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Perception in the Service of Goal Pursuit:

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

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Abstract

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 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 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.

Key words: functional size perception; deprivation; implicit motivation; nonconscious goal pursuit

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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 1970’s.

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, in press) 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 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 a top-down processes (Bruner, 1957) that require a goal to be accessible. In line with our recent work discussed above (Veltkamp et al., in press), 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 2 aimed to extend Study 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 augmented size perception is a content-free feature of goal pursuit (cf. Bargh et al., 2001). Accordingly, Study 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 1 it can be only assumed that deprivation increases the motivation to drink, in Study 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-concept (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, 2005a). 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 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., in press) This notion is in line with data in research on nonconscious goal pursuit (for an overview, see e.g., Custers & Aarts, 2005b; 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 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; Veltkamp et al., in press).

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., in press).

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, 2005b; Veltkamp et al., in press).

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[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, β = .23, $t(72) = 2.10$, $p = .04$, and prime, β = .22, $t(72) = 1.97$, $p = .05$. As expected, the results showed a significant two-way interaction, β = .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), $\beta = -.05$, $t(72) = -0.31$, $p = .76$.

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 2

Although Study 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 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 2, while the accessibility of the goal representation remained constant. The manipulation of motivation was based on research of Custers and Aarts (2005a), 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 (2005a) 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 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 (2005a) 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 (2005a). 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 v's (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, 2005a; 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, 23 ms). Then, a row of crosses appeared again (postmask, 100 ms), followed by a positive, neutral, or negative word (150 ms). After 23 ms a row of V's could be presented (regular or bold text type, 23 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 1. 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, $F < 1$.

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 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 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 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 increased 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., 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, although in earlier studies we showed that our negative shaping treatment changes the evaluation of goal objects (Custers & Aarts, 2005a), 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.

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Footnotes

[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 longdrink 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).

Figure Captions

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

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

Figure 1.

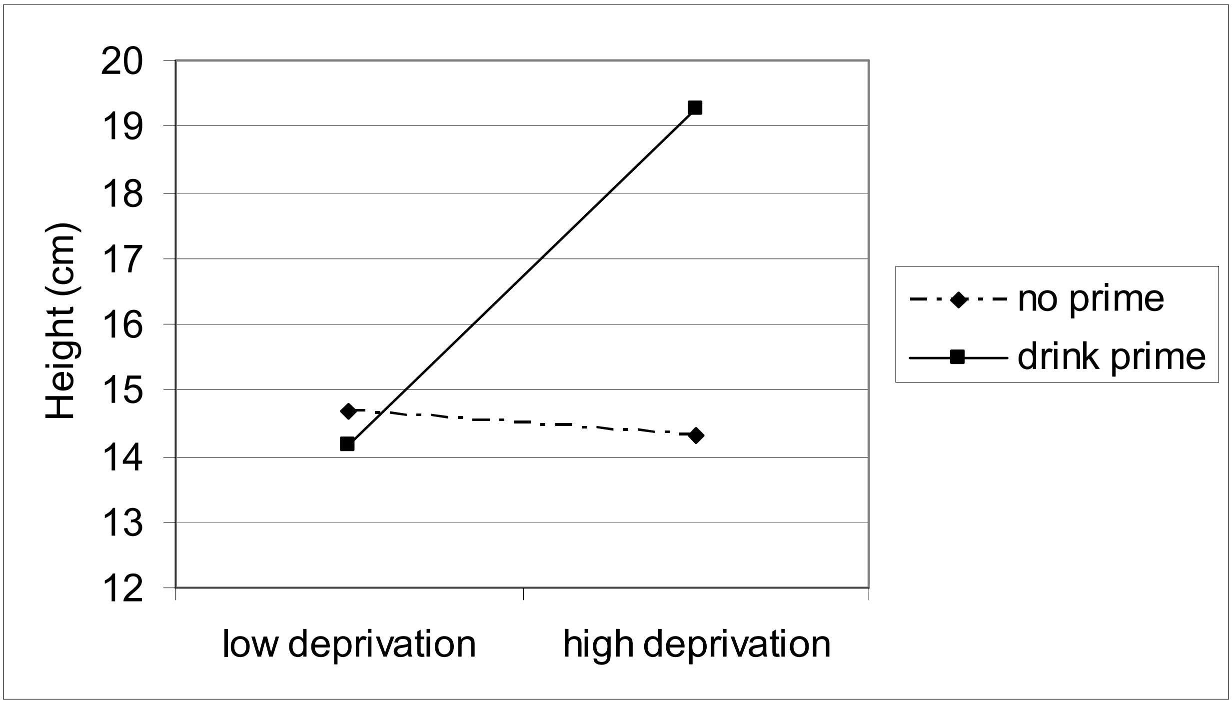
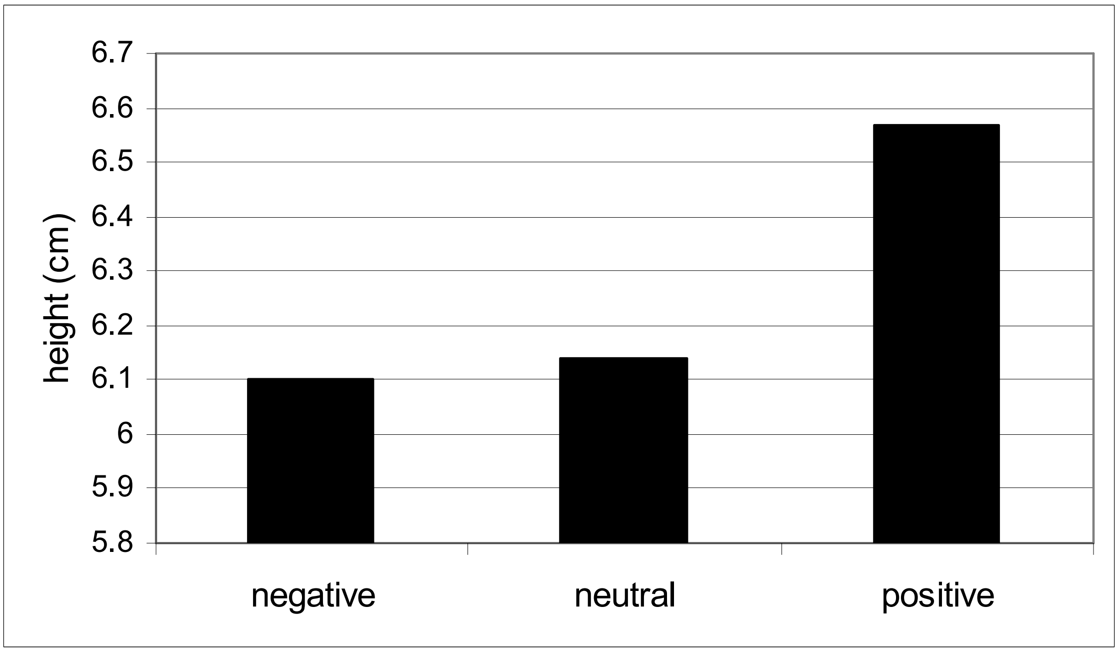

20
19
18
17
16
15
14
13
12
Height (cm)
low deprivation
high deprivation
no prime
drink prime

Figure 2.


6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
height (cm)
negative
neutral
positive

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