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On the Emergence of Deprivation-reducing Behaviors:

Subliminal Priming of Behavior Representations Turns Deprivation into Motivation

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Abstract

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.

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 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 1

Study 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, $\beta = .23$, $t(75) = 2.10$, $p = .04$. 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, $\beta = .49$, $t(40) = 3.53$, $p < .01$, but not in the nondrink-prime condition, $\beta = .12$, $t(34) = 0.71$, $p = .49$. 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, $\beta = .39$, $t(75) = 2.55$, $p = .01$. 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.

Study 2

The goal of Study 2 was to replicate the moderating role of priming in deprivation on motivation that was found in Study 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 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.[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 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, $F < 1$.

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 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 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; 2007). 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 preexisted 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.

References

Aarts, H., Dijksterhuis, A., & de Vries, P. (2001). On the psychology of drinking: Being thirsty and perceptually ready. *British Journal of Psychology, 92,* 631-642.

Aarts, H., Gollwitzer, P. M., & Hassin, R. R. (2004). Goal contagion: Perceiving is for pursuing. *Journal of Personality and Social Psychology, 87,* 23-37.

Aarts, H., & Hassin, R. R. (2005). Nonconscious goal inference and contagion: On pursuing goals one perceives in other people's behavior. In J. P. Forgas & K. D. Williams (Eds.), *Social motivation: Conscious and unconscious processes* (pp. 153-167). New York: Cambridge University Press.

Bargh, J. A., Gollwitzer, P. M., Lee Chai, A., Barndollar, K., & Trötschel, R. (2001). The automated will: Nonconscious activation and pursuit of behavioral goals. *Journal of Personality and Social Psychology, 81*, 1014-1027.

Berridge, K. C. (2001). Reward learning: Reinforcement, incentives, and expectations. In D. L. Medin (Ed.), *The psychology of learning and motivation* (Vol. 40, pp. 223-278). New York: Academic Press.

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

Bolles, R. C. (1972). Reinforcement, expectancy, and learning. *Psychological Review, 79*, 394-409.

Cabanac, M. (1979). Sensory pleasure. *The Quarterly Review of Biology, 54(1),* 1-29.

Campfield, L. A., Smith, F. J., Rosenbaum, M., & Hirsch, J. (1996). Human eating: evidence for a physiological basis using a modified paradigm. *Neuroscience and Biobehavioral Reviews, 20*, 133-137.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression / correlation analysis for the behavioral sciences.* Mahwah, NJ: Lawrence Erlbaum.

Custers, R., & Aarts, H. (2005a). Beyond priming effects: The role of positive affect and discrepancies in implicit processes of motivation and goal pursuit. In M. Hewstone & W. Stroebe (Eds.), *European Review of Social Psychology,* (Vol. 16, pp.). Hove, England: Psychology Press/ Taylor & Francis (UK).

Custers, R., & Aarts, H. (2005b). Positive affect as implicit motivator: On the nonconscious operation of behavioral goals. *Journal of Personality and Social Psychology, 89,* 129-142.

Custers, R., & Aarts, H. (2007). In search of the nonconscious sources of goal pursuit: accessibility and positive affective valence of the goal state. *Journal of Experimental Social Psychology, 43*, 312-318.

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

Dunlap, W. P., & Kemery, E. R. (1987). Failure to detect moderating effects: is multicollinearity the problem? *Psychological Bulletin, 102*, 418-420.

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

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

Geen, R. G. (1995). *Human motivation: a social psychological approach.* Pacific Grove: Brooks/Cole.

Hull, C. L. (1931). Goal attraction and directing ideas conceived as habit phenomena. *Psychological Review, 38*, 487-506.

Hulshof, K. F. A. M., Ocké., M. C., Rossum, C. T. M. van, Buurma-Rethans, E. J. M., Brants, H. A. M., Drijvers, J. J. M. M., & Doest, D. ter (2004). *Resultaten van de*

voedselconsumptie 2003 (Results of food consumption 2003). Bilthoven: RIVM rapport 350030002.

Jones, B. T., Bruce, G., Livingstone, S., & Reed, E. (2006). Alcohol-related attentional bias in problem drinkers with the flicker change blindness paradigm. *Psychology of Addictive Behaviors, 20*, 171-177.

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

Lusher, J., Chandler, C., & Ball, D. (2004). Alcohol dependence and the alcohol Stroop paradigm: evidence and issues. *Drug and Alcohol Dependence, 75*, 225-231.

Marcel, A. J. (1983). Conscious and unconscious perception: experiments on visual masking and word recognition. *Cognitive Psychology, 15*, 197-237.

McClelland, D. C., & Atkinson, J. W. (1948). The projective expression of needs: 1. The effect of different intensities of the hunger drive on perception. *The Journal of Psychology, 25,* 205-222.

Mogg, K., Bradley, B. P., Hyare, H., & Lee, S. (1998). Selective attention to food-related stimuli in hunger: are attentional biases specific to emotional and psychopathological states, or are they also found in normal drive states? *Behavior Research and Therapy, 36,* 227-237.

Moskowitz, G. B., Li, P., & Kirk, E. R. (2004). The implicit volition model: on the preconscious regulation of temporarily adopted goals. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology* (Vol. 36, pp. 317-404). New York: Academic Press.

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

Raynor, H. A., & Epstein, L. H. (2003). The relative-reinforcing value of food under differing levels of food deprivation and restriction. *Appetite, 40,* 15-24.

Read, P. P. (1996). *Alive: The story of survivors.* Mass Market Paperback.

Rolls, B. J., & Rolls, E. T. (1982). *Thirst*. Cambridge: Cambridge University Press.

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

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

Skinner, B. F. (1953). *Science and human behavior.* New York: Macmillan.

Strahan, E. J., Spencer, S. J., & Zanna, M. P. (2002). Subliminal priming and persuasion: Striking when the iron is hot. *Journal of Experimental Social Psychology, 38*, 556-568.

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

Watson, J. B. (1925). *Behaviorism*. New York: People's Institute.

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

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

Footnotes

[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), $t(144) = 3.68$, $p < .001$.

Figure Captions

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

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