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The costs (or benefits) associated with attended objects do little to influence inattentional blindness

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ABSTRACT

We sometimes fail to notice unexpected objects or events when our attention is directed elsewhere, a phenomenon called inattentional blindness. We explored whether unexpected objects that shared the color of consequential objects would be noticed more often. In three pre-registered experiments, participants played a custom video game in which they avoided both low- and high-cost missiles (Experiment 1 and 2) or tried to hit rewarding missiles while avoiding costly ones (Experiment 3). After participants had played the game for about 8 min, an unexpected object moved across the screen. Although participants selectively avoided more costly missiles when playing, they were no more likely to notice an unexpected object when its color was associated with greater costs. Apparently, people are no more likely to notice unexpected objects that are associated with negative consequences. Future research should examine whether objects that are themselves consequential are noticed more frequently.

1. Introduction

In 2014, home security camera footage captured a couple walking out of their home as a bear approached them, stopped, and then stood approximately 10 ft away, directly in the husband's line of sight. Neither noticed it. Fortunately, the couple survived mostly unscathed (Huffington Post, 2014), but this and other real-world cases of inattentional blindness (e.g., looked-but-failed-to-see automobile crashes), can have consequences. For example, a Boston police officer was convicted of perjury and obstruction of justice for claiming not to have witnessed a beating when he plausibly could have experienced inattentional blindness (Lehr, 2009).

Inattentional blindness—the failure to notice unexpected objects or events when attention is otherwise occupied—has been observed in a wide range of contexts: during simple computer tasks (e.g., Mack & Rock, 1998), in videos (e.g., Simons & Chabris, 1999), while driving in a simulator (Most & Astur, 2007; Strayer, Drews, & Johnston, 2003), during real-world experiments (Chabris, Weinberger, Fontaine, & Simons, 2011), and in observational studies of typical behavior (Hyman, Boss, Wise, McKenzie, & Caggiano, 2010). Noticing rates for unexpected objects vary with the age of the observer (Graham & Burke, 2011; Stothart, Boot, & Simons, 2015; Stothart, Boot, Simons, Charness, & Wright, 2016), the salience of the object, and how well the object matches the observer's goals and attention set (Most, Scholl, Clifford, & Simons, 2005). Yet, anecdotes like the unexpected bear and looked-but-failed-to-see crashes suggest that even objects that pose a direct threat or risk to people might go unnoticed. Despite this suggestive evidence, few studies have explored whether the risk or threat of an unexpected object increases the likelihood of noticing it.

Several studies have examined whether evolutionarily-relevant threats (e.g., spiders and snakes) are noticed more than non-threatening objects or threatening objects that were not evolutionarily-relevant (e.g., guns and needles; Wiemer, Gerdes, & Pauili, 2013; New & German, 2015; Calvillo & Hawkins, 2016). Some found higher noticing rates for threatening objects (New & German, 2015), but others did not (Wiemer et al., 2013; Calvillo & Hawkins, 2016). Yet, in all cases, the unexpected object was a picture of a threatening or non-threatening object, and participants knew that nothing about the displays they viewed could affect them.

Although a laboratory study cannot put participants in physical danger from an unexpected object, they can vary whether an unexpected object has consequences for task performance. However, making the unexpected object task-relevant potentially changes the nature of the primary task. So, we varied whether the features of the unexpected object matched those of task-relevant objects. Specifically, we varied whether the color of the unexpected object matched that of other

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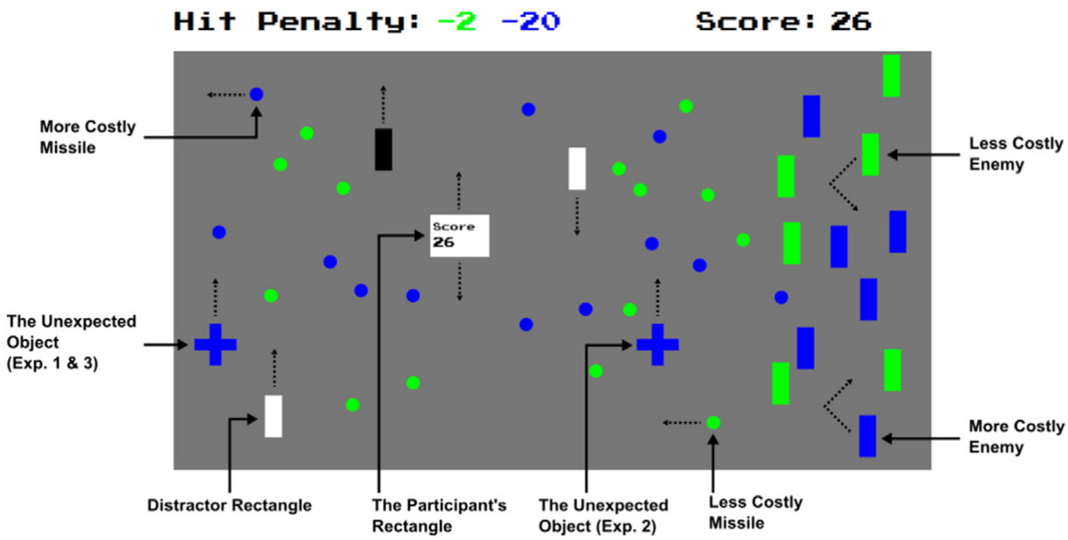

Fig. 1. Illustration of the video game. Both versions of the game can be played at http://www.cary-stothart.net/files/mean-rectangles.html and http://www.cary-stothart.net/files/mean-nice-rectangles.html. The highest score participants achieved was 882, 898, and 1120 for Experiments 1, 2, and 3, respectively.

objects in the display that themselves varied in their consequences for task performance.

In three pre-registered experiments, we examined the role of such associated consequences on inattentional blindness with a custom-designed video game in which participants tried to dodge enemy missiles of varying cost or dodge enemy missiles while hitting "friendly" ones. On a critical trial, we introduced an unexpected object that matched the color of the low cost, high cost, or reward missiles. This design allowed us to measure whether unexpected objects whose color matched more costly objects would be noticed more frequently. Unlike earlier studies that compared noticing rates for threatening objects to non-threatening ones, our unexpected objects varied only in color. With appropriate counterbalancing, the inherent features of the stimuli themselves cannot explain overall differences in noticing rates.

In Experiments 1 and 2, the game featured enemy missiles that varied in their costs. We examined whether people were more likely to notice an unexpected object if its color matched the more costly missiles. In Experiment 3, the game featured both enemy and friendly missiles to determine whether people would be more likely to notice unexpected objects associated with cost than ones associated with reward. All three experiments also included a baseline "neutral" condition in which the unexpected object matched neither the enemy nor friendly missiles. Finally, we explored whether the spatial proximity of the unexpected object interacted with consequentialness: The unexpected

Table 1
The characteristics of the objects in the game.

Object	Size (px)	Color	Speed (px/s)
Game display	900 × 500	Gray	N/A
Participant's rectangle	70 × 50	White	180
Missiles	8 (radius)	Yellow, green, or blue	Exp. 1 & 2: 240; Exp. 3: 360
Enemies and friends	20 × 50	Yellow, green, or blue	60
Distractor rectangles	20 × 50	White or black	180
Unexpected object	50 × 50	Yellow, green, or blue	180

Table 2
The number and percentage of participants matching each exclusion criterion in each experiment. Note that participants could be excluded for multiple reasons (see our preregistration for a full description of the exclusion rules).

Exclusion rule	Exp. 1	Exp. 2	Exp. 3	All
Previous participation in current study	33 3.99%	33 3.70%	33 3.94%	99 3.87%
Reported not having normal or corrected-to-normal vision	64 7.73%	57 6.39%	61 7.29%	182 7.12%
Failed the colorblindness test	24 2.90%	22 2.47%	13 1.55%	59 2.31%
Failed an attention test	41 4.95%	42 4.71%	44 5.26%	127 4.97%
Entered a nonsensical response for one of the open response questions or reported that the task did not work correctly	65 7.85%	38 4.26%	51 6.09%	154 6.02%
Failed to follow instructions	96 11.59%	109 12.22%	20 2.39%	225 8.80%
Participated in previous experiment	0 0%	100 11.21%	69 8.24%	169 6.61%
Total tested	828	892	837	2557
Total excluded	252	297	238	787