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Short Communication

# Misdirected by the gap: The relationship between inattentional blindness and attentional misdirection

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ABSTRACT

In several of our articles we have drawn analogies between inattentional blindness paradigms and misdirection. Memmert (in press) however, has criticized this analogy and urged for caution in assuming too much of a close relationship between these two phenomena. Here we consider the points raised by Memmert and highlight some misunderstandings and omissions in his interpretation of our work, which substantially undermine his argument. Debating the similarities and differences between aspects of misdirection and inattentional blindness is valuable and has the potential to highlight the utility of these two phenomena. However, it is important not to be misdirected by subtle differences between particular instances of each phenomenon, at the expense of failing to detect the opportunities that these phenomena present for extending our understanding of attention and awareness.


## 1. Introduction

Misdirection typically refers to the magician's ability to manipulate your attention in order to prevent you from seeing how the trick was performed. In a series of experiments, we have used misdirection to manipulate people's attention and influence what they see (Kuhn & Findlay, 2010; Kuhn & Tatler, 2005; Kuhn, Tatler, & Cole, 2009; Kuhn, Tatler, Findlay, & Cole, 2008). In these experiments the magician systematically orchestrates the observer's attention, which results in the failure to see a fully visible event (e.g., dropping a cigarette, or a lighter). Inattentional blindness (IB) refers to a phenomenon in which observers often fail to notice a fully visible item or event whilst being otherwise preoccupied with an attentionally demanding distractor task (e.g. Mack & Rock, 1998; Most, Scholl, Clifford, & Simons, 2005; Simons & Chabris, 1999). In several of our articles we have drawn analogies between IB paradigms and misdirection. Memmert (in press) however, has criticized this analogy and urged for caution in assuming too much of a close relationship between these two phenomena. The purpose of this reply is twofold: firstly, we would like to highlight some misunderstandings in Memmet's interpretation of our work, which substantially undermine his argument. Secondly, we would like to encourage the debate about misdirection and its value in science and put forward a novel idea of how misdirection relates to current theories IB (Most, in press).

There has been much interest in drawing links between magic and science and there have been calls to investigate some of the principles used by magicians scientifically (Kuhn, Amlani, & Rensink, 2008; Macknik et al., 2008). We have argued that psychologists as well as neuroscientists can learn much from incorporating the magician's real world experience and knowledge in their field of research. The collaboration between science and magic requires a thorough discussion of the principles of magic and as such we strongly encourage a debate on this issue of misdirection. Memmert's comment is valuable in that it explores the similarities and differences between the two paradigms, and has encouraged a debate on this issue (Memmert &

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Furley, in press; Moran & Brady, in press; Most, in press). However, we have some serious concerns about the content of his comments, based both on the interpretation of existing empirical data, and the extent to which his arguments generalize to the concept of misdirection more generally.

In his article, Memmert suggests four key disconnections between misdirection – specifically of the kind that we have used in our recent work – and inattentional blindness. We will first respond to each of these four disconnections, before discussing the utility of misdirection more widely.

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

Memmert's first disconnection between IB and the misdirection paradigm relates to people's expectations about what is about to happen. He argued that "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 IB paradigm while performing a task." Whilst expectations are indeed an important component of misdirection, this is not a valid disconnection between the two paradigms. This is because neither the tricks we have studied nor other instances of misdirection necessarily depend upon the observer expecting the unexpected.

Misdirection is a technique that can be used independently of magic tricks. Whilst magicians are true masters of misdirection, similar misdirection techniques are commonly used in other domains. For example, pick pockets typically use misdirection in situations in which the victim's attentional set does not include watching a magic trick (Macknik et al., 2008). Similarly, card cheats often use misdirection to conceal their sleight of hand when attempting to gain an unfair advantage in a card game. As is apparent from the above examples, misdirection does not necessarily rely on the spectator anticipating an unexpected event.

In our own work we have explicitly explored this issue of the spectator's expectation, by employing the misdirection paradigm in situations in which observers did not know that they were about to see a magic trick. In our first study, (Kuhn & Tatler, 2005) half of the participants knew that they were about to see a magic trick whilst the other half of the participants were naïve. The naïve group thought they were participating in a standard memory task, which meant that the dropping cigarette was truly unexpected. Both groups were prone to the misdirection and likely to miss the cigarette and lighter drops. Misdirection therefore works regardless of whether observers foresee an unexpected event or not.

That said, investigating the way in which expectations influence event perception and in particular the ability to perceive unattended events is indeed very interesting. Much of misdirection involves keeping the spectator in suspense as to what is about to happen so as to reduce the expectancy of an unusual event. For example, this is exactly why participants who knew that the magician was about to make a lighter and a cigarette disappear were slightly more likely to detect the drop (Kuhn, Tatler, et al., 2008). Similarly, expectations can have subtle effects on how the misdirection influences the spectator's allocation of overt attention, even if the spectator is no more likely to detect the unexpected event (Tatler & Kuhn, 2007). Whilst manipulating expectations is an interesting aspect of misdirection, it does not make it functionally different from IB.

## 3. Disconnection 2: control task – no control vs. control

Memmert argues that the two paradigms are fundamentally different with regard to the control task, which is typically included in IB paradigms to ensure that the unexpected event is perceivable. The IB paradigm typically includes a full-attention trial in order to ensure that participants can see the unexpected event. The full-attention trial is thought to act as a control condition in order to ensure that the participants follow the task and that they perceive the object when attended. Memmert argues that "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."

In Kuhn and Tatler (2005), as well as in all of the other misdirection studies, participants were shown the magic trick until they saw the item drop. Most of the participants see it drop on the second trial, and in Kuhn and Tatler (2005), the crucial analysis involved looking at differences in eye movements between the detected and the undetected trials. Misdirection, as well as many other magic principles, partly relies on keeping the spectator in suspense, which is why magicians typically avoid repeating a trick using the same method. If a trick is repeated, the observer can focus attention to where he/she thinks the method is taking place thus enabling him/her to disengage from the misdirection increasing the likelihood of noticing the method. As such the repetition of the misdirection trick is similar to the full-attention trial in the IB paradigm, resulting in the same outcome; the detection of the unexpected event. Most importantly, as in the IB paradigm, detecting the unexpected event on the second trial demonstrates that the previously unseen event is indeed perceivable. As both tasks have an appropriate control trial, this difference between the two tasks becomes less relevant and does not present a disconnection between IB and misdirection.

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

Here Memmert makes two points about the difference between IB and misdirection. First he suggests that in IB there is an attentionally demanding primary task, which is not present in our misdirection studies. Second, he suggests that IB can occur at the focus of overt attention, whereas misdirection relies on direction attention away from the unexpected event.



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If trying to detect an unexpected event is the primary task, then we agree that this is unlike the situation in many of the classic IB tasks, where the primary task does not overlap with the unexpected event. However, as we have already argued, misdirection is not confined to such situations. In many cases misdirection is used where the observer is unaware of the misdirection. In our own work, we have shown that misdirection does not rely upon the primary task being to detect the event (Kuhn & Tatler, 2005; Tatler & Kuhn, 2007). When observers were unaware that they were about the watch a magician perform, the primary task in our studies was merely to interact with another individual during what they believed was the build up to a memory experiment. Here the unexpected event is no more related to the primary, attention-demanding task as in typical IB paradigms.

Memmert argues that a crucial difference between IB and misdirection concerns whether the unexpected event occurs at the focus of overt attention. Certainly it is the case that IB can occur at fixation (Mack & Rock, 1998), but this is neither a requisite of IB, nor an anti-requisite of misdirection. It is true that in many cases overt attention is directed away from the unexpected even in our misdirection studies. However, we did find cases in which fixation was at or near to the dropping cigarette but it was still not detected (Kuhn, Tatler, et al., 2008; Kuhn et al., 2009; Tatler & Kuhn, 2007). Thus, like IB, misdirection can result in a failure to detect a fixated unexpected event. Of course, the finding that IB can occur at fixation highlights that fixation and covert attention can be disconnected at times. We have used misdirection to make the same observation (Kuhn & Tatler, 2005; Kuhn et al., 2008).

Memmert concludes in this section that misdirection is more like change blindness than inattentional blindness. This is in part because he argues that "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." It is not the case that during the unexpected event the cigarette is "absent". The cigarette is present, unoccluded and moving for a period of around 140 ms. In contrast, change blindness typically involves an instantaneous change that occurs during an interruption to viewing all or part of the scene. The mechanisms underlying the failure to detect the cigarette drop are unlikely to be those that underlie change blindness. Change blindness primarily involves a failure of (visual short term) memory for scene details. IB on the other hand, can result from failures at a variety of stages from encoding to retrieval (Most, in press). In our paradigm it is more likely that non-memorial limitations result in the failure to detect the drop, placing our work closer to IB than to change blindness. The attentional load of the primary task, the overlap between the primary task and the unexpected event, and whether or not the event can occur at fixation without detection are all comparable in many ways between IB and misdirection an as such do not present a clear disconnection between the two paradigms.

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

A further disconnection is highlighted in terms of the relevance of the object. Memmert argues that as participants are asked to discover how the trick was performed, the unexpected objects are important to the task and therefore relevant for the participants' task. In IB on the other hand, the unexpected is entirely task irrelevant. There are two problems with this proposed disconnection. Memmert's argument relies on participants knowing that they are seeing a magic trick and/or them being aware of the relevant aspect of the trick. In the Kuhn, Tatler, et al. (2008) study participants were asked to discover the method used to make the cigarette and the lighter disappear, and the cigarette and lighter (though not necessarily the drops) were indeed relevant to the task. However, as we have discussed above, misdirection does not rely on observers being aware of watching a magic trick. For the participants in the Kuhn & Tatler study (2005) who thought they were participating in a memory experiment, the magic trick was an entirely surprising event and the dropping of the lighter and the cigarette were therefore irrelevant to the observer's "task". These participants were only aware that they saw a magic trick once they realized that the objects had disappeared, which was after the misdirection took place. Thus the dropping of the cigarette was entirely unexpected and task irrelevant, yet the unexpected event was not detected. This situation is very similar to that in typical IB paradigms.

On a more general level distinguishing between IB and misdirection based on relevance makes little sense. One of the reasons why magicians are so secretive about their tricks is because they don't want their audience to become aware of their methods. The key to a successful magic trick lies in making the spectator think that the method is not relevant to the trick. In fact, in most cases the spectator is totally unaware of the method (e.g., use of secret props such as a thumb tip), and misdirection is used as an additional security measure to ensure that it is invisible to the audience. The role that task relevance has in enhancing IB or the effectiveness of misdirection is one that is indeed of great interest. However, it seems less fruitful to use task relevance as a way of distinguishing between IB and misdirection.

## 6. Future (mis-)directions

We fully agree that there are differences between misdirection and IB, and we encourage a careful examination of the similarities and differences. However, by focusing on ill conceived and rather pragmatic issues relating to one particular paradigm, we are in danger of missing the great opportunity that misdirection offers to the study of attention and awareness. The main difference between the misdirection and IB paradigms lies in how attention is manipulated. Whilst the IB task requires an explicit distractor task, the attentional distraction in misdirection occurs through the implicit yet very effective and systematic orchestration of attention. It is this difference that makes misdirection particularly valuable to science. Magicians

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have tried and tested their misdirection in front of live audiences, which has resulted in powerful and robust attentional principles. It is the ease and the consistency by which magicians can manipulate our attention that should be of interest to the scientist. By studying misdirection we can discover the aspects of the environment that are generally reliable in driving our attentional selection mechanisms. Moreover, the study of misdirection can uncover attentional principles that are typically ignored by visual scientists. As such for example, we are currently investigating the way in which semantic social cues influence attention (Teszka, Risko, Kuhn, & Kingstone, 2010).

The misdirection paradigm also offers a valuable way of investigating visual attention in naturalistic, yet controlled environments (Moran & Brady, in press). For example we have used the misdirection paradigm to investigate the relationship between overt and covert attention (Kuhn & Findlay, 2010). We have also used a related magic paradigm to study attentional difficulties in autism (Kuhn, Kourkoulou, & Leekam, in press), and have explored how attention is influenced by where another person is looking (Kuhn et al., 2009). The advantage of using a misdirection paradigm is that we can study attentional processes outside the confinements of the laboratory and thus gain insights into attentional processes in the real world.

Memmert's discussion of misdirection is restricted to one type of paradigm that we have used to study specific aspects of misdirection. The science of magic is still in its infancy and by limiting the discussion to this simple paradigm we fail to acknowledge the richness and complexity of misdirection. Misdirection is not solely of the kind employed in our cigarette and lighter trick: there are several varieties of misdirection (Lamont & Wiseman, 1999; Sharpe, 1988). Moreover, different types of misdirection are likely to involve different perceptual and cognitive processes, some of which show more or less resemblance to IB. Similarly, Most (in press) has argued that the term "inattentional blindness" may be an over simplification of what people have considered under this label. Most suggests that there is a clear case for IB resulting from at least two rather different processes. One of these is driven by covert allocation of spatial attention and the failure to perceive an object results from a failure in encoding. IB may also occur at a later stage in the perceptual chain, and result due to preoccupation or disruption of a non-spatial selection mechanism, which lead to storage or access difficulties. Whilst information may have been encoded perceptually, it never enters our awareness. Although these two processes are phenomenologically similar, they are driven by two very different mechanisms.

Just as Most (in press) suggests for IB, misdirection is a complex principle, and its function is to manipulate what people see and/or remember. This perceptual manipulation can occur at several stages in the perceptual chain. In our experimental work we have so far focused on the ways in which magicians misdirect our spatial attention. For example, we have investigated how social cues (i.e. where the magician is looking) affect our orientation of spatial attention and, as a result, influence what we see (Kuhn & Land, 2006; Kuhn et al., 2009). Magicians often use several other cues, such as bright colors, movement or loud sounds to misdirect spatial attention. Misdirection using these types of cues is known as physical misdirection (Kuhn, Amlani, et al., 2008; Lamont & Wiseman, 1999; Sharpe, 1988) and it though to work by manipulating spatial attention. This form of misdirection is likely related to the IB Most (in press) refers to as covert allocation of spatial attention.

Paralleling Most's argument that IB can involve non-spatial, cognitive factors, much of misdirection involves manipulations that are independent of spatial attention. The concept of psychological misdirection refers to the magician's ability to manipulate the observers' suspicion and expectations rather than spatial attention. Whilst psychological misdirection can at times affect the allocation of spatial attention, it mainly works by influencing what people remember. One example of psychological misdirection is the sucker trick, or theory of false solution (Tamariz, 1988). The principle of false solution relates to situations in which the magician pretends to have been caught out, so that the spectator will ignore all other less obvious solutions. Once the spectator has been sent down this garden path, this false solution is revealed to be false, by which time most of the tracks have been covered and the spectator will find it difficult to discover the correct solution (Kuhn, Amlani, et al., 2008). Whilst psychological misdirection is likely to influence certain aspects of spatial attention, its main function is to prevent people from remembering the correct solution. This and many other forms of misdirection are more closely related to IB that result from preoccupation or disruption of a non-spatial selection mechanism. Magicians have a plethora of techniques that are used to manipulate our perception and we are very much at the beginning of understanding the mechanisms by which they work. However, analogous to Most's suggestion for different IB principles, misdirection involves manipulating both spatial attention and more central interference and disruptions.

It is clear from our work and from the arguments presented by Most (in press) that our understanding of the factors that underlie IB and misdirection is still in its infancy. Both IB and misdirection are to be broad sets of phenomena encompassing and arising from a range of different underlying mechanisms. It is important to utilize the opportunities presented by these paradigms rather than dwell upon the minutiae of subtle differences between particular instances of each. Let's not be misdirected by the detail to the extent that we fail to detect the insights offered by these paradigms.

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