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Abstract We are susceptible to failures of awareness if a stimulus occurs unexpectedly and our attention is focused elsewhere. Such inattentional blindness is modulated by various parameters, including stimulus attributes, the observer's cognitive resources, and the observer's attentional set regarding the primary task. In three behavioral experiments with a total of 360 participants, we investigated whether mere semantic preactivation of the color of an unexpected object can reduce inattentional blindness. Neither explicitly mentioning the color several times before the occurrence of the unexpected stimulus nor priming the color more implicitly via color-related concepts could significantly reduce the susceptibility to inattentional blindness. Even putting the specific color concept in the main focus of the primary task did not lead to reduced inattentional blindness. Thus, we have shown that the failure to consciously perceive unexpected objects was not moderated by semantic preactivation of the objects' most prominent feature: its color. We suggest that this finding reflects the rather general principle that preactivations that are not motivationally relevant for one's current selection goals do not suffice to make an unexpected object overcome the threshold of awareness.

Keywords Inattentional blindness · Awareness · Priming

Conscious perception is one of the most fundamental aspects of human experience and has long fascinated scholars from various disciplines (e.g., Dehaene & Naccache, 2001; Metzinger, 1995; Overgaard, Rote, Mouridsen, & Ramsøy, 2006). Substantial evidence indicates that a crucial precursor of awareness is attention (for a discussion, see Cohen, Cavanagh, Chun, & Nakayama, 2012; but see Mole, 2008). A striking demonstration of this dependency is inattentional blindness, which refers to the phenomenon that unexpected objects that are located well within the visual field do not reach awareness when attention is focused elsewhere (Mack & Rock, 1998; Simons & Chabris, 1999).

The likelihood of inattentional blindness depends on various parameters, such as the attributes of the unexpected object (Calvillo & Jackson, 2014; Mack & Rock, 1998), cognitive capabilities (Hannon & Richards, 2010; O'Shea & Fieo, 2014; but see Bredemeier & Simons, 2012), and perhaps even personality traits (Richards, Hellgren, & French, 2014). Moreover, noticing unexpected objects depends on a person's attentional set: Unexpected objects are more likely to be perceived when they are similar to the objects that are being attended to as part of the primary task, for example, regarding their luminance, shape, or color (Koivisto & Revonsuo, 2008; Most, Scholl, Clifford, & Simons, 2005; Most et al., 2001). Crucially, an attentional set involves the specific focus on the very dimension (or selection criterion) that allows discriminating relevant from irrelevant items in the context of the currently performed primary task (Aimola Davies, Waterman, White, & Davies, 2013; Most et al., 2005). For example, when participants track black items in a dynamic visual display, they detect unexpected black objects far more frequently than unexpected white objects (Most et al., 2001; see also Simons & Chabris, 1999). This applies not only to physical features but also to the level of semantic categories: When participants look for pictures of animals, they detect an unexpected word more frequently when it is the name of an animal rather than the name of a piece of furniture (Koivisto & Revonsuo, 2007).

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The beneficial effects of a matching attentional set might be an example of a more general principle of conscious perception (Dehaene, Changeux, Naccache, Sackur, & Sergent, 2006), namely that both bottom-up stimulus strength as well as top-down attentional amplification are needed for conscious perception to arise. It is often assumed that unexpected stimuli are processed on a preconscious level (Mack & Rock, 1998), and some of them succeed in overcoming the threshold of conscious perception due to an additional activating process (often described as "attentional capture"; Calvillo & Jackson, 2014; Devue, Laloyaux, Feyers, Theeuwes, & Brédart, 2009). This amplification is usually caused by the stimuli's current or general relevance, which is, for example, due to the observer's attentional set, the object's evolutionary relevance, its relevance to the observer's self, or its animacy (Calvillo & Jackson, 2014; Devue et al., 2009; Downing, Bray, Rogers, & Childs, 2004; Mack & Rock, 1998; Most et al., 2001; New & German, 2014). However, if an additional activation process causes unexpected objects to reach awareness (Deheane et al., 2006), it seems plausible that the consciousness threshold might be reached by processes other than the relevance-induced attentional capture. Indeed, recent experimental evidence suggests that semantic preactivation might suffice to increase the likelihood of noticing unexpected sensory input that typically fails to reach awareness (Rattan & Eberhardt, 2010). Participants who performed an initial task on African-American names subsequently noticed an unexpected gorilla more often than participants who had dealt with European-American names. According to the authors, the concept of African-Americans activated the semantic concept of apes, which then facilitated the conscious perception of an exemplar of this category (for other studies regarding the African American-ape association see Goff, Eberhardt, Williams, & Jackson, 2008). Thus, the preactivation of a social association, even an incorrect one, had an impact on the likelihood of conscious perception, even though the activated concept was neither currently nor generally relevant to the participants (Rattan & Eberhardt, 2010; but see Koivisto, Hyönä, & Revonsuo, 2004).

In the present study, we further explored whether mere semantic preactivation of a feature affects the likelihood that an unexpected object that possesses this very feature is noticed. In other words, is an unexpected object detected more frequently when one of its most prominent characteristics of appearance—although completely irrelevant for any selection process within the primary task and without inherent significance to the individual—is activated prior to or during the task? While Rattan and Eberhardt (2010) made use of assumed social associations to create preactivations, we manipulated semantic activation more directly and systematically across three experiments. Research on priming has shown that objects are processed differently when their color has previously been activated (e.g., Goolsby & Suzuki, 2001). Building upon this work and using three different ways to activate specific colors, we measured whether the propensity to miss an unexpected shape decreased when its color was preactivated.

Experiment 1

In Experiment 1, we manipulated preactivation of a key feature of an unexpected object by means of a simple priming procedure. Participants performed a lexical-decision task in which a certain color word was repeatedly presented in between other unrelated words and several non-words. Unexpectedly, a small colored square appeared during the task. We hypothesized that the unexpected square would be noticed more frequently when one of its defining features was semantically preactivated, that is, when its color matched the previously presented color word.

Method

Participants. A total of 120 participants took part in Experiment 1. All participants gave written informed consent and received either course credit or monetary compensation. We excluded participants from the analysis if they (a) did not have normal or corrected-to-normal vision (2 participants) or (b) did not notice the unexpected object in the control condition in which they did not have to perform the primary task (full-attention trial; 3 participants). Additionally, the data of 4 participants were incomplete due to errors in data recording. No participant indicated in the follow-up questionnaire that he or she had anticipated the unexpected object or knew that inattentional blindness was the subject of the study. Thus, no one had to be excluded from further analysis based on this criterion. Data from the remaining 111 participants were analyzed (M = 22.6 years; SD = 5.4 years; 77.5 % female).

Materials and Procedure. Participants signed a declaration of consent and were seated at a distance of approximately 40 cm from a laptop with a 15.6-inch display (resolution: 1920 × 1080 pixels). The angle of the display was kept constant between participants. The inattentional-blindness task was programmed and run on Presentation (Neurobehavioral Systems, Albany, NY) and participants responded using the laptop keyboard. Participants were tested alone or in pairs (dividers separated the two work spaces). Instructions were given on-screen prior to the task. Participants were randomly assigned to one of the two experimental conditions: the color of the unexpected object either matched the previously presented color word (match) or it did not match the color of the previously presented color word (mismatch). Also, half of the participants were presented with a blue unexpected object and half of the participants were presented with a green unexpected object. After completion of the inattentional-blindness task, participants filled out a questionnaire collecting demographics, general knowledge about inattentional blindness, and anticipation of the unexpected object. Finally, participants were debriefed.

The inattentional-blindness task was adapted from similar procedures presented by Mack and Rock (1998): We employed a static task in which an unexpected object was presented for 200 ms alongside the primary-task stimulus. Specifically, participants performed a lexical-decision task. On each trial, following a black fixation point with a random duration between 1000 and 3000 ms, a string of four black letters was presented for 200 ms in the center of the display. The letter string was approximately 3° wide and either formed a proper German word or was a meaningless non-word. Participants were instructed to respond as quickly as possible and to indicate by button press if the presented string was a proper German word or not. Key assignment to the two possible responses was counterbalanced across participants. If participants did not respond within a 2000-ms interval that started with the appearance of the letter string, the next trial started automatically. The five words were "SEIL" (rope), "ENDE" (end), "RUHE" (calm), "FEIN" (nice), and, depending on the condition, either "BLAU" (blue) or "GRÜN" (green). The non-words were created from the words by relocating the letters ("ELIS", "NEDE", "ERUH", "NIEF", "LUBA", "RÜNG"). The background was grey (RGB: 128, 128,128).

Each participant completed 20 practice trials with each of the letter strings presented twice. In the 40 experimental trials, each string was presented 4 times. The color word was presented in trials 16, 26, 33, and 40. Following trial 40, the critical trial was presented immediately and without forewarning. In this critical trial, the fixation point was presented with the fixed duration of 1000 ms to ensure that for all participants the same time elapsed between the last presentation of the color word and the appearance of the unexpected object. The unexpected object was a colored square (0.5° x 0.5°; either green [RGB: 70,150,70] or blue [RGB: 86,135,168]) that was presented alongside a non-word string for the entire 200 ms. The square was always presented on one of the imaginary 45° lines bisecting the quadrants defined by the display. For each participant it was randomly chosen in which quadrant the square appeared. The distance of the square from the center of the display was approximately 2.9°. After participants had responded to the letter string (or after the 2000-ms response interval had elapsed), participants were asked if they had seen anything (other than the letter sequence) that had not been presented before. Irrespective of their answer, participants were then asked in which part of the display the additional object had been presented (upper right, lower right, lower left, upper left), which shape (6 choices), and which color it had (5 choices). They were told to guess if they had not noticed anything. After these questions, participants were instructed that the experiment would proceed as before and that they had to complete some more trials of the lexical-decision task. Following three normal lexical-decision trials, the colored square appeared for a second time (divided-attention trial), again following the color-word and alongside a non-word. For each participant it was the same color as in the critical trial, but the position was again chosen randomly. After having made the lexical decision, participants answered the same questions that had followed the critical trial. Following the divided-attention trial, there was a final trial in which participants were instructed to still fixate on the center of the display, but they did not have to perform the lexical decision any more (full-attention trial). The position of the additional square was again chosen randomly, whereas its color was the same as before for each participant. The questions concerning the additional square were exactly the same as those presented before.

Results and Discussion

Participants were considered to have missed the unexpected object if they did not report noticing it or claimed to have seen something but could not define at least its position or its shape. We deliberately did not include participants' answer concerning the color of the unexpected object in this definition of inattentional blindness. Participants who did not consciously perceive the unexpected object might be inclined to guess the color that was previously presented in the lexical-decision task. Thus, participants in the match condition might have an advantage in correctly guessing the object's features and would therefore be more easily coded as noticers compared with participants in the mismatch condition. Thus, we avoided this possible confound. Also, only data from participants who noticed the additional colored square in the control condition (full-attention trial) and correctly identified its position or its shape were analyzed. Thus, missing the unexpected object in the critical trial or the divided-attention trial cannot be attributed to basal visual problems or a poor contrast. All statistical analyses conducted were two-tailed. As a standardized measure of effect size, risk ratios (RR) with 95 % confidence intervals in square brackets are reported.

The results of Experiment 1 are depicted in Fig. 1. Approximately half of our participants did not notice the unexpected shape. Thus, we successfully generated inattentional blindness without any floor or ceiling effects that might conceal potential variations due to semantic preactivation. Nevertheless, noticing rates of the unexpected object for the critical trial did not differ between the match and the mismatch condition, χ^2 (1) = 1.02, p = 0.31, RR (match/mismatch) = 1.26 [0.81, 1.96]. Thus, even though there was a slight tendency in the hypothesized direction, individuals did not notice the unexpected object significantly more often

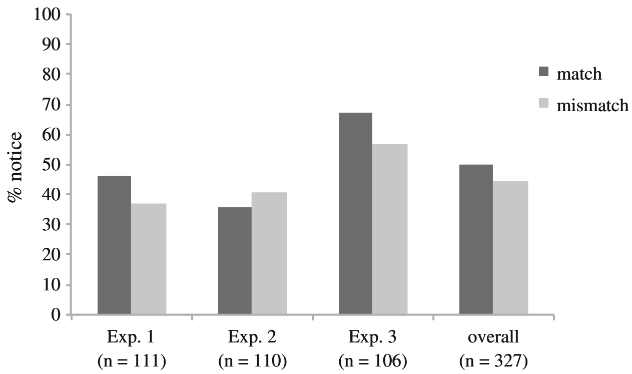

Fig. 1 Percentage of participants in the match condition and in the mismatch condition who noticed the unexpected colored square in the critical trial. Results are illustrated for all three experiments separately and averaged across all three experiments ("overall")

when its color was primed. The same pattern was observable for the divided-attention trial, χ^2 *(1)* = 0.82, *p* = 0.37, RR (match/mismatch) = 1.08 [0.92, 1.27], and it remained the same when the data were analyzed separately for male and female participants or blue and green unexpected objects. Summed up, on the basis of Experiment 1, we cannot conclude that the mere semantic preactivation of a feature leads to a higher probability of conscious perception of a feature-related visual event. However, to further test this notion, the shortcomings of Experiment 1 were addressed in a second experiment and an additional attempt was made to find out whether semantic preactivation decreases inattentional blindness.

Experiment 2

It might be argued that in Experiment 1 the specific color concept was not preactivated with sufficient strength and/or in sufficient depth. Judging a letter string regarding its lexical correctness does involve semantic activation (Balota, Cortese, Sergent-Marshall, Spieler, & Yap, 2004), but maybe the strength of this semantic preactivation was not enough to facilitate the detection of an unexpected object featuring this specific concept. Indeed, Overson and Mandler (1987) showed that brief stories containing words related to a specific concept produced stronger activation of this specific concept than mere presentation of related words (i.e., not embedded in a narrative). Preactivation induced by short stories affected subsequent processing for at least several minutes. In Experiment 2, we implemented a procedure similar to the one presented by Overson and Mandler, thereby choosing a completely different approach to prime the colors than in Experiment 1: Participants read a short story whose content was clearly associated with either the color green or the color blue and were instructed to memorize the story as precisely and vividly as possible. They were told that they had to reproduce the story after an interjacent task, which was the inattentional-blindness task. Thus, the color concept was activated right before the inattentional-blindness task. Given that the color was an integral part of the story that participants temporarily stored, it most likely persisted during the inattentional-blindness task and the presentation of the unexpected object. As in Experiment 1, we hypothesized that an unexpected colored object would be detected more frequently when its color had recently been activated than when a different color had been activated.

Method

Participants. A total of 120 participants took part in Experiment 2. All participants gave written informed consent and received candy as reward for their participation. We excluded participants from the analysis if they (a) did not have normal or corrected-to-normal vision (4 participants), (b) did not notice the unexpected object in the control condition in which they did not have to perform the primary task (full-attention trial; 4 participants), or (c) indicated in the follow-up questionnaire that they had anticipated the unexpected object or knew that inattentional blindness was the subject of the study (1 participant). Data from the remaining 110 participants were analyzed (*M* = 22.5 years; *SD* = 3.0 years; 52.7 % female).

Materials and Procedure. Except as noted, all materials and procedures were identical to those of Experiment 1. Participants were seated at a distance of approximately 60 cm from a 24-inch screen (resolution: 1920 × 1080 pixels) and were first given three minutes to read and memorize a short story. In the instructions it was mentioned that information is best memorized when it is imagined as vividly as possible. Half of the participants read a story that prominently featured multiple concepts that are strongly related to the color blue (such as water, ocean, or sky). The other half of the participants read a story that contained multiple concepts clearly related to the color green (grass, forest, or salad). After three minutes, participants were asked to perform a brief unrelated task before being tested for their memory of the story. Instructions for the inattentional-blindness task were rather brief in order to keep the interval between the active engagement with the story and the appearance of the unexpected object as short as possible. To test whether the stories indeed activated the concept of the assumed colors, we performed an independent manipulation check in a subsample. At the end of the experiment, randomly selected participants (*n* = 26) were asked to briefly think of the memorized story again and to spontaneously name any color that came to mind.

The procedure of the inattentional-blindness task was very similar to the one used in Experiment 1. Changes were made only in regard to the following: Instead of a lexical-decision task, participants had to decide as quickly as possible whether or not the letter string (all non-words) contained an "E" or "O." Half of the letter strings contained an "E" or "O" and half did not. There were no practice trials and participants performed 20 experimental trials before the critical trial was presented.

Results and Discussion

First, we verified that the two stories were indeed associated with the intended concepts of the colors blue and green. In the open-question manipulation check, the respective color was mentioned as currently coming to mind by 88 % of the participants. Thus, the stories were indeed associated with the specific concept of the color and we can act on the assumption that the respective color concept was activated by memorizing the story. As in Experiment 1, participants were considered to have missed the unexpected object in the actual inattentional-blindness task if they did not report noticing it or claimed to have seen something but could not define at least its position or its shape.

The results of Experiment 2 are depicted in Fig. 1. Approximately 60 % of the participants were inattentionally blind. Thus, we successfully generated inattentional blindness without any floor or ceiling effects that might conceal the potential impact of semantic preactivation. However, noticing rates of the unexpected object for the critical trial did not differ between the match and the mismatch condition, χ^2 (1) = 0.29, p = 0.59, RR (match/mismatch) = 0.88 [0.54, 1.41]. Thus, individuals did not notice the unexpected object more often when its color was primed, and there was not even a tendency in the hypothesized direction. The same pattern was observable for the divided-attention trial, χ^2 *(1)* = 0.79, p = 0.37, RR (match/mismatch) = 0.95 [0.83, 1.07], and it remained the same when the data were analyzed separately for male and female participants or blue and green unexpected objects. Thus, as Experiment 1, Experiment 2 does not support the notion that semantic preactivation of a feature leads to a higher probability of conscious perception of a feature-related visual event.

It should be noted that in Experiments 1 and 2 we employed priming paradigms in which a certain color was semantically activated *before* the appearance of the unexpected object. The concept of the color therefore might have decayed even despite the short lag, such that it was not as available as intended during the critical moment. Not finding a difference between matching and mismatching conditions might still be the consequence of insufficient semantic activation of the color during the decisive moment of the unexpected object's appearance. Thus, we ran a third experiment in which the color concept was undoubtedly cognitively available when the unexpected shape appeared. Moreover, we devised a specific manipulation check to secure the assumed activation of the color during the critical trial.

Experiment 3

In Experiment 3, we asked participants to generate words that were associated with a certain color (e.g., "tree" or "lawn" might be named as words related to the color green). Crucially, an unexpected colored shape—either matching the currently relevant color or not—appeared during a short retention interval in which participants were retrieving a color-related word. This task and the choice of this specific moment for the object to appear guaranteed that the color was activated when the unexpected shape was presented. Also, this allowed ascertaining that participants were indeed dealing with the color, as we registered whether they retrieved appropriate, color-related words. The procedure of Experiment 3 was another attempt to further enhance a potential priming effect, as priming effects have been shown to increase when participants generate words instead of merely reading them (Gardiner, 1988). We hypothesized that an unexpected colored square would be noticed more frequently among participants who were currently dealing with the matching color than among those who were focusing on a different color.

Method

Participants. A total of 120 participants took part in Experiment 3. All participants gave written informed consent and received candy in exchange for their participation. We excluded participants from the analysis if they (a) did not have normal or corrected-to-normal vision (3 participants), (b) did not notice the unexpected object in the full-attention trial (6 participants), or (c) indicated in the follow-up questionnaire that they had anticipated the unexpected object or knew that inattentional blindness was the subject of the study (7 participant). Data from the remaining 106 participants were analyzed (M = 21.9 years; SD = 2.4 years; 50 % female).

Materials and Procedure. Except as noted, all materials and procedures were identical to those of Experiment 1. Participants were seated at a distance of approximately 60 cm from a 24-inch screen (resolution: 1920 × 1080 pixels) and were instructed to generate words that are clearly related to a specific color. Half of the participants were asked to generate words related to the color blue and half of the participants were asked to generate words related to the color green. Participants were given a random interval between 4 and 7 seconds to think of a new color-related word. Within this interval, a "-"-symbol was presented for 200 ms every second in the center of the display. After 4 to 7 seconds, a "+"-symbol appeared instead of the "-"-symbol and marked the start of the report interval. Participants had 6 seconds to type the color-related word. After these 6 seconds, the next trial started.

The unexpected object was presented alongside the last "-"-symbol on the fourth trial and was presented at a distance of 2.2° from the center of the display. After the 6-s response interval had elapsed, participants were asked the same questions regarding the unexpected object as in Experiments 1 and 2. There was no divided-attention trial in Experiment 2. However, there was a full-attention trial in which participants were instructed to still fixate on the center of the display, but they learned that they did not have to think of another color-related word.

Results and Discussion

First, we established that participants indeed actively dealt with the specified color. During the critical trial, 82.1 % of the participants named a word that was clearly associated with the specified color. Thus, the vast majority of participants indeed successfully retrieved a correct word, which clearly indicates that they were dealing with the color in the very moment the unexpected object appeared.

The results of Experiment 3 are depicted in Fig. 1. Again, the overall inattentional-blindness rate was near 50 % and, thus, showed neither floor nor ceiling effects. Noticing rates of the unexpected object for the critical trial did not differ between the match and the mismatch condition, χ^2 (1) = 1.22, p = 0.27, RR (match/mismatch) = 1.18 [0.88, 1.60]. This pattern of results remained the same when the data were analyzed separately for male and female participants or blue and green unexpected objects. Additionally, we tested whether the results were different when only participants who obviously dealt with the color in the critical trial (as indicated by the correct retrieval of an appropriate word) were considered. Restricting the analysis to those participants did not fundamentally alter the results, χ^2 (1) = 2.21, p = 0.14, RR (match/mismatch) = 1.30 [0.91, 1.85]. Thus, as in Experiment 1 and 2, individuals did not notice the unexpected object significantly more often when its color was preactivated.

Given that our central result is a null effect, it is a noteworthy strength of this study that we ran a particularly large overall number of participants. Following a meta-analytical approach, we additionally combined the data of the individual experiments, which resulted in a total sample of 360 participants, of which 327 could be included. This analysis further supported the previous results, showing that noticing rates of the unexpected object in the critical trial were not different whether or not the object's color was semantically activated (χ^2 (1) = 0.91, p = 0.34, RR (match/mismatch) = 1.12 [0.89, 1.41]). A post-hoc power analysis confirmed that pooling our data across all three experiments yielded a power (1 – β) > 0.99 to detect a medium effect and a power of 0.95 to detect even a small-to-medium effect (Faul, Erdfelder, Lang, & Buchner, 2007). Thus, it is highly unlikely that our findings merely represent statistical error.

General Discussion

Previous work on inattentional blindness has shown that unexpected objects are more likely to be noticed if they are inherently or currently relevant to the observer (e.g., Calvillo & Jackson, 2014; Devue et al., 2009; Downing et al., 2004; Mack & Rock, 1998; Most et al., 2001). This is in line with a formal model of conscious perception that suggests that sensory input needs to overcome a certain threshold to enter awareness, which can be achieved by means of top-down amplification (Deheane et al., 2006; Ellis, 2001). In the present study, we investigated whether a rather different kind of amplification, namely a simple semantic preactivation, would lead to a similar mitigation of inattentional blindness: We tested whether preactivating a defining feature of an unexpectedly appearing object would affect the likelihood of its conscious perception. To preclude that any result in response to this question hinged on the use of a specific paradigm or setting, we employed three completely different manipulations to activate a certain color. Nevertheless, in none of the three experiments did participants notice an unexpected object more frequently when its color had previously been activated. This result does not hinge on insufficient power to detect an effect, as combining data of all three experiments did not yield a significant effect of preactivation either. Thus, our findings allow us to conclude that semantic preactivation of a defining feature of an object, at least with the tasks and manipulations presented here, does not affect awareness of this object.

As discussed before, an unexpected object's relevance (either inherent or as part of the current task) increases noticing and in turn decreases inattentional blindness. This finding is nicely summarized by the relevance-of-a-representation framework (ROAR; Eitam & Higgins, 2010), which postulates that the strength of an activation largely depends on its motivational relevance. Thus, the framework offers a theoretical foundation for findings such as decreased inattentional blindness for stimuli that are threatening, animated, or related to the observer's identity (Calvillo & Jackson, 2014; Mack, Pappas, Silverman, & Gay, 2002; New & German, 2014). Also, the framework can account for the beneficial effect of a matching attentional set (Koivisto & Revonsuo, 2008; Most et al., 2001, 2005): Stimuli that are part of the observer's attentional set are motivationally relevant in terms of being at the center of one's current task goals. Therefore, their activation is sufficiently strong to overcome the threshold of awareness (Dehaene et al. 2006). As a side note, it should be mentioned that this explanation might be a slightly more formal account of what has previously been termed the "signal value" of an unexpected object (Mack & Rock, 1998; Rattan

& Eberhardt, 2010). Also, Ellis (2001) similarly argued that only items that are useful to the organism's purposes, and are thereby motivationally relevant, are amplified by means of attentional selection and become conscious.

However, the ROAR framework (Eitam & Higgins, 2010) also suggests that the strength and duration of a *preactivation* similarly depends on the motivational relevance of the preactivated concept. Thus, if this model indeed applies to inattentional blindness, one might assume that only a preactivation that is relevant to the observer should have an effect on the likelihood of conscious perception of a related object. The present findings support this view, as the preactivations, being neither inherently nor currently relevant to our participants (Experiment 1 and 2), did not moderate inattentional blindness (for similar results, see Koivisto et al., 2004). Moreover, this perspective allows integrating these findings with the rather different results by Rattan and Eberhardt (2010), who reported decreased inattentional blindness when the unexpected stimulus was preactivated: They primed a concept which might be interpreted as an example of motivational relevance as it had a clear social meaning. Socially meaningful stimuli are typically processed particularly intensively (see, e.g., Eimer, Holmes, & McGlone, 2003; Ito & Urland, 2005; Kanske & Kotz, 2007), which has been attributed to their inherent motivational relevance (Hajcak, Weinberg, MacNamara, & Foti, 2012; Ito & Urland, 2005). Therefore, names (as in the study by Rattan & Eberhardt, 2010) should be more motivationally relevant than color words (as in the present study).

In Experiment 3, we *did* make a specific color task-relevant, but awareness of an object featuring this color nevertheless did not increase. According to our suggestion, based on the ROAR framework (Eitam & Higgins, 2010), that motivational relevance determines the effectiveness of a (pre)activation to decrease inattentional blindness, one might assume that this manipulation should have boosted conscious perception. However, it should be noted that the specific color, despite it being the attentional goal of the primary task, was not a perceptual *selection criterion* in Experiment 3. In contrast to studies reporting strong effects of task-relevance on inattentional blindness (i.e., studies in which the unexpected object either matched or mismatched the attentional set), our task did not involve the detection of the relevant category in the visual display. Thus, even though the color itself was preactivated and task-relevant, its actual visual *selection* was not. We propose that semantic preactivation can best unfold its influence on the probability of failures of awareness if the concept in question is motivationally relevant to the observer in terms of being essential to one's current perceptual selection process (see Koivisto & Revonsuo, 2007; Most et al., 2001). This has similarly been suggested by Koivisto et al. (2004), and it is in line with recent findings by Aimola Davies and colleagues (2013), who demonstrated that the very feature that was relevant, as it was currently being used as the selection criterion, affected conscious perception of an unexpected object.

Limitations of the Present Study

The findings of the present study, although statistically sound, only reflect a selection of possible settings and manipulations to investigate the question at hand. For example, in all three experiments, we used the static inattentional-blindness paradigm established by Mack and Rock (1998) and presented the unexpected object for only 200 ms. This paradigm might be fundamentally different from more dynamic and sustained paradigms in which the unexpected object appears for several seconds (Most, Simons, Scholl, & Chabris, 2000; Simons & Chabris, 1999). Thus, our findings might not be generalizable to all inattentional-blindness paradigms. Potentially, a preactivation can only develop an influence on the likelihood of detection of an unexpected object if the unexpected object is dynamic and/or if there is more time to detect it (see Kovisto & Revonsuo, 2007; Rattan & Eberhardt, 2010).

Moreover, the potential moderating influence of semantic preactivation on the detection of an unexpected object might depend on the specific concept. First, priming a single color might not elicit increased sensitivity to this *specific* color as compared to a different color, because the general concept of color might be activated. Thus, comparing awareness for objects of a color that matches vs. mismatches a previously mentioned color would not be a comparison of objects whose central feature was preactivated vs. not preactivated. It should be noted, though, that this concern is weakened by the classical priming literature: priming a specific color measurably affects subsequent processing of this very color (e.g., Goolsby & Suzuki, 2001; Di Pace, Marangolo, & Pizzamiglio, 1997). Second, preactivating a specific perceptual feature of the unexpected object might not be sufficient to lower the probability of inattentional blindness. Preactivation might only exert an influence on awareness if it refers to the meaning or the complete concept of the unexpected object. This might be an alternative explanation for the finding that priming the concept of African Americans increases the likelihood of detecting an unexpected ape (Rattan & Eberhardt, 2010).

Conclusion and Outlook

Across three behavioral experiments, we have shown that the failure to consciously perceive an unexpected object was not moderated by semantic preactivation of the object's most prominent feature, its color. We suggest that this reflects the rather general principle that preactivations that are not motivationally relevant do not suffice to make an unexpected object overcome the threshold of awareness.

Clearly, further studies are needed to generalize our results to other inattentional-blindness paradigms and other preactivated concepts. The identification of the circumstances and conditions which allow semantic preactivation to alter the probability of inattentional blindness is no end in itself but would illuminate the preconditions of such failures of awareness as well as the underlying mechanisms of conscious perception. This is crucial for basic research on determinants of conscious perception as well as for every-day life. If we knew how to preactivate certain concepts or features to successfully circumvent inattentional blindness, we might be able to apply this to prevent fatal consequences of these failures of awareness, for example, in the military, during security monitoring, or in traffic.

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Ethical statement All participants gave their informed consent prior to their inclusion in the study and were debriefed afterwards. The work conforms to Standard 8 of the American Psychological Association's Ethical Principles of Psychologist and Code of Conduct.

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