Consciousness and Cognition xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

Review article

Inattentional blindness on the full-attention trial: Are we throwing out the baby with the bathwater?

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ARTICLE INFO

Keywords:
Attentional set
Data screening
Exclusion criterion
Forced-choice display
Full-attention trial
Inattentional blindness

ABSTRACT

When attention is otherwise engaged, observers may experience *inattentional blindness*, failing to notice objects or events that are presented in plain sight. In an inattentional blindness experiment, an unexpected stimulus is presented alongside primary-task stimuli, and its detection is probed. We evaluate a criterion that is commonly used to exclude observers from the data analysis. On the final experimental trial, observers do not perform the primary task, but instead look for anything new. Observers who fail to report the unexpected stimulus on this *full-attention trial* are excluded. On the basis of 4 hypothetical experiments and a review of 128 actual experiments from the literature, we demonstrate some potentially problematic consequences of implementing the full-attention-trial exclusion criterion. Excluded observers may cluster in experimental conditions and the exclusion criterion may lead researchers to understate the pervasiveness of inattentional blindness. It may even render us *blind* to *inattentional* blindness on the *full-attention* trial.

1. Introduction

When an observer's attention is taken up with a task, she may fail to notice an unexpected stimulus (an object or event) that is presented in plain sight (Neisser & Becklen, 1975) and precisely where her attention is directed as she carries out her task. Real-world examples of inattentional blindness can be amusing (e.g., failing to notice a friend who is waving to capture one's attention; Simons, 2010) or they can be devastating (e.g., failing to notice an obstacle in the path of one's car; Most & Astur, 2007). Therefore considerable importance attaches to research that advances our understanding of this striking phenomenon.

In most inattentional blindness experiments, following trials in which the observer's attention is engaged by a task, there is a final *full-attention trial*, which is treated as a control trial. Observers who do not notice the unexpected stimulus even on this control trial are excluded from subsequent data analysis. This is the *full-attention-trial exclusion criterion*. We shall argue, first, that this exclusion criterion is potentially problematic. Some differences in reported rates of inattentional blindness in the literature (differences between experiments or differences between conditions within a single experiment) may reflect the exclusion criterion, rather than being explained by the experimenter's theoretically motivated manipulations.

Failures of noticing on the full-attention trial sometimes cluster in experimental conditions that produce high rates of inattentional blindness on the critical trial. We shall argue, second, that these failures of noticing may be evidence, not of the need to exclude

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https://doi.org/10.1016/j.concog.2017.10.002
Received 1 June 2017; Received in revised form 31 August 2017; Accepted 1 October 2017

observers, but of something theoretically more interesting – a form of genuine inattentional blindness on the full-attention trial (paradoxical though that may sound). Investigating how, and in which experimental paradigms and conditions, this continued failure to notice the unexpected stimulus arises, may enhance our understanding of inattentional blindness itself.

To demonstrate the potentially problematic implications of implementing the full-attention-trial exclusion criterion, we shall present four hypothetical experiments (Section 4). To support the suggestion that some failures of noticing on the full-attention trial result from continuing inattentional blindness, we shall provide an account of how this might arise (Section 5). We have also compiled a table with 128 actual experiments (57 studies) from the inattentional blindness literature, detailing the structure of the trials used in these studies and the percentage of observers excluded from each experiment on the basis of the full-attention trial. The table includes, for each experiment, an indicative maximum percentage of observers excluded from a condition if (hypothetically) all the observers excluded from the experiment clustered in a single condition (Section 3).

We outline the potential problems with the full-attention-trial exclusion criterion, and argue for the possibility of inattentional blindness on the full-attention trial, in the hope that this will stimulate further discussion among researchers. For readers who are less familiar with inattentional blindness, we preface our discussion with a brief review of the methods used for investigating inattentional blindness.

2. Inattentional blindness experiments

2.1. Static and dynamic paradigms

Static inattentional blindness paradigms involve primary tasks with brief presentation times, ranging from approximately 200 ms (Mack & Rock, 1998) to 1000 ms (Koivisto & Revonsuo, 2007). The observer performs a detection or discrimination task. In Mack and Rock's (1998) pioneering inattentional blindness experiments, the primary task was to discriminate the longer arm of a briefly-presented cross. The unexpected stimulus was a simple geometric shape (e.g., a small square), which was presented alongside the cross for 200 ms. Depending on the location of the unexpected geometric shape in the display, it went undetected by as many as 80% of observers (see also Mack & Rock, 1999).

Dynamic inattentional blindness paradigms involve primary tasks with longer presentation times, ranging from approximately 8 s (Simons & Jensen, 2009) to 75 s (Simons & Chabris, 1999). The observer performs a visual-tracking task (see Most, Scholl, Clifford, & Simons, 2005; Most et al., 2001; Simons & Chabris, 1999). In what is arguably the best-known inattentional blindness study (Simons & Chabris, see Neisser & Becklen, 1975 who inspired the paradigm), observers watched a video depicting two teams of basketball players passing a ball. The two teams could be distinguished from one another by the colour of their t-shirts – white or black. The task was to count the number of passes made by one of the two teams, as specified by the experimenter. In the easy version of the task, the observer kept a single count of passes, including bounce passes and aerial passes, and in the hard version of the task, the observer kept separate counts of bounce passes and of aerial passes. In one version of the video, the unexpected event was a person, dressed in a gorilla suit, walking through the centre of the action, remaining clearly visible for 5 s. Rates of inattentional blindness varied, depending on which team's passes were to be counted and on the level of difficulty of the counting task. When observers were doing the easy version of the task, the 'gorilla' went undetected by 58% of observers attending to the team wearing white t-shirts and by 17% of observers attending to the team wearing black t-shirts. For observers attending to the team wearing black t-shirts and doing the hard version of the task, the rate of inattentional blindness increased from 17% to 42%. This latter difference is consistent with explanations for inattentional blindness based on the demands of the primary task (e.g., Cartwright-Finch & Lavie, 2007; White & Aimola Davies, 2008).

Most et al. (2001; see also 2005) incorporated many features of Simons and Chabris' (1999) experiment in a computer-based dynamic paradigm. Black and white Ls and Ts moved around a display (with a grey background), occasionally bouncing off the edges of the display window. The primary task was to count the bounces made by the letters of one colour (either black or white) during a 15-s trial. Letters of the other colour were *distractors* and could be ignored. The unexpected stimulus was a cross (the same size as the letters), which moved across the display, remaining visible for 5 s. Of 16 observers whose task was to count the bounces by the *white* letters, 15 (94%) failed to notice a *black* cross as it moved across the display. In contrast, only one of 16 observers (6%) whose task was to count the bounces by the *black* letters failed to notice the *black* cross. When primary-task stimuli include distractors as well as targets, observers are much less likely to notice an unexpected stimulus that is similar to the distractors (and so is *incongruent* with the observers' attentional set) than an unexpected stimulus that is similar to the targets (and so is *congruent* with the observers' attentional set).

2.2. The unexpected stimulus: Critical trial, divided-attention trial, full-attention trial

In some studies, there is only one trial of the primary task, and the unexpected stimulus is presented on this trial (e.g., the gorilla: Simons & Chabris, 1999). But in the majority of studies, there are at least two (pre-critical) trials of the primary task before the unexpected stimulus is presented. Following these pre-critical trials, the unexpected stimulus may be presented once (i.e., on the critical trial), twice (i.e., on the critical and full-attention trials), or three times (i.e., on the critical, divided-attention, and full-attention trials).

The first trial with an unexpected stimulus is referred to as the *critical trial* or the critical-inattention trial. Following this trial, the experimenter assesses whether the unexpected stimulus was noticed, by asking the observer a standard set of questions. For example, in Mack and Rock's (1998) experiment in which the primary task was to discriminate the longer arm of a briefly-presented cross,