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Short Communication

The gap between inattentional blindness and attentional misdirection[☆]Daniel Memmert^{*}

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ABSTRACT

Kuhn and colleagues described a novel attentional misdirection approach (deliberate diversion of attention away from a visually salient stimulus) to investigate overt and covert attention mechanisms in connection with inattentional blindness (not being able to perceive something that is plainly visible because one's attention has not been focused on it). This misdirection paradigm is valuable to study the temporal relationship between eye movements and visual awareness. Although, as put forth in this comment, the link between attentional misdirection and inattentional blindness needs to be developed further. There are at least four differences between the two paradigms which concern the conceptual aspects of the unexpected object and the methodological aspects of the task design. This highlights the need for a broader theoretical framework incorporating inattentional blindness and overt and covert attention mechanisms. Two possible research lines focusing on the orienting attention research and the "selection-for-action" paradigm are discussed.

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1. Introduction

Kuhn and colleagues examined in a series of interesting experiments how misdirection can prevent observers from perceiving an unexpected salient object (Kuhn, Amlani, & Resnsink, 2008; Kuhn & Tatler, 2005; Kuhn, Tatler, Findlay, & Cole, 2008). They described a novel experimental method to investigate overt and covert attention mechanisms in an ecologically valid situation by showing observers a magic trick in which the magician made an obviously visually salient lighter and a cigarette disappear by manipulating the attentional focus of the observers (e.g., moving the arm/head in the opposite direction).¹ For example, in one of the standard video clips by Kuhn and colleagues, a magician makes both a lighter and a cigarette disappear by intentionally misdirecting the attentional focus of the observer away from his hand (besides covering the objects with this hand) from which he drops both of the objects into his lap. In this way the magician draws attention away from the hand that is relevant for the trick towards the hand that is not relevant. With that misdirection paradigm Kuhn and colleagues can investigate the link between fixation and visual awareness.

Kuhn and colleagues stated in a number of publications that the misdirection trick is analogous to inattentional blindness (Kuhn, Amlani, et al., 2008; Kuhn & Tatler, 2005; Kuhn, Tatler, et al., 2008). For example: "The misdirection employed by magicians parallels inattentional-blindness paradigms" (Kuhn & Tatler, 2005, p. 1156), "our chosen magic trick employs similar principles to those used in recent inattentional-blindness studies" (Kuhn & Tatler, 2005, p. 1156), or "this misdirection trick is analogous to inattentional blindness" (Kuhn & Findlay, in press). In this comment we will argue that the link between the attentional misdirection paradigm and the inattentional blindness paradigm needs to be developed further.

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¹ Overt attention processes imply that visible shifts of attention are taking place, which is generally monitored by eye tracking. Covert attention processes aim at capturing non-visible (cannot be measured by eye tracking) allocations of attention (for a discussion, see Findlay, 2004; Henderson, 2003).

For this purpose a definition of the “inattentional blindness” paradigm is needed: “When attention is diverted to another object or task, observers often fail to perceive an unexpected object, even if it appears at fixation – a phenomenon termed inattentional blindness” (Mack & Rock, 1998, p. 14). For example, in the famous video clip by Simons and Chabris (1999), the observers had to watch a basketball game involving six players, three wearing a white shirt and three wearing a black shirt. They were instructed to watch only the players in black and to count the number of passes and bounces made by the attended team. Because of this attention-demanding counting-task, many observers failed to perceive the unexpected gorilla walking straight through the scene. Without this attention-demanding counting-task, nearly all participants noticed the unexpected object in the same video clip. The major finding is that conscious perception seems to require attention (Becklen & Cervone, 1983; Mack & Rock, 1998; Neisser & Becklen, 1975, see also Most, Scholl, Clifford, & Simons, 2005).

There are at least four differences between the attentional misdirection and inattentional blindness paradigm. These differences concern conceptual and methodological aspects that show that extreme caution is required when comparing theoretical discussions and empirical evidence. To state it clearly here, the attentional misdirection paradigm is by itself valuable to explore the relationship between overt and covert attention. Nevertheless we will argue why one has to be careful comparing the two paradigms. Four differences between these paradigms will be discussed one by one in the following paragraphs. The first three disconnections raise possibilities suggesting how inattentional blindness might be a different phenomenon than attentional misdirection. The fourth disconnection focuses more on the type of stimulus material used in both paradigms.

2. Four arguments for the disconnection between attentional misdirection and inattentional blindness

2.1. Disconnection 1: definition of unexpected object – foreshadowing vs. no foreshadowing

In the attentional misdirection paradigm, observers might anticipate an unexpected event (e.g., drop of the cigarette) because they know they are watching a magician perform a magic trick, whereas they do not expect to perceive unexpected objects in the inattentional blindness paradigm while performing a task. For example, in the aforementioned study by Mack and Rock (1998), the participants were asked to judge which of the two arms of a briefly displayed cross is longer. In the critical trial, nobody anticipated an unexpected object in the form of a geometric shape which appeared at a nearby position for the same duration. The same is true for the participants of Simons and Chabris' (1999) famous basketball experiments, who did not expect a man in a gorilla suit or a woman with an umbrella moving through the group while they counting the number of passes made between three basketball players. Thus, the conceptualization of the unexpected object in the attentional misdirection and inattentional blindness paradigm differ to a certain degree. This argument concerns the mind-set (=what the participants think that will happen next) of the observers. The significant role of the mind-set in perceiving unexpected objects could be revealed under laboratory conditions (Most et al., 2005) and in realistic scenarios (Most & Astur, 2007).

To sum up, the first disconnection concerns the fact that both paradigms differ concerning the foreshadowing or no-foreshadowing of the unexpected object by the participants. This raises questions on the specific overt and covert attention mechanisms present in both paradigms.

2.2. Disconnection 2: control task – no control vs. control

The inattentional blindness paradigm includes a full-attention trial in order to ensure that all participants perceive the unexpected object without the primary attention-demanding task. In this full-attention trial the participants were told to simply watch the screen without performing the primary attention-demanding task (e.g., counting the passes in the gorilla video). Observers who failed to report the unexpected object in this trial were rejected from the data analysis. The full-attention trial can be seen as a kind of control task for two reasons: first, it can be used to ensure that the participants followed task instructions, and second, that the participants consciously noticed the unexpected object under full-attention conditions. A full-attention trial does not exist in the misdirection paradigm. Therefore, it remains unclear if the observers perceive the unexpected object under full-attention conditions without misdirection.

On the whole, the difference between having a control condition vs. having no control condition creates an important difference between the two paradigms. This distinction has to be taken into consideration if one attempts to compare and discuss results from both paradigms concerning the relationship between fixation and detection.

2.3. Disconnection 3: attentional workload of the task – no distractor vs. distractor

In the attentional misdirection paradigm there is no primary attention-demanding task (“distractor task”) in contrast to the inattentional blindness paradigm (e.g., counting passes in the gorilla video). Hence it remains unclear how much conscious overt attention the participants employ on the whole task during the magic trick. This point was recognized by Kuhn and Findlay (in press) as well. “In the misdirection trick, participants' attentional resources are constrained through the systematic, but implicit orchestration of attention”. In this context, the attention demanding primary task in the inattentional blindness paradigm does not necessarily lead to a kind of attentional misdirection. For example, a series of studies used a

dynamic monitoring inattentional blindness task by Most, Simons, Scholl and Chabris (2000), in which the participants had to count the total number of times that letters cross a horizontal line in the middle of a display. During a critical trial, an unexpected object moved horizontally over different distances (on-line, near, far, very far) from the line passing through the center of the display. Less than half the observers noticed the unexpected object, even though the object always stayed on what was presumably the focus of attention and was clearly visible for 5 s.

In this experimental setting of the inattentional blindness paradigm, the unexpected object appeared in the area of focal attention of the participants. In the attentional misdirection paradigm by Kuhn and colleagues, the unexpected object (e.g., drop of a cigarette) was not directly in the attentional focus of the observers because the magician drew the observers' attention away from the cigarette. Thus, the drop of the cigarette was indeed unexpected but not according to the definition of inattentional blindness at fixation of the observers (see Mack & Rock, 1998, p. 14). In two experiments, Koivisto, Hyönä, and Revonsuo (2004) and Memmert (2006) demonstrate this point empirically. They show that no time differences in holding fixation on the unexpected object were evident between the subjects who perceived this object and the ones who did not perceive it. For the misdirection task, the critical event is transient (e.g., the drop) rather than sustained, and the critical object (e.g., a cigarette) is absent rather than present.

To sum up, the inattentional blindness paradigm includes a distractor in the form of a primary task while there is no distractor task in the misdirection paradigm because no demanding primary task is given. This manipulation allows for experimental control over the amount of attention deployed by the participants in the inattentional blindness paradigm (by varying the difficulty of the primary task) and not in the misdirection paradigm. Thus, the misdirection paradigm seems more like change blindness than inattentional blindness in some ways. Change blindness refers to the failure to perceive something different about a display whereas inattentional blindness refers to a failure to notice something present in a display (e.g., Rensink, 2002). For example, in the change blindness task by Simons, Chabris, Schnur, and Levin (2002), a basketball is removed from a scene and the participants have to notice that unexpected disappearance.

2.4. Disconnection 4: functionality of the unexpected object – relevant vs. not relevant

In the inattentional blindness paradigm, the unexpected objects are not important and therefore irrelevant for the task of the participants (for a discussion of attentional capture and inattentional blindness, see Simons, 2000). For example, it is not necessary to notice the man in the gorilla suit in the Simons and Chabris (1999) study while counting accurately in the primary passing task. This is highly significant when considering that various results from inattentional blindness literature (Most et al., 2005) suggest that limited attentional resources—beside the attentional set—are a main factor for missing the irrelevant object (for a similar interpretation in the area of the perceptual load paradigm, see Cartwright-Finch & Lavie, 2007; Lavie, 1995). In line with this argument is evidence showing that experienced observers in the inattention tasks have a greater possibility of perceiving the unexpected object because of a reduction of the attentional demands of the primary task leaving more attentional resources for the irrelevant object (Memmert, 2006; Neisser & Dube, 1978, cited in Neisser (1979)). However, this argument stands in contrast to the misdirection paradigm that suggests that more attention is paid to the unexpected object when it has a function with regard to the task at hand. This was the case in the Kuhn paradigm where the unexpected object becomes relevant because the participants were asked how the magician performs the trick.

On the whole, the usual unexpected stimuli used in the inattentional blindness paradigm and in almost all studies (exceptions: Haines, 1991; Most & Astur, 2007; Strayer, Drews, & Johnston, 2003), with no functional relevance for the task (e.g., perceiving the man in the gorilla suit), stand in contrast to the unexpected stimuli used in the misdirection paradigm with functional relevance for the task (e.g., drop of a cigarette).

3. Beyond awareness, inattention and misdirection

The inattentional blindness paradigm and the attentional misdirection paradigm are valuable on their own to investigate attentional processes. But the four aforementioned disconnections between inattentional blindness and attentional misdirection suggest that these paradigms are not equivalent. Thus, the relevant findings cannot be compared with each other without considerable caution. The recent literature demonstrates the need for a unified theoretical framework incorporating inattentional blindness and overt and covert attention mechanisms. In order to initiate such a framework, insights from one line of literature must be tested in the other. This comment aims to initiate this development. Consequently, two possible avenues of future research emerge from the described disconnections and will be discussed next. We focused on outlining first thoughts for further research avenues in line with disconnections 1 (definition of unexpected object – foreshadowing vs. no foreshadowing) and 4 (functionality of the unexpected object – relevant vs. not relevant).

The misdirection trick could be a valuable tool for a first research line which could be connected to disconnections 1. Kuhn and colleagues developed an experimental setting to investigate overt and covert attention mechanisms with a paradigm where the participants pay attention to a trick performed by a magician. With the misdirection approach and data from eye movement behavior they showed that conscious perception is not related to where the participants were looking at the time of the event, and thus demonstrate how overt and covert attention can be spatially dissociated (Kuhn & Findlay, in press).

In future work, this result by Kuhn and colleagues could be discussed in closer connection with the selective attention and orienting attention research by Posner (1980). Selective attention is closely linked to attentional orienting, because both sub-processes are involved in directing attention (steering) to certain areas (Awh, Armstrong, & Moore, 2006). According to Posner (1980), orienting of attention in the visual field facilitates the processing of the information present in the attended location and inhibits the processing of information present in the unattended location. The cueing paradigm by Posner (1980; see also Posner & Peterson, 1990) is usually used to examine the costs and benefits of orienting attention in the visual field.

In general, Posner and Peterson (1990) have shown that performance in signal detection tasks is enhanced by pre-cueing the location where the target stimulus is likely to appear. The head start given to the attentional system leads to better reaction times and response accuracies if the target appears at the location indicated by the precue (valid condition). Performance decreases if the target appears at an uncued location (invalid condition) (Gottlob, Cheal, & Lyon, 1999). The experimental settings used by Posner and colleagues seem valuable in order to establish a closer link between attentional misdirection and the established overt and covert attention mechanism.

The inattentional blindness approach could be a valuable tool for a second research line, in which the inattentional blindness paradigm could profit from the kind of unexpected object in the attentional misdirection paradigm (see Section 2.4). Here, the cigarette had a functional meaning in the attention test. Prior studies have already put a stronger emphasis on the importance of functionality in selective attention processes (Neumann, 1987; Neumann, Van der Heijden, & Allport, 1986). Allport (1987) suggests within his principle “selection-for-action” that perceptual selection is a necessary precondition for any action in the environment. So far, the unexpected object in the inattentional blindness paradigm had no functional relevance for the primary task and therefore was irrelevant for the given task.

A future line of research could be to develop real world scenarios of inattentional blindness in which the unexpected object has a functional role in the attention task. We are aware of only a few experimental approaches in the area of inattentional blindness utilizing a “functional” inattentional blindness task. In the area of flying, Haines (1991) investigated pilots in a flight simulation system. The task for the experienced pilots was to land a plane safely (primary performance task) while monitoring a superimposed head-up display (secondary attention-demanding task). While they were landing the plane virtually, another plane was placed directly on the runway (unexpected object) that the pilots often failed to notice. The airplane on the runway could be interpreted as a functional object, because security was obviously important for the primary task.

In the area of driving, Most and Astur (2007) as well as Strayer et al. (2003) provide evidence for inattentional blindness in a driving simulation system. Strayer et al. (2003) demonstrated that participants failed to notice a running child (unexpected object) crossing the street while driving a car (primary performance task) and speaking on the telephone (secondary attention-demanding task). The crossing child could again be interpreted as a functional element because security was clearly important for the primary task. In the area of sport, Memmert and Furley (2007) showed that inattentional blindness exists among skilled athletes who failed to detect a free team mate (unexpected object) when attention was diverted to the direct opponent (primary performance task: name the position of your direct opponent player). If attention was not engaged in the primary performance task (full-attention trial) all participants passed to the obviously unmarked team-member. The open player can be interpreted as a functional object because it was obviously the best solution (controlled for by expert ratings) in the secondary attention-demanding task.

Both directions of research are intended to give preliminary suggestions on how future studies could incorporate inattentional blindness and attentional misdirection in order to study selective attention processes in more depth. The research could focus on the targeted intentional or coincidental unintentional misdirection of attention in dealing with a primary task, when new, albeit task-relevant, functional stimuli emerge. These results would also directly lead to practical implications for complex real life scenarios (e.g., security when driving cars). Recent research on inattentional blindness and attentional misdirection has shown that these paradigms have great potential for the development of more differentiated attention frameworks leading to new testable assumptions of attention mechanisms.

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