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# GOAL PRIMING AND THE AFFECTIVE-MOTIVATIONAL ROUTE TO NONCONSCIOUS GOAL PURSUIT

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Recent work has discovered that human goal pursuit can emerge in the absence of conscious awareness. Whereas the evidence of these goal priming effects is mounting, it remains a mystery how the mental apparatus informs people to pursue a primed goal in the absence of conscious will. This paper addresses this issue by proposing an affective-motivational route to nonconscious goal pursuit. Specifically, it is suggested that positive affect associated or coactivated with the cognitive representation of a goal triggers the motivation to pursue the given goal, while negative affect ceases it to the extent that the goal is already positive and thus carries potential motivation to pursue the goal when being primed. The paper discusses recent findings speaking to this conceptualization of nonconscious goal pursuit and presents two new experiments that examined the role of positive affect in rendering people ready for goal pursuit by testing effects on functional size perception.

A substantial share of research in social cognition centers on the question of how people set and pursue their goals. In the search for the mental faculties that make us uniquely human, people's goal pursuit is assumed to be governed by a kind of "self" or some other inner agent such as "consciousness" or "the will." This assumption is reflected in several theories and models of goal-directed behavior, such as the theory of reasoned action (Fishbein & Ajzen, 1975), goal-setting theory (Locke & Latham, 1990), self-determination theory (Deci & Ryan, 1985) and self-efficacy theory (Bandura, 1986). They all share the view that goal setting is accompanied by a conscious reflection process, and that goal pursuit is associated with conscious intent. However, it may be questioned whether goal pursuit should be always characterized by a conscious and willful process. As our thinking and doing are produced by mental processes that are not always open to introspection,

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we are often unconscious of the processes underlying our thoughts and motivated behaviors (Blackmore, 2003; Nisbett & Wilson, 1977; Nørretranders, 1991). This raises the intriguing possibility that human goal pursuit is guided by unconscious mental processes, irrespective of the conscious experiences that people have about their goal pursuit.

In the last decade, researchers have begun to empirically explore this idea. Several lines of experimentation have discovered that a variety of social goals, such as cooperation, making money, and socializing, are nonconsciously triggered by environmental cues and direct and motivate our thinking and doing in line with the goals (see for reviews, Custers & Aarts, 2005a; Moskowitz, Li, & Kirk, 2004). Although the evidence for nonconscious goal pursuit is growing, it remains rather unclear how the mental apparatus directs and motivates people to either pursue a primed goal or not in the absence of conscious will (see also Bargh, 2006). This paper aims to address this question. We argue that it is not only important to examine how the priming of goals directs behavior; it is of equal importance to consider and understand the motivational source underlying goals and their pursuit. This motivation may be expressed in many different ways (in terms of e.g., importance, value, utility, commitment), but for the present purpose we will focus on one source of information that allows people to modulate their motivation to pursue goals nonconsciously: affective signals that directly accompany representations of goals available in the organism's repertoire.

Before we move on, we want to be clear about how we use the terms goal, motivation, and affect. First, in line with current conceptualizations of human goal pursuit (Geen, 1995; Gollwitzer & Moskowitz, 1996) we define goals as mental representations of desired states pertaining to behaviors (e.g., solving puzzles, socializing) or outcomes (e.g., owning money, being proud). Defining goals in this way implies the ability to represent actions in terms of effects that allow people to direct their behavior by means of anticipating the effect (e.g., Aarts, Dijksterhuis, & Dik, 2008; Prinz, 1997; Vallacher & Wegner, 1987). For instance, the act of socializing can be identified as a consequence (and hence, represented as the goal) of meeting up with friends at a bar. Accordingly, the cognitive representation of the goal (which we refer to as the goal concept) can serve as a reference point in directing lower (motor) actions and skills. Because the goal concept designates a desired state and thus carries potential motivation, activating the goal concept motivates the person to pursue the goal. Secondly, as commonly used in process approaches to study the intensity and persistence of behavior (Geen, 1995; Brehm & Self, 1989; Young, 1961), we consider motivation as the amount of energy a person mobilizes to invest effort and allocate resources to pursue the primed goal. Finally, following work on automatic processes of evaluation and affect, in our research 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). This affective valence, we argue, acts as a basic source in determining the motivation to pursue a goal.

Human functioning evolves from multiple levels of valence-based processing mechanisms, ranging from rudimentary spinal cord reflexes (Sherington, 1906) to subcortical affective-motivational computations (Berridge, 2001; Shizgal, 1999) to cortical processes related to higher cognitive functions (Davidson, 1993; Lang, 1995). In essence, positive and negative affect are now being considered as basic in many motivational analyses of human behavior (Cacioppo & Berntson, 1999;

Carver & Scheier, 1998; Elliot & Church, 1997; Higgins, 1997). Moreover, recent work suggests that implicit affective processes play a pivotal role in decision making and goal pursuit (Bechara, Damasio, & Damasio, 2000; Ferguson & Bargh, 2004; Phelps, 2005; Winkielman & Berridge, 2004). Building on these developments, we propose that nonconscious goal pursuit results from the priming of goal representations and subsequent affective signals that together implicitly guide mental processes and control perception and behavior in the service of goal attainment. We further posit that positive and negative affect play a different role in nonconscious goal pursuit. Specifically, positive affect associated or coactivated with goal concepts triggers the motivation and operation of the given goal, while negative affect ceases it to the extent that the goal is already positive and thus carries potential motivation to pursue the goal when being primed.

In the following, we first briefly address a few issues pertaining to the conceptualization of goal priming and nonconscious goal pursuit. Next, we provide a theoretical analysis of the role of positive and negative affect in implicit motivation of human goal pursuit, and discuss recent findings that offer new insights into the affective-motivational route to nonconscious goal pursuit proposed here. Finally, we present two new experiments that examine the role of positive affect in rendering people ready for goal pursuit implicitly by testing effects on (basic) functional size perception.

## GOAL PRIMING AND NONCONSCIOUS GOAL PURSUIT

### FROM HABITS TO EXECUTIVE CONTROL

Most research on nonconscious goal pursuit assumes that goals are mentally represented as desired states, and that these representations can be nonconsciously activated because they preexist in the actor's mind. These preexisting personal goals are assumed to be part of knowledge structures stored in memory that are shaped by one's history, including the context, the goal itself, actions as well as opportunities and objects that may aid goal pursuit (Aarts & Dijksterhuis, 2000a; Aarts & Dijksterhuis, 2003; Bargh & Gollwitzer, 1994; Kruglanski et al., 2002). For example, a visit to a bar may be connected to interacting with good friends and the goal to socialize. These knowledge structures enable people to act on goals without intentional control or forming explicit expectancies, as goal representations can be primed by, and interact with behavioral and contextual information outside awareness.

Several different research programs provide evidence in support of nonconscious goal pursuit. For instance, pursuing the goal to perform well and achieve can be automatically put in place if the representation of the goal is directly primed (Bargh et al., 2001; Oikawa, 2004). In addition, there is research to suggest that goal pursuit is automatically triggered when goals are inferred from the behavior of others, a process termed goal contagion (Aarts, Gollwitzer, Hassin, 2004; Dik & Aarts, 2007). Furthermore, goals and their pursuit seem to be activated in the presence of important others (Fitzimons & Bargh, 2003; Shah, 2003). These goal priming effects are replicated and extended in the realm of social stereotypes, in the sense that priming the representation of members of social groups that contain the

representation of a goal that is believed to be held by that group causes people to automatically pursue the goals, such as the goal of helping or making money that are stereotypical for nurses or stockbrokers, respectively (Aarts, Chartrand et al., 2005; Custers, Maas, Wildenbeest, & Aarts, 2008).

Goal priming effects on cognition and behavior can be understood in terms of habits: reflexive processes that, once activated, follow a well-practiced route to completion (Aarts, 2007a; Cooper & Shallice, 2006; but see Wood & Neal, 2007; for a more conventional approach to habits in terms of s-r links that are not organized by goals, and hence independent of cognitive processes). A closer look at the available data, however, suggests a different picture that deviates from a mere habit account. For instance, research demonstrates that nonconsciously primed goals can remain mentally accessible for minutes, suggesting that some kind of updating or rehearsal process maintains goals active unconsciously (Aarts, Custers, & Holland, 2007; Aarts et al., 2004; Bargh et al., 2001). There are data showing that nonconsciously activating a goal (e.g., studying) inhibits competing goals (e.g., socializing), which provides suggestive evidence for the nonconscious operation of an inhibition mechanism that shields goals from distracting thoughts (Aarts et al., 2007; Shah, Friedman, & Kruglanski, 2002). Finally, behavioral studies indicate that situations (e.g., exceeding one's budget) that are discrepant with subliminally primed goals (e.g., earning-money) encourage people to exploit new opportunities in novel settings (e.g., engaging in a lottery) without awareness of the operation of the goal, suggesting that goal pursuit is supported by nonconscious monitoring and feedback processing (Aarts et al., 2004; Custers & Aarts, 2007a). Thus, nonconscious goals do not only run off in a habitual, automatic way, but they may serve adaptive functions that operate via cognitive processes following principles of executive control and working memory (e.g., Baddeley & Hitch, 1974; Miyake & Shah, 1999). Contrary to most current views, however, these processes (and the information on which they operate) seem to run below the threshold of consciousness.

The idea that goal pursuit is supported by nonconscious executive processes raises the intriguing and fundamental question whether these processes are effortful and demand mental resources. Contemporary social cognition research often assumes that nonconscious processes are efficient and do not claim mental resources. This view may hold when we merely consider nonconscious goal pursuit as automatic behavior that results from habitual, reflexive processes. However, this "automaticity" argument may be too simplistic and hard to maintain. That is, all else being equal, engaging in nonconscious goal pursuit can have costs: The execution of the processes alluded to above renders them less available for other tasks (cf., Barrouillet, Bernardin, Portrat, Vergauwe, & Camos, 2007; Cocchini, Logie, Della Sala, & Baddeley, 2002). In other words, nonconscious goal pursuit may rely on mental resources, and as such represents a class of mental processes in which lack of awareness and effort do not go hand in hand (Aarts, 2007a; see also Hassin, this issue).

In a recent test of this notion, we reasoned that if priming a goal encourages people to engage in executive processes, then this should impair performance on another WM-task unrelated to the goal (Aarts, Hassin, Custers, & Eitam, 2007; Hassin, Aarts, Eitam, Custers, & Kleiman, in press). In one study, we subliminally primed participants with a desired goal that they indicated to be important to attain on the short-term (e.g., studying, visiting parents) and then measured perfor-

mance on a goal-unrelated WM-task. The WM-task required active maintenance of information in Short Time Memory (STM) and inhibition of prepotent thoughts to attend to later task-relevant information (see also Smith & Jonides, 1999). Results showed that after goal priming participants' performance on the task was impaired. These findings suggest that goal priming motivates people to deploy executive processes to support goal attainment, but that these processes usurp mental resources without people's conscious awareness of doing so (cf., Naccache et al., 2005). Consistent with this view, in a recent study we showed that individuals devote extra effort in surmounting obstacles that get in the way to attain goals that are activated and operate outside of awareness (Custers et al., 2007).

The findings discussed above raise the interesting issue of how people mobilize effort and allocate resources to pursue a primed goal without being aware of the activation and operation of the goal. That is, what is the nonconscious (motivational) source that brings people into a state of readiness for goal pursuit? This is the issue to which we turn now.

## THE AFFECTIVE-MOTIVATIONAL ROUTE TO NONCONSCIOUS GOAL PURSUIT

Most research on human goal pursuit has focused on goals as representations of reference points directing perception and concrete actions to reduce discrepancies with the actual state of the world. However, the step from cognitive goal representations to the process motivating goal pursuit has either been ignored or assumed to involve an act of conscious will (e.g., Ajzen, 1991; Gollwitzer, 1990; Locke & Latham, 1990; Monsell & Driver, 2000). Research on nonconscious goal pursuit suggests that this step can be taken nonconsciously. An important issue, though, concerns the question how this works: How do people resolve whether to pursue and to invest effort or recruit resources to attain a given behavioral goal without involvement of conscious will?

Current social cognition research tends to answer this question by proposing that the process of forming an intention to pursue a goal can take place outside awareness. Whereas this proposition led researchers to come up with original terms to conceptualize the source of human goal pursuit, such as nonconscious will (Bargh et al., 2001), implicit intention (Wood, Quinn, & Kashy, 2002), or implicit volition (Moskowitz et al., 2004), these terms merely stretch the applicability of inherently conscious concepts featured in existing models to the unconscious level. Although this strategy has certainly helped put the exciting notion of nonconscious goal pursuit on the scientific research agenda, it does not tell us much about how the unconscious can do what until recently was assumed to require consciousness.

In our research program we take a somewhat different stance on the matter. In our view, the issue that requires scrutiny is how a primed goal concept (i.e., how the mere activation of a cognitive representation of e.g., "cooperating" or "making-money") is nonconsciously translated into a motivational goal state, and modulates the amount of effort or resources in working for the goal. To deal with this issue, we propose an affective-motivational route to nonconscious goal pursuit that involves interactions of representations of goals and affect (Aarts, Custers, & Marien, 2008; Aarts, Custers, & Holland, 2007; Custers & Aarts, 2005a, 2005b; Veltkamp, Aarts, & Custers, 2008). Specifically, following the idea that people (learn

to) represent their actions in terms of the effects or possible means for goals (e.g., Aarts et al., 2008; Hommel, Muesseler, Aschersleben, & Prinz, 2001; Kruglanski et al., 2002; Vallacher & Wegner, 1987), priming the representation of these goals automatically provides a current reference point for directing cognition and action (see, Pulvermüller, 2005; for the possible brain mechanisms linking action goal concepts and the action system). However, we posit that the goal concept is more likely to motivate people to pursue the goal if the concept is directly followed by positive affect. This affective valence signals that the accessible goal is worth pursuing and puts people into a state of readiness for goal pursuit, so to speak.

This implicit affective-motivational process stems from associations between the representation of a goal and positive affect that are shaped by one's history (e.g., when a person was happy when making money). In this case, the goal is said to pre-exist as a desired state of mind (e.g., Aarts et al., 2004, Aarts, Chartrand, et al., 2005; Bargh et al., 2001). Priming the cognitive representation of the goal enhances the motivation to pursue it and thus energizes mental and behavioral processes that operate on goal-relevant information in the situation at hand. However, we posit that this process relies on content-free affective signals, and can also result from mere coactivation of a neutral goal concept (i.e., a goal concept that provides a reference point but does not designate a current desired state that one is motivated to pursue) and positive affect evoked by a variety of cues that not necessarily refer to a reward for pursuing the goal. Although repeated coactivation will likely lead to a lasting association, we argue that this coactivation itself can be enough to get motivation going. This sensitivity toward the coactivation of goal concepts and affective signals is thought to play a fundamental role in social and reward learning (Miller & Dollard, 1941), and is treated as basic in motivational analyses of human behavior (Berridge, 2001; Cabanac, 1992; Shizgal, 1999). More generally, goal concepts become an immediate motivator when the perception of these concepts is coactivated with positive affect. This idea is in agreement with theory and research on incentive learning (Bindra, 1974; Bolles, 1972; Toates, 1986).

Importantly, whereas positive affect can act as a nonconscious motivator for goal pursuit, we propose that the motivation to pursue a preexisting (desired) goal is reduced if the representation of that very goal is directly succeeded by negative affect. In other words, the pursuit of a goal rapidly vanishes as a result of negative evaluations upon being motivated to pursue the desired goal state. At first glance, this cessation of goal pursuit suggests that negative affect dismisses the desire and operation of goals by an act of conscious will. Thus, people may decide to not waste energy in keeping a goal alive and recruit resources for goals that are no longer considered to be desirable or expected to be worth striving for (Carver, 2004; Klinger, 1975). However, it is possible that negative affect directly ceases nonconscious goal pursuit without conscious intervention. That is, reducing the motivation of a goal that coactivates with negative affect is adaptive in weakening the goal's influence when potentially inappropriate, and hence, such a process may be automated.

The view elaborated here builds on research suggesting that affective processes can moderate decision making and behavior very quickly without reaching conscious awareness (Damasio, 1994; Dijksterhuis & Aarts, 2003; Fazio, 2001; LeDoux, 1996; Zajonc, 1980). Furthermore, it builds on theories arguing that affect consists of two separate dimensions—positive and negative affect—that independently contribute to motivation and behavior in different ways (Cacioppo & Berntson,

1999; Gray, 1987; Lang, 1995; Watson & Clark, 1992). Extrapolating from this view, we propose that positive affect succeeding a primed goal concept actuates motivational activity to pursue the goal, whereas negative affective feedback dampens motivational activity of a primed preexisting desired goal. According to this proposition, the coactivation of a neutral goal concept (one that does not sufficiently evoke motivational activity) and negative affect does not tune down the motivation to attain the goal, as the motivation to pursue that goal is not triggered to begin with. We now briefly discuss the research that has been conducted so far to offer support for these ideas.

*Positive Affect as Implicit Motivator.* The proposed role of positive affect in goal priming effects lead to two different hypotheses. First, a goal that preexists as a desired state (i.e., a goal that is already attached to positive affect and thus has potential motivation) should enhance the readiness for goal pursuit if the representation of the goal is primed. Second, a neutral goal concept that is coactivated with positive affect should mimic this process.

Evidence for the first hypothesis comes from a recent study conducted in our lab (Custers & Aarts, 2007b). We subliminally primed half of the participants with the goal of going out socially. 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 (or fast) on the task can be seen as a means to get to the goal of socializing. It was established that participants put more effort into the instrumental task to attain the goal state when the goal concept of "socializing" was primed, and that this effect was more pronounced when the goal concept was more positive (as assessed by the EAST, De Houwer, 2003). Comparable findings have been reported in a recent study on the emergence of the egalitarianism goal (Ferguson, 2007). Ferguson showed that priming the goal concept of "being equal" caused participants to vote against cutting Medicare (a federal program that offers aid to specific minority groups, such as the elderly) when they implicitly evaluated the goal concept of egalitarianism to be more positive. Together, these findings show that goal priming effects on motivated behavior are conditional on the positive valence attached to the primed goal concept.

Findings presented above indicate that nonconscious goal pursuit may result when a preexisting desired goal is activated, which because of its association with positive affect sets off a positive affective signal. In theory, this process could be simulated by externally triggering the affective signal just after activation of a neutral goal concept. This hypothesis that mere coactivation of a neutral goal concept and positive affect produces nonconscious goal pursuit was tested in another line of research (Custers & Aarts, 2005b). For instance, in one set of studies we were able to coactivate neutral goal concepts (e.g., words such as drinking, cleaning-up) and affectively valenced information (e.g., words such as home or nice) outside of conscious awareness by exploiting the evaluative conditioning paradigm (De Houwer, Thomas, & Baeyens, 2001). The findings of these studies showed that repeated pairing of the representation of a neutral goal concept and positive affect increased participants' experienced motivation to pursue the goals. Additional experimentation, using within participants-designs, ruled out that these affective-motivational goal shaping effects were caused by changes in subjective mood (thus ruling out an attribution—mood as information—account).

Furthermore, in a set of studies assessing behavioral effects, we established that the positive shaping of behavioral goal concepts motivated participants to work harder on an intervening task to secure engagement in the goal, suggesting that the shaping treatment rendered participants ready for goal pursuit in the context at hand. Interestingly, we also showed that coactivation of neutral goal concepts and negative affect did render evaluations of the goal concepts more negative, but did not influence the motivation measures. This finding concurs with our suggestion that negative affect dampens the pursuit of a goal to the extent that the goal preexists as a desired (positive) state in people's mind and thus emits motivational activity when the goal concept is primed.

*Negative Affect as Demotivator.* In a first empirical demonstration of this idea, we (Aarts, Custers, & Holland, 2007) subliminally primed undergraduates with the goal of partying (a goal they clearly perceived as a desired state and are motivated to pursue when the goal is primed, see also Sheeran et al., 2005) in temporal proximity of negatively valenced object words (e.g., war, trash), and tested effects of this affective goal treatment on the motivation to work for the goal in a goal-relevant task. It was found that participants worked less hard to attain the goal when the goal was coactivated with negative affect, compared to conditions in which the goal was neither primed nor directly followed by negative affect. In their recent work on unconscious emotions, Winkielman, Berridge, and Willbarger (2005) exposed thirsty participants who had the goal to drink to subliminal faces of distinct negative emotions (anger) and, similar to the negative valence effects obtained in the Aarts, Custers, & Holland (2007) study, showed a decline in the motivation to drink. These findings suggest that the motivation to pursue a goal decreases when the goal is coactivated with negative affect, thereby leading to nonconscious cessation of goal pursuit. Importantly, these nonconscious cessation of goal pursuit effects occur when a preexisting goal is closely followed in time by negative signals emanating from different sources, such as objects and emotions.

In another study, Aarts and colleagues (Aarts, Custers, et al., 2007) primed their participants either with the goal to party or not, and assessed the accessibility of the goal (and control objects) in a lexical decision task 2.5 minutes later. Following the idea that effective goal pursuit relies on cognitive processes that follow principles of executive control and working memory (Aarts, 2007a; Hassin et al., in press), they reasoned that the nonconscious activation of a desired goal triggers active maintenance processes that can keep the goal alive in mind for several minutes—in comparison to the mere activation of semantic knowledge, which shows a rapid decay of activation over very short periods of time, usually within a couple of seconds (Baddeley & Logie, 1999; Higgins, Bargh, & Lombardi, 1985; Wyer & Srull, 1986). In other words, motivational goal states operate nonconsciously in STM to actively maintain goal-relevant information (see McKone, 1995; Maljkovic & Nakayama, 2000, for evidence of nonconscious processes in STM). Results showed that the representation of the goal of partying remained accessible when participants were primed to attain the goal, while the accessibility of the control objects were unaffected.

However, this is not the whole story. Some participants were primed with the goal in temporal proximity to the activation of negative affect, assuming that this would reduce the motivation to pursue the goal. When a person becomes less motivated to pursue the goal (e.g., going out partying), the representation of the

goal concept should, in principle, behave as any other semantic (nonmotivational) concept. Aarts, Custers et al. showed that participants experienced less motivation to pursue the goal-state as a result of the coactivation with negative affect, and that the activation level readily dropped to base-line. These findings suggest that when a preexisting desired goal is activated nonconsciously, that particular goal is mentally maintained or rehearsed to keep it at a heightened level of accessibility, and that these "readiness for goal pursuit" effects disappear quickly when one becomes demotivated to pursue it as a result of negative signals following the activation of the goal.

In sum, the findings presented above offer evidence for the idea that human goal pursuit can emerge from nonconscious interactions of representations of goals and affect. Positive affect associated with, or coactivated with a goal promotes readiness for goal pursuit, while negative affect coactivated with a preexisting goal reduces this readiness.

## READINESS FOR GOAL PURSUIT AND FUNCTIONAL SIZE PERCEPTION

The findings that the coactivation of a neutral goal concept and positive affect enhances the readiness for goal pursuit suggest that this nonconscious goal shaping manipulation may also change basic perceptual processes in the service of readiness for pursuit. We report two experiments that offer a first test of this intriguing possibility.

The idea that motivational states (such as desired goals) can influence basic perception was first explored in research on functional perception (see Bruner, 1957). Researchers in this tradition propose that perception is functional in that it is a tool in the service of one's motivation and therefore driven by top-down processes. Balcetis and Dunning (2006), for example, have recently demonstrated that people disambiguate ambiguous figures in the direction of their goals: People see what they want to see. Apart from the notion that perceptual-interpretational processes are biased in the direction of the content of people's goals, functional perception researchers hypothesized that goal-relevant objects become perceptually accentuated in the sense that they seemingly look bigger. This perceptual accentuation causes the object to be noticed more easily amongst other objects in one's environment and increases the probability that it is used as an opportunity to achieve the goal. In line with this reasoning, several findings showed that people who are motivated to engage in behavior or to use specific objects perceive these objects as bigger (Bruner & Goodman, 1947; Bruner & Postman, 1949). For instance, Bruner and Goodman (1947) tested the hypothesis that valuable objects are perceived as bigger by asking participants to estimate the size of coins and paper discs. Intriguingly, coins were judged to be bigger as compared to the valueless discs of the same size, and this effect increased with greater value of the coins.

In a reinterpretation of the functional size perception effects, Tajfel (1957, 1959; see also Eiser & Stroebe, 1972) noticed that most studies showing the effect used objects for which an increase in size corresponded with an increase in objective value (e.g., monetary unit of coins), and argued that people explicitly use this knowledge about the relation between value and size as input for their size estimates. Hence, the relation between value and perceived size may be explained

by a non-motivational (cognitive) account. However, according to the notion of functional perception, the perceptual accentuation of goal-related objects should be driven by the subjective motivation to attain the goal. Therefore, one way to demonstrate this basic link between desired goals and size perception is to manipulate participant's motivation to pursue the goal and to hold the objective value of objects constant.

The idea that our goals bias perceptual processes on a fundamental level is supported by recent findings from neurological studies on vision. This research suggests 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. That is, objects that comprise utility for current behavior and functioning are allocated more processing resources (i.e., brain cells) and therefore occupy a larger area of the visual cortex. Consequently, these objects may be perceived as being bigger (e.g., Bundesen, Habekost, & Kyllingsbaek, 2005; Serences & Yantis, 2006). Thus, a book may look bigger when one wants to read, or a glass of water may appear higher when one is thirsty (see also, Veltkamp, Aarts, & Custers, in press). Inspired by these findings, here we aimed to test that coactivating a neutral goal concept (of doing puzzles) with positive affect renders people ready for goal pursuit nonconsciously, and that this nonconscious goal creation causes them to perceive goal-related objects (e.g., a puzzle book) as bigger.

Our experiments served another important purpose. Earlier we argued that nonconscious goals rely on the operation of specific cognitive functions associated with executive control and working memory that maintain and manipulate information in the service of goal pursuit. Basically, this view on nonconscious goal pursuit takes into account the functional architecture of human information processing that does not allow concurrent goals to use the same resources (e.g., Navon, 1984; Neumann, 1997; Pashler, 1998), operations (e.g., Barrouillet et al., 2007; Cocchini et al., 2002) or hardware (e.g., Johnson, Strafella, & Zatorre, 2007; Szameitat, Schubert, Muller, & Von Cramon, 2002). Moreover, this view implies that, in principle, it should not matter whether the employment of the mechanism underlying goal pursuit arises from conscious or nonconscious sources of goal activation. In both cases, the same cognitive function and hardware (e.g., active maintenance of goal-relevant information supported by the dorsolateral prefrontal cortex; e.g., Curtis & D'Esposito, 2003) may be involved in the process of goal achievement.

Note that this idea does not suggest that two goals relying on the same operation or hardware cannot run together. They only compete with each other for the same resources, and hence, a conscious goal taxing these resources is more likely to impair the operation of a nonconscious goal (just like a Dutch bicycle can ride faster when carrying one person rather than two persons). Thus, confronting people with an additional task that taxes the function employed by a nonconscious goal may cause them to be less capable of pursuing the latter goal (Aarts, 2007a; Oikawa, 2004). For instance, if nonconsciously shaped goals keep alive over time by a process of active maintenance (or rehearsal), then effects on size perception over time may be impaired when engaging in another taxing information maintenance task during the retention interval. In an attempt to substantiate this suggestion, we tested whether the effects of people's readiness for goal pursuit on functional size perception as a result of positive goal shaping (a) survive over time (Experiment 1)

and (b) vanish when another information maintenance task competes for the same resources that are supposed to support the nonconscious goal (Experiment 2).

## EXPERIMENT 1

### METHOD

#### Participants and Design

Ninety-three Dutch undergraduates were randomly assigned to the cells of a 2 (Shaping: neutral vs. positive) x 2 (Delay: no vs. yes) between-participants design and received €4 or course credits for their participation.

#### Materials

Based on pilot testing we selected five (Dutch single) words that describe the neutral behavioral goal concept of doing puzzles: puzzle piece, doing puzzles, riddling, cryptogram, crossword. Also, we used five positive (happiness, smile, beach, friend, summer) and 5 neutral words (ballpoint, bucket, entrance, window, sidewalk).

#### Procedure

On arrival at the lab, participants were told that they would take part in research conducted by different research teams and that they had to perform several unrelated tasks on a computer. Participants worked in separate cubicles in which the instructions and the tasks were presented on a computer with an 85-Hz CRT screen. After some general instructions and practice with the computer program, participants started with the experiment.

#### Goal shaping task

The experiment started with a task designed to examine the detection of briefly flashed dots. Allegedly to make the task more complex, participants were told that a series of words would be presented on the screen, and that they had to indicate whether or not a dot was presented either above or below these words. Thus, a dot could be presented or not, and it could either occur above or below a word. In actuality, this feature of the procedure ensured us that participants paid attention to the screen and the words during the goal shaping task. The computer determined whether and where a dot would be presented randomly. After reading the instructions, participants first practiced the task with unrelated stimuli words, and then worked on 50 experimental trials.

In these 50 trials, the five positive and five neutral words were all presented five times. In the *positive-shaping condition*, the five "doing puzzles" related words were each presented subliminally on five trials in direct combination with the five different positive words (25 trials). Furthermore, five different random letter strings were each presented in combination with the five different neutral words (25 trials). In the *neutral-shaping condition* the puzzle words were paired with neutral words (25 trials), and the random letter strings were paired with positive words

(25 trials). In each condition, then, participants were exposed to puzzle words and to neutral and positive words. The only difference was that the concept of doing puzzles was directly coactivated with positive affect (positive-shaping condition) or not (neutral-shaping condition). The order of the 50 trials was randomized.

Each trial consisted of the following events: First, a cross was presented on the screen for 500 ms, signaling the beginning of the trial. Next, a row of *X*'s (pre-mask) appeared on the screen for 500 ms, immediately followed by the subliminal prime word—either a goal word, or a random letter string (e.g., GBLPNSKR)—that was displayed for 23 ms (two cycles on a 85-Hz screen). After that, again a row of *X*'s appeared for 150 ms (post-mask), followed by the supraliminal word—either a neutral or a negative word—that was presented for 150 ms. Next, 23 ms after this word had disappeared, a dot was, or was not presented for 23 ms (the dot was not masked, and therefore it was easily visible). Finally, participants were asked whether they had seen a dot or not (by pressing a yes or no key), and 1000 ms later a new trial started.

### Size Perception Measure

After the goal-shaping task participants were asked to estimate the size of two objects related to the concept of doing puzzles: a crossword puzzle and a puzzle book. Participants were told that they would see two photographs on the screen, each depicting an object (the name of the objects were not mentioned). The objects were displayed in such a way that height was the dominant dimension rather than width. Size estimations of objects are usually based on the most dominant dimension (e.g., Krider, Raghubir, & Krishna, 2001; Rulence-Paques & Mullet, 1998). Hence, as our first dependent variable participants estimated how tall the objects were. As an additional measure, they were also asked to estimate the width of the object. Participants were instructed to give an estimation as the objects were presented on the screen (cf., Haber & Levin, 2001). Participants could type in their object-size-estimation in centimeters (in decimals, e.g., 13.2 cm).

### Delay Conditions

The size estimation measure was either immediately assessed or after a delay of 2.5 minutes (for a similar period of delay, Aarts, Custers et al., 2007). In the delay condition participants were given a number of stimuli presentation trials in which they simply had to estimate the presence of a few red squares among a set of black squares on the screen.

### Debriefing

After the size estimation task participants were debriefed and probed for awareness of the puzzle words presented in the goal shaping task by using a similar procedure to that suggested by Bargh and Chartrand (2000). Specifically, they were asked whether they had seen words flashed on the screen before the presentation of the visible (positive and neutral) words, and if they had, to mention the word(s). As in our previous work employing the nonconscious shaping of motivational goal-state task (Custers & Aarts, 2005b), none of the participants was able to report the subliminal prime words. Furthermore, none of them indicated that the dot-detection task had influenced their responses on the size estimation task. Thus, if

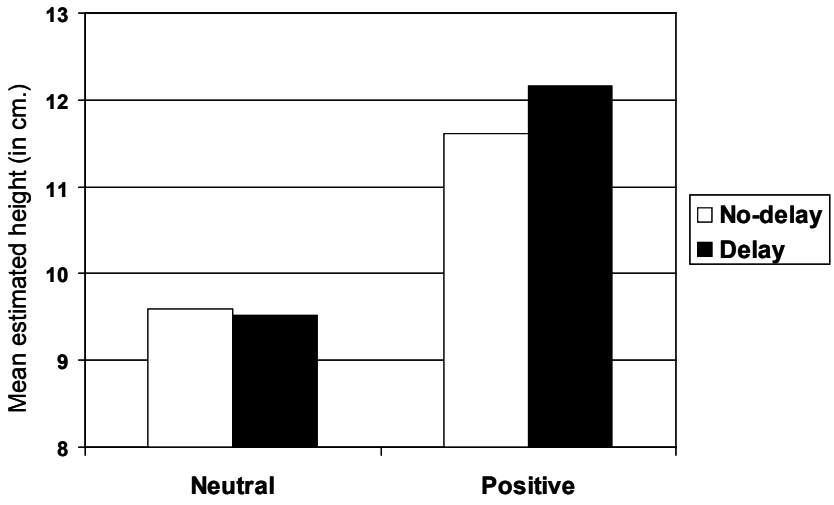


FIGURE 1A. Estimated height as a function of goal shaping and delay.

effects on the size perception occur they seem to be caused outside of participants' conscious awareness of the operation of the goal.

## RESULTS AND DISCUSSION

Our main dependent variable was the averaged height estimation across the two puzzle objects. This averaged height score was subjected to a 2 (Shaping: neutral or positive) x 2 (Delay: no or yes) between participants ANOVA. The mean height estimations (in cm) for each cell in the design are presented in Figure 1A. The results showed the expected main effect of shaping, $F(1,89) = 8.43$, $p = .005$, $\eta^2 = .09$; participants perceived objects to be higher in the positive-shaping condition than in the neutral-shaping condition. Importantly, this effect was not qualified by an interaction with the delay factor, $F < 1$, indicating that the goal shaping effect persisted over time. The simple main effect of shaping in the no delay and delay conditions were $F(1,90) = 3.33$, $p = .07$, and $F(1,90) = 5.39$, $p = .03$, respectively. The main effect of delay was also non-significant, $F < 1$.

Furthermore, we also subjected the averaged width estimation score to the same ANOVA. This analyses corroborated the previous effect on size estimation: There was only a reliable main effect of shaping $F(1,89) = 14.01$, $p = .001$, $\eta^2 = .13$; the estimated width of the objects was larger in the positive-shaping condition than in the neutral-shaping condition (see Figure 1B). The simple main effect of shaping in the no delay and delay conditions were $F(1,90) = 5.84$, $p = .002$, and $F(1,90) = 8.56$, $p = .004$, respectively. The main effect of delay and the interaction effect were not significant, $F < 1$.

The findings of Experiment 1 supported our ideas: a neutral goal concept of doing puzzles coactivated with positive affect rendered people more ready to pur-

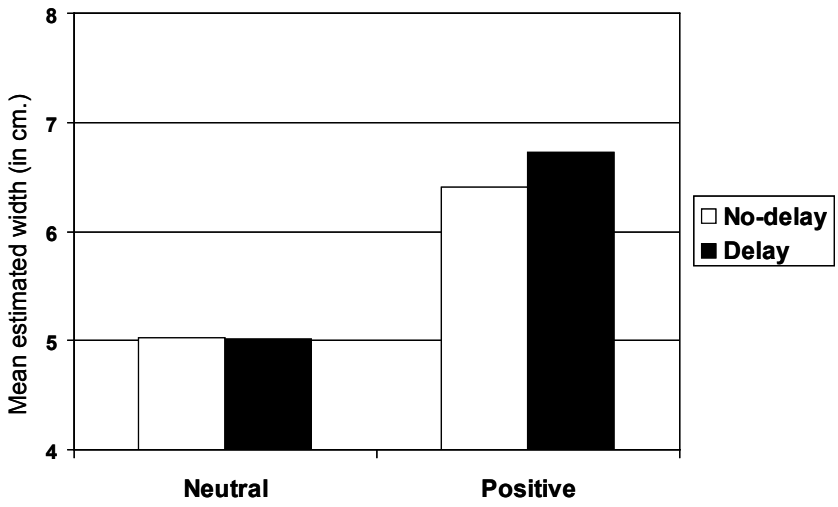


FIGURE 1B. Estimated width as a function of goal shaping and delay.

sue the goal nonconsciously, and this enhanced readiness caused them to perceive goal-related objects as bigger. Importantly, these effects survived a 2.5 minutes delay, suggesting that participants kept their goal active. In the second experiment we wanted to replicate and extend these effects by testing that the active maintenance effects of the nonconsciously created goal are likely to vanish when participants' mental apparatus is more strongly seized by another secondary information maintenance (rehearsal) task.

## EXPERIMENT 2

### METHOD

#### Participants and Design

Fifty-six Dutch undergraduates participated in the study and received €4 or course credits for their participation. Participants were randomly assigned to either a neutral-shaping, positive-shaping or positive-shaping-plus-cognitive-load condition.

#### Procedure

The instructions and procedure were similar to those used in the delay condition of Experiment 1. In addition, in the positive-shaping-plus-load condition participants had to perform an information maintenance task while doing the filler (delay) task. Therefore, they were instructed to memorize a random sequence of six digits and to reproduce the exact sequence after the delay task (cf., Gilbert & Hixon, 1991). They were given 5 seconds to memorize the sequence and 5 seconds to enter it into the computer after the delay task (they were all accurate in recall).

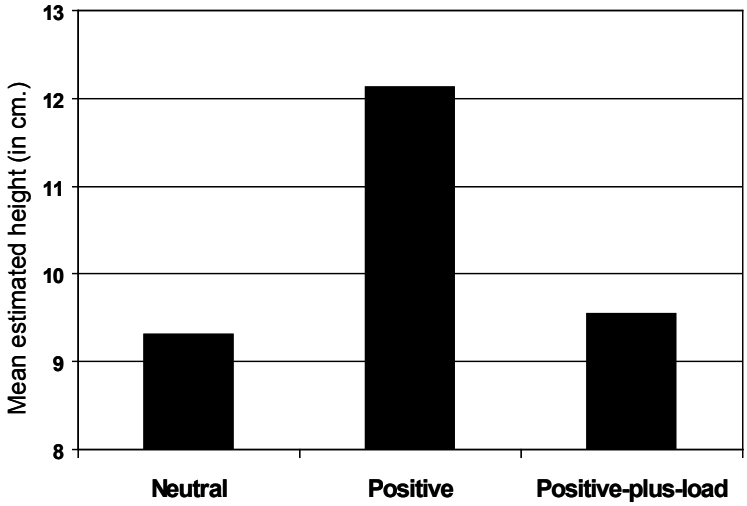


FIGURE 2A. Estimated height as a function of goal treatment.

To ensure that all three conditions would be exposed to the same time-delay, participants in the no-load conditions were paused for 5 seconds before and after the delay task. After the delay task all participants performed the size estimation task. Thus, the goal of doing puzzles was either shaped (in the positive conditions) or not (in the neutral condition), and in one of the positive-shaping conditions the facility to keep the nonconscious goal active was taxed by a secondary information maintenance task.

Finally, similar to Experiment 1 debriefing indicated that participants had not seen the primes. Furthermore, they did not realize the true nature of the study. Participants were also asked to rate the importance of engaging in a puzzle task and the extent to which this importance was influenced by the dot detection (goal shaping) task. Crucially, no significant differences emerged, $F$'s < 1. These findings indicate that the goal treatment did not lead to an increase in conscious commitment to the goal, thus supporting the claim that possible differences in size perception are due to largely nonconscious goal pursuit.

## RESULTS AND DISCUSSION

The height estimations were averaged into one score. This score was subjected to a one-factorial (Goal treatment: neutral-shaping vs. positive-shaping vs. positive-shaping-plus-load) ANOVA that produced a significant difference between conditions, $F(2,53) = 4.45$, $p = .02$, $\eta^2 = .14$. Planned comparisons revealed that participants in the positive-shaping condition perceived the goal-related objects as higher than participants in the neutral-shaping and the positive-shaping-plus-load conditions, $F(1,54) = 7.89$, $p = .007$, and $F(1,54) = 5.05$, $p = .03$, respectively. There was no significant difference between the neutral-shaping and the positive-shaping-plus-load condition, $F < 1$ (see Figure 2A). Analyzing this effect for the estimated width

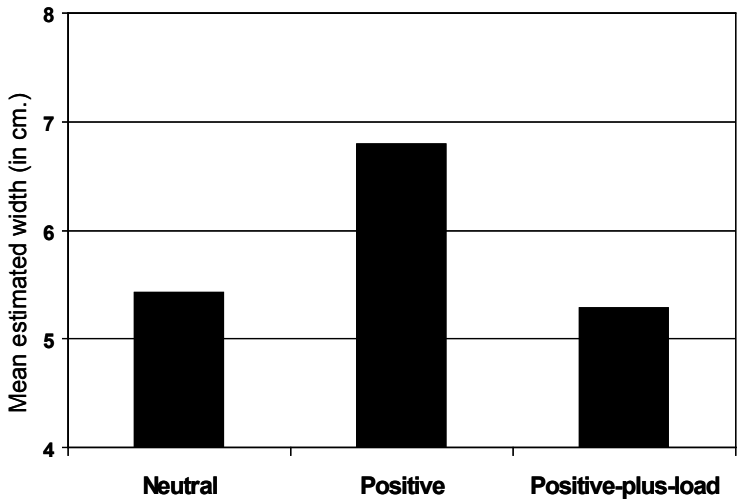


FIGURE 2B. Estimated width as a function of goal treatment.

measure yielded the same pattern of results: a significant difference between the goal treatment conditions, $F(2,53) = 3.52$, $p = .04$, $\eta^2 = .12$. Furthermore, the estimated width of the goal-related objects was larger in the positive-shaping condition, compared to the neutral-shaping and the positive-shaping-plus-load conditions, $F(1,54) = 4.86$, $p = .03$, and $F(1,54) = 5.62$, $p = .02$, respectively (see Figure 2B).

In short, the results replicate and extend those of the first experiment. The positive treatment of a neutral goal concept increased the perceived size of goal-related objects after 2.5 minutes. However, this effect disappeared when participants' ability to keep the goal active was impaired by an intervening task that required them to engage in additional active maintenance processing, thereby corroborating the suggestion that the nonconsciously shaped goal remained active by a kind of updating or rehearsal process.

## CONCLUSIONS

The present work considers an affective-motivational route to nonconscious goal pursuit. Our research demonstrates that subliminal priming of goal concepts in temporal proximity of the activation of affect alters people's readiness for goal pursuit. Positive affect facilitates readiness for goal pursuit, while negative affect puts the pursuit of pre-existing goals on a hold. Previous research on motivation agrees that positive (or negative) affect increases (or decreases) the motivation to engage in behavior when it refers to a reward (or punishment) for performing the behavior. Here we tested a more basic and content-free process by showing that such motivational modulation also emerges when the activation of a goal representation is directly followed by affectively valenced stimuli that do not explicitly pertain to the attainment of the goal itself but nevertheless act as reward/punishment signals. In a sense, then, affective signals accompanying the activation of

goal representations act as a common currency that allows one to rapidly and nonconsciously value qualitatively different options for behavior (cf., Cabanac, 1992). We obtained evidence for this idea by showing effects on functional perception (size perception of goal-objects), executive control (active maintenance of goal-relevant information) and overt behavior (physical effort).

Our work concurs with the idea that goal-directed behavior is an emergent property of dynamic interactions of multiple brain systems (Miller & Cohen, 2001; O'Reilly, Braver, & Cohen, 1999). For example, the cognitive control model of Cohen and colleagues includes three specialized brain systems (prefrontal cortex, hippocampus and a posterior perceptual and motor cortex) that contribute to working memory functions and goal-directed thought and behavior. However, the cortical processing in these systems is conceived to be modulated by the mesolimbic dopamine system—a brain system that is associated with affective-motivational processes (see also Berridge, 2007, for a recent debate of the different functions that have been assigned to the dopamine system). The present research may offer a social-cognitive perspective on this matter that considers the motivation and resultant operation of goals to emerge from nonconscious interactions of representations of goal concepts and affect.

Furthermore, we showed that effects of nonconsciously shaped goals disappear if the ongoing mental operation aiding the nonconscious goal is taxed by conscious task goals. At first sight these findings seem incompatible with the notion entertained in previous work in which automatic goal-directed behaviors are conceived of as habitually driven and thus arise from reflexive processes that are effortless and do not require mental resources. However, the present studies suggest that nonconscious goal pursuits are not necessarily habitual, and can be effortful as they rely (partially) on the same resources and hardware as conscious goal pursuits do. While the impairment of executive control under conditions of multiple conscious goals that compete for resources is well-documented, the notion that nonconscious and conscious goals share overlapping resources may provide a new perspective on the neurological foundation of goal pursuit. Although it is not clear whether the resource allocation process underlying nonconscious goals is (like that of conscious goals) also implemented by a frontal brain component, the relation between nonconscious goals and mobilization of resources has some interesting implications (see also Hassin et al., in press). First, it assumes that the resource allocation processes of nonconscious goals are not based in the frontal lobes, or that they are frontal but subserved by neural networks that are not involved in conscious goals. In this case, the affective-motivational route to nonconscious goal pursuit suggests that inhibiting the frontal brain area involved in the allocation of resources should impair conscious but not nonconscious goal pursuit (cf., research with frontal lobes patients; Shallice, 1982). A second possibility is that nonconscious and conscious goal pursuit are implemented by the same neural structure (Pessiglione et al., 2007). In that case, the difference between conscious and nonconscious goal pursuit concerns their phenomenological experiences.

Although the present analysis indicates that human goal pursuit does not (always) require conscious intervention, we do not suggest that people are never aware of goals. Goals manifest themselves if their representations gain access to consciousness (Aarts et al., 2004; Baars, 1998; Wegner & Smart, 1997). Such access is probably gated by focus of attention and occurs when people are, for example, directly asked to indicate their current goals (e.g., "What do you want to drink?").

While such reflective responses point to the human capacity (and willingness) to report goals, they may not be the source of people's every day life experience of willfully controlling and realizing their goals, which lead them to believe that conscious will causes goal pursuit. If we assume that our goals emerge from nonconscious sources and can operate outside of awareness, how can the present analysis account for the way people arrive at these experiences of willfulness?

The way our conscious experiences of willfulness arise from unconscious processes is an essential problem in its own right, and remains a topic of intriguing theorizing and empirical scrutiny (e.g., Aarts, 2007b; Blackmore, 2003; Dennett, 1991; Nørretranders, 1991; Wegner, 2002). Our belief in willful causation is often thought to originate from the human capacity to foresee events, hence, to anticipate goal attainment. When the goal is attained that we intended to pursue (e.g., getting a beer), we are likely to infer that we caused it because it matches our previously activated goal. The likelihood of making such causal inferences is considerably facilitated by the ability to actively maintain goals, especially when there is a time-gap between goal activation and attainment (e.g., one sometimes has to wait before one can order or gets a drink). Interestingly, this mechanism coincides with the one that underlies nonconscious goal pursuit proposed here. Specifically, our analysis, as well as the results of our research program, cultivates the idea that the coactivation of a goal concept and positive affect energizes nonconscious maintenance processes that keep the goal active and support the achievement of the goal, and these processes may enhance the experience of willful goal pursuit upon later perception of goal attainment. Whereas the mechanism proposed here offers a key to understanding how nonconscious goals are translated in a conscious sense of agency (see for a related view, Wegner, 2002), it can produce experiences of willfulness independently of actual causation, resulting in illusory experiences (Aarts, Custers, & Wegner, 2005; Wegner & Wheatley, 1999). Thus when the waitress brings a beer one may believe to have willfully ordered it—not so much because one actually did so, but because the goal of having a beer is nonconsciously activated and maintained in ones mind.

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