

# Beware of the gorilla: Effect of goal priming on inattention blindness

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When people pursue a goal, and particularly when this goal requires an attention consuming activity, they often are blind to unexpected events occurring in their environment. This phenomenon is called “inattention blindness”. In this study, we examine inattention blindness in regard of goal priming. After being primed (or not) with a detection goal participants watched a short sequence in which they had to count passes made by basketball players. An unexpected event occurred during the video (a gorilla walked over the game area). Results suggest that goal priming can improve the detection of an unexpected event, particularly when attentional demands of the monitoring task are not too high. Implications in the understanding of nonconscious management of attention will be discussed.

Did you ever notice that when someone (even you) is engaged in an activity, he/she sometimes tends to be deaf to what happens around? This is often the case when say, your Dad is watching sports on TV, or when your girlfriend is on the phone with her best friend Nicole. In this kind of situations, if you try to question him/her, the best answer you often obtain is an automatic “mmmh, yeah”. In many times, you will not have any answer at all. If this phenomenon occurs frequently on the auditive channel, it also affects the visual channel and is known as “inattention blindness”. Although daily manifestation of inattention blindness may sometimes appear annoying but funny, the phenomenon is likely to have more important implications. For instance, drivers involved in a car accident frequently claim that they “looked but failed to see” the other vehicle. But they were also frequently engaged in a parallel activity such as listening to the radio, or having a conversation on the phone. Thus, many collisions between cars and motorcycles can be accounted by inattention blindness. So, if focusing attention on a single activity is generally an adaptative process, it can also lead to glitches when attention would have been required for the processing of an unexpected event or for a rapid adaptation to the ongoing situation. In the present paper, we explore the potential for a strategy based on goal priming in improving the detection of a subsequent unexpected event. After a short presentation of inattention blindness and goal priming, we present a study designed to test the effect of goal priming on this phenomenon.

## *Inattention blindness*

Inattention blindness (Mack & Rock, 1998) refers to the fact that many salient objects or events fail to reach awareness when attention is otherwise engaged in a task. Attentional blindness occurs frequently. It is striking that “*approximately half of the observers fail to notice a highly salient but unexpected event while they are engaged in a primary monitoring task*” (Simons & Chabris, 1999, p. 1069). Even if research about the capture of attention by unexpected events or objects takes its roots in the 1970s (Neisser, 1979), the study of inattention blindness came into prominence in the late 1990s (Simons & Chabris, 1999). In a classical paradigm used to assess inattention blindness and explicit attention capture, participants engage in a monitoring task in which they focus attention on some aspects of a dynamic display. During the observation of this display, an unexpected—and generally salient—event occurs. In a research based on Neisser’s work, Simons and Chabris (1999) asked participants to watch a short video in which two teams of players passed basketballs. Participants were instructed to count the number of passes made by one of the two teams. During the video, a person in a gorilla suit unexpectedly walked across the field, stopped, thumped his chest, and then resumed his walk. Even if the gorilla was fully visible for an extended time and that the monitoring task was quite easy, 50% of the participants failed to notice it.

Research (Most, Scholl, Clifford, & Simons, 2005; Simons & Jensen, 2009) demonstrated that two factors play a particularly important role in the appearance of inattention blindness: unexpected event’s features and demands of the primary task. Thus, observers are more likely to detect an unexpected event that shares visual features (color, shape, etc.) with the events or objects they are attending to. In the gorilla example, detection rates were higher when observers had to monitor the passes made by the black shirts team (that shared the

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same color as the gorilla) than when they had to count the passes of the white shirts team. It also appeared that the level of inattention blindness depends on the difficulty of the monitoring task: the more difficult and demanding is the task, the less observers detect the unexpected event. In other words, the more the monitoring goal is difficult (i.e., requires a high level of attention), the more inattention blindness occurs. For instance, in Simons and Chabris (1999) participants who were asked to monitor two distinct outcomes (i.e., the total number of passes and of the number of aerial and rebound passes) obtained lower detection rates than participants who had to monitor only one outcome (i.e., the total number of passes). In sum, inattention blindness depends on the unexpected target's characteristics and on goal's demands.

### Goal priming

Even if goal pursuit is usually considered as a voluntary and consciously controlled activity, research demonstrated that it can also occur outside of awareness, intent and control (Bargh & Chartrand, 1999; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Shah & Kruglanski, 2002; Dijksterhuis, Chartrand, & Aarts, 2007). Indeed, if goals are generally set in a volitional way, they can also—as other knowledge structures stored in memory—be activated automatically. It has been demonstrated that nonconscious goal activation (i.e., goal priming) led to comparable outcomes (Chartrand & Bargh, 1996) and has the same characteristics as conscious goal setting (Bargh et al., 2001). In short, once activated—either consciously or nonconsciously—a goal operates and guides behavior until goal completion. Nonconscious goals can influence a broad range of behaviors: judgment and interpersonal relationships (Fitzsimons & Bargh, 2003), anagram resolution or production (Shah & Kruglanski, 2002), voice intensity (Aarts & Dijksterhuis, 2003), motor performance (Légal, Meyer, & Delouée, 2007). Interestingly, nonconscious goal pursuit can also influence information processing, recall and recognition performance (Chartrand & Bargh, 1996; Mitchell, Macrae, Schooler, Rowe, & Milne, 2002). For instance, repeated subliminal priming (34 ms) of the word “forget” during a word-learning task leads subsequently to a decreased recognition performance, whereas priming “remember” leads to an increase in performance (Mitchell et al., 2002). If goal priming effects on diverse areas of human behavior are clearly demonstrated, much remains to discover concerning the way nonconscious and conscious goals are related (Bargh, 2006; Légal & Meyer, 2009). Particularly, the question of joint conscious and nonconscious regulations of behavior remains unsolved.

As noted by Ambinder and Simons “*noticing rates are tied largely to the observer's primary task and to their expectations and attentional goals.*” (Ambinder & Simons, 2005, p. 73). Since inattention blindness relies on the allocation of observer's attentional resources, it is closely related to the processing of goals. Particularly,

the primary task goal defines what to observe: it defines how attentional resources have to be channeled, what is important or not, the characteristics of the object to detect or track, etc. In other words, the primary task goal sets up a prioritization of the scope of attention as well as it determines the allocation of attentional resources, creating what is called an attentional set (Most et al., 2005). Goal priming has been demonstrated to allow the nonconscious pursuit of a goal. Interestingly, this particular goal pursuit not only occurs outside of awareness, but can also run in the background of a current conscious activity (i.e., of a conscious goal pursuit). In previous research on motor performance (Légal & Meyer, 2009), we hypothesized that goal priming could be a way to nonconsciously influence the allocation of attentional resources while task performance, allowing a sharing or a concentration of resources depending on the compatibility of the primed goal with the primary task's goal. In our view, goal priming could be a way to set a nonconscious (or preconscious) attentional set or, at least, a way to involve attentional resources on other aspects than those related to the primary task objectives.

In this article we explore whether goal priming can predict subsequent noticing rates for an unexpected event. To do so, we combined two classical paradigms presented as separate and unlinked studies. The first one, from the goal priming literature, allowed us to prime (or not) a nonconscious detection goal in participants. The second refers to Simons et al.'s (1999) “Gorilla experiment” on inattention blindness. The main idea is that goal priming can constitute a way to create a nonconscious attentional set that can then improve the detection of a subsequent unexpected event.

## Method

### Participants and design

Hundred and one students (25 men and 76 women, aged from 17 to 21,  $M = 19.3$  years) voluntarily participated in this study. They received course credits in exchange of their participation. All participants were tested individually. They were randomly assigned to one of the 4 experimental conditions of a 2 (priming: detection goal vs. no-prime)  $\times$  2 (monitoring task difficulty: normal vs. high) between-subjects design. Preliminary analyses revealed no effect of sex or age on subsequent measures; these variables will not be discussed further in this study.

### Materials and procedure

Participants were told they would have to participate in two unrelated studies. They were first invited to complete a short task presented as a “decision task”. Under the cover of this task, we used a subliminal priming procedure to activate a goal of detection. Participants were informed that shapes would rapidly appear on the computer screen. Specifically, they were instructed to press the “Q” key on the keyboard when a circle (O) appeared on the screen and the “M” key when a cross (X) appeared

on the screen. For each trial, the sequence was the following: 1) Display of the fixation point (500 ms), 2) Pre-mask (50 ms), 3) Prime or no prime (40 ms), 4) Post-mask (50 ms), 5) Display of the target to detect (180 ms). Priming manipulation took place after a block of 10 practice trials. In the 30 trials of the goal priming condition, each target to detect was preceded by a prime for 40 ms. Primes were verbs typically associated with a detection goal. On the basis of the results of a pilot study conducted on 23 students, we used the following 10 verbs as primes: to detect, to remark, to identify, to discover, to see, to spot, to perceive, to locate, to distinguish and to notice<sup>1</sup>. Each verb appeared randomly for a total of 3 times. In the No-prime condition, participants performed the detection task, but no primes were flashed. Once the detection task was over, participants were asked to move on to the second study. Procedure and materials for this second part are inspired from Simons & Chabris (1999). Instructions on the screen informed the participants that a short video sequence involving two basketball teams ("Black shirts" and "White shirts") would be displayed on the screen.

We used one of the video sequences<sup>2</sup> produced and used by Daniel Simons in 1999. In this 62 s long sequence, two teams of basketball players passed a standard basketball to one another. Passes were either aerial passes or bounce passes. Players also made movements consistent with their activity (dribble the ball, wave arms, move around the game area). Thirty five seconds after the beginning of the sequence, an unexpected event occurred: a person in a gorilla suit walked from the right to the left into the live game, stopped in the middle of the players as the action continued all around it, turned to face the camera, thumped his chest, and then resumed his walk across the screen. The total length of the "gorilla walk" was approximately 9 s. As inattention blindness is closely related to the monitoring task (and particularly the difficulty of this task), the characteristics of the unexpected event (features sharing) as well as the goal(s) of the observer were taken into account. In order to really challenge the potential effect of goal priming, and according to the results of previous research, we chose to place observers in a difficult setting. First, we asked participants to monitor basketball players wearing white shirts, so that the unexpected event (a black gorilla walking across the screen) did not share features with the activity to monitor. Then, we manipulated the difficulty of the monitoring task itself through different sets of instructions. The monitoring task always consisted in counting basketball passes made between the members of the White team but, in the Normal condition, participants only had one goal to pursue, whereas participants in the High difficulty condition had 2 simultaneous goals. Specifically, in the Normal monitoring condition (1 goal to pursue), participants were asked to mentally count the total number of passes made by the White team. In the High difficulty monitoring condition (2 goals to pursue), they were requested to keep a silent mental count of the

total number of passes as well as the number of aerial passes.

After viewing the video and performing the monitoring task, participants had to write down their count(s) and then answered the following questions: While you were doing the counting, did you notice anything unusual? Did you notice anything other than the basketball players? Did you see anyone else (beside the players)? Did you see a gorilla walking through the screen? After any yes response, participants were asked to precisely indicate what they noticed. Participants were also asked whether they knew the video or watched a similar sequence before. Finally, age and sex were collected and participants were debriefed. Main dependent measures were the count(s) of passes and the detection (or not) of the unexpected event.

## Results

*Manipulations check.* In order to check our manipulation of the difficulty of the monitoring task, we analyzed the total pass counts. We computed an error score for each participants, defined as the deviation of their reported count from the actual number of passes (i.e., 18). As expected, the mean error was more important in the High difficulty condition ( $M = 5.63$ ,  $SD = 6.05$ ) than in the Normal condition ( $M = 1.13$ ,  $SD = 1.02$ ),  $F(1, 90) = 28.83$ ,  $p = .001$ <sup>3</sup>. The analysis also revealed a marginal effect of the priming manipulation,  $F(1, 90) = 3.69$ ,  $p = .06$ . Participants' mean error was higher in the No-prime condition ( $M = 4.52$ ,  $SD = 5.70$ ) compared to the Goal condition ( $M = 2.61$ ,  $SD = 4.10$ ), indicating an unexpected positive effect of priming on the monitoring task performance.

Concerning the priming manipulation, we asked participants, in the final questionnaire, whether they noticed anything particular or strange during the detection task. None of them declared having seen words during the task, confirming the nonconscious character of the priming manipulation.

*Unexpected event detection.* Data from 7 participants were discarded either because they reported losing count of the passes ( $n = 6$ ) or because the participant already knew about the video ( $n = 1$ ).

Unexpected event detection was analysed using a binomial logistic regression. We used goal priming, task difficulty and the interaction between those variables as predictors. The global model proved to be predictive of the probability of detection of the unexpected event

<sup>1</sup> Infinitive verbs are single words in French

<sup>2</sup> Sequences are available on <http://www.viscog.com/>.

<sup>3</sup> Due to heteroskedasticity, Levene's  $F(3, 90) = 14.42$ ,  $p = .001$ , we performed a power transformation (McClelland, 2000). This transformation was sufficient to correct for variance heterogeneity, Levene's  $F(3, 90) = .96$ ,  $p = .41$ . In the results section, we report  $F$ -values and  $p$ -values computed on the basis of the transformed variable. However, we report means and standard deviations in their untransformed versions.

( $\chi^2(3) = 23.30, p < .001$ ). First of all, analyses revealed that in our sample, only 48% of the participants reported having seen the gorilla. Analyses also revealed a main effect of task difficulty,  $Wald \chi^2(1) = 13.67, p = .001$ . Detection rates were higher in the Normal condition (69.6%) than in the High difficulty condition (27.1%). Participants were more prone to detect the unexpected event when they had to process one goal (1 global count of passes) rather than two goals (2 separate counts of passes). This result confirmed the role of difficulty in the elicitation of inattentional blindness.

One of our main assumptions was that goal priming effect on detection could vary as a function of the level of available attentional resources. In other words, we assumed an interaction between goal priming and the difficulty of the task. The difficulty  $\times$  priming interaction contributed significantly to the prediction,  $Wald \chi^2(1) = 4.34, p = .037$ . Importantly, further analyses revealed that priming participants with a detection goal significantly increased the detection of the gorilla in the Normal difficulty condition compared to the No-Prime condition  $Wald \chi^2(1) = 5.00, p = .025$ . However, there were no difference in the High difficulty condition,  $Wald \chi^2(1) = .45, p = .50$ . Percentage of participants noticing the gorilla in each condition are presented in Table 1.

## Discussion

This article aimed to explore whether the priming of a detection goal could predict noticing rates for an unexpected event in the framework of a classical inattentional blindness paradigm. We hypothesized that goal priming could improve detection of unexpected events. Results indicated such an improvement, but only in specific conditions. In absence of priming, results are consistent with previous research showing that a large number of persons failed to notice the appearance of an unexpected event. Noticing rates we found corresponded to those obtained by Simons et al (1999) with comparable conditions of difficulty and the very same video sequence. Particularly, 50% of the observers in the Normal monitoring and no priming condition (which was our baseline for the assessment of the goal priming effect) failed to detect the Gorilla. Findings also confirmed that inattentional blindness occurs more frequently as the difficulty of the monitoring task increases. In addition, our results suggest that goal priming can significantly improve the detection of an unexpected event when the difficulty of the monitoring task is normal (about +29% compared to the No-prime condition). In other words, priming is efficient when the monitoring task is not too too demanding in terms of attentional resources. Conversely, when attentional resources are highly used by the conscious task demands, priming does not improve detection.

Attention capture literature distinguishes transient and sustained components of attention. When transient attention is associated with reflexive shifts of attention, sustained attention is associated with voluntary attention shifts. Transient shifts of attention are relatively auto-

matic while sustained shifts of attention are more open to the influence of strategic processes. According to Neisser (1976, cited by Most et al. 2005), what determines whether a transient shift of attention is followed by a sustained allocation of attention is “*a person's own expectations of what belongs in a scene; influenced by the relatively sparse information gleaned through a transient shift.*” In other words, this is people's attentional set that determines how sustained attention is directed. Indeed, when observers are engaged in a task requiring a selective processing of information, they establish an attentional set on the basis of the dimension(s) critical to proper selection (Most et al., 2005). This attentional set, willingly determined according to the instructions given about the monitoring task, is the result of a conscious goal pursuit. For instance, in our study, participants were instructed to pay attention to the white color of the players' t-shirts, on the basketball and, for those in the high difficulty condition, on the type of pass performed by the players. Adoption of an attentional set directs sustained attention in the sense that it prepares observers to receive a specific kind of information and, conversely, avoid irrelevant information. By this way, people are able to filter out information when they actively try to ignore it. On the dark side, attentional set is also the source of inattentional blindness.

Neisser, in his perceptual cycle framework (Neisser, 1976), also suggests that preconsciously processed information may guide attention. In line with this idea, we propose that goal priming may create a “nonconscious attentional set”. This nonconscious (or preconscious) attentional set would be of a lower level of specificity than a conscious “instructed” attentional set and could be considered as nonconscious expectancies. In our study, even if primed participants were not aware of it, they were engaged in the pursuit of a detection goal, leading to expectations or at least the search of something happening in the environment. Thus, goal priming could allow for some kinds of features to draw processing resources while filtering others out. If it unlikely defines a specific critical dimension for information selection, nonconscious attentional set would be enough to create a state of attentional readiness that subsequently allows a better detection of unexpected events. Finally, there would be a complementarity between nonconscious and conscious attentional sets: when attentional set would mostly influence sustained attention, nonconscious attentional set could influence preconscious processing of information, transient attention and, possibly, the shift from transient to sustained attention. This explanation is also consistent with the fact that implicit and explicit attention capture appear to be dissociated (Most et al., 2005).

On a goal-level explanation, it appeared that a backgrounded goal of detection leads to higher rates of detection when the task does not imply the pursuit of multiple goals. Indeed, it seems that there is a multiplicative effect of running several conscious goals on the residual

Table 1

*Percentage (and number) of subjects noticing the gorilla in each condition.*

|            | Priming       | Control  | Detection goal |
|------------|---------------|----------|----------------|
| Difficulty |               |          |                |
|            | <i>Normal</i> | 50.00(9) | 78.57(22)      |
|            | <i>Hard</i>   | 31.81(7) | 23.07(6)       |

amount of attention. When two goals are pursued (the conscious easy monitoring goal and the nonconscious detection goal), priming has a positive effect on detection. Though, when people have three goals in mind (the conscious goals of keeping the two running counts in working memory and the nonconscious detection goal) positive effect of priming disappears. One can assume that, in the case of multiple conscious goals, less attentional resources would be available and, as a consequence, would leave less room for the priming effect to occur. In the hardest situation, attentional resources could presumably be depleted or at least allocated in priority to the conscious goals through a process of shielding (Shah & Kruglanski, 2002). The same would probably occur if the primed goal was totally irrelevant to the consciously pursued activity. This also indicates that, even if it runs nonconsciously and presumably in a parallel fashion, nonconscious goal pursuit uses and relies on the same attentional resources as conscious goals. Further evidence about this argument is provided by the effect of priming on the monitoring task performance. Indeed, priming not only improves detection of the unexpected event when the difficulty monitoring task is normal but it also improves performance on the monitoring task itself, whatever its level of difficulty is. Nevertheless, priming has no effect on the detection rate when the primary task is hard. This deterioration of performance can be viewed as an indicator of the regulation of cognitive load and attention.

In sum, when attentional demands of the primary task are moderate or low, goal priming allows an improvement of the detection of the gorilla as well as an improvement of performance on the monitoring task. In the normal difficulty condition, we assume that mental resources are not totally engaged and that available resources could then be used on the simultaneous processing of the two activities. This is made possible because of the nature of the goal we primed. Indeed, because of the main objective of this experiment, we chose to prime a detection goal, which is a goal with a low level of specificity. Because of its low level of specificity, the detection goal can be translated in several ways in order to be applied to the situation. If we initially used this goal with the idea that it would enhance the detection of an unexpected event, it can also apply to the detection of passes during the monitoring task. So, as the primed detection goal is applicable (Bry, Meyer, & Oberlé, 2009; Higgins & Brendl, 1995) to both tasks, it could lead to a repartition of attentional resources on the monitoring task as well as on the detec-

tion task.

When the task is hard, goal priming marginally improves performance on the primary task, but failed to significantly enhance the gorilla detection. In this case the monitoring task is more demanding in terms of mental resources, and most of them is probably needed to perform the task correctly. A mechanism of goal shielding (Shah & Kruglanski, 2002) could also direct resources allocation so that it primarily occurs on the main, conscious task. Though, as the primed goal is compatible with and applicable to the task, it could also allow a concentration of resources on the conscious goal, explaining performance improvement on the monitoring task.

This article bridges two distinct lines of research: inattention blindness and nonconscious goal pursuit. As far as we know, the insights from the one have never been applied to the other. The present study underscores the role of nonconscious processes on the capture of attention and detection of unexpected events. It puts in light how a specific goal priming can increase detection rates. It also extends evidence and knowledge about effects of goal priming on attentional processes and their regulation. Particularly, goal priming appears to be a way to set some kind of default attention through nonconscious expectations, what we called a "nonconscious attentional mindset." Through this mindset, nonconscious goal pursuit may play a role in the way in which attention resources are allocated, recruited or freed. It also opens new perspectives in the comprehension of how and why attention becomes sustained following the detection of an unexpected event. In the case of attention switching, models suppose complex interactions between top-down and bottom-up processes. Particularly, it is assumed that top-down expectations could affect performance through the setting of a default level of attention. In our view, goal priming procedures could be a way to investigate these top-down expectations and their interactions with stimulus properties. Beyond the laboratory, implementation of nonconscious expectations could have relevance to everyday life as well as practical implications (air-traffic control, car accidents, mental preparation in sports, etc.).

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