of drinking-related words caused participants who were relatively highly deprived of fluid at the time of their participation (before lunch) to consume more fluid in an alleged tasting task than low-

deprived participants (participating after lunch). Together, these results give convergent evidence for our hypothesis that, in the domain of thirst and drinking, the effects of deprivation on motivation are moderated by accessibility. The present research thus concurs with studies showing that deprivation affects motivation (e.g., Campfield, et al., 1996; McClelland & Atkinson, 1948; Raynor & Epstein, 2003; Seibt et al., 2007; Sherman, et al., 2003). Importantly however, our research also extends previous work on the relation between deprivation and motivation by disentangling the influence of enhanced mental accessibility of deprivation-reducing behavior from deprivation and showing that they both may matter for people to become motivated to lift their deprivation.

The present findings corroborate our suggestion that priming the representation of specific deprivation-reducing behaviors under conditions of deprivation causes that behavior to become associated with positive consequences. Such deprivation-driven rewarding property of behavior and its relation with motivation is not new, but was already predicted by incentive theories. Incentive theories propose that behaviors that become associated with positive affect form an incentive that enhances the motivation to engage in those behaviors (see for a review, Berridge, 2001). These incentive learning effects are assumed to occur because the positive affect aroused by, for instance, the act of eating when being hungry, becomes linked to the behavior itself. As a consequence, the hungry organism can be motivated to eat by priming cues referring to eating behavior without explicitly reinforcing the behavior. Consistent with this view, our research suggests that the underlying mechanism by which deprivation translates into motivation involves the priming of the mental representation of the behavior that becomes attached to positive affect, as the behavior is known to have positive implications (i.e. reducing the deprivation) under the condition of deprivation. The present findings thus extends and integrates current inquiries into priming, motivation and behavior with the previous study on the role of deprivation in incentive learning.

An important issue emanating from the present work concerns the question of how deprivation affects goal priming effects. Research in this area assumes that goals are mentally represented as positive behavioral states, and has demonstrated that priming of these representations (such as earning money, helping, socializing) motivates people to engage in the behaviors outside of conscious awareness (for an overview, see Custers & Aarts, 2005a; Moskowitz, et al., 2004). Whereas the effects of deprivation are rarely assessed in the goal priming literature (but see, Aarts et al., 2004; Strahan et al., 2002), it may be the case that similar effects emerge as in the present studies – that is, a main effect of priming, but qualified by level of deprivation. However, even when one assumes that deprivation may not play a role in goal priming effects, the present studies suggest that it is not so much the priming of the behavior representation per se that increases the motivation, but the link between the behavior and positive affect.

Evidence for this idea comes from recent research (Custers & Aarts, 2005b; 2007a). In one study, the valence of the behavioral concept of doing puzzles was rendered more positive by exposing participants subliminally to prime words representing the behavior. The prime words were briefly followed by positive stimuli (e.g., friend, summer). Results showed that this nonconscious positive shaping (or creation) of goals enhanced participants' motivation to engage in the behavior. Subsequent studies revealed that subliminal priming effects on motivated behavior were more pronounced when the primed concept pre-existed as a desired state associated with positive affect in participants' mind. These findings indicate that positive affect forms a basic part of the representation and motivation of nonconsciously activated representations of behaviors. Thus, priming the behavior representation triggers the motivation to perform the behavior. Whereas the present studies capitalize on the idea that deprivation renders the primed representation of deprivation-reducing behavior more positive, future research could shed light on this important matter by examining, for instance, how deprivation and positive affect work together to produce and regulate motivation and behavior nonconsciously.

Indeed, recent work has just started to investigate the role of deprivation and implicit affective processes in the instigation and regulation of goal pursuit. Winkielman, Berridge and Wilbarger (2005), for example, asked their participants to rate their level of thirst, and showed that subsequent consumption behavior and value judgments of an unfamiliar beverage were influenced by subliminally presented happy or angry faces, but only for thirsty (deprived) participants. These findings demonstrate the intricate interplay of deprivation and affect in motivation. However, in their studies deprivation did not influence behavior unless happy faces were subliminally flashed on the computer screen, even though drinking related thoughts were explicitly activated by thirst ratings at the beginning of the experiment.

Although the findings reported by Winkielman et al. (2005) may at a first glance be at odds with our and other findings, they may actually provide more insight in how states of deprivation give rise to motivational behavior. That is, the crucial difference is that in the studies of Winkielman and colleagues, the drink that participants could use to reduce their state of deprivation was an unfamiliar beverage stored in a pitcher. In this case, there was no clear information about the desirability of drinking the beverage in terms of instrumentality in reducing the state of deprivation, but the additional affective cues may have mimicked the positive affective signal that otherwise is linked to behavior as a result of the reduction of the deprivation (cf. Custers & Aarts, 2005b). In other words, the nonconsciously presented happy faces offered participants an extra affective-motivational boost to drink the beverage in order to reduce the state of deprivation. However, this suggested interplay between deprivation, accessibility of behavior and affect in producing nonconscious goal pursuit is rather speculative, and hence it awaits further empirical scrutiny.

Another question that is raised by the present data is whether external priming of deprivation-reducing behavior is always required for effects of deprivation

on motivation to occur. The answer is probably “no”. When people are extremely deprived they may not be able to think of anything else (see Murray, 1938; Fitzsimons, 1972), and hence other psychological processes are called for to deal with the self-threatening situation (e.g., rumination about current concerns, cf. Klinger, 1975). Indeed, it is a commonly reported fact that castaways or survivors start to fantasise about water and food after a period of extreme deprivation (e.g., Read, 1996; Wolf, 1958). Although under these conditions deprivation and accessibility may be no longer independent, it may just be the case that under conditions of moderate deprivation, like in the present studies, external primes help to prevent such conditions. Indeed, it is known that organisms usually engage in actions that reduce deprivation long before the level of deprivation is harmful to the organism (Cabanac, 1979; cf. the role of deprivation in anticipatory goal responses; Geen, 1995; Toates, 1986). Such a mechanism that reacts to deprivation-reducing cues in the environment at levels of mild deprivation would be highly adaptive, as it allows the organism to seize opportunities to reduce deprivation, long before it threatens their survival (Fitzsimons, 1972; Rolls & Rolls, 1982).

To conclude, we believe that the present research gives interesting new insights in how the gap between bodily states of deprivation and cognitively motivational behavior is filled. Our motivation to engage in behavior does not appear out of nothing, it is produced by mental processes that can operate outside of conscious awareness and interact with states of deprivation. Thus, conveniently, we may not want to drink that cold glass of water until our environment brings it up.

Footnote

[3.1]In another study with different students as participants we examined the level of deprivation of fluid when measured before lunch (between 10.30 am – 12.30 pm) and after lunch (1.00 pm – 3.00 pm). This study showed that our students were virtually twice as much deprived of fluid before lunch (M = 2.82 hours) than after lunch (M = 1.45 hours), $t(144) = 3.68$, $p < .001$.

Chapter 4

Perception in the Service of Goal Pursuit:

Motivation to Attain Goals Enhances the Perceived Size of Goal-Instrumental Objects

Two experiments tested the functional perception hypothesis (Bruner, 1957) according to which objects that are instrumental in attaining ones' goals are perceived to be bigger if one is motivated to attain these goals. Study 4.1 demonstrated that participants perceived a glass of water to be bigger when deprived of fluid, and that this effect mainly occurred when the goal-concept of drinking was rendered accessible. In Study 4.2 the motivation to engage in initially neutral action goals (e.g., gardening) was increased by unobtrusively pairing their mental representation with positively valenced stimuli, which resulted in enhanced size perception of instrumental tools (e.g., shovel). Together, these findings support and extend the functional perception hypothesis by demonstrating that this effect results from a top-down process that depends on cognitive accessibility of the goal-representation, while ruling out several alternative explanations. Implications for research on motivated perception and parallels with other research areas are discussed.

This chapter is based on: Veltkamp, M., Aarts, H., & Custers, R. (2008b). Perception in the service of goal pursuit: Motivation to attain goals enhances the perceived size of goal-instrumental objects. *Social Cognition, 26,* 720-736.

The question of how people perceive the size of objects has fascinated scientists throughout history. As early as the 2nd century, the astronomer Ptolemy – looking up at the moon – wondered why it appears to be bigger when it is closer to the horizon. By now, research has shown that perceived object size depends on factors like retinal image size, distance, angle and contextual cues (Kaufman & Rock, 2001; Rookes & Willson, 2000). However, apart from such objective factors, size perception may also be influenced by more subjective factors. It has been suggested that the motivation to attain goals perceptually accentuates objects or tools that are instrumental in attaining goals in a spontaneous manner, which leads to an increase in the perceived size of objects. This perceptual accentuation is thought to facilitate goal attainment. Thus, according to this line of reasoning a phone should be perceived to be bigger if one wants to call a friend. The perceptual accentuation, it is argued, causes the phone to be perceived more easily amongst other objects in one's environment and increases the probability of using it as an opportunity to attain the goal. Although a number of early studies have yielded results that are consistent with the functional perception hypothesis (e.g., Bruner & Goodman, 1947; Bruner & Postman, 1949) these studies were heavily criticized (Eiser & Stroebe, 1972; Tajfel, 1957, 1959), which leaves the question of whether motivation affects size perception still open to scientific debate.

Recently, there seems to be a renewed interest in how subjective factors may influence perception under specific circumstances (e.g., Balcetis & Dunning, 2006, 2007; Proffitt, 2006). Balcetis and Dunning (2006), for example, have recently demonstrated that people disambiguate a perceived ambiguous figure in the direction of their goals. For example, one of their experiments showed that when participants learned that in a task detecting a specific stimulus (e.g., 8) belonging to one category (numbers) would yield more reward compared to detecting another stimulus (e.g., F) belonging to a different category (letters), an ambiguous stimulus that could either be perceived as the number 13 or the letter B was perceived more often in terms of the rewarding category. Although this suggests that basic perceptual processes are biased in the direction of the content of people's goals (e.g., detecting a specific number), solid evidence for increased size perception in the service of people's goals is lacking. Rather than focusing on processes that depend on the content of people's goals, we report two studies that were designed to demonstrate the more general effect that the motivation to pursue a goal causes objects that are instrumental in attaining ones goals as being perceived as bigger, ruling out a few critical problems with earlier studies on this topic. Moreover, we aim to show that this effect is caused by a top-down process that requires a goal-representation to be mentally accessible. In doing so, the present paper provides stronger evidence for the idea that motivation affects size perception but also sheds new light on the process by which this phenomenon occurs. Before we present our studies, we first discuss previous work on the relation between motivation and size perception as well as crucial issues that were raised to interpret this evidence for a basic motivation-functional perception link.

Motivation and Size Perception

The idea that the motivation to attain goals affects the perceived size of goal-instrumental objects was first addressed in research on functional perception. Researchers in this tradition claimed that perception is functional in that it is a tool in the service of one's motivation (Bruner, 1957). It was argued that when one is motivated to attain a desired state (i.e., a goal), the perceptual system is tuned towards achieving that state via top-down processes, rendering goal-instrumental objects easier to find. Specifically, functional perception researchers hypothesized that when one is ready for goal pursuit, goal-instrumental objects become perceptually accentuated amongst other environmental stimuli in the sense that they are perceived to be bigger.

In a classic study on this idea, Bruner and Goodman (1947) asked children to adjust an iris-diaphragm to match the size of coins and paper discs they saw in front of them. Bruner and Goodman expected that coins would be perceived as bigger because their participants were motivated to obtain money. Indeed, coins were judged to be bigger as compared to the valueless discs of the same size. This effect was even more pronounced when the coin was of a higher value and thus more functional in attaining the goal to obtain money. Other studies yielded similar findings when it comes to the perceived size of objectively valuable objects (for an overview, see e.g., Bruner & Postman, 1949; Tajfel, 1957). Interestingly, Bruner and Goodman (1947) obtained further results consistent with the functional perception claim that objects relevant in attaining a desired goal influence the perceived size of those objects, by not merely focusing on the objective value of coins, but also on the subjective motivation to gain money. Their results showed that poor people, who were assumed to be more strongly motivated to gain money, judged coins to be bigger than rich people.

However, although the findings discussed above seem to support a functional perception perspective, it is not clear whether these effects are indeed the result of motivational processes. Most functional perception studies relied on the *objective* value of goal objects (e.g., the value of coins) rather than participants' actual motivation to attain the goal (e.g., getting money). In an analysis of the functional size perception literature, Tajfel (1957, 1959; see also Eiser & Stroebe, 1972) addressed this notion and proposed a non-motivational account for the effects of value on size perception. He noticed that most functional perception studies used objects for which an increase in size corresponded with an increase in objective value (e.g., coins) and that, moreover, the size perception measure was assessed by means of comparisons (e.g., small vs. large coins). Participants, then, might have been encouraged to use these differences in objective value as input for their size estimates, because this was the only information to base their judgments on. In support of this idea, Tajfel noted that studies without such an obvious size-value relation yielded inconsistent results.

Although comparison processes and explicit knowledge of the relation between objective value and size of objects may be an explanation for enhanced size perception effects in studies focusing on objective value, they cannot easily explain the

relation between the level of "poorness" and the perceptual accentuation of the coin-size (Bruner & Goodman, 1947). Based on the concept of needs (e.g., Geen, 1995; Murray, 1938), one may argue that the motivation to attain the goal to make money is stronger for poor than for rich persons, and that the differences in size perception between poor and rich people therefore reflect differences in subjective motivational strength to attain that goal. Alternatively, however, the results could also be explained in terms of differences in familiarity, as rich people may be more familiar with coins and therefore are more accurate in their size-estimates of coins when comparing them (Eiser & Stroebe, 1972; Tajfel, 1957). Accordingly, these results are not conclusive as to whether an increase in the motivation to attain a goal enhances the perceived size of goal-instrumental objects. Consequently, research on motivated perception was largely abandoned after the 1970s.

Recent insights of neurological studies, however, suggest that top-down processes do affect basic perceptual processes and as a result can influence size perception. In a discussion on functional size perception studies, Tolman (1949) already plead "for a more explicit statement of the neurological brain models which are implied" (p. 48). Although at that time technology was not sufficiently advanced to test such models, recent neurological studies on visual perception may shed new light on the matter. There is evidence to suggest that stimuli that reach the retina compete for the limited resources of the visual system in order to be further processed and, importantly, that this competition is biased. Specifically, objects or tools that are instrumental for current behavior and functioning are allocated more processing resources (i.e., brain cells) and therefore occupy a larger area of the visual cortex (e.g., Bundesen, Habekost, & Kyllingsbaek, 2005; Desimone & Duncan, 1995; Serences & Yantis, 2006). Consequently, these objects may be perceived as being bigger in relation to other stimuli in the visual field. These recent neurological findings thus give reason to suggest that basic perceptual processes that are beyond the reach of conscious awareness are tuned towards objects that are related to a current goal before consciously seeing the object. Hence, effects on size perception may not so much be the product of a conscious and explicit size-estimation process (see e.g., Tajfel, 1957, 1959), but rather occur spontaneously because the motivation to attain a goal creates a nonconscious state of readiness for goal pursuit that impinges on basic perceptual processes.

In a recent study (Veltkamp, Aarts, & Custers, 2008) we obtained further evidence suggesting that such a nonconscious state of readiness for goal pursuit does indeed, at least partly, rely on top-down processes. In two experiments, participants that varied in their level of deprivation from fluids were either subliminally primed with drinking related words or not. After this manipulation they participated in an alleged taste test in which they could taste and consume fluids. It was found that for mildly deprived participants, priming increased fluid consumption, whereas such an effect was absent for non-deprived participants. Furthermore, consumption only increased with deprivation when drinking related words were primed (cf., Strahan,

Spencer, & Zanna, 2002). Thus, mild deprivation seems to prepare the body for goal-pursuit when goal-related representations of deprivation-reducing behavior are activated. In the light of this research, it could be the case that other processes in the service of motivation also rely on such a top-down process.

The Present Research

In the current paper we report two studies in which we tested the hypothesis that goal-instrumental objects are perceived to be bigger when the motivation to attain the goal is stronger. Study 4.1 was designed to assess two main points. First, we aimed to show that effects on size perception depend on *subjective motivation* rather than *objective value*, by focusing on the motivation for the goal to drink. That is, we asked participants to estimate the size of a glass of water under different levels of fluid deprivation. If subjective motivation indeed affects size perception, then perceived object size should increase with the level of deprivation. Second, we aimed to show that increases in perceived object size are the result of top-down processes (Bruner, 1957) that require a goal to be accessible. In line with our recent work discussed above (Veltkamp et al., 2008), we predict that (mild) fluid deprivation has more pronounced effects on size perception when the concept of drinking is rendered mentally accessible. To exclude the possibility that explicit comparison processes influence size judgments (Tajfel 1957, 1959) participants estimated the absolute size of objects depicted on a picture.

Study 4.2 aimed to extend Study 4.1 in two important ways. First, the functional perception claim holds that goal motivation results in increased perceived object size irrespective of the content of the goal (e.g., Bruner & Goodman, 1947) and thus that augmented size perception is a content-free feature of goal pursuit (cf., Bargh, Gollwitzer, Lee Chai, Barndollar, & Trötschel, 2001). Accordingly, Study 4.2 was designed to examine this idea by assessing the effects of motivational strength on perceived object size for a set of everyday goals unrelated to deprivation of basic resources like water. Second, while in Study 4.1 it can be only assumed that deprivation increases the motivation to drink, in Study 4.2 motivational strength was manipulated directly. For this purpose, we relied on previous work showing that participants' motivation to engage in behavior can be enhanced by pairing a subliminally presented mental representation of a neutral behavioral goal (e.g., gardening) with positively valenced stimuli (e.g., friend), without participants being aware of the goal prime and the source of their motivation (Aarts, Custers, & Holland, 2007; Custers & Aarts, 2005b). A major advantage of this unobtrusive shaping treatment is the exclusion of demand characteristics, rendering the notion that size perception effects may be only the result of explicit, strategic processes (Tajfel, 1957, 1959) less plausible. Indeed, if the nonconscious enhancement of goal motivation modulates the perceived size of goal-instrumental objects, then this would provide stronger support for the claim that effects on size perception do occur spontaneously when one is motivated to attain a goal.

Study 4.1

In this study the hypothesis that motivation affects size perception was directly tested by investigating the relation between the motivation to drink and the perceived size of a glass of water. A biologically motivated goal was selected because it is widely accepted that motivational value or strength of a goal increases as the level of deprivation of crucial resources (e.g., water) increases (Logue, 1991; Toates, 1986). Thus, according to the functional perception hypothesis the perceived size of a glass of water should increase when deprivation of fluid increases. However, recent studies showed that under conditions of mild deprivation, the representation of the deprivation-reducing behavior (e.g., drinking) may have to be accessible for motivated goal-directed behavior to occur (Strahan et al., 2002; Veltkamp et al., 2008) This notion is in line with data in research on nonconscious goal pursuit (for an overview, see e.g., Custers & Aarts, 2005a; Moskowitz, Li, & Kirk, 2004) showing that priming a goal instigates motivational goal-directed behavior. As such, rendering a goal accessible might be required to translate potential motivation for a goal into a state of readiness for goal pursuit, resembling what Bruner (1957) called "perceptual readiness": the perceptual facilitation of accessible motivating constructs. Thus, if motivational strength affects the perceived size of objects through a top-down process, an increase in deprivation would be more likely to lead to an increase in the perceived size of goal-instrumental objects when the goal of drinking is primed.

In a recent study, Brendl, Markman, and Messner (2003, Study 4.1) obtained results that seem to point to effects of deprivation on size perception. They showed that when participants were asked to indicate the true length of a cigarette, high-deprived nicotine participants picked a longer cigarette (amongst a picture showing 14 cigarettes differing in length) than low-deprived participants. Although this result may appear to be a functional size perception effect, it is more complicated. Participants were not asked to estimate the length or height of the presented cigarettes, but to compare them with a memory representation of true cigarette size. The effect, then, may represent memory distortion rather than size perception. Moreover, the findings of Brendl et al. are not conclusive regarding the role of accessibility because participants explicitly knew the study was concerned with smoking (as is often the case in research on deprivation with human participants). Thus, the smoking representation might have been accessible at the start of the experimental session for all participants, confounding the subjective measure of deprivation and accessibility (for a discussion on this issue see Veltkamp et al., 2008).

In the present study, accessibility of the drinking representation was therefore manipulated by subliminally priming half of the participants with drinking-words and the other half not. Next, a photograph of a glass of water was unexpectedly presented on the computer screen, and participants were asked to estimate the objects' size. Finally, deprivation of fluid was measured using a self-report method that asked participants to indicate the last time they had drunk in hours before participating in the experiment (e.g., Mogg, Bradley, Hyare, & Lee, 1998; Seibt, Hafner, & Deutsch,

2007). Thus, to prevent that the measure of deprivation renders drinking accessible, we assessed the level of fluid deprivation after the priming procedure and dependent variable (see also Veltkamp et al., 2008).

To eliminate the possibility that participants use differences in objective value to arrive at their size estimations (Eiser & Stroebe, 1972; Tajfel, 1957, 1959) participants were asked to provide absolute instead of comparison estimations, without other objects being present that could trigger comparison processes. Furthermore, to avoid the criticized complexity of indirect measurements such as adjusting an iris-diaphragm (Blum, 1957; Bruner & Rodrigues, 1953), participants had to estimate the size of the objects (in cm.) as they were presented on a computer screen.

Method

Participants and design. Seventy-five Dutch undergraduates participated in this study, receiving 2 euros for their participation. They were randomly assigned to a drink-prime or nondrink-prime condition. Deprivation of fluid was measured using a self-report method.

Procedure. Participants worked in separate cubicles in which the experiment was presented on a 100 Hz computer screen. All participants started with the subliminal priming task. Subsequently they performed a size estimation task where they had to estimate the size of a glass of water and were then asked to indicate their level of deprivation.

Priming task. The first task was announced as a task on basic perception, allegedly assessing people's ability to distinguish stimuli (dots) from backgrounds varying in brightness. The task consisted of 60 trials (including 20 practice trials). The background was grey during the practice trials and black during the experimental trials. Every trial started with a row of crosses as a pre-mask (1000 ms), followed by a prime word (20 ms) and another row of crosses as a postmask (1000 ms), all presented at the center of the screen. In the drink-prime condition the words "drinking" and "thirst" were primed (20 times each), whereas in the nondrink-prime condition a random letter string served as a control prime. During the postmask, a dot could appear either above or below the row of crosses (10 ms). Participants had to count the number of dots (for a similar subliminal priming procedure, see Custers & Aarts, 2005a; Veltkamp et al., 2008).

Size estimation task. Participants were told that a photograph would be presented by a computer and that their task was to estimate the size of the object (the size of the object as it was presented on the screen) by indicating how tall the object was in centimeters[4.1].The photograph of the glass of water then appeared and participants could type in their object-size-estimation in centimeters (in decimals, e.g., 13.2 cm). To circumvent any other source of priming of the goal-concept of drinking (other than the subliminal primes) before the dependent variable was assessed, nothing was said or suggested about the object of estimation (i.e., the glass of water).

In other words, the glass of water just appeared on the screen without any announcement of the object itself.

Deprivation measure. To assess the level of deprivation, participants were asked to report how many hours before the experimental session they had drunk for the last time (M = 2.1, SD = 1.8). An ANOVA showed that the reported time of deprivation was not affected by priming, $F < 1$.

Debriefing. At the end of the experimental session all participants were debriefed. The debriefing indicated that participants had no clue about the real purpose of the study. Furthermore, they had not been aware of the primes in priming task.

Results and Discussion

To test our specific hypotheses, we conducted a regression analysis in which height was predicted by prime (nondrink-prime = 0, drinkprime = 1) and deprivation. To reduce multicollinearity bias, all variables were standardized before computing the cross-products (Dunlap & Kemery, 1987). Analyses revealed a significant main effect for deprivation, $\beta = .23$, $t(72) = 2.10$, $p = .04$, and prime, $\beta = .22$, $t(72) = 1.97$, $p = .05$. As expected, the results showed a significant two-way interaction, $\beta = .26$, $t(72) = 2.39$, $p = .02$. Regression lines are presented in Figure 1. Additional analyses revealed that the perceived size of the glass increased as function of deprivation in the prime $\beta = .45$, $t(34) = 3.00$, $p < .01$, but not in the no prime condition $\beta = -.05$, $t(37) = -0.29$, $p = .78$. Furthermore, we examined the effect of priming for people who were high or low deprived (see Cohen, Cohen, West, & Aiken, 2003, p. 273). When deprivation was high (1 SD above the mean), perceived size increased significantly as a function of priming, $\beta = .48$, $t(72) = 3.08$, $p < .01$. However, when deprivation was low rendering the drinking goal accessible did not affect perceived object size (1 SD below the mean), $\beta = -.05$, $t(72) = -0.31$, $p = .76$.

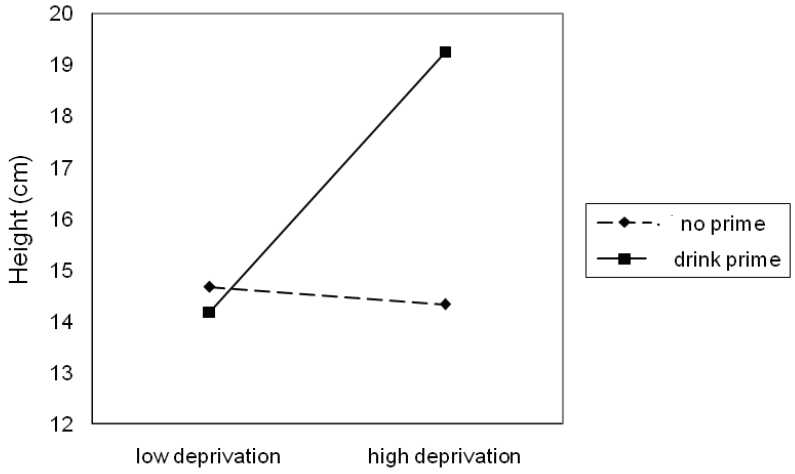

Figure 1. Estimated height of glass in centimeters as a function of deprivation and prime (real size: 14.9 cm).

In short, these results demonstrate that deprivation of fluids affects size perception of instrumental objects as the result of top-down processes that require the appropriate goal-representation (here that of drinking) to be mentally accessible. This suggests that although deprivation may increase the motivational value of a behavior (e.g., Bolles, 1972; Toates, 1986), accessibility of the appropriate behavioral goal is needed to tune basic perceptual processes towards attainment of this goal. It should be noted in this context that when people are extremely deprived, they may not be able to think of anything else (Murray, 1938) and under these conditions deprivation and accessibility may be no longer independent. However, under normal circumstances people are likely to drink before they are extremely deprived (cf. the role of needs in anticipatory goal responses; Geen, 1995; Toates, 1986). Priming may therefore play an important role in altering basic perceptual processes that serve goal pursuit at the usual levels of mild deprivation that exist in daily life.

Study 4.2

Although Study 4.1 strongly supports the idea that motivational strength affects size perception, it remains an empirical question whether the same holds for mundane goals that do not arise from deprivation of crucial resources but that people do pursue in daily life, like the goal of getting dressed or writing a letter. Therefore, the aim of this study was to test whether perceiving goal-instrumental objects to be bigger as a result of being motivated to achieve a goal is a content-free feature of goal pursuit (cf., Bargh et al., 2001) and consequently also pertains to common objects or tools like a pencil when one wants to write, as functional perception researchers would suggest (e.g., Bruner & Goodman, 1947).

Furthermore, the evidence for effects of motivation on size perception obtained in Study 4.1 was correlational in nature (although this correlation was only found when drinking was primed), and relied on the assumption that deprivation of fluids increased people's motivational strength of the goal to drink. For this reason, motivation was directly manipulated outside participants' awareness in Study 4.2, while the accessibility of the goal representation remained constant. The manipulation of motivation was based on research of Custers and Aarts (2005b), who showed that the motivation to engage in a particular behavior increases in strength when the representation of the behavior is co-activated or attached with positive affect, thus turning the behavior into a goal that people want to attain (see also incentive learning theories, e.g., Berridge, 2001; Toates, 1986).

To test this idea, Custers and Aarts (2005b) adapted the evaluative conditioning paradigm (De Houwer, Thomas, & Baeyens, 2001), which allowed them to co-activate subliminally presented words referring to neutral behavioral goal-concepts (e.g., doing puzzles) with positively valenced words (e.g., smile). They demonstrated that this affective shaping treatment enhanced participants' motivation to engage in the behavior while participants were unaware of the source of the motivation. Thus, although the motivation to pursue neutral goal-concepts was assumed to be absent,

co-activating the concept with positive affect inducted an approach motivation towards the behavioral goal. The shaping treatment may thus have the same effects as those of deprivation in Study 4.1, where it was shown that priming of drinking increased the perceived size of a glass of water for deprived (motivated) but not for low-deprived (not motivated) individuals.

For the present study, the Custers and Aarts (2005b) task was used to render initially neutral behavioral goal-concepts (e.g., gardening) mentally accessible and, at the same time, to enhance the motivation to engage in them. We hypothesized that pairing the goal-concept with positive words causes participants to perceive goal-instrumental objects (e.g., a shovel) to be bigger as a result of the induced motivation for the goal, in comparison to pairing the goal-concept with neutral words, which does not induce such motivation. Finally, we also co-activated neutral goal-concepts with negative affect. In the original functional perception studies, inconsistent or null-effects have been reported concerning goal-objects that were negatively valenced (e.g., Klein, Schlesinger, & Meister, 1951; Solley & Lee, 1955). However, these findings make sense if, as is proposed by the functional perception account, one assumes that not mere valence but motivational strength to perform a behavior or to attain a goal object drives size perception effects. Co-activating neutral goal-concepts with negative affect should – like activating neutral goal-concepts on their own – not lead to changes in size perception, as in both cases people are not motivated to engage in or to attain the behavioral goal (see for a more detailed discussion of this issue, Aarts et al., 2007). Thus, testing size perception effects as a result of pairing neutral goal-concepts with neutral, negative and positive stimuli may offer a way to understand and demonstrate whether people perceive goal-instrumental object to be bigger if they are more motivated to attain the goal.

Method

Participants and design. Eighty undergraduates participated in this study. Nine goal-concepts were divided into 3 sets of 3 concepts that did not differ on mean evaluation. For each participant, the three sets were assigned to the three shaping (positive, neutral, or negative) conditions. The combinations between set and valence condition were counterbalanced. Thus, a one-factorial within-participants design was used.

Materials. On the basis of a pilot study (N = 56) nine neutral behavioral goal-concepts were selected (M = 4.84 on a 9-point scale): washing, writing, carpenting, calculating, cleaning, painting, doing puzzles, gardening, ironing. The valence words were taken from Custers and Aarts (2005b). We used 4 positive nouns (smile, beach, friend, summer), 4 negative nouns (garbage, sorrow, thief, disease) and 8 neutral adverbs (why, when, although, therefore, however, such, also, because). Finally, for each of the nine goal-concepts (e.g., gardening), 3 objects were selected that were instrumentally related to the goal (e.g., a shovel). Photographs of these objects were used in the size estimation task. A list of all objects is given in the Appendix.

Procedure. Participants worked in separate cubicles on a PC (85-Hz screen). They were informed that they were participating in a study on visual perception. They were told that they would have to estimate the size of objects which would be presented on the computer screen. Furthermore, allegedly to make the task more complex, they learned that all kinds of words would be first presented on the screen with regular or bold printed rows of Vs (VVVVV), appearing very briefly above or below these words and that their task was to count the bold printed rows before producing the size estimation. In actuality, this feature of the procedure ensured us that participants paid attention to the screen during the affective shaping event (identical to Custers and Aarts, 2005b; see below). After reading the instructions, participants practiced the task. Subsequently nine experimental trials started.

Trials. In each trial, a goal-concept was first paired with positive, neutral or negative affect and then participants estimated the size of photographs showing objects associated with the concept. In each trial, 16 pairings were presented. In the *positive shaping trials*, a goal-concept was paired with 8 positive nouns (each noun twice) while nonwords were paired to 8 neutral words. In the *neutral shaping trials,* the goal-concept was paired with 8 neutral words and nonwords were paired with 8 positive words (each noun twice). In the *negative shaping trials* the goal-concept was paired with 8 negative words and nonwords were paired with 8 neutral words. The order of presentation of all experimental trials and of all pairings within the trials was randomized. After the last pairing in a trial, participants estimated the size of three goal-instrumental objects as presented on the screen, by indicating how tall each object was. The next trial started after participants pressed enter.

Pairings consisted of the following events: a cross was presented on the screen for 500 ms, signaling the beginning of the trial. Next, a row of crosses appeared on the screen (premask, 500 ms), immediately followed by a goal-concept or a nonword (e.g., MJDSPW, 30 ms). Then, a row of crosses appeared again (postmask, 100 ms), followed by a positive, neutral, or negative word (150 ms). After 30 ms a row of Vs could be presented (regular or bold text type, 30 ms). Participants counted the number of times a bold printed row appeared.

Results and Discussion

To test our hypothesis, we first standardized all size estimations and then computed the mean of the three estimations for each goal-concept. Thus, we obtained one size estimate for each shaped concept. Subsequently, size estimations across the valence conditions were subjected to an ANOVA according to the design. Means in centimeters are presented in Figure 2. A significant effect of shaping was found, $F(2,146) = 3.10$, $p < .05$, $\eta^2 = .04$. In accordance with our hypothesis, contrast analysis showed that objects were seen as bigger in the positive shaping than in the neutral shaping condition, $F(1,73) = 5.63$, $p = .02$, $\eta^2 = .07$, and the negative shaping condition, $F(1,73) = 4.05$, $p < .05$, $\eta^2 = .05$. There was no difference between the negative and the neutral shaping condition, $F < 1$.

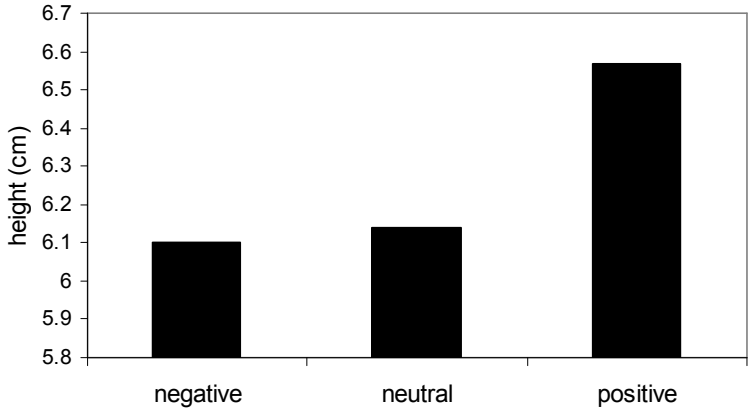

Figure 2. Mean estimated object size in centimeters per valence condition (real size: 6.5 cm).

To summarize, directly pairing goal-concepts with positive words resulted in accentuated perception of goal-instrumental objects in comparison to conditions in which the goal-concepts were not directly paired with positive words, but instead with neutral or negative words. It should be noted that, while the motivation to attain goals is assumed to have increased as positive reward signals add value to it, the familiarity of the objects which sizes are estimated remained constant, thus excluding the possibility that familiarity could account for perceived size differences (Eiser & Stroebe, 1972; Tajfel, 1957, 1959).

General Discussion

Two studies examined whether an increase in the motivation to attain a goal enhances the perceived size of objects that are instrumental in attaining that goal. In line with our expectations, Study 4.1 showed that participants perceived a glass of water to be bigger when they were deprived of fluids and when the drinking-representation was mentally accessible. This finding extends previous research by showing that effects on size perception result from a top-down process (requiring an accessible behavior representation) and depend on subjective motivation rather than objective value (see e.g., Bruner & Postman, 1949). Study 4.2 extended these findings by manipulating the motivational strength for a set of initially neutral behavioral goal-concepts. In doing so, we were able to alter motivational strength outside participants' awareness, thus countering most criticism on classic studies (e.g., Tajfel, 1957, 1959) by reducing the influence of demand characteristics and keeping the accessibility of the goal-concepts and the familiarity of the goal-instrumental objects constant. In support of our hypothesis, the results showed that when behavioral goal-concepts were paired with positive affect and thus became desired to attain, instrumental objects or tools were perceived to be bigger compared to when goal-concepts were co-activated with

neutral or negative affect. Together, these findings combine and advance research on size perception and nonconscious goal pursuit by showing that goals that are nonconsciously created spontaneously give rise to a state of readiness for goal pursuit, in that the perceptual system is tuned toward goal attainment.

The current findings also extend recent studies on motivated perception by showing that goal-motivation not only leads to perceptual effects in line with the specific content of the goal or ones' knowledge about the corresponding instrumental objects, but rather is a content-free feature of goal pursuit. That is, recent research showed that when people know they get rewarded after perceiving a specific object, they tend to reconstruct their environment in line with this knowledge: They see what they desire to see (Balcetis & Dunning, 2006). Furthermore, studies by Proffitt on the energy-consideration account (for an overview, see Proffitt, 2006) show that people perceive the environment in such a way, that they are most efficient in their energy expenditure. In these studies, the specific direction of the effects may depend on peoples' knowledge about the object in relation to their desired state. If one wears a heavy backpack and is motivated not to waste energy, one perceives a hill to be steeper and will as a result climb it at a slower pace, hence distributing energy more efficiently. In a similar vein, the arm of a socket wrench may be perceived to be shorter if one is motivated to save energy when using the tool, constituting a kind of anticipation effect on perception as a result of explicit motivation. The perceptual accentuation of size in the current studies, however, depends on the motivation to attain a goal state and seems to be the result of a more basic perceptual effect, as the effect was found for a range of goals and even when people were not consciously aware of the source of their motivation (Study 4.2).

Perceiving goal-instrumental objects to be bigger when motivated may not be the only way in which goals facilitate their attainment. Ferguson and Bargh (2004), for example, measured implicit evaluations of drinking-related objects after deprivation of fluids was manipulated and drinking-related cognitions were rendered accessible. They found that goal-instrumental objects were evaluated more positively when the drinking-goal was active, suggesting that goal pursuit is facilitated by triggering approach reactions. How do these data relate to the present findings? First of all, the effect on evaluation was found to be specific for goal-instrumental objects, which indicates that it is not a general result of motivation, but a specific effect which may play a key role in goal pursuit (for a more detailed discussion on how goals affect evaluations, see Förster, Liberman, & Friedman, 2007). This is in line with our approach, although no goal-irrelevant objects were used in our studies. Hence, since both effects rely on motivation it could be the case that they reflect the same process. Moreover, because research shows that bigger objects are often evaluated as more positive (Silvera, Josephs, & Giesler, 2002), it may be the case that evaluation effects are a result of differences in size perception. According to that line of reasoning, increased size perception may be functional because it facilitates approach reactions. This possibility remains open for further research.

Apart from enhanced positivity, larger objects also may appear to be closer because size is a cue to distance. As our willingness to expend effort increases when the distance to the goal becomes smaller (Cacioppo & Berntson, 1994; Miller, 1951), this apparent closeness as a result of an increase in perceived size may lead to the recruitment of more resources to reach the goal. In a similar manner, increased size perception may lead to more concrete actions. Construal level theory (Trope & Liberman, 2003) posits that distant events are processed at a more abstract level, whereas close events are processed at a more concrete level. If objects that are perceived as being larger appear closer, they may evoke more concrete actions. Augmented size perception thus not only renders objects easier to detect; it also may affect the type of actions that are executed as well as the effort that is expended to attain it.

Although object size perception may be a functional process, the functionality of the effect may be questioned under specific circumstances. For example, in our studies people perceived objects to be bigger that were not really present and thus not functional in attaining the goal. However, perceiving objects to be bigger may have been useful in the evolution of mankind and could still be useful nowadays, as people usually perceive objects that are actually present or (in the case of pictures) indicate the nearby presence of instrumental objects (e.g., sign of a book outside a bookstore). Perhaps more disturbing, one may wonder whether perceiving objects to be bigger makes it more difficult to actually grasp and get the objects. Recent studies on visual perception suggest that it does not. That is, the visual system can be separated in two largely independent operating streams, one mainly dealing with the identification of objects (ventral), the other with the execution of action on the objects (dorsal; see e.g., Ganel, Tanzer, & Goodale, 2008; Goodale & Milner, 1992). As a result, increased size perception may facilitate detection of the object, but this perceptual accentuation does not impinge on the information that is used by the system that deals with getting the object.

Another interesting finding established in the present study is that, in line with earlier findings (e.g., Klein et al., 1951; Solley & Lee, 1955), negatively shaped behavioral goals did not alter size perception of goal-instrumental objects. However, because in earlier studies we showed that our negative shaping treatment can diminish the evaluation of goal objects (Custers & Aarts, 2005b), one may wonder whether negative shaping of goal objects can nevertheless produce effects on size perception. Two possibilities are discussed here. First, Aarts et al. (2007) showed that negative affect co-activated with an initially positive goal can act as a demotivator. That is, it wipes out the motivational effects normally associated with activation of the goal. Although in the current study there was no motivation to reduce to begin with as the potential goals were initially neutral, negative shaping may wipe out size perception effects if goals are initially positive and goal-instrumental objects therefore already perceived as larger.

A second, more speculative way in which negative affect may influence functional perception may occur when people take action to avoid a negatively valenced, undesired state. In the present studies we focused on activities that people either want to engage in or not (approach motivation) and in that case there is no difference between neutral or negative shaping as people did not want to engage in an activity to begin with. However, there are also activities that people may actively want to avoid (e.g., bungee-jumping). Under these circumstances, it may be functional to perceive objects relevant for the avoidance goal to be bigger, rendering it easier to avoid ending up in an undesired situation. Note however, that avoiding an undesired state often involves pursuing another state that is desired (see Carver & Scheier, 1998; Higgins, 1997; Kruglanski et al., 2002). As a result, objects related to the desired goal that help to avoid the undesired state may be perceived to be bigger. For example, suppose that someone evaluates home-cooking as being negative. In this case, the size of cooking-instrumental items (e.g., a frying-pan) may not be perceptually altered. Rather, the brochure of a home-serving restaurant may be perceived to be bigger, as one wants to approach this brochure to order a meal. An interesting avenue for further research, then, is to investigate these processes in more detail to fully understand and appreciate the way in which negative affect is related to functional (size) perception.

To conclude, the present studies suggest that objects are perceived to be bigger when they are useful in attaining the goals that we want to pursue. Even when we are not aware of the source of our motivation, we have the remarkable capacity to mentally prepare ourselves for goal pursuit. That is, the perception of the environment is influenced in a way that objects related to the things we desire are easier to see. This readiness for goal pursuit may allow us, then, to live our lives a lot more efficiently and easily.

Footnote

[4.1] In both studies we used photographs of objects of which the vertical dimension on the screen was always the most salient one (e.g., a long-drink glass or shovel standing upright). Research shows that people primarily use the most salient dimension to estimate object size (Raghubir & Krider, 1999; Krider, Raghubir, & Krishna, 2001). Thus, by asking participants how tall the object on the screen was, we made sure that the size measure is based on the most salient dimension (for height judgments as a proxy for size, see also e.g., Haber & Levin, 2001; Patla & Goodale, 1996).

Appendix. Names of Behaviors and Goal-Instrumental Objects

Behavior	Object name
Washing	Bottle of liquid washing soap
	Soap
	Washing machine
Writing	Pen
	Paper
	Pencil
Carpenting	Hammer
	Nail
	Block of wood
Calculating	Calculator
	Math book
	Math noteblock
Cleaning	Bottle of all-purpose cleaner
	Cleaning towel
	Bucket
Painting	Brush
	Can of paint
	Painting cloth
Doing puzzles	Puzzle piece
	Crossword puzzle
	Puzzle booklet
Gardening	Rake
	Shovel
	Mower
Ironing	Flat-iron
	T-shirt
	Ironing board

Chapter 5

Deprivation and Positive Affect as Distinctive Sources of Motivation

Human behavior is often motivated by deprivation of essential resources. However, whereas such needs propel behavior as part of a homeostatic process, sometimes people are motivated to engage in behavior because the mental representation of the behavior is associated with positive affect and therefore desirable in its own right. Here, we investigate how motivated behavior may arise from these two sources. In a series of studies, effects of fluid deprivation on motivational measures of drinking behavior were pitted against the experimental establishment of an association between the representation of this behavior and positive affect. Results showed that the motivation to drink a glass of water either emanated from an association of the behavior with positive affect or deprivation. However, the contribution of the two sources were also found to differ in that reducing fluid-deprivation in other ways than drinking (i.e., eating) reduced drinking motivation when it was deprivation-based, but remained intact when it was positive affect-based. Together, these findings allow for more specific predictions regarding the instigation of motivational behavior as a result from deprivation or positive affect.

This chapter is based on: Veltkamp, M., Custers, R., & Aarts, H. (2009). Deprivation and positive affect as distinctive sources of motivation. *Manuscript submitted for publication*.

Research over the last fifteen years suggests that much of human behavior is propelled by motivational processes that often operate without conscious intent and thought (see for overviews e.g., Bargh, 2006; Custers & Aarts, 2005a; Moskowitz, Li, & Kirk, 2004). This does not only pertain to concrete behaviors that are directly relevant for survival, such as drinking water and eating food, but also to behaviors that are part of our social nature, such as calling a friend and helping others. Studies in social cognition have taught us a lot of how such behavior may emerge. In general, for motivated behavior to occur people access the mental representation of the specific behavior, and an internal signal ultimately motivates them to engage in the behavior. Theories on motivation propose two main accounts to explain why people become motivated to engage in a specific behavior (e.g., Allport, 1937; Deci & Ryan, 2000; Maslow, 1970; Lowe & Butryn, 2007). First, being deprived of crucial resources is expected to induce motivated behaviors functional in reducing a state of deprivation as part of a homeostatic process. Second, behaviors may become associated with positive affective information (e.g., praise, interest, pleasure), which in turn, can motivate people to perform them. Thus, one can be motivated to call a friend because one is deprived of social contact, or because the behavior is represented as a positive event one wants to engage in. In principle, then, most of our behavior has deprivation-motivated or positive affect-motivated roots.

Whereas it is important to acknowledge the existence of these two sources of motivation, distinguishing between them can be crucial in real life. Consider for example a teenager who spends a fortune on chat-boxes. She may be motivated to do so either because she is lonely, or because she enjoys calling chat-boxes. In the first case, stimulating social contact (e.g., signing her up for soccer) may reduce chat-box calling. However, this may not be true in the latter case. Vice versa, making chat-boxes less attractive may reduce chat-box calling but not the need for social contact, which may cause other detrimental behaviors to arise. Not only can failing to correctly distinguish between those two sources lead to bad parenting decisions in daily life, it may also seriously hamper theoretical research on motivation. Hence, it is important for practical as well as theoretical reasons to correctly identify behavior as either motivated by deprivation or positive affect.

There is quite some literature showing that deprivation and positive affect attached to a behavior representation both causally motivate people to engage in a specific behavior. For example, being deprived of fluids for a few hours raises the motivation to drink a glass of water (Fitzsimons, 1972; Veltkamp, Aarts, & Custers, 2008a), and people who are deprived from a positive self-view are more inclined to stereotype outgroup members (Fein & Spencer, 1997). Furthermore, research testing the effects of social influence techniques, such as persuasion and evaluative conditioning, indicates that changing people's affective responses toward behaviors alters their motivation to engage in them (Aarts, Custers, & Marien, 2008a; Custers & Aarts, 2005b; Petty, Wegener, & Fabrigar, 1997). However, whereas studying behaviors that are motivated by deprivation or positive affect is intriguing in its own

right, previous work on this matter has mainly examined both sources separately. Accordingly, the question of how these two sources interact in motivating concrete behavior has hitherto received only little theoretical analysis and empirical attention. If one is, for example, deprived of fluid and motivated to drink a soda, will creating a link between this specific behavior and positive affect further increase the motivation to use this soda, or will such social influence attempts have no additional value? Also, if one is deprived of social contact, would replenishing resources by encouraging participation in team sport always reduce the motivation to use chat-boxes, or does this depend on whether the representation of using chat-boxes is attached to positive affect and therefore a motivator in itself?

In the present paper, we aim to address these questions. Specifically, we set out to combine the two sources of motivated behavior in one research design and report three experiments that examine how they are related to each other in motivating behavior. Before we move on, we want to be clear about how we use the terms deprivation and positive affect. First, in line with earlier conceptualizations we define deprivation as a lack of resources that are crucial for an individual's well-being (lacking these resources is sometimes also conceptualized as having a need; e.g., Deci & Ryan, 2000; Fiske, 2004). There are resources on a biological level that people clearly cannot do without (e.g., food, water). However, the basic nature of human needs becomes less clearly articulated on a social level. Although we do not wish to enumerate the social needs that have been proposed in the literature (e.g., need for social contact, relationships, control; Fiske, 2004; Mook, 1996; Pittman & Zeigler, 2007), important for the present work is the notion that behaviors functional in reducing states of deprivation can have rewarding properties conditional on the state of deprivation and thus motivate behavior only within that state. Secondly, following work on automatic processes of evaluation and affect, in our research positive affect is conceptualized in terms of valence assigned to an entity (Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Zajonc, 1980), and not a feeling state or emotion that people consciously experience (Isen & Diamond, 1989; Russell, 2003). We propose that the affective valence of a behavior representation can act as a reward signal and thus increase motivation to engage in the behavior.

How deprivation and positive affect produce motivated behavior

To understand how the motivation to engage in a specific behavior arises from deprivation or positive affect, we depart from the notion that the actual performance of behavior, in essence, starts with accessing the mental representation of a behavior (Aarts, Custers, & Veltkamp, 2008b; Bargh, 2005; Jeannerod, 1997; Prinz, 1997). The imperative role of mental representations of behavior was already stressed in the principle of ideomotor action (Carpenter, 1874; James, 1890), which stated that merely thinking about a behavior activates the corresponding behavior representations, which renders the behavior more likely to be executed. In line with this notion, research showed that (subliminally) priming of behavior representations can suffice to increase the occurrence of those behaviors and even to increase the

motivation to perform them (for an overview, see Dijksterhuis, Chartrand, & Aarts, 2007).

An important question emanating from this research is how the mental apparatus "knows" whether a behavior is worth engaging in or not. We propose here that deprivation and positive affect linked to a behavior are crucial to this matter as they are expected to alter the rewarding value of a behavior. Thus, although the influence of deprivation and positive affect on motivated behavior may differ in their origin (e.g., being deprived of fluid for a few hours versus linking the act of drinking water to positive affective information by means of evaluative conditioning), both motivational sources are thought to act upon the same mental representation of the given behavior (see also, Strahan, Spencer, & Zanna, 2002; Veltkamp et al., 2008a). In line with this idea, neurological data suggest that perception and performance of behaviors that are rewarding due to a state of deprivation or to its association with positive affect activate the mesolimbic dopamine system involved in motivational processes (Berridge, 2001; McFarland & Kalivas, 2003; Robbins, & Everitt, 1996).

The idea that deprivation motivates behavior through the representation of the deprivation-reducing behavior derives from the observation that animals, humans included, do not merely learn to associate deprivation (e.g., of fluid) with a particular behavior (e.g., drinking), but rather that performing a specific behavior is rewarding given that there is a state of deprivation (incentive theory, Bindra, 1974; Bolles, 1972; Toates, 1986). Thus, although potentially there may be multiple behaviors (e.g., drinking, eating) instrumental in reducing a state of deprivation (e.g., thirst, hunger), motivation will dominantly ensue for the specific behaviors of which one has learned that they are rewarding conditional on the state of deprivation (cf. instrumental learning, Dickinson & Balleine, 2002). Not surprisingly, the motivation of eating or drinking behavior, for example, has been found to be high under conditions of food or fluid deprivation, but reduces after eating or drinking until satiation is obtained (e.g., Le Magnen, 1985; Rolls et al., 1980). Supporting the idea that deprivation motivates behavior through a reward-mechanism, research showed that the rewarding properties of such behaviors diminish after deprivation reduction: One is less eager to eat haggis after a recent meal as compared to when one is food deprived (cf. alliesthesia; Berridge, 2004; Cabanac, 1979). Thus, deprivation increases the motivation for specific behaviors by modulating the rewarding value of the mental representation of behaviors associated with reducing the deprivation.

Although deprivation is an important source of motivated behavior, several researchers have acknowledged that many behaviors are not driven by needs, but instead comprise rewarding value because they are desirable to perform in themselves (see e.g., Custers & Aarts, 2005a; Deci & Ryan, 2000; Lowe & Butryn, 2007). Specifically, whereas the rewarding value of deprivation-reducing behaviors is assumed to be conditional on an underlying state of deprivation, this reward signal may also emanate from positive affect that is directly attached to the behavior representation, hence motivating behavior regardless of a state of deprivation.

Recently, researchers have started to explore how motivated behavior may result from such behavior representations that are associated with positive affect (Aarts et al., 2008a; Cesario, Plaks, & Higgins, 2006; Custers & Aarts, 2005b; Ferguson, 2007). Of particular importance for the present work is research by Custers and colleagues (Aarts et al., 2008a; Custers & Aarts, 2005b; Custers & Aarts, 2007a; Veltkamp, Aarts, & Custers, 2008b) on the role of positive affect as an implicit motivator in goal-directed behavior. They argue that, in principle, most motivated behaviors originate from previous experiences in which the representation of a behavior was closely linked in time to cues that activate positive affect, even if the cues were perceived as being unrelated to the behavior. Specifically, if hearing about, seeing, or performing a given behavior is repeatedly accompanied with positively valenced information, the representation of the behavior and positive affect are linked together. Once positive affect is linked to the behavior representation, it can act as a reward signal indicating that the behavior is worth pursuing, and can therefore propel motivation to engage in that behavior unconditional on deprivation states (for an elaborate discussion of the underlying mechanism of this affective-motivational route to behavior, see Aarts et al., 2008b).

In a recent series of studies testing this idea, Custers and colleagues employed an evaluative conditioning paradigm (De Houwer, Thomas, & Baeyens, 2001) that enabled them to link behavior representations to positive affect in the absence of participants' conscious awareness. They examined and demonstrated effects of this unobtrusive positive shaping of behavior on various measures qualifying motivated behavior, including enhanced experiences of motivation, higher rate of action, effort, persistence, and perceived size of action-relevant objects, and these effects were independent of subjective mood states and awareness of the source of the motivation (Aarts et al., 2008a, 2008b; Custers & Aarts, 2005b; Custers & Aarts, 2007a; Veltkamp et al., 2008b).

So far, our conceptual analysis suggests that motivated behavior can result from deprivation or positive affect associated with the representation of the behavior. However, an important question that we have not addressed is how these two distinctive sources produce motivation when they act in concert. One possibility is that they have an independent contribution. Such an additive model may hold under the assumption that the effects of deprivation and positive affect on the motivation to engage in behavior ultimately emanate from two different processes that do not take each other's input into account. That is, if deprivation-motivated and positive affect-motivated behavior derives from two independently operating reward signals.

However, the notion that the two sources of motivation may impinge on the same behavior representation to produce motivated behavior opens the possibility that they interact. The idea that deprivation and positive affect interact in their contribution to motivation does not only concur with the finding that positive affect attached to behavior can motivate behavior in the absence of deprivation; it also suggests that if one source (e.g., deprivation) motivates behavior, the second source

(e.g., positive affect) may not add much to the motivational equation, as the presence of a single source already gives input or signals that the behavior is rewarding to perform. Specifically, whereas deprivation is thought to typically motivate behavior by providing a reward signal to engage in the behavior, positive affect will offer such a signal and motivate behavior in the absence of deprivation.

Circumstantial evidence for this idea comes from animal research. For example, the amount of consumed fluid in nondeprived rats has been shown to be positively related to the strength of the rewarding property of the fluid (operationalized as the percentage of sucrose added to it), while overall fluid consumption is high when they are deprived (Mook & Cseh, 1981; see Mook, 1996). In addition, the influence of food preferences on consumption in animals seems to be inversely correlated with deprivation (Barbano & Cador, 2006; Rudski, Billington, & Levine, 1994). Assuming that preferences are largely based on affective processes, these studies suggest that deprivation and positive affect associated with behavior can interact in their effects on the motivation to engage in behavior.

An interesting implication of the line of reasoning addressed above is that, in the case of a deprivation-motivated source, the motivation for a specific behavior (e.g., drinking) can be reduced without performing that behavior, if for example deprivation (and hence, the rewarding value of drinking) is reduced by performing another action (e.g., eating). In the case of a positive affect-motivated source, however, an established link between the representation of the behavior and positive affect may still offer the signal that performing the behavior itself is desirable and therefore the motivation for that specific behavior can remain intact when the deprivation is reduced by other means.

The Present Research

In the present article, we report three studies that were designed to test our ideas about how deprivation and positive affect attached to a behavior representation produce motivation for a specific behavior. In these experiments, we studied the act of drinking water as an example of such motivated behavior. This behavior was selected because it is a well-known and effective way to reduce deprivation of fluid, and unlike many other needs, fluid is widely accepted to be an essential resource of which people should not become too much deprived. However, apart from being motivated by fluid deprivation, people can, in principle, also be motivated to drink water because this is rewarding in itself. Apart from theoretical considerations, the focal behavior of drinking water allowed us to operationalize deprivation-based motivation in different ways (e.g., self-reported time of fluid deprivation, manipulating deprivation by allowing participants to quench their thirst or not), and to specifically link the behavior to positive affect by co-activating the very representation of the behavior with positive affective stimuli.

The first two studies address the hypothesis that a relatively high deprivation results in deprivation-motivated behavior, but that positive affect attached to a behavior representation can produce motivation for that same behavior when

deprivation is low. The third study examines whether effects of the deprivation-motivated source, but not of the positive affect-motivated source, can diminish by engaging in a behavior that, in essence, is not perceived to reduce fluid deprivation (eating a high-fluid content food item).

Study 5.1

This first study serves as an initial test of the notion that the motivation to drink water is related to the level of fluid deprivation, but that the pairing of the representation of that behavior with positive affect can simulate this process in the absence of such a deprivation. For this purpose, we assessed fluid deprivation in minutes with a self-report as a continuous variable (Veltkamp et al., 2008a). Furthermore, all participants were primed with the concept of drinking water to ensure that the accessibility of the drinking representation was equal for all participants. For some of them the primes were co-activated with neutral words; for others the primes were co-activated with positively valenced words (Aarts et al., 2008b; Custers & Aarts, 2005b). In order to make sure that participants were not aware of the pairings between the drinking words and positive affect, which could make them suspicious about the hypotheses, the drinking words were primed subliminally. Finally, effects of both sources of motivation were observed on a measure of subjective experienced motivation to drink a glass of water. In line with earlier work (e.g., Seibt, Häfner, & Deutsch, 2007; Veltkamp et al., 2008a), it was expected that motivation would increase as a function of fluid deprivation. Importantly however, it was also expected that the co-activation of the representation of drinking with positive affect increases the motivation to drink a glass of water, but only under conditions of relatively low deprivation. In other words, higher deprivation leads to a stronger motivation to drink because the act of drinking is rewarding given this bodily state, but when deprivation is low the positive shaping of the act of drinking resembles the deprivation effect.

Method

Participants and design. Sixty-six undergraduates participated in exchange for course credits or a small payment. They were randomly assigned to either a positive or neutral shaping condition. Deprivation of fluids was measured using the self-report method reported above.

Procedure. Upon arrival in the laboratory, participants were told that they would take part in research conducted by different research teams. Participants worked in separate cubicles in which the experiment was presented on a 100 Hz computer screen. Participants started with an inventory of physiological states, followed by a filler task, a shaping task, and the assessment of the experienced motivation to drink. A computer program provided all instructions.

Self-reported deprivation of fluids. First, all participants filled out a questionnaire to map students' physiological states concerning differing crucial resources (e.g., fluid and food). It was told that the deprivation of these resources can differ a lot during the day and between students and that this information was

allegedly needed for forthcoming research. The crucial question in this questionnaire was the self-reported time measure of fluid deprivation (*M* = 115 minutes, *SD* = 62). Next, participants worked on an unrelated filler task for about 20 minutes. Subsequently, they started with the shaping task, which was introduced as a study on visual perception.

Positive shaping of drinking manipulation. Participants learned that they would do a "dot-detection task" where all kinds of words would be presented on the screen, sometimes followed by dots presented very briefly above or below these words. Their task was to indicate whether they had seen a dot or not. In actuality, in this task drinking words were subliminally presented and paired with either positive or neutral affective words, and the dot-detection task ensured us that participants paid attention to the screen during the exposure of the words (see also, Custers & Aarts, 2005b; Aarts et al., 2008a). Because the focal behavior of interest was drinking a glass of water, we used the following three drinking words: drinking, glass and water. These words were each paired with either nine positive words (good, nice, fun, love, great, smile, friend, pleasant, peace) or nine neutral words (thus, furthermore, when, although, therefore, however, such, also, because; taken from Custers and Aarts, 2005b).

The task consisted of 54 pairing trials (randomized presentation). In the *positive shaping* condition, each drinking word was paired with 9 positive words (27 pairings) while nonwords were paired to 9 neutral words (27 pairings). In the *neutral shaping* condition*,* drinking words were paired with the neutral words (27 pairings) and nonwords with the positive words (27 pairings). Thus, the number of drinking words and positive words was identical in both conditions, but the crucial difference was that in the positive shaping condition the drinking words were directly linked to the positive words.

A pairing trial consisted of the following events: a cross was presented on the screen for 500 ms, signaling the beginning of the trial. Next, a random letter string (e.g., HBSNPXR) appeared on the screen (premask, 500 ms), immediately followed by either a drinking word or random letter string that was presented subliminally (30 ms; for a subliminality check of this procedure, see Aarts et al., 2008a). Then, a random letter string appeared again (postmask, 100 ms), followed by a positive or neutral word (150 ms). Occasionally, a dot was presented for 30 ms (not post-masked, hence consciously visible), either above or beneath the neutral or positive word. Participants indicated whether they had seen a dot, and 2500 ms later a new trial started.

Motivation to drink. After the shaping manipulation, participants filled out a short questionnaire where experienced motivation to drink water was measured. Specifically, participants had to respond to the following two items: "To what extent do you want to drink a glass of water right now?" and "To what extent do you want to quench your thirst right now?". Participants responded to a 9-point scale varying from not at all (1) to very much (9). Responses to these two items (r = .60, p < .001) were

averaged to obtain an index of experienced motivation to drink (Veltkamp et al., 2008a).

Finally, participants were thoroughly debriefed. The debriefing showed that participants were unaware of the hypotheses under investigation. In addition, in line with our previous subliminality check of this procedure (Aarts et al., 2008a), participants had not seen the drinking words in the dot-detection task.

Results

To test our hypotheses we conducted a regression analysis in which level of experienced motivation was predicted by the fluid deprivation measure and positive shaping manipulation (neutral = 0, positive = 1). To reduce multicollinearity bias, all variables were standardized before computing the cross-products (Dunlap & Kemery, 1987). Analysis revealed significant main effects for deprivation, β = .40, $t(65)$ = 3.48, p < .01, and shaping, β = .31, $t(65)$ = 2.83, p < .01. The analysis also showed the expected two-way interaction, β = -.22, $t(65)$ = -1.98, p = .05[5.1]. Regression lines are presented in Figure 1.

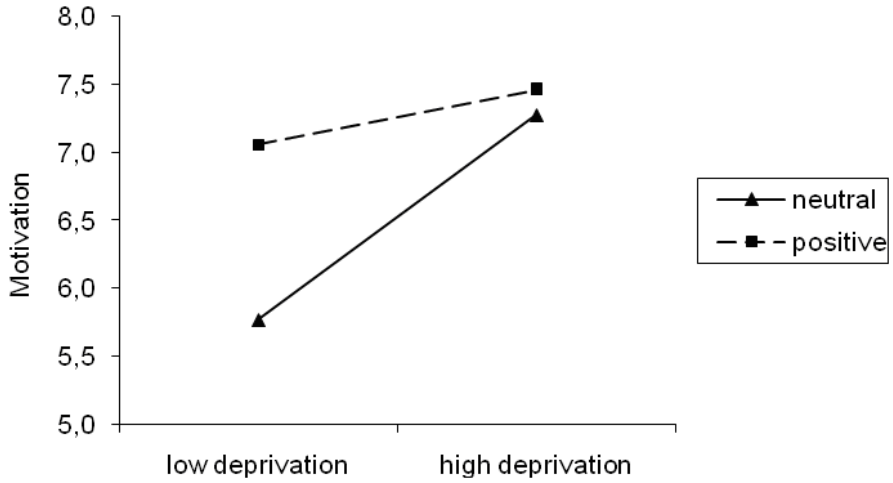

Figure 1: Motivation to drink as a function of deprivation and shaping.

To test whether shaping influenced experienced motivation only for relatively low deprived participants, additional analyses were run to test differences for participants who were high or low deprived (see Cohen, Cohen, West, & Aiken, 2003). As expected, when deprivation was low (1 SD below the mean), motivation increased significantly as a function of shaping, β = .54, $t(65)$ = 3.56, p < .01, but not when deprivation was high (1 SD above the mean), β = .08, $t(65)$ = 0.47, p = .64.

Discussion

The findings of Study 5.1 supported the hypothesis that deprivation-based motivation and affect-based motivation produce similar effects on motivation. That is,

the motivation to drink a glass of water increased as the deprivation of fluid increased and, as research on incentive learning (e.g., Toates, 1986) suggests, such increase is caused by the rewarding properties of the drinking behavior under conditions of relatively high fluid deprivation. However, when deprivation of fluid was relatively low, participants were motivated to drink water as a result of the established link between the positive affect and behavior. That is, when the representation of drinking a glass of water was co-activated with positive affect, the motivation to drink increased in the absence of fluid deprivation.

Study 5.2

Study 5.1 showed that deprivation and positive affect interacted in their effects on subjectively experienced motivation to drink, such that deprivation increased motivation when the drinking representation was not shaped positively, and that positive shaping of the drinking representation enhances motivation when deprivation was low. This supports our argument that that there are two sources of motivation, deprivation-based and positive affect-based, that act upon the motivation for a behavior in a similar vein. The aim of Study 5.2 was to replicate these findings and to investigate whether these two routes to motivation indeed lead to changes in overt behavior. In order to assess changes in behavior, we unobtrusively measured the amount of drinking water as part of a product comparison task.

Study 5.2 served one further purpose. Whereas Study 5.1 used a self-reported measure to assess the level of fluid deprivation in minutes, in Study 5.2 the level of fluid deprivation was manipulated in order to more directly examine the causal role of deprivation. For this purpose, participants were asked to eat a number of crackers under the disguise of a consumer product task. In actuality, consuming the crackers was expected to exacerbate participants' need for fluid (cf. Aarts, Dijksterhuis, & De Vries, 2001), and thus was part of the deprivation manipulation procedure. Next, one group of participants was allowed to drink water, the other group was not. The rationale behind this manipulation, then, is that participants who have consumed crackers but are not allowed to quench their thirst would end up with a relatively high level of fluid deprivation, whereas participants that are allowed to drink water would have a relatively low level of fluid deprivation.

Based on the results of the previous study, we expected deprivation of fluid to increase the amount of water consumption. Furthermore, we expected that co-activating the representation of drinking with positive affect would enhance the amount of water consumption, but only when fluid deprivation is relatively low.

Method

Participants and design. Sixty-five undergraduates participated in the experiment in exchange for course credits or a small fee. This study used a 2 (deprivation: low vs. high) X 2 (shaping: neutral vs. positive) between participants design. The dependent variable, the amount of consumed water (in grams), was assessed in an alleged product comparison task at the end of the experimental session.

Procedure. Participants were recruited by means of a sign-up procedure. To conceal the real purpose of the study, the study was announced as an experiment on perception and consumer product judgment. Once the participants entered the laboratory, they were told they first would participate in the product-comparison task, and that there would be a perception task and another product comparison task at the end of the session. The experiment was run in a room containing three tables separated by large screens. Thus, in each part of the experimental session participants could see only their own table.

Deprivation manipulation. Participants then started with the first part of the experiment, which was framed as a consumer product-comparison task. In this task, participants had to eat two different crackers, and filled out a short questionnaire to rate different aspects of the crackers, such as shape and color. Next, participants in the low deprivation condition were provided with an empty glass and a jug filled with water, allowing them to take water before proceeding to the next part of the experiment. In the high deprivation condition, participants were not provided with the drinking gear, and hence, did not have the opportunity to quench their thirst.

Pilot-work. Prior to the experiment we conducted a pilot-test to assess the effects of our treatment on self-reported measure of thirst. Thirty-one undergraduates (drawn from a different population than in the experiments) were assigned randomly to either the low or high deprivation conditions. After a filler task of 10 minutes, they responded to the following item assessing the degree of thirst: “How thirsty do you feel right now?”. A unipolar 9-point answer scale ranging from “not at all” (1) to “very much” (10) was used. An ANOVA revealed a significant effect of the manipulated deprivation level on ratings of thirst, $F(1,30) = 24.04$, $p < .001$, $\eta^2 = .45$. The reported level of thirst was significantly higher in the high deprivation ($M = 6.50$, $SD = .43$) than in the low deprivation ($M = 3.65$. $SD = .39$) condition. Thus the test crackers without water consumption treatment (high level of fluid deprivation) increased rated thirst over 10 minutes post-ingestion.

Positive shaping of drinking manipulation. Next, participants moved to another table where they were seated behind a computer and performed the “dot-detection task” on a 100 Hz computer screen. The task was identical to Study 5.1. After the dot-detection task, participants were directed to the third table, where they expected to do another product comparison task. This part of the experiment contained the dependent variable, namely the amount of water consumption in grams.

Water consumption. At the last table, there were three glasses that differed in shape. Each glass was filled with 100 gram water. Participants learned that this part of the experiment was again a product-comparison task, where they had to compare three glasses on different dimensions (e.g., shape, ease of use). Accordingly, participants had to drink from all three glasses to form an impression of the different dimensions, however remained ignorant on the real purpose of this test, that is, to measure the amount of water they consumed. Next, they completed the ratings on the dimensions.

Finally, participants were debriefed. As in the first study, the debriefing showed that participants were unaware of the hypotheses under investigation. In addition, none of them indicated that they had seen the drinking words in the dot-detection task and that the dot-detection task had influenced their consumption of the water in the product comparison task.

Results and Discussion

To test whether the deprivation and shaping manipulations affected the amount of water consumption, the quantity measure was subjected to a 2 (shaping: neutral or positive) x 2 (deprivation: low or high) between participants ANOVA. The results showed a main effect of deprivation, $F(1,64) = 5.18$, $p = .03$, $\eta^2 = .08$. Participants consumed more water in the high deprivation condition compared to the low deprivation condition. The main effect of shaping was not significant, $F(1,64) = 1.41$, $p = .24$, $\eta^2 = .02$. Most importantly however, the two-way interaction showed the expected interaction of shaping and deprivation: $F(1,64) = 4.50$, $p = .04$, $\eta^2 = .07$ (see also Figure 2). Closer inspection of this interaction effect showed, in line with our hypothesis, that water consumption increased as a function of shaping in the low deprivation condition, $F(1,64) = 5.43$, $p = .02$, $\eta^2 = .08$. In the high deprivation condition, shaping had no additional effect on the amount of water consumption, $F < 1$.

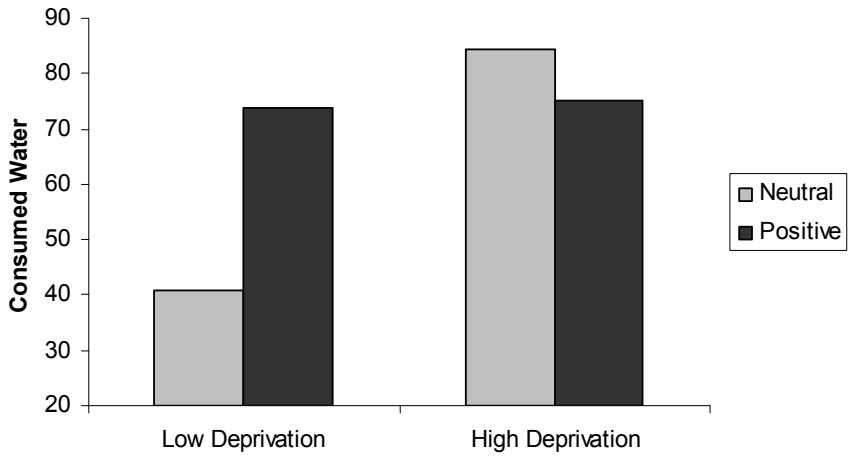

Figure 2: Quantity of drinking (in grams) as a function of deprivation and shaping.

In short, these results extend the findings of Study 5.1 and provide even stronger support -- by showing effects on actual drinking behavior -- for the hypothesis that deprivation and an association of a behavior with positive affect motivate behavior in a similar fashion. By manipulating fluid deprivation, Study 5.2 showed in addition to Study 1 that a relatively high deprivation of fluids caused an increase in the motivation

to drink a glass of water. As expected, creating an association between the behavior representation of drinking a glass of water and positive affect resulted in drinking motivation unconditional on deprivation states. That is, when deprivation was low and the drinking behavior therefore not deprivation-motivated, the positive shaping manipulation still resulted in affect-motivated behavior, thus simulating the effects of high deprivation.

Study 5.3

So far, the results of two studies indicate that the motivation to drink can be increased both by fluid deprivation and by positive shaping of the drinking representation. In the third study, the potential distinction between deprivation-motivated and affect-motivated drinking behavior is tested. Specifically, we tested the assumption that effects of affect-motivated behaviors pertain to the specific behavior being associated with positive affect, while deprivation-motivated behaviors may be more prone to opportunities that are not part of the instrumental repertoire of these needs (i.e., the rewarding behaviors), yet capable of reducing the current state of deprivation. That is, the motivation for a behavior is thought to depend on the rewarding properties of the behavior. For deprivation-motivated behaviors, the behavioral reward signal is conditional on the state of deprivation and should therefore wane whenever the state of deprivation diminishes, regardless of the performed actions that led to this deprivation reduction. However, the reward signal emanating from positive affect attached to the behavior may still motivate people to engage in the behavior, even though the state of deprivation has been reduced.

To test these ideas, all participants were first instructed to abstain from drinking or eating for at least two hours, thereby creating a relatively high level of fluid deprivation. Next, the act of drinking water was either positively shaped or not. Accordingly, at this point participants may be motivated to drink either because of fluid deprivation or of the nonconscious association with positive affect. However, the experiment then took a crucial twist. One half of the participants were allowed to eat a certain amount of a high fluid-content food item – i.e., a cucumber (containing 96% of water; Davidson, 1999) – whereas the other half were not. In the eating condition, then, participants reduced their fluid deprivation without performing or making reference to the focal behavior of drinking. Finally, participants were allowed to drink water to allegedly prepare for an upcoming concentration test. Based on the line of reasoning addressed before, it was expected that because eating cucumber reduces fluid deprivation, the motivation to drink would attenuate as well, at least in the no shaping condition. However, when drinking water was linked to positive affect, participants were expected to remain motivated irrespective of cucumber consumption.

Method

Participants and design. Eighty-two undergraduates participated in the experiment in exchange for a small payment. They were randomly assigned to one of

the conditions of the 2 (deprivation-reduction: no vs. yes) X 2 (shaping: neutral vs. positive) between participants design.

Procedure. Participants were recruited by means of a sign-up procedure. To conceal the real purpose of the study, the study was announced as an experiment on the relation between drinking and eating and performance on a concentration test. Participants were therefore instructed to refrain from drinking and eating for a minimum of two hours before arriving at the laboratory (see Strahan et al., 2002). To check whether participants had adhered to the abstinence regime, a bogus pipeline technique was used (Jones & Sigall, 1971). Specifically, participants were asked to hold a cotton bud against the inside of their cheek and to put it in a plastic bag that was sealed afterwards, which they thought allowed us to analyze the objective level of deprivation later on. Participants also reported how many minutes ago they had last drunk and eaten. These reports showed that the participants indeed had adhered to the instructions. Participants were then seated at a large table behind a computer.

Positive shaping of drinking manipulation. Next, participants were told that the experiment consisted of two perceptual tasks to test concentration abilities, with a break in-between. They then proceeded with the first concentration task, which was actually the shaping task. The shaping manipulation was identical to Studies 1 and 2. After this task, participants moved on to the next stage of the experiment.

Deprivation-reduction manipulation. In the deprivation-reduction condition, participants received a plate of cucumber slices (200 grams). They were asked to eat the cucumber before they would start with the second concentration task. This food item was selected because cucumber contains 96% water, which means that by consuming the cucumber that contained 192 grams of water, participants reduced their fluid deprivation. Participants were given three minutes to eat the cucumber. Pilot tests showed that our sample of participants (1) like to eat cucumber; (2) do not consider cucumber consumption as a way to reduce fluid deprivation; and (3) are able to eat 200 grams within three minutes. In the no deprivation-reduction condition, participants were told that there would be a break for three minutes before starting with the second concentration task.

Water consumption. Next, all participants received an empty glass and a jug filled with approximately 700 grams of water. Participants were allowed to consume the water *a bene placito* before the second concentration task would start. Thus, participants had access to water during the remaining time of the experiment.

After participants completed the second concentration task they were debriefed, paid and dismissed. The debriefing showed that participants did not realize the true nature of the study. Furthermore, none of them indicated that they had seen the drinking words in the dot-detection task and that the dot-detection task had influenced their water intake.

Results and Discussion

The average amount of consumed water (in grams) for each cell in the design is depicted in Figure 3. A 2 (shaping: neutral or positive) x 2 (deprivation-reduction: no

vs. yes) between participants ANOVA with grams of consumed water as dependent variable revealed a main effect of deprivation-reduction, $F(1,81) = 12.85$, $p < .01$, $\eta^2 = .14$, as well as of shaping, $F(1,81) = 3.98$, $p = .05$, $\eta^2 = .05$. That is, while eating cucumber decreased water consumption, positive shaping increased it (see also Figure 3). However, in line with the predictions, these main effects were qualified by a two-way interaction of shaping and deprivation: $F(1,81) = 4.04$, $p = .05$, $\eta^2 = .05$.

Further analysis of this interaction effect showed that water consumption remained fairly constant at a high level in the positive shaping condition, $F(1,81) = 1.05$, $p = .31$, $\eta^2 = .01$, while it decreased sharply after deprivation reduction for participants in the neutral shaping condition, $F(1,81) = 14.68$, $p < .01$, $\eta^2 = .16$. In addition, positive shaping had no reliable effect within the no deprivation reduction condition, $F(1,81) = 0.01$, $p = .96$, $\eta^2 = .00$, while positive shaping significantly increased the amount of drinking in the deprivation reduction condition, $F(1,81) = 6.76$, $p = .01$, $\eta^2 = .08$.

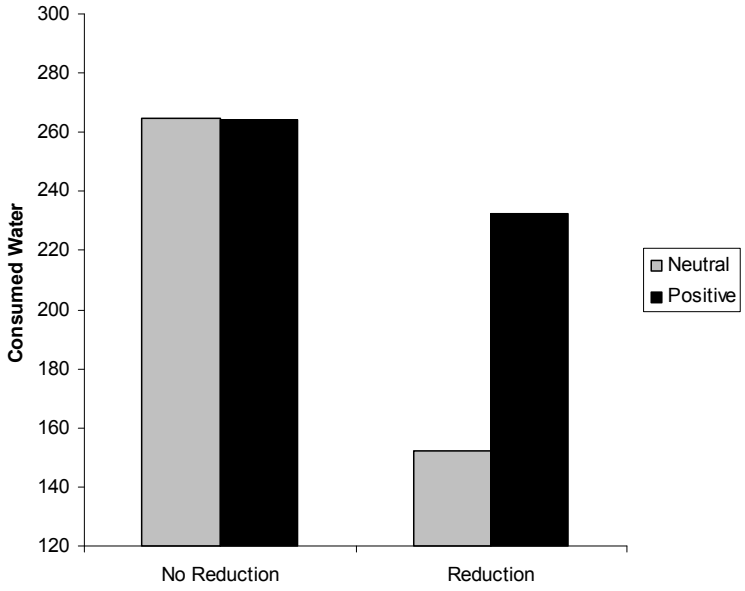

Figure 3: Quantity of drinking (in grams) as a function of deprivation-reduction and shaping.

In sum, the findings of Study 5.3 show that the motivation to drink water as a result of deprivation can cease to exist without executing the behavior after deprivation has been reduced by eating a high fluid-content food item, while the motivation for that specific behavior remained intact after a link between drinking and positive affect had been established. These findings support the idea that motivation to engage in a specific behavior can emerge from two different sources, i.e., deprivation and positive affect, but that both sources react differently to deprivation-reducing methods that do

not pertain to the behavior at issue. Specifically, while the rewarding property of drinking water under conditions of fluid deprivation can be removed by eating, the link between drinking and positive affect can still encourage people to drink water.

General Discussion

The aim of the present article was to illustrate how two sources of motivation – deprivation from crucial resources and the association between a behavior representation and positive affect – work together to produce the motivation to engage in specific behaviors. It was shown that experimentally attaching a positive affective tag to the behavior of drinking a glass of water increased reported motivation for this behavior and actual water consumption for non-deprived participants, but that this manipulation did not affect motivation of deprived participants for whom motivation to drink was already high. Nonetheless, it was found that reducing this deprivation by means of an atypical action (eating) reduced subsequent water consumption of control participants, but not for participants for whom a positive affective tag was attached to this behavior.

Together, these interactive effects suggest that deprivation and positive affect operate as two distinct sources of motivation that both provide a signal about the rewarding properties of specific behaviors. Although stemming from different sources, these reward signals function as a common currency (Cabanac, 1992) and provide information about the overall utility (Shizgal, 1999) of the behavior. Each signal guides motivational behavior in a similar manner when a signal from the other source is absent, but appears to be considered redundant – not motivating behavior additionally – when the other source already provides such a signal. As combined effects of deprivation and positive affect have been rarely studied in the literature, this finding offers new insights in how the two major sources of motivation work together to guide human behavior.

Contributions to research on motivated behavior

The present research may help to further understand how and when motivational behavior emerges. In line with the notion that such behavior first of all relies on the activation of mental representations, recent research has demonstrated that mere activation of representations of desired behaviors (i.e., behavioral goals) suffices to get motivational behavior going. It has, for example, been demonstrated that such goal priming causes behavior to be more persistent (Bargh, Gollwitzer, Lee Chai, Barndollar, & Trötschel, 2001); effortful (Aarts et al., 2005) and less easily blocked by obstacles (Custers, Maas, Wildenbeest, & Aarts, 2008). Until recently, however, it was unclear how such cognitive representations could motivate behavior without people consciously reflecting on the behavior. The current findings demonstrated that deprivation and positive affect both modulate the reward signal pertaining to a specific behavior representation, which in turn should moderate priming effects on motivational behavior (cf. Custers & Aarts, 2005a). Hence, whether primes in the environment may affect behavior may depend on deprivation and positive affect.

Such moderating effects of these sources have been demonstrated separately in the literature. In their research on goal contagion, Aarts, Gollwitzer and Hassin (2004) found that activating the goal concept of making money by exposing participants to another person executing a behavior that implies that goal, makes them work harder to earn additional money, but this effect is more pronounced when people are currently in need of money. Similarly, Veltkamp et al. (2008a), found that priming people with drinking a glass of water had more effects on motivation and actual water consumption when people were deprived of fluids (see also Strahan et al., 2002). The present findings suggest that this moderating effect of deprivation on motivational behavior would only occur for behaviors that are not associated with positive affect and hence not desirable in themselves.

On the other hand, research has shown that priming effects on motivational behavior can also be moderated by the value or affective valence of the primed behavior. Shah (2003), for example, primed participants with a significant other (i.e., their father) after which they participated in a task that was allegedly diagnostic for analytical reasoning. It was found that priming increased performance and persistence on the task, but only for participants who represented analytical reasoning as a positive behavior. That is, when their father valued analytical reasoning and they were close to their father. Moreover, Custers and Aarts (2007b) demonstrated that priming people with the behavior of socializing and going out only motivated instrumental actions (i.e. spending effort to obtain tickets to a party), when the implicitly measured affective valence of the behavior was positive. Again, the current findings suggest that these effects would only occur when participants are not deprived. If, for example, people were deprived of social contact, priming people with the behavior of socializing and going out would motivate people to do so, regardless of whether that behavior would be associated with positive affect or not. As such, the present results provide knowledge about the boundary conditions of the moderating effects of deprivation and positive affect in priming effects on motivational behavior.

Relation with homeostatic and hedonic principle

The interactive effect of deprivation and positive affect is in line with similar effects of homeostatic and hedonic processes described in the literature. As outlined in the introduction, water consumption in rats only increases with the amount of sugar added to water for nondeprived rats (Mook & Cseh, 1981), but the influence of such preferences fades when deprivation is high (Barbano & Cador, 2006; Rudski et al., 1994). As these preferences rely on affect and motivate behavior in the absence of deprivation, these findings are in line with the present research and thus could be thought of in terms of positive affect associated with the behavior representation. This demonstrates that motivation can stem from both homeostatic and hedonic processes. Whereas hedonic processes seem to dominate behavior when deprivation is low, homeostatic processes dominate behavior when preferences for the behavior are low.

The idea that hedonic properties of a behavior impinge on motivational processes may seem to be at odds with Robinson and Berridge's (1993, 2000) incentive sensitization theory. In this theory, they refer to the hedonic reactions to substances such as foods, drinks and drugs as *liking* which are thought to arise from a system that is different from, and unrelated to the motivational system that causes *wanting.* Their claim is supported by studies demonstrating that opioid antagonists that block hedonic reactivity to foods, do not suppress general energy intake (see Berridge, 2001; Epstein, Truesdale, Wojcik, Paluch & Raynor, 2003; Robinson & Berridge, 2000). In contrast, dopamine antagonists reduce the incentive value of food, but do not alter hedonic reactivity (Epstein et al., 2003; Robinson & Berridge, 2000).

It has to be noted that Robinson and Berridge's (1993, 2000) conceptualization of hedonic specifically pertains to *sensory experiences of pleasure*. Our manipulation of positive affect by means of evaluative conditioning, however, does not evoke or rely on such hedonic (i.e., pleasurable) experiences per se, but rather updates representations in memory. It directly affects the overall utility of behavior representations that can be accessed in memory, and can therefore bypass the experience of pleasure (Custers & Aarts, 2005b). Whereas these sensory experiences of pleasure may provide feedback to update the utility of the representations of behavior, once established these representations can influence the wanting system without relying on the liking system that is involved in producing pleasure experiences itself. Indeed, it has been demonstrated that cues referring to desired behaviors activate the dopamine system related to wanting rather than the liking system (Berridge, 2007; Schultz, 1998; Stuber et al., 2008). As such, positive affect associated with a behavior does not reflect the hedonic properties of a behavior in terms of liking, but rather its potency to activate the motivational wanting system. This concurs with recent work testing the homeostatic and hedonic courses of behaviors that are sensitive to addictive processes, such as alcohol use, overeating or smoking (see e.g., Drobes & Tiffany, 1997; Lowe & Butryn, 2007; Pinel, Assanand, & Lehman, 2000).

Needs, deprivation and positive affect

By clearly defining and distinguishing between two sources of motivation, the present research may further our understanding of specific issues in the need literature. That is, in the literature on needs there is an ongoing debate about what comprises a need and which concepts can be considered to be basic human needs (e.g., Allport, 1937; McDougal, 1908; Murray, 1938; Sheldon, Elliot, Kim, & Kasser, 2001). Most current theorists conceptualize needs as deprivation from resources crucial for survival (e.g., Baumeister & Leary, 1995; Fiske, 2004; Pittman & Zeigler, 2007). Although such a conceptualization may fit experimental findings for some needs (e.g., need for fluid, food or social contact), many needs have been defined over the years (e.g., achievement, autonomy, self-enhancement, cognition, closure, competence; see e.g., Fiske, 2004; Pittman & Zeigler, 2007) for which it is less clear whether they refer to crucial resources and whether they are motivated by states of

deprivation. Indeed, sometimes the concept of needs seems to simply refer to individual differences in the desirability of, or preferences for, a particular behavior or resource (Kruglanski & Chun, 2008; Thompson & Schlehofer, 2008). Whereas some people seem to have chronically high needs (e.g., for control; Thompson & Schlehofer, 2008), others may have no need for that resource at all and can do without it. Such needs are therefore more likely to be motivated by positive affect than by deprivation.

If these positive affect-based needs trigger specific behaviors it may be important to realize that these behaviors may not become less desirable during performance, and as a consequence, have to be terminated by other mechanisms than decreases in desirability. If someone for example associates self-enhancement with positive affect, self-enhancing behaviors (e.g., studying) may be executed without losing their desirability. These behaviors, then, may unfold until behavior is blocked by other sources such as competing goals (e.g., party), or biological needs (e.g., sleep). Such needs, then, may produce behavior that is qualitatively different from the behaviors produced by biological needs, especially when it comes to termination. Importantly, the current research suggests that such positive-affect based needs may not be sensitive to motivation by deprivation. If, for example, people with a high need for self-enhancement that is motivated by positive affect have their self affirmed (Fein & Spencer, 1997), this would not affect their behavior, as the positive valence of self-enhancement is unrelated to deprivation of a positive self view.

However, some of these affect-based needs may be hard to separate from biological needs, as they can be characterized as continuous rather than consummatory goals (Austin & Vancouver, 1996; Boldero & Francis, 2002). The characteristic of consummatory goals is that they are no longer relevant for the organism once that goal is achieved. These goals are therefore usually part of a hierarchically ordered structure of behaviors that are instrumental in reducing basic needs (cf. Kruglanski, Shah, Friedman, Chun, & Sleeth-Keppler, 2002; Shah & Kruglanski, 2003). On the other hand, continuous goals refer to states that remain desirable at all times (e.g., being in control). These goals typically need to be maintained as external and internal factors tend to push the current state away from the desired state (see also Powers, 1973). Hence, continuous goals may operate according to homeostatic principles, but they differ from biological needs in the sense that they are not crucial for survival (cf. quasi-needs, Lewin, 1935).

In sum, research on needs appears to be hampered by a lack of clear definitions. Although different types of needs may be hard to separate, our distinctions between affect motivated and deprivation motivated behaviors may offer a conceptualization that helps to understand and predict when needs will affect motivational behavior and when they will not.

Limitations and future directions

As the main hypotheses in this article were tested specifically for the focal behavior of drinking a glass of water, one may wonder whether the current findings can be generalized to other behaviors as well. For example, the amount of chocolates

one consumes may normally increase with food deprivation (LeMagnen, 1985; Nisbett, 1968), but will chocolate intake also be high in the absence of deprivation when the act of eating chocolate is associated with positive affect? Or the motivation to stereotype outgroup members may depend on the need to restore ones' positive self-image (Fein & Spencer, 1997), but will it remain high if the act of stereotyping has become associated with positive affect through past experiences?

Based on the notion that all behaviors rely on activated behavior representations, one would expect this to be true. That is, deprivation and positive affect should also apply to a broader area of our behavior repertoires. For example, if stereotyping can be motivated by deprivation of a positive self image, it has to rely on a behavior representation that emits a reward signal conditional on the state of deprivation. In theory, then, attaching this representation to positive affect should motivate stereotyping, and make this behavior no longer sensitive to deprivation of a positive self image. Although we believe that the results that were demonstrated in the present paper are produced by a general mechanism that should govern biological as well as social needs, testing these predictions in a social setting would prove an interesting avenue for further research.

The current research demonstrates that human behavior can be motivated by two different sources, namely deprivation and positive affect associated with behaviors, that each provide a separate reward signal. An interesting question that is raised by these findings is what the functionality of such separate reward signals may be. From a functional point of view, relying on these two different sources makes sense if you take into account the availability of resources in the environment. In an environment in which resources (e.g., food) are scarce, it would be functional for an organism to represent related behaviors (e.g., eating) in such a way that they are invariably rewarding. Such an organism would eat as much a physically possible when food is available (e.g., goldfish). The primary function of such a mechanism would be to keep behavior going as long as the opportunity is there. A homeostatic system on the other hand is more sophisticated in that it not only motivates behavior given the opportunity, but also puts the brakes on motivation when deprivation is resolved. Such a system would be functional in an environment where resources are freely available (as any goldfish that died in a bowl from overeating would confirm). Depending on the characteristics of the environment in relation to a particular behavior, then, the one or the other source may be most functional in motivating behavior.

Hence, considering how positive affect and deprivation motivate specific behaviors in a specific environment may help to tackle important issues related to regulation in social and health contexts. In research on health behavior, for example, the free availability of high caloric foods in today's environment (also referred to as the "toxic environment") is often proposed as one of the main causes of the global increase in obesity (Hill & Peters, 1998; Wadden, Brownell, & Foster, 2002). However, this would not be the case if food intake would be fully controlled by a homeostatic mechanism. It may be the invariability of the reward signal pertaining to the eating of

particular types of food (e.g., candy bars, sugar) that gets people into trouble. Although the above line of reasoning is rather speculative, it may be worthwhile to investigate the role of deprivation and positive affect in the occurrence of problematic behaviors such as overeating in more detail.

To conclude, the current research demonstrates in controlled experiments that rewarding properties of such behaviors may be acquired through learning and that resolving deprivation is not an effective way to get rid of their potentially detrimental motivational effects. A better understanding of how the sources that motivate behavior operate and work together in a specific environment, then, could open new doors to understanding and changing human motivational behavior.

Footnote

[5.1]To test whether the experienced motivation to drink was specifically related to fluid deprivation and not to a general state of deprivation, the effects of food deprivation were also tested. As expected, food deprivation had no effect on the experienced motivation to drink, β = .06, p = .60, and did not interact with the shaping manipulation, β = -.09, p = .45.

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Samenvatting

(summary in Dutch)

Een groot deel van de dag zijn mensen bezig met dingen waarvoor ze gemotiveerd zijn. Soms zijn dit zaken waar mensen van te voren goed over nagedacht hebben. Je kunt je bijvoorbeeld 's ochtends voornemen om voor het einde van de dag een document voltooid te hebben en vervolgens de rest van de dag gemotiveerd zijn om het document op tijd af te krijgen. Vaak zijn mensen echter juist gemotiveerd voor dingen waar ze van te voren helemaal niet zo bewust over nagedacht hebben, en over die situaties gaat dit proefschrift. Zo kan het bijvoorbeeld zijn dat je veel langer in een kledingzaak blijft dan je vooraf had kunnen bedenken, en met twee shirts en een broek thuiskomt zonder dat je van plan was iets te kopen. Of je kunt in de trein zitten en min of meer gedachteloos aan de kruiswoordpuzzel in de krant beginnen, om vervolgens met moeite de half-voltooide puzzel te kunnen wegleggen wanneer je de trein weer uit moet. Of wellicht neem je op een feestje alleen uit beleefdheid het aangeboden drankje aan, om het vervolgens toch in één teug op te drinken.

In dit proefschrift wordt onderzocht waardoor het komt dat mensen gemotiveerd kunnen zijn voor zulke gedragingen, zonder dat zij zich hier bewust van zijn. Na een algemene introductie op het proefschrift in Hoofdstuk 1, wordt deze onderzoeksvraag in Hoofdstuk 2 beantwoord door een overzicht te geven van de relevante psychologische literatuur en dierenonderzoek en door het presenteren van een theoretisch raamwerk om precies te begrijpen waaruit onbewust motivationeel gedrag voortkomt. Hoofdstuk 3 tot en met 5 beschrijven vervolgens experimenten die werden uitgevoerd om het theoretische raamwerk te toetsen.

Om te begrijpen hoe iemand buiten het bewustzijn om gemotiveerd kan raken om specifieke gedragingen uit te voeren, wordt in **Hoofdstuk 2** eerst beschreven hoe het kan dat mensen *überhaupt* gedrag uitvoeren zonder interventie van het bewustzijn. Daarna wordt ingegaan op de vraag waar motivatie vandaan komt (dat wil zeggen, wat zijn de bronnen of oorzaken van motivatie?), en op hoe die bronnen mensen kunnen motiveren zonder dat daar bewustzijn voor nodig is.

Ten aanzien van het eerste punt wordt uitgelegd dat al het gedrag, van het simpele zoals het bewegen van je wijsvinger tot het complexe zoals het schrijven van een verslag, in het hoofd is *gerepresenteerd*. Dat wil zeggen, dat kennis over dit gedrag in je lichaam is opgeslagen. Zulke gedragsrepresentaties moeten mentaal toegankelijk (beschikbaar) zijn om een gedrag te kunnen uitvoeren. Uit onderzoek is gebleken dat

het toegankelijk maken van zulke gedragsrepresentaties door signalen uit de omgeving al voldoende kan zijn om dat gedrag te laten toenemen, zonder dat mensen daar bewust over nadenken. Bijvoorbeeld, wanneer je op straat een advertentie voor Coca-Cola passeert, dan zal dit de gedragsrepresentatie “drinken” of misschien “cola drinken” toegankelijk maken, en alleen dit zorgt al voor een grotere kans dat je zult gaan drinken, zelfs al ben je je daar niet van bewust.

Of het toegankelijk maken van een gedragsrepresentatie tot *motivatie* om dat gedrag uit te voeren leidt, hangt echter af van hoe begerenswaardig dat gedrag voor iemand is. Het zien van een colareclame bijvoorbeeld, zal voor iedereen de representatie “drinken” toegankelijk maken, maar voor iemand die al lang niets meer gedronken heeft is drinken waarschijnlijk begerenswaardiger dan voor iemand die zojuist nog gedronken heeft. De vraag blijft dan nog, waardoor bepaald gedrag begerenswaardig wordt zodat motivatie voor dat gedrag ontstaat.

In de psychologische literatuur worden twee bronnen van motivatie onderscheiden, die kunnen bepalen hoe begerenswaardig een specifieke gedraging is. De eerste is deprivatie. Een deprivatie (gebrek) van bronnen die belangrijk zijn om gezond te blijven (zoals voedsel, vloeistoffen of sociaal contact) is van invloed op de motivatie voor gedragingen die de deprivatie kunnen oplossen (zoals eten, drinken of uitgaan). De tweede is positief affect. Gedragingen kunnen op zichzelf positief zijn om uit te voeren, wanneer de representaties van dat gedrag geassocieerd zijn met positief affect. Bijvoorbeeld, wanneer je in het verleden positieve ervaringen met wielrennen hebt gehad, zal de representatie van `wielrennen` vergezeld gaan met een algemeen positieve lading (geassocieerd zijn met positief affect), waardoor je eerder gemotiveerd zult raken om te gaan fietsen. Kortom, deze twee bronnen (deprivatie en een associatie van een gedragsrepresentatie met positief affect) zorgen ervoor dat mensen gemotiveerd raken om een specifiek gedrag uit te voeren.

Op basis van het voorgaande wordt in Hoofdstuk 2 daarom een theoretisch raamwerk gepresenteerd waarin wordt aangenomen dat de toegankelijkheid van gedragsrepresentaties noodzakelijk is om tot (gemotiveerd) gedrag te kunnen komen, maar dat de daadwerkelijke motivatie afhangt van deprivatie of positief affect: deze twee bronnen geven ieder een signaal af dat aangeeft hoe begerenswaardig bepaald gedrag is. Wanneer 1 van deze bronnen aangeeft dat een gedraging de moeite waard is om uit te voeren, mag men dus verwachten dat er motivatie voor dat gedrag ontstaat, wanneer dat gedrag toegankelijk is. Er is uit eerder onderzoek heel weinig bekend over hoe gedragsrepresentaties, deprivatie en positief affect *gezamenlijk* in motivatie voor specifiek gedrag leiden: deze factoren zijn vooral afzonderlijk van elkaar onderzocht. In de hoofdstukken 3 tot en met 5 worden de aannames van het theoretische raamwerk in een aantal studies dan ook nader onderzocht.

Hoofdstuk 3 beschrijft twee experimenten waarin het idee wordt onderzocht dat gedragsrepresentaties mentaal toegankelijk moeten zijn voordat deprivatie van belangrijke bronnen tot motivatie voor gedrag leidt. Dit werd onderzocht voor het gedrag drinken. In beide experimenten werd bij de helft van de deelnemers de

mentale representatie van “drinken” toegankelijk gemaakt door subliminaal (onder de grens van het bewustzijn) de woorden “*drinken*” en ”*dorst*” op een computerscherm te laten flitsen (te *primen*). Het gedrag “drinken” is op deze manier dus bij de helft van de deelnemers toegankelijk. Om motivatie te meten werd mensen in Studie 3.1 gevraagd aan te geven hoe graag ze iets zouden willen drinken. Om te weten hoe gedepriveerd de deelnemers waren van water, werd iedereen ook gevraagd wanneer zij voor het laatst iets gedronken hadden. Uit dit onderzoek bleek, zoals verwacht, dat het toegankelijk maken van “drinken” door priming ervoor zorgde, dat mensen meer gemotiveerd waren om te gaan drinken, maar vooral wanneer mensen al een tijdje niets meer gedronken hadden.

In Studie 3.2 werd motivatie om te drinken gemeten door mensen echt iets (namelijk frisdrank) te laten drinken. Deprivatie werd in deze studie gemanipuleerd; de helft van de deelnemers deed het onderzoek voor de lunch (deze mensen waren relatief hoog gedepriveerd), terwijl de andere helft kort na de lunch deelnam (deze mensen waren laag gedepriveerd). De resultaten lieten zien dat mensen meer frisdrank namen wanneer ze subliminaal geprimed waren met “drink”-woorden, maar dit was alleen zo wanneer mensen voor de lunch meededen en dus hoog gedepriveerd waren. Kortom, in beide experimenten raakten mensen gemotiveerd om te gaan drinken, zonder dat deze mensen zelf doorhadden waar deze motivatie vandaan kwam (namelijk van woorden die zij niet bewust konden waarnemen). De experimenten laten dus zien dat gedragsrepresentaties (hier: “drinken”) toegankelijk moeten zijn om tot onbewuste motivatie te leiden, maar ook dat de hoeveelheid motivatie afhangt van hoe gedepriveerd iemand is; de deprivatie geeft namelijk aan of het toegankelijke gedrag begerenswaardig is of niet.

In **Hoofdstuk 4** werd onderzocht of mensen die onbewust gemotiveerd zijn om een specifieke gedraging uit te voeren, automatisch meer gericht zijn op objecten in hun omgeving die nuttig zijn om dat gedrag uit te voeren. Bijvoorbeeld, valt een pen in je omgeving meer op als je gemotiveerd bent om te gaan schrijven? Meer specifiek, in twee experimenten werd onderzocht of objecten die nuttig zijn om je doelen (oftewel, begerenswaardige gedragingen of uitkomsten) te bereiken spontaan groter worden waargenomen dan andere objecten. In Studie 4.1 werd dit onderzocht bij een gedraging die werd gemotiveerd door een staat van deprivatie. Dit experiment verliep precies hetzelfde als Studie 3.1, maar er werd nu niet gevraagd hoe graag mensen wilden drinken. In plaats daarvan zagen de deelnemers op de computer een foto van een glas water en moesten ze schatten hoe groot het glas was. Het glas bleek groter te worden ingeschat wanneer mensen gemotiveerd waren te drinken: wanneer de representatie `drinken` subliminaal was geprimed *en* mensen al een tijdje niets meer hadden gedronken.

In Studie 4.2 werd onderzocht of ook gedragingen die worden gemotiveerd doordat ze met positief affect zijn geassocieerd tot het groter waarnemen van nuttige objecten leidt. Om dit te onderzoeken werden sommige neutrale gedragingen (bijvoorbeeld schrijven) subliminaal op een computerscherm aangeboden en direct

gevolgd door positieve woorden, als gevolg waarvan het gedrag met positief affect werd geassocieerd. Bij andere neutrale gedragingen werd het gedrag niet door positieve woorden gevolgd. Vervolgens moesten de deelnemers de grootte schatten van objecten die nuttig waren om het gedrag uit te voeren (bijvoorbeeld een potlood, een pen). Zoals verwacht bleken objecten groter te worden waargenomen wanneer dat gedrag voor iemand een doel was geworden (wanneer het gekoppeld was aan positief affect), dan wanneer het gedrag dat niet was. Kortom, de experimenten laten zien dat de manier waarop wij de wereld waarnemen automatisch in dienst staat van de doelen die we nastreven, zelfs al zijn wij ons niet bewust van de oorsprong van die doelen.

Hoofdstuk 5 richt zich op de vraag wat er met de motivatie voor een gedraging gebeurt wanneer deze door *zowel* deprivatie *als* een associatie met positief affect wordt veroorzaakt. Daartoe werd in drie experimenten onderzocht hoe de motivatie om water te drinken afhangt van deprivatie van vloeistoffen en een associatie van “water drinken” met positief affect. In alle drie de experimenten werd bij de helft van de deelnemers de representatie van drinken gekoppeld aan positief affect, bij de andere helft niet. Dit werd op dezelfde manier gedaan zoals beschreven in Studie 4.2. In Studie 5.1 werd mensen vervolgens gevraagd hoe lang ze al niet meer hadden gedronken (als indicatie voor deprivatie) en tenslotte hoe graag ze een glas water wilden drinken (als indicatie van motivatie). In Studie 5.2 werd deprivatie gemanipuleerd: de helft van de mensen dronk aan het begin van het experiment zoveel water als ze wilden (en was dus laag gedepriveerd), de andere helft niet. Aan het einde van dit onderzoek dronken deelnemers water, waarbij werd gemeten hoeveel zij dronken als indicatie van motivatie. Uit beide onderzoeken bleek dat het koppelen van positief affect aan het gedrag `drinken` ervoor zorgt dat mensen meer gemotiveerd raken om te drinken, wanneer zij niet gedepriveerd waren van vloeistoffen. Het koppelen van `drinken` aan positief affect had echter geen effect op mensen die wel al gedepriveerd waren; zij waren immers sowieso al gemotiveerd om te drinken *doordat* zij gedepriveerd waren.

In Studie 5.3 werd onderzocht wat er met de motivatie om te drinken gebeurt wanneer de deprivatie van water afneemt zonder dat mensen hebben gedronken (namelijk door komkommer te eten, wat ook veel water bevat). Er werd verwacht dat dit verschillende gevolgen heeft, afhankelijk van de oorsprong van de motivatie (deprivatie of positief affect). Bij aanvang van het onderzoek waren alle deelnemers gedepriveerd van vloeistoffen. Vervolgens werd bij de helft van de deelnemers drinken gekoppeld aan positief affect (de motivatie om te drinken komt bij deze mensen nu dus voort uit een associatie met positief affect *en* uit deprivatie). Daarna at de helft van de deelnemers komkommer, aldus vloeistofdeprivatie opheffend. De resultaten lieten zien dat het reduceren van deprivatie door komkommer voor een lagere drinkmotivatie zorgt, wanneer deze voortkwam uit deprivatie (deze mensen dronken aan het einde van het experiment daadwerkelijk minder water). Wanneer de motivatie om te drinken mede voortkwam uit positief affect, bleef deze hoog, ook wanneer

mensen water hadden binnengekregen door komkommer te eten. Kortom, deze drie onderzoeken laten zien dat motivatie voor specifiek gedrag (zoals drinken) ontstaat wanneer dat gedrag *of* een bestaande deprivatie oplost *of* geassocieerd is met positief affect. Deze twee bronnen geven ieder afzonderlijk aan dat een gedraging de moeite waard is om na te streven, en wanneer zij beiden tegelijkertijd dat signaal geven, leidt dat niet tot extra motivatie.

Samengevat biedt dit proefschrift meer inzicht in hoe onbewust gemotiveerd gedrag ontstaat. Door te laten zien dat gedragsrepresentaties cruciaal zijn voor het motiveren voor gedrag, zelfs als dit gaat om gedragingen die fundamentele behoeftes zoals die aan water oplossen (Hoofdstuk 3), door te laten zien dat zowel gedrag dat gemotiveerd wordt door deprivatie als door een associatie met positief affect, op een heel basaal niveau de waarneming van iemands omgeving beïnvloedden (Hoofdstuk 4), en door te laten zien wat de gezamenlijke effecten van deprivatie en positief affect op de motivatie voor een gedrag zijn (Hoofdstuk 5), biedt dit proefschrift zowel een theoretische als een empirische bijdrage aan eerder onderzoek naar onbewust gemotiveerd gedrag.

Dankwoord

(Acknowledgements)

Op deze plaats is het gebruikelijk allen te bedanken die een intellectuele of mentale bijdrage leverden aan de totstandkoming van een proefschrift. Graag bedank ik eerst de mensen die er mede voor zorgden dat ik de mogelijkheid en interesse kreeg om überhaupt met studeren en promoveren te starten. Bovenal wil ik daarbij mijn ouders bedanken, die me een leven lang gesteund hebben in alle keuzes die ik heb gemaakt en me de mogelijkheid hebben gegeven om zorgeloos de opleiding te volgen die ik wenste. Voor het delen en stimuleren van een wetenschappelijke interesse bedank ik Gert voor de vrijdagavondgesprekken aan de Nieuweweg en Jan Sietsma voor een middelbare school vol filosofie.

In Oktober 2004 vertrok ik naar Utrecht om te gaan promoveren op een sociaal cognitief onderwerp (iets waar ik maar weinig ervaring mee had), wat in dit proefschrift resulteerde, en dat ging niet vanzelf. Henk, als promotor wil ik daarom in eerste instantie jou bedanken. Ik heb de afgelopen jaren veel van je geleerd en je scherpzinnigheid, enthousiasme, en je betrokkenheid bij het project waren voor mij van grote waarde; ik schat je groot in. Ruud, al snel raakte je als co-promotor bij mijn project betrokken, waar ik blij mee ben. Het was prettig en voor mij erg nuttig om met je te brainstormen over nieuwe studies, artikelen en data. De meeste afspraken afgelopen jaren hadden we met zijn 3-en. Niet alleen heb ik daar veel aan gehad, ook al ging het af en toe even moeilijk of zat het tegen, na werktijd duurden de afspraken soms tot diep in de nacht en dat was erg leuk.

Natuurlijk ook dank aan mijn kamergenootjes in Utrecht, met wie ik niet alleen altijd onderzoeksissues kon bespreken, maar met wie het ook vooral erg gezellig was, en dat is minstens zo belangrijk; Giel (het was een warm welkom in Utrecht), Lotte (voor de leuke gesprekken en Rupert), Rupert (voor de Ideeën) en Esther (voor de leuke tijd samen en de fijne gesprekken over werk, onderzoek, und Deutschland; ik ben blij dat je mijn paranimf bent). Jullie waren fantastische kamergenoten.

Voor de leuke tijd niet alleen op en na het werk, maar tevens voor het gezelschap op congressen en de mooie dagen daaromheen, bedank ik, voorzover niet al genoemd, ook Unna, Remco, Ron en Annemarie.

Verder wil ik iedereen van de SCAN- en SPORT-groep bedanken voor het meedenken over mijn onderzoek, en meer in het algemeen iedereen met wie ik van gedachten heb kunnen wisselen of simpelweg een leuke tijd heb gehad de afgelopen jaren, op congressen, workshops en small-group meetings. Jullie input was nuttig en inspirerend. Het KLI dank ik voor de cursussen, onderzoeksmeetings en het congres; dit

waren ideale momenten om met vakgenoten te spreken en te focussen op algemene wetenschappelijke vaardigheden.

Het is goed om te kunnen blijven relativeren met wat je ook doet, en ik wil dan ook mensen buiten de werksfeer bedanken die hebben geholpen om blijven in te zien dat het niet alleen belangrijk is om onbewust motivationeel gedrag te voorspellen, maar ook ontzettend belangrijk om de winnaar van de Ronde van Vlaanderen te voorspellen.

In het bijzonder mijn (schoon)broers, (schoon)zussen en nichtjes (in de tijd dat ik een proefschrift schrijf, wordt een ander mens geboren, leert te kruipen, lopen en met je te communiceren; dat is niet alleen heel bijzonder maar ook relativering ten top), maar ook mijn schoonfamilie, dank ik voor de warmte en steun de afgelopen jaren. Ik kon altijd bij jullie terecht, jullie leefden ontzettend met me mee en het was altijd gezellig met jullie.

Buiten de werksfeer dank ik ook mijn vrienden, en dan met name Patricia; wat heerlijk dat we samen ook na de studie in Leiden op dezelfde werkplek terechtkwamen. Ik heb genoten van de koffie (thee eigenlijk) en lunches samen op de uni (al was de koffie vies en het brood droog, dat zegt genoeg), en zal ze missen. Voor de mooie avonden bedank ik Vladimir (ook voor het omslagdesign, mooi man!), Nikolai (ook voor de Muziek en het Schrijven), Fjodor (ook voor literaire gesprekken), en Rose Bemmel voor de overpeinzingen over de mooie woorden uit Hooglied:

Hoe mooi is de liefde
Het heerlijkste dat je verlangen kunt.

En daarmee ben ik bijna aan het einde van dit dankwoord en proefschrift gekomen. Lieve Lau, bedankt voor het zijn van mijn paranimf, maar dat is slechts een klein begin. Ik ben gelukkig met jou in mijn leven, niet alleen omdat je me de afgelopen jaren steunde, naar me luisterde en me met praktische zaken af en toe hielp, maar vooral omdat je me liefde geeft en de wereld om me heen kan doen vergeten. Het is heerlijk om met je samen te zijn.

Curriculum Vitae

Martijn Veltkamp was born on November 14, 1980 in Zwolle and was raised in the nearby medieval town Hattem. After primary school he continued his education at the Carolus Clusius College in Zwolle (Carolus Clusius was the 16th century founder of Dutch tulip breeding and of the botanical garden in Leiden). After his graduation in 1999 he started to study Psychology at (possibly still under the influence of Carolus Clusius) Leiden University. At that university he obtained his masters degree in Social Psychology in 2004. Since October 2004, he worked as a PhD-student at Utrecht University where he conducted research together with Henk Aarts and Ruud Custers, resulting in the dissertation you are currently reading and in the publication of research articles in several scientific journals. Since November 2008, Martijn works at the University of Twente as an assistant professor at the department of Marketing Communication and Consumer Psychology.

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