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Inattentional blindness is influenced by exposure time not motion speed

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Inattentional blindness is a striking phenomenon in which a salient object within the visual field goes unnoticed because it is unexpected, and attention is focused elsewhere. Several attributes of the unexpected object, such as size and animacy, have been shown to influence the probability of inattentional blindness. At present it is unclear whether or how the speed of a moving unexpected object influences inattentional blindness. We demonstrated that inattentional blindness rates are considerably lower if the unexpected object moves more slowly, suggesting that it is the mere exposure time of the object rather than a higher saliency potentially induced by higher speed that determines the likelihood of its detection. Alternative explanations could be ruled out: The effect is not based on a pop-out effect arising from different motion speeds in relation to the primary-task stimuli (Experiment 2), nor is it based on a higher saliency of slow-moving unexpected objects (Experiment 3).

Keywords: Inattentional blindness; Motion; Speed.

Inattentional blindness is a striking phenomenon that has been shown across diverse paradigms (e.g., Most et al., 2001; Newby & Rock, 1998; Simons & Chabris, 1999). It is defined as not noticing a salient unexpected object right within the visual field if attention is focused elsewhere. Inattentional blindness not only is a laboratory phenomenon but can have important consequences on real-life situations (Chabris, Weinberger, Fontaine, & Simons, 2011; Haines, 1991). Therefore, it is important to determine the stimulus features and situational factors that influence noticing of unexpected objects and events.

The probability of inattentional blindness is influenced by different attributes of the unexpected object, such as size (Mack & Rock, 1998), colour (Koivisto, Hyönä, & Revonsuo, 2004), or semantic content (e.g., Calvillo & Jackson, 2013; Mack, Pappas, Silverman, & Gay, 2002) and by different situational factors such as physical exercise AQ1

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(Hüttermann & Memmert, 2012) or perceptual and cognitive load (Cartwright-Finch & Lavie, 2007; de Fockert & Bremner, 2011). In addition, noticing an unexpected object is dependent on whether it matches certain features of the attended objects such as colour or luminance (attentional set; Most, Scholl, Clifford, & Simons, 2005; Most et al., 2001).

One feature of the unexpected object that has received little research attention is its speed in dynamic inattentional blindness tasks. An exception in this respect is a study by Beanland and Pammer (2010), in which the unexpected object took either 5 s or 9 s to cross the display. The main interest, however, was to investigate pop-out effects resulting from the speed difference between the unexpected object and the other stimuli in the display and not the speed of the unexpected object itself. Thus, in the experimental set-up, the speed of the unexpected object varied with the speed difference between the unexpected object and the other stimuli in the display (attended and unattended objects): The stimuli moved at the same pace as the unexpected object in the slow condition and at a different pace to the unexpected object in the fast condition. The authors did not find a significant difference in inattentional blindness rates between the two conditions and concluded that speed difference did not have an impact on inattentional blindness (see also Simons & Jensen, 2009).

Although the speed of the unexpected object did not influence inattentional blindness in the study of Beanland and Pammer (2010), the speed of the attended items has been demonstrated to have a substantial influence on the inattentional blindness rates found (Simons & Jensen, 2009). However, to date no study has investigated noticing rates as a function of the speed of the unexpected object in a dynamic and sustained inattentional blindness task (Most, Simons, Scholl, & Chabris, 2000) when deviations in speed of the unexpected object from attended (and to be ignored) stimuli are kept constant. We attempted to fill this empirical gap to further enhance understanding of the underlying mechanisms of those failures of awareness.

EXPERIMENT 1

In Experiment 1, we created two versions of a dynamic inattentional blindness task: While the stimuli of the tracking task moved at the exact same speed in both conditions, the unexpected object moved 2.8° s^{-1} slower in the slow condition and correspondingly 2.8° s^{-1} faster in the fast condition. By keeping the deviation in speed constant for the slow and the fast unexpected object, we ruled out that either of them captured attention more strongly due to a pop-out effect. Hence, we could explore the effect of the speed of an unexpected object on noticing rates unconfounded by such a pop-out effect.

As is customary in this inattentional blindness paradigm, the unexpected object travelled across the whole width of the display and, thus, covered the same distance in both conditions. Consequentially, a difference in speed of the unexpected object concerned differences in two dimensions simultaneously: the speed itself and the amount of time the object was visible and could be detected. On the one hand, one might expect the speed itself to influence detection rates. Several distinct lines of research might provide indirect evidence supporting the possibility that a higher speed of an unexpected object captures attention in an inattentional blindness paradigm. First, from an evolutionary perspective (see Pratt, Radulescu, Guo, & Abrams, 2010, for a similar argumentation) one might assume that faster moving objects are more likely to capture attention than slower moving objects. Second, the speed of a transient has been shown to fundamentally influence the probability of change detection (Simons, Franconeri, & Reimer, 2000). That is, if changes are sufficiently gradual and slow they do not draw attention, go undetected, and, thus, elicit change blindness. A fast change, however, is detected instantaneously. Even though inattentional blindness and change blindness "are related but nevertheless distinct phenomena" (Rensink, 2000, p. 7), those findings from the change blindness literature might suggest that a faster unexpected object might be more salient and, as a consequence, should be detected with a higher probability. On the other hand, a slower unexpected object increases the time the participant is exposed to the unexpected object, allowing more time for detection.

If the speed of the unexpected object itself and the potential accompanying difference in saliency change the detectability of the object we would expect higher noticing rates in the fast condition than in the slow condition. If, however, the amount of time an unexpected object is visible is crucial for its detection we would expect higher noticing rates in the slow condition than in the fast condition.

Method

Participants

A total of 100 participants took part in Experiment 1. They were recruited from campus and received sweets for their participation. All participants reported normal or corrected-to-normal vision and gave written informed consent. Five participants were excluded from the analysis since they indicated in the follow-up questionnaire that they had anticipated the unexpected object or knew that inattentional blindness was the subject of the study. Thus, data from 95 participants were analysed ($M = 23.7$ years, $SD = 3.0$ years, 43.2% female). Neither age nor gender significantly influenced the inattentional blindness rates found. The study was carried out in accordance with the Helsinki Declaration of 1964 and its later amendments.

Materials and procedure

Participants signed a declaration of consent and were seated in front of a 24″ display (resolution: 1920 × 1080 pixels). A chin rest was used, which ensured that every participant viewed the stimuli from a distance of exactly 50 cm. The inattentional blindness task was programmed and run on Presentation (Neurobehavioral Systems, Berkeley, CA), and participants responded using a standard keyboard. Participants were tested alone or in pairs with dividers separating the two work spaces. Instructions were given on the screen prior to the task. Participants were randomly assigned to one of the two experimental conditions: slow unexpected object or fast unexpected object. After completion of the inattentional blindness task, participants filled out a questionnaire collecting demographics, anticipation of the unexpected object, and general knowledge about inattentional blindness. Finally, participants were debriefed.

The inattentional blindness task was adapted from Most et al. (2000). On each trial, four red (RGB: 255, 0, 0) and four blue (RGB: 0, 0, 255) T and L shapes ($1.15° \times 1.15°$) moved within a white window ($20.3° \times 15.2°$). The window was divided by a black horizontal line into two equal halves, and a small black fixation square was located centrally on the line. The stimuli moved on randomly chosen linear paths with a rate of $7.6°\ s^{-1}$ and changed direction randomly whenever they bounced against an edge of the window. Whenever two stimuli occluded each other the red stimuli covered the blue stimuli. Participants were instructed to fixate the central square and count the number of times the red stimuli touched or passed the line. After each trial, participants were prompted to type the total number of touches/crossings of the red stimuli. Each trial lasted for a total of 8900 ms with a 600-ms frozen start screen (for orientation) and a 300-ms frozen end screen (to facilitate ambiguous counting decisions at the end of the trial, i.e., if one or more of the letters were located near the middle line when the trial ended). Thus, the stimuli moved for 8000 ms.

Each participant first completed six practice trials. Three practice trials were at half speed, and stimuli moved at 3.8° per second. In the other three practice trials, stimuli moved at experimental speed. Participants then completed 16 experimental trials. The first 10 trials did not contain any unexpected events. The eleventh trial was a critical trial in which an unexpected light-grey cross ($0.9° \times 0.9°$; RGB: 228, 228, 228) moved horizontally from right to left through the window. For each participant it was randomly chosen if the cross moved 1.5° above or below the horizontal middle line. The cross appeared 2.9 s after stimuli had started moving and took 4 s to cross the window in the slow condition ($4.8°\ s^{-1}$) and 1.8 s to cross the window in the fast condition ($10.5°\ s^{-1}$). After reporting the number of touches/crossings, participants were prompted to answer if they had seen anything other than the eight letters in the previous trial that had not been present in the trials before. Independent of their answer, participants then had to choose whether the additional object had been above or below the middle line, and which colour (five choices) and which shape it had (six choices). They were instructed to guess if they had not noticed anything. After having answered the questions regarding the unexpected object, participants were instructed that the experiment would continue as before and that they should count the number of times the red stimuli touch/cross the middle line. Following three tracking trials (without an additional object and without questions about it) there was another trial in which the unexpected object appeared (divided-attention trial). For each participant it had the same speed as that in the critical trial but the position (above or below middle line) was again chosen randomly. After reporting the number of touches/crossings, participants were prompted with the exact same questions as those that had followed the critical trial. On the 16th and last trial, participants were instructed to focus on the fixation square but to attend the whole display, this time without counting the touches/crossings of the red stimuli (full-attention trial). Again, the grey cross moved horizontally from right to left with the same speed for each participant as before. Its position, however, was chosen randomly. Participants were prompted with questions identical to those presented before.

Results and discussion

To account for unpredictable variations in trial difficulty, counting performance was defined as correct when the response was within 10% of the exact count (rounding up). 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 two of the following three features of the unexpected object: position, colour, shape. All statistical analyses conducted were two-tailed.

The results of Experiment 1 are illustrated in Figure 1. Importantly, noticing rates of the unexpected object for the critical trial were significantly higher in the slow condition than in the fast condition, $\chi^2(1) = 5.50$, $p = .019$, risk ratio(slow/fast) = 1.58 [1.06, 2.36]. Consequently, individuals showed more inattentional blindness if the unexpected object moved faster and, thus, was present for a shorter amount of time. The same pattern was observable for the divided-attention trial, in which the additional object was not completely unexpected any more, but did not reach significance (slow: 83.7% notice, fast: 75.6% notice), $\chi^2(1) = 1.36$, $p = .24$, risk ratio(slow/fast) = 1.13 [0.92, 1.40]. In the full-attention trial, all 95 participants noticed the additional grey cross and correctly identified at least two of its features. 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.[1]

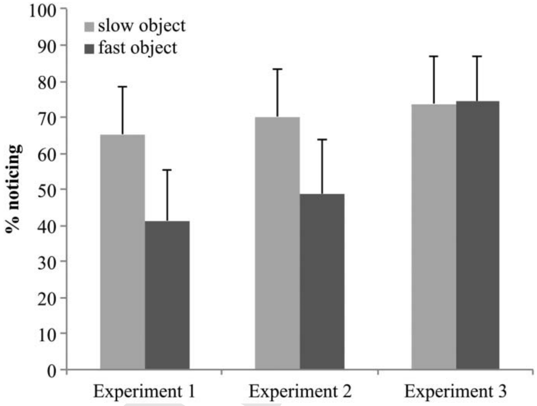

Figure 1. *Percentage of participants in the slow condition and in the fast condition who noticed the unexpected grey cross. Results are illustrated separately for Experiment 1, Experiment 2, and Experiment 3. The error bars display the 95% confidence interval for the proportions of noticing.*

The results of Experiment 1 suggest that the probability of inattentional blindness is influenced by the amount of time an observer has to detect the unexpected object. On the other hand, a faster unexpected object does not seem to possess a higher saliency that helps it to overcome the threshold of awareness. Importantly, the speed of

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[1] Additional exploratory analyses regarding performance on the primary task and position of the unexpected object and the raw data of all three experiments can be found on the Open Science Framework (https://osf.io/s4ae6/).

the slow and the fast unexpected object differed to the same extent from that of the other stimuli in the display: The slow unexpected object moved 2.8° s^{-1} slower than the stimuli of the primary task, while the fast unexpected object moved 2.8° s^{-1} faster than the stimuli of the primary task. Thus, the difference in detection rates should not be attributable to differentially strong potential pop-out effects in contrast to the other stimuli in the visual display. Admittedly, one potential flaw in this conclusion might arise from the fact that we equalized the speed difference in absolute terms. In relative terms, the fast unexpected object moved 1.4 times faster than the primary-task stimuli while the primary-task stimuli moved 1.6 times faster than the slow unexpected object. Thus, in relative terms, the speed difference between the unexpected object and the primary-task stimuli was higher in the slow condition than in the fast condition. Perception of speed follows Weber's law (e.g., Nover, Anderson, & DeAngelis, 2005; Zanker, 1995), and, therefore, the speed difference might have been more noticeable in the slow condition. Hence, our findings might be attributable to a pop-out effect after all. We addressed this potential confound in Experiment 2.

EXPERIMENT 2

In Experiment 1, participants noticed a slow unexpected object significantly more often than a fast unexpected object. In order to conclude that this effect is in fact driven by the amount of time the unexpected object is visible for, it is essential to thoroughly eliminate a pop-out explanation for the pattern of results in Experiment 1. While we equalized the speed difference between the unexpected object and the other stimuli in the display between conditions in absolute terms, a higher relative difference in speed might have made the unexpected object more salient in the slow condition of Experiment 1. To exclude this potential confound, we performed a second experiment in which we equalized the speed difference in the slow and the fast condition in relative instead of absolute terms. The stimuli of the tracking task moved at 7.6° s^{-1} in both conditions while the unexpected object moved at 4.8° s^{-1} in the slow condition and at 12.2° s^{-1} faster in the fast condition. Consequentially, the fast unexpected object moved 1.6 times faster than the primary-task stimuli, and the primary-task stimuli moved 1.6 times faster than the slow unexpected object. In this manner, we made sure that a difference in noticing rates between conditions cannot be attributed to a potential pop-out effect in Experiment 2. Based on the findings of Experiment 1, we hypothesized that the amount of time an unexpected object is visible is crucial for its detection and, thus, expected higher noticing rates in the slow condition than in the fast condition.

Method

Participants

A total of 100 participants took part in Experiment 2. They were recruited from campus and received sweets for their participation. All participants reported normal or corrected-to-normal vision and gave written informed consent. Nine participants were excluded from the analysis since they indicated in the follow-up questionnaire that they had anticipated the unexpected object or knew that inattentional blindness was the subject of the study. Additionally, one participant did not notice the additional object in the full-attention trial (did not report to have seen it or was unable to correctly identify at least two of its three features). As is common procedure in the inattentional blindness literature, this participant was excluded from the analysis. If the additional object is not noticed in a control condition in which the primary task does not distract attention, the participant potentially did not follow task instructions or has basal visual problems. Data from the remaining 90 participants were analysed ($M = 24.5$ years, $SD = 3.4$ years, 50.0% female). Neither age nor gender significantly influenced the inattentional blindness rates found. The study was carried out in accordance with the Helsinki Declaration of 1964 and its later amendments.

Materials and procedure

Materials and procedure for Experiment 2 were identical to those of Experiment 1. The only deviation concerns the speed of the unexpected object: The cross appeared 2.9 s after the stimuli had started moving and took 4 s to cross the window in the slow condition (4.8° s^{-1}) and 1.6 s to cross the window in the fast condition (12.2° s^{-1}).

Results and discussion

Parallel to Experiment 1, counting performance was defined as correct when the response was within 10% of the exact count (rounding up). 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 two of the following three features of the unexpected object: position, colour, shape. All statistical analyses conducted were two-tailed.

The results of Experiment 2 are illustrated in Figure 1. Replicating the findings of Experiment 1, noticing rates in the critical trial were significantly higher in the slow condition than in the fast condition, $\chi^2(1) = 4.28$, $p = .039$, risk ratio (slow/fast) = 1.44 [1.00, 2.06]. Thus, we again found more inattentional blindness if the unexpected object moved faster and, therefore, was present for a shorter amount of time. This pattern was not evident in the divided-attention trial this time (slow: 74.4% notice, fast: 83.7% notice), $\chi^2(1) = 1.15$, $p = .28$, risk ratio(slow/fast) = 0.89 [0.72, 1.10]. All of the 90 participants that were included in the analysis noticed the additional grey cross when their attention was not diverted by the tracking task (full-attention trial). Hence, missing the unexpected object in the critical trial or the divided-attention trial cannot be attributed to basal visual problems or a poor contrast.

The results of Experiment 2 replicate those of Experiment 1 and demonstrate that the magnitude of inattentional blindness is higher for a fast unexpected object than for a slow unexpected object. Combined, Experiments 1 and 2 rule out the possibility that these findings stem from a stronger pop-out effect due to a higher speed difference between the unexpected object and the primary-task stimuli in the slow condition. If a higher motion speed led to a higher saliency of the unexpected object, we should have found higher noticing rates for the fast unexpected object. And while we can infer that a higher motion speed does not draw attention effectively (or at least not more efficiently than a longer duration of presentation does), the two dimensions of motion speed and exposure time are still entangled: Although exposure time is the most intuitive explanation for the findings obtained in Experiments 1 and 2, it is equally likely that the slower unexpected object was more salient than the fast unexpected object and, thus, captured attention due to its speed. We addressed this alternative explanation in a third experiment.

EXPERIMENT 3

In Experiments 1 and 2 the speed of the unexpected object covaried with the duration of exposure. This was due to the fact that the unexpected object, as is customary in this inattentional blindness paradigm, crossed the display once and, thus, covered the same distance in both conditions. To manipulate the motion speed and equate the duration of exposure at the same time, the unexpected object has to cover a larger distance in the fast condition than in the slow condition. However, it might be problematic to have the unexpected object appear or disappear at different locations in the two conditions since this would create transients at varying distances from fixation. Potentially, the sudden appearance or disappearance of an object would draw more attention near fixation. Thus, such a difference between conditions has to be avoided in order to circumvent another covarying confounding factor.

In Experiment 3 we controlled for the duration of exposure and the location of the transients. The unexpected object crossed the width of the display once in the slow condition and travelled back and forth in the fast condition. The unexpected object was twice as fast in the fast condition than in the slow condition, and, thus, the exposure time was exactly the same for the two conditions. If it is indeed the amount of time an unexpected object is visible that is crucial for the likelihood of its detection, there should be no difference in noticing rates between the slow and the fast condition in Experiment 3. If, however, the effect in Experiment 1 and 2 was due to increased attentional capture by a slower motion speed, then the slow condition should yield higher noticing rates than the fast condition in Experiment 3.

Method

Participants

We tested another 100 participants for Experiment 3. They were recruited from campus and received sweets for their participation. Two participants did not report normal or corrected-to-normal vision and, thus, were excluded from the analysis. An additional nine participants were excluded from the analysis because they indicated in the follow-up questionnaire that they had anticipated the unexpected object or knew that inattentional blindness was the subject of the study. Data from the remaining 89 participants were analysed ($M = 22.51$ years, $SD = 3.3$ years, 37.1% female). Neither age nor gender significantly influenced the inattentional blindness rates found. All participants gave written informed consent, and the study was carried out in accordance with the Helsinki Declaration of 1964 and its later amendments.

Materials and procedure

Materials and procedure of Experiment 3 were identical to those of Experiment 1. The only deviation concerned the unexpected object: The cross appeared 2.9 s after the stimuli had started moving and was visible in the display for 3.5 s in both the slow and the fast condition. The cross moved at a speed of $5.4^\circ\ \mathrm{s}^{-1}$ in the slow condition and at a speed of $10.8^\circ\ \mathrm{s}^{-1}$ in the fast condition. In the slow condition, the cross travelled the width of the display once. The directionality was counterbalanced between participants: For half the participants the cross moved from right to left, and for half the participants it moved from left to right. In the fast condition, the cross travelled the width of the display twice, thus, moved back and forth.

The chosen speed values ensured that (a) the fast object moved exactly twice as fast as the slow object since the fast object had to cover the double distance, and (b) the speed difference in relation to the primary-task stimuli ($7.6^\circ\ \mathrm{s}^{-1}$) was identical for the slow and the fast unexpected object in relative terms (1.4 times faster). Thus, we again ruled out varying pop-out effects of the unexpected object between conditions.

Results and discussion

Parallel to Experiments 1 and 2, counting performance was defined as correct when the response was within 10% of the exact count (rounding up). 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 two of the following three features of the unexpected object: position, colour, shape. All statistical analyses conducted were two-tailed.

The results of Experiment 3 are illustrated in Figure 1. Noticing rates in the critical trial did not differ between the slow condition and the fast condition, $\chi^2(1) = 0.01$, $p = .94$, risk ratio(slow/fast) = 0.99 [0.78, 1.27]. Actually, noticing rates were nearly identical for the two conditions (slow: 73.8%, fast: 74.5%). Thus, if the exposure time is kept constant between a slow and a fast unexpected object there is no difference in inattentional blindness rates. A slow-moving object does not seem to capture attention more effectively than a faster unexpected object. The same pattern was evident in the divided-attention trial (slow: 85.7% notice, fast: 89.4% notice), $\chi^2(1) = 0.27$, $p = .60$, risk ratio (slow/fast) = 0.96 [0.82, 1.12]. All of the 89 participants that were included in the analysis noticed the additional grey cross in the full-attention trial. Hence, again, missing the unexpected object in the critical trial or the divided-attention trial cannot be attributed to basal visual problems or a poor contrast.

GENERAL DISCUSSION

The central aim of the present study was to test whether the speed of an unexpected object influences noticing rates in an inattentional blindness task when deviations from the speed of the attended stimuli are controlled for. We found that, if the travel distance is kept constant, an unexpected object that moves fast across the display is missed more often, and thus creates higher inattentional blindness rates, than a slower unexpected object. The participants were approximately 1.6 times more likely to notice the slow cross than to notice the fast cross (Experiments 1 and 2).

A previous study that also manipulated the speed of the unexpected object did not find a significant difference between a slow and a fast condition (9 versus 5 s; Beanland & Pammer, 2010). In this experimental set-up, however, the absolute speed of the unexpected object varied with the speed difference between the unexpected object and the other stimuli in the display: The unexpected object in the fast condition moved faster than the other stimuli in the display, whereas the unexpected object in the slow condition moved at the same pace as the other stimuli in the display. We suggest that there might have actually been the hypothesized pop-out effect of the fast object, which led to higher noticing rates. But, in addition, there also might have been higher noticing rates for the slow object as it was visible in the display for longer. These two effects might have cancelled each other out, leading to similar noticing rates for both the slow and the fast object.

In the present study, we controlled for a possible confounding factor that might have been induced by speed differences between the unexpected object and the other stimuli in the display by keeping the speed difference constant across both experimental conditions. The slow unexpected object was noticed significantly more often than the fast unexpected object when we controlled for the speed difference in absolute terms (Experiment 1). This finding was replicated in Experiment 2 in which we controlled for the speed difference in relative terms.

In both Experiments 1 and 2 the dimensions of motion speed and exposure time were closely entangled because the unexpected objects covered the same distance in both experimental conditions. We found that the slow unexpected object was noticed more often than the fast unexpected object and, thus, can conclude that a faster unexpected object does not capture attention more effectively than a slower object. Rather, it is either the higher exposure time of the slow object that leads to increased noticing rates or a slow unexpected object draws attention more readily than a fast unexpected object. In Experiment 3 we equated the exposure times of the slow and the fast unexpected object. There was no difference in noticing rates between the slow and the fast unexpected object then. We can conclude that it is not the motion speed that influences the probability of inattentional blindness as a slow unexpected object did not have a unique ability to capture attention.

Taking all three experiments together, we show that the probability of noticing an unexpected object is primarily dependent on the time one has to detect it and not on its speed. This finding is striking considering that motion transients have been shown to be highly related to attentional capture (Abrams & Christ, 2003; Kawahara, Yanase, & Kitazaki, 2012) and change detection (Simons, 2000). Gradual transients produce very powerful change blindness in contrast to faster and more abrupt changes in a scene (Simons et al., 2000). Thus, change detection is strongly influenced by the speed of the occurring change. Also, from an evolutionary point of view, it seems beneficial to especially notice those unexpected objects or creatures that are moving quickly, possibly approaching you. Although recent evidence from both attentional capture (Pratt et al., 2010) and inattentional blindness studies (Calvillo & Jackson, 2014; New & German, 2014) has suggested that some evolutionary significant stimulus features do indeed have the potential to capture attention, the present data suggest that the speed of an unexpected object does not affect the likelihood that the object crosses the threshold of conscious awareness and is noticed. There is no attentional capture by speed that amplifies the probability of conscious perception in the absence of expectations—that is, in an inattentional blindness setting. Instead, the dominant factor in noticing unexpected objects seems to be the amount of time available to detect the unexpected object.

Eye movements and the number of times an individual fixates the unexpected object are not valid predictors for its conscious detection (Beanland & Pammer, 2010; Koivisto et al., 2004; Memmert, 2006). Thus, overt attentional shifts do not account for individual differences in inattentional blindness. However, covert attentional shifts can occur independently from overt attentional shifts (Newby & Rock, 1998; Posner, 1980). We suggest that noticing or missing the unexpected object depends on random variations in covert attentional allocation. If this assumption is valid, the chance that covert attention shifts towards the unexpected object or to the area in which the unexpected object is located increases with the duration the unexpected object is present within the display. Hence, the longer an unexpected object is visible, the more time is available for covert attention to coincidentally catch it, and the lower is the overall probability of inattentional blindness. Inattentional blindness is highly dependent on various situational and stimulus parameters that determine the probability that an unexpected object captures attention and is noticed consciously (e.g., Calvillo & Jackson, 2014; Most et al., 2000, 2001). If, however, all those parameters are kept constant, individual differences in noticing might to some extent depend on random variations in spatial attentional distribution, or even random neuronal fluctuations (Dehaene & Changeux, 2005). Note that we did not adjust the difficulty of the primary task for each participant as individual differences in the ability to meet the demands of the primary task do not affect inattentional blindness rates (Simons & Jensen, 2009). Further, individual differences in speed perception were not the focus of the presented study and, due to the random allocation of participants to the respective experimental groups, should not have systematically influenced the findings.

An alternative explanation for our findings might be derived from the fact that the attended stimuli moved randomly around the display. This implies that, with longer exposure time to the unexpected object, there was a greater probability that an attended stimulus appeared close to the unexpected object. This might contribute to the higher noticing rates of the slow unexpected object. We cannot distinguish whether the participants tracked the targets constantly or whether they rather constantly attended to the middle line or whether there was a mixed strategy. Irrespective of that, the present data suggest in tandem with previous findings that the probability of inattentional blindness is mainly dependent on stimulus factors and/or the situational context (this would include the stimulus duration and also the potential difference in duration near the attentional focus).

In conclusion, the presented findings contribute to the growing body of literature specifying the stimulus attributes and situational conditions that influence the probability of inattentional blindness. Inattentional blindness studies are usually conducted with an arbitrary unexpected-object duration, and the present results might raise awareness to the fact that this variable can indeed affect the inattentional blindness rates found. In addition, the present findings are important as they contrast with previous research that did not find an effect of speed when speed covaried with a potential pop-out effect (Beanland & Pammer, 2010). Most importantly, though, the present paper adds to the clarification of the underlying mechanisms of inattentional blindness. And as to practical implications: Inattentional blindness is long acknowledged to be a phenomenon with widespread every-day life and safety consequences (Chabris et al., 2011; Drew, Vo, & Wolfe, 2013; Hyman, Boss, Wise, McKenzie, & Caggiano, 2010). Thus, each variable that is found to influence the probability of inattentional blindness might one day play a valuable role in the circumvention of this failure of awareness. Based on our findings, we suggest: If you want to be seen, be persistent not quick.

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