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Gaze cues influence memory…but not for long☆

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ABSTRACT

Many factors influence the manner in which material is encoded into memory, with one of the most important determinants of subsequent memorability being the degree to which an item is attended at study. Attentional gaze manipulations – which occur when a task-irrelevant face at fixation looks towards or away from a target – have been shown to enhance attention such that stimuli that are gazed at elicit quicker responses. In the present study, four experiments were conducted to determine whether attentional gaze cues can also influence the recall of items appearing at gazed-at or gazed-away from locations. In Experiment 1, an irrelevant gaze cue at fixation preceded the presentation of to-be-remembered items, with each item remaining on screen for 1000 ms. Gaze direction had no effect on memory for words. In Experiment 2, the presentation time for to-be-remembered items was reduced to 250 ms or 500 ms. Now gazed at items were more memorable. In Experiment 3, we manipulate the intentionality of the memory instruction and demonstrate that gaze cues influence memory even when participants are not explicitly attempting to memorize items. Finally, Experiment 4 demonstrates that these findings are specific to gaze cues as no memory effect is observed when arrow cues are presented. It is argued that gaze cues can modify memory for items, but that this effect is primarily attributable to shifts of attention away from target items when a gaze cue is invalid.

1. Introduction

On a daily basis, we are continually confronted with more stimuli than can be processed simultaneously. Consequently, it is the role of the attentional system to determine which items will be selected for additional processing and which items will be ignored. Though it is often the case that attention is under the volitional control of the observer, it is well established that numerous stimuli can lead to reflexive shifts of attention independent of an observer's intent. For example, new onsets in the periphery have been repeatedly shown to capture attention (Jonides, 1981; Posner & Cohen, 1984). In addition, it has been shown that overlearned stimuli that can readily convey directional information – such as arrows, numbers, and directional words – tend to shift spatial attention in a direction that is congruent with the meaning of the stimulus, independent of whether a shift in spatial attention is necessary or useful (Dodd, Van der Stigchel, Leghari, Fung, & Kingstone, 2008; Fischer, Castel, Dodd, & Pratt, 2003; Hommel, Pratt, Colzato, & Godijn, 2001; Pratt & Hommel, 2003).

Complementing the aforementioned influences on spatial attention, a great deal of research has examined the influence of gaze cues on spatial attention. For example, developmental studies have shown that children as young as 3 months of age will follow the direction of another individual's eye movements or gaze (e.g., Scaife & Bruner, 1975). Similarly, research with adult populations has shown that gaze cues lead to reflexive shifts of spatial attention in the direction consistent with gaze. These effects closely resemble those observed when arrows and directional words are presented at fixation (e.g., Bayliss & Tipper, 2006; Driver, Davis, Ricciardelli, Kidd, Maxwell, & Baron-Cohen, 1999; Friesen & Kingstone, 1998; Kingstone, Tipper, Ristic, & Ngan, 2004), though the effects of gaze appear to be most strongly automatic (e.g., Friesen, Ristic, & Kingstone, 2004). The standard gaze cue paradigm involves the presentation of a photograph or schematic drawing of a face at fixation which looks to either the left or right side of the screen. Though participants are explicitly informed that the gaze cue is spatially uninformative and thus does not predict the location of the upcoming target, target detection is enhanced when the cue is valid (the target appears in a location consistent with gaze) relative to when the cue is invalid (the target appears in a location inconsistent with gaze). Indeed, gaze cueing effects are so strong that they have also been observed in situations where the gaze cue is counterpredictive of target location (e.g., even if the target is likely to appear in the location directly opposite the direction of gaze on 75% of trials, participants are still faster to detect targets at the gazed at location relative to other locations that are not gazed at but equally likely to contain a target; Friesen et al., 2004).

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Gaze cues are of particular interest to attention researchers given the biological relevance of human eyes. Direction of gaze in the real world tends to be an important indicator of an individual's interest and intent, meaning that it may provide an important insight into cognitive processes. To that end, numerous investigations have sought to determine whether the influence of gaze cues extends beyond merely shifting spatial attention. For example, Bayliss, Frischen, Fenske, and Tipper (2007) reported that gaze direction can also influence affective evaluations of objects. In their study, participants were shown a number of images of common tools or kitchen items which they had to initially categorize as quickly as possible, and then provide an affective rating of how much they liked each item. Critically, each image was preceded by an irrelevant gaze cue at fixation with faces displaying the emotion of either happiness or disgust. Though standard gaze cueing effects were observed in the reaction time task, the evaluation task was moderated by facial expression such that participants liked items that happy faces looked at rather than away from (there was no difference for disgust faces). Similarly, Bayliss and Tipper (2006) have demonstrated that the specific faces that looked at a target location were perceived to be most trustworthy. Additionally, Macrae, Hood, Milne, Rowe, and Mason (2002) have demonstrated that categorization responses (is the target face male or female) and semantic priming (speed of responding to masculine items vs. feminine items) are facilitated when the gaze of a face target is directed towards the observer relative to when the gaze of a face target is directed away from an observer. Collectively, this suggests that the influence of gaze cues may extend beyond simple shifts of spatial attention.

In the present study we examined if the effect of gaze cues extends to item memory. To date no published study has addressed this issue, possibly because some previous findings provide evidence that averted gaze can negatively affect memory for face targets.[1] For example, it has been demonstrated that individual faces are remembered better when the faces are directing gaze centrally rather than peripherally (e.g., Mason, Hood, & Macrae, 2004; Vuilleumier, George, Lister, Armony, & Driver, 2005; though see Daury, 2009). The interpretation of this result is that face memory is enhanced by perceived eye contact rather than because attention is shifted away from the faces when gaze is directed peripherally leading to worse subsequent memory at the invalid (in this case central) location. On the other hand, as noted, several previous studies have shown significant effects of peripheral gaze direction on spatial attention, with slowed object processing at the invalid versus the valid location. Given the tight link between attention and memory, it is reasonable to think that there will in fact be a memory effect when gaze is directed peripherally, with item memory being poorer at the invalid location than the valid location. The present series of experiments directly address this issue.

2. Experiment 1

The purpose of Experiment 1 was to determine whether the presentation of an irrelevant gaze cue at fixation would enhance memory for items which subsequently appeared at the location that was gazed at (valid location) relative to items appearing at the location not gazed at (invalid location). To this end, the standard gaze cueing paradigm was moderated: rather than presenting a detection target (usually these target types require a key press response the moment the target is detected) to the left or right visual field following the presentation of an irrelevant gaze cue, to-be-remembered words appeared on either side of the central face.

[1] It could also be the case that previous investigations regarding this issue have been conducted but not reported if a null result was obtained. Anecdotally, the present authors are aware of at least one other investigation of the influence of gaze cues on memory in which cue direction did not impact recall. This point was also raised to us by an anonymous reviewer who is also aware of a similar null result though given that these findings have not been previously reported we are unable to cite these works.

2.1. Method

2.1.1. Participants

Forty-one undergraduate students from the University of Nebraska–Lincoln (26 females, 15 males) underwent individual 30-minute sessions, receiving course credit as remuneration for participating. All had normal or corrected-to-normal vision and were naïve about the purpose of the experiment.

2.1.2. Materials, apparatus, procedure, and design

The experiment was controlled by a Pentium IV PC with participants seated approximately 44 cm from the computer screen. Participants were tested individually and informed that they would be taking part in a memory experiment and that they would have to memorize items that would be presented on the left or right side of the computer screen, though item location was not relevant to the task. The sets of items to be remembered were 16 common tools and 16 common kitchen items as adapted from Bayliss et al. (2007). At the beginning of each trial, a central fixation cross (black, 1.0° in diameter) was presented on the computer monitor with a white background (see Fig. 1 for a complete trial sequence). Participants were instructed to fixate the central fixation point, and to not move their eyes for the duration of the experiment. Following a period of 250 ms, the fixation cross was replaced by a schematic drawing of a face (black, 6.0° in diameter) though no pupils were present in the eyes of the initial image. After an additional 750 ms, pupils appeared in the eyes such that the schematic drawing was now looking to either the left or right. Participants were explicitly informed that the direction of gaze was not predictive of the location of the words that would appear on the screen. Given that gaze cuing effects are reliably observed with stimulus onset asynchronies (SOA) between 250 and 750 ms (Driver et al., 1999; Friesen & Kingstone, 1998; Kingstone et al., 2004), a 500 ms cue-target SOA preceded item presentation, at the end of which a to-be-remembered item (e.g. "screwdriver") appeared to either the left or right of the gaze cue.

The target was equally likely to appear on either the left or right side of the face and equally likely to appear at either a valid or invalid location. Each item was presented for 1000 ms at the end of which the screen went blank for a period of 500 ms before the next trial began. Participants were instructed to memorize all items for a later memory test. At the conclusion of all 32 trials, participants were given a blank sheet of paper and asked to recall as many studied items as possible. Participants had up to 5 min for the recall test though the majority of participants turned in their paper prior to the 5 minute maximum and no participant indicated that they did not have enough time to complete the test.

2.2. Results and discussion

Initial analyses indicated that participants did not differ in their ability to remember words presented on the left side of the screen vs. words presented on the right side of the screen so all data were collapsed across this variable. The mean number of items recalled overall and as a function of cue type (gazed at vs. gazed away from) can be found in Table 1.

To examine the memory by gaze direction effects, a paired samples *t*-test was conducted. There was no difference in memory for items that appeared at valid relative to invalid locations during study, $t(41) = .06$, $p > .9$. Thus, in the present experiment, gaze cues had absolutely no influence on subsequent memorability of items. This null result indicates that participants did not encode gazed-at items differently than gazed-away from items meaning that both item types were equally accessible during later recall.

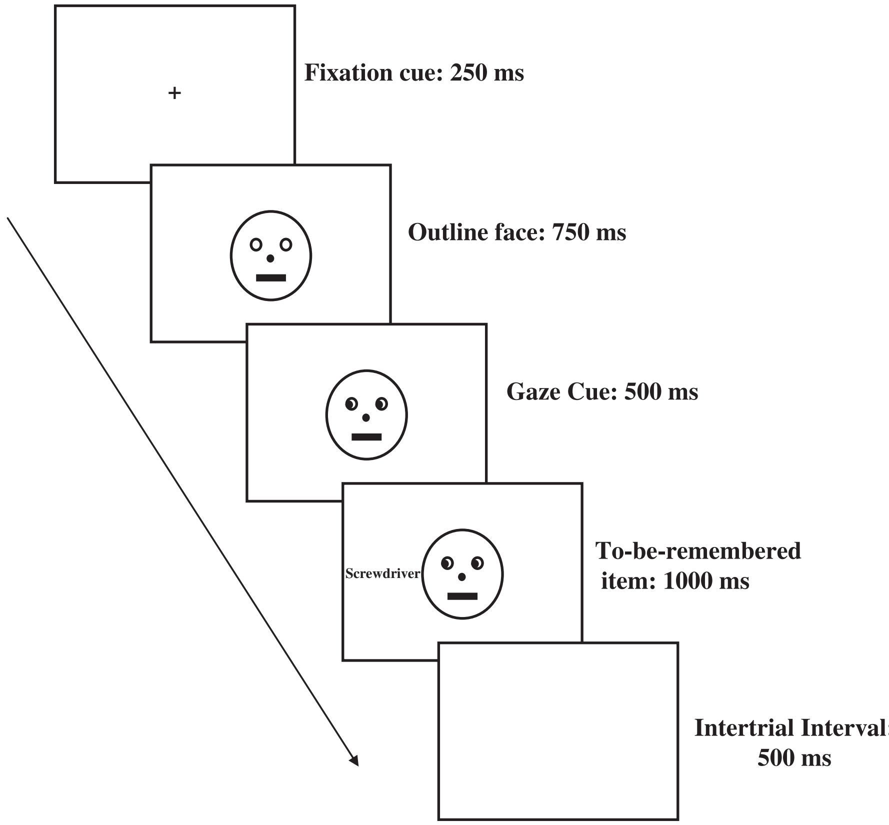

Fig. 1. The timing and sequence of events in Experiment 1.

3. Experiment 2

In Experiment 1, no influence of gaze cues on memory was observed. It is important to note, however, that the attention effects of gaze direction are first observed very early after an item is presented (Friesen & Kingstone, 1998) and are greatly reduced or eliminated with SOAs more than 1000 ms. As such, the relatively long 1000 ms target display duration in Experiment 1 may have been long enough to override attention effects that would have been apparent with shorter presentation durations. That is, if the critical influence of gaze cues is to shift attention early in the direction of gaze, it stands to reason that memory differences may be apparent with a shorter presentation durations.

3.1. Method

3.1.1. Participants

Eighty-two undergraduate students from the University of Nebraska–Lincoln (49 females, 33 males) underwent individual 30-minute sessions, receiving course credit as remuneration for participating. All had normal or corrected-to-normal vision and were naïve about the purpose of the experiment. None of the participants had taken part in Experiment 1.

3.1.2. Materials, apparatus, procedure, and design

Experiment 2 was identical to Experiment 1 with the exception that the to-be-remembered items were presented for either 250 ms or 500 ms. Forty-one participants were in the 250 ms presentation duration condition while the other 41 participants were in the 500 ms presentation duration condition.

Table 1
Mean number of items recalled as a function of presentation duration (Experiment 1 = 1000 ms; Experiment 2 = 250 or 500 ms) and cue type (valid or invalid). Standard deviations appear in parentheses below each mean and gaze cueing effect (valid − invalid) and total memory for items independent of cue type appear to the right.

Cue type	Valid	Invalid	Gaze cueing effect (valid − invalid)	Total memory
Experiment 1	5.83	5.80	.03	11.63
(1000 ms)	(2.10)	(1.71)		
Experiment 2	5.71	4.83	.88*	10.54
(500 ms)	(2.03)	(2.45)		
Experiment 2	5.73	4.15	1.58*	9.88
(250 ms)	(2.09)	(1.70)		

* = $p < .05$.

3.2. Results and discussion

Initial analyses indicated that participants did not differ in their ability to remember words presented on the left side of the screen vs. words presented on the right side of the screen so all data were collapsed across this variable. The mean number of items recalled overall and as a function of cue type (gazed at vs. gazed away from) for the two presentation durations can be found in Table 1.

To examine the memory by gaze direction effects, a 2 (Cue Type: Valid vs. Invalid) × 2 (Presentation Duration: 250 ms vs. 500 ms) mixed analysis of variance (ANOVA) was conducted. There was a significant main effect of cue type, $F(1, 80) = 23.85$, $MSE = 2.66$, $p < .01$, $\eta^2 = .23$ with participants remembering more items that appeared at valid locations relative to items appearing at invalid locations. This was true for both the 250 ms and 500 ms presentation duration conditions ($p < .01$, $\eta^2 = .40$ and $p < .05$, $\eta^2 = .11$ for the 250 ms and 500 ms conditions, respectively; the main effect of SOA approached but did not reach conventional levels of significance, $F(1,80) = 2.17$, $MSE = 5.42$, $p = .14$). Though the difference between the number of gazed at items remembered and the number of gazed away from items remembered was numerically smaller in the 250 ms condition relative to the

500 ms condition, the interaction between cue type and presentation duration was not significant, F(1,80) = 1.80, MSE = 2.66, p = .18.

4. Comparing Experiments 1 and 2

Given that Experiments 1 and 2 were identical with the exception of presentation duration, it is possible to directly compare the three presentation durations. Unsurprisingly, as presentation duration increased, so too did the overall number of items remembered as was confirmed by a one-way ANOVA with total memory as the dependent variable and presentation duration as the critical factor, $F(2,122) = 2.93$, p = .05, $d = .69$.

A 2 (Cue Type) × 3 (Presentation Duration) ANOVA revealed a significant main effect of cue type, F(1,120) = 14.73, MSE = 2.93, p < .01, $\eta^2 = .11$ as, overall, participants were more likely to remember gazed at items relative to gazed away from items. This effect was moderated, however, by a significant interaction between cue type and presentation duration, F(2,120) = 4.29, MSE = 2.93, p < .05, $\eta^2 = .07$ as the difference in memory between gazed at and gazed away from items decreased as SOA increased, with no difference remaining at the 1000 ms presentation duration. It is important to note that as item duration increased, memory at the invalid location improved while performance at the valid location remained stable. This suggests that the memory effect reflects a cost in performance due to attention being drawn quickly, and briefly, away from locations that are not gazed at.

5. Experiment 3

Though we observed an effect of gaze cues on memory in Experiments 1 and 2 it was also the case that participants were explicitly instructed to memorize the items that were being presented. As such, it is difficult to determine whether the effect of gaze cues was linked to attentional processes, memory processes, or some combination of the two. In Experiment 3, we manipulated the intentionality of memory encoding by either a) explicitly instructing participants to memorize items being presented (thus serving as a replication of the previous experiments) or b) presenting items within the context of a target detection task which was followed by a surprise recall task.

5.1. Method

5.1.1. Participants

Sixty-two undergraduate students from the University of Nebraska–Lincoln (39 females, 23 males) underwent individual 30-minute sessions, receiving course credit as remuneration for participating. All had normal or corrected-to-normal vision and were naïve about the purpose of the experiment. None of the participants had taken part in any of the previous experiments.

5.1.2. Materials, apparatus, procedure, and design

Experiment 3 was identical to Experiment 1 with the following exceptions. Half of the participants took part in an intentional memory condition that closely resembled the first two experiments. To-be-remembered items were presented for 500 ms following the presentation of an irrelevant gaze cue and participants were instructed to encode these items for a later memory test. In addition to the primary memory task, participants were also told that on a small subset of trials, they would see the word "target" and that they should press the spacebar as quickly as possible the moment that item was detected. The word target was presented four times (the irrelevant gaze cue was directed towards the word "target" twice and was directed away from the word "target" twice). The other half of participants took part in an incidental memory condition which was presented as a vigilance task. Participants monitored items that were presented for 500 ms following an irrelevant gaze cue and were instructed to press the spacebar any time the word "target" appeared. Though participants were not instructed to memorize the other items that were presented, the target detection task required that all items be processed to determine whether the word "target" had been presented. Following the vigilance task, participants were given a surprise recall task in which they were asked to write down any item that they could remember from the experimental session. Thus, both conditions consisted of 36 trials, with a target detection response required on four of these trials meaning that the incidental and intentional conditions were identical with the sole exception that participants in the intentional condition were attempting to memorize each of the presented items.

5.2. Results

Initial analyses indicated that participants did not differ in their ability to remember words presented on the left side of the screen vs. words presented on the right side of the screen so all data were collapsed across this variable. The mean number of items recalled overall and as a function of cue type (gazed at vs. gazed away from) for both the intentional and incidental encoding conditions can be found in Table 2. Reaction times for the target trials are not included as these trials were incidental to our primary interest in memory performance.

A 2 (Encoding Type: Incidental vs. Intentional) × 2 (Cue Type: Towards vs. Away) mixed ANOVA revealed a significant main effect of encoding type, F(1,60) = 25.00, MSE = 4.72, p < .01, $\eta^2 = .29$. Unsurprisingly, participants recalled more items when encoding was intentional rather than incidental. There was also a significant main effect of cue type, F(1,60) = 6.45, MSE = 3.79, p = .01, $\eta^2 = .10$. Follow-up t-tests revealed that participants recalled more of the items that appeared at valid locations relative to invalid locations for both intentionally encoded items (t(30) = 1.65, p = .05, $d = .60$) and incidentally encoded items (t(30) = 2.04, p < .05, $d = .74$). There was no interaction between cue type and encoding type (p > .40).

6. Experiment 4

In the first three experiments, we observed an influence of irrelevant gaze cues on memory for items, both when encoding is intentional and incidental. These effects, however, only occur when the item is presented for a brief duration (500 ms or less) which would seem to indicate that these effects are attributable to cue-consistent shifts of attention. The purpose of Experiment 4 was to determine whether similar effects would be observed with central arrow cues rather than gaze cues. It has been repeatedly demonstrated that gaze cueing effects are similar in both magnitude and time course to arrow cueing effects, which tend to occur because the spatial meaning of the cue is difficult to ignore, even when the cue is irrelevant (e.g., Bayliss & Tipper, 2006; Driver et al., 1999; Friesen & Kingstone, 1998; Kingstone et al., 2004). Despite these similarities, however, gaze cueing effects appear to be more strongly automatic than arrow cueing effects

Table 2
Mean number of items recalled as a function of encoding condition (intentional vs. incidental) and cue type (valid or invalid) for both gaze cues (Experiment 3) and arrow cues (Experiment 4). Standard deviations appear in parentheses below each mean and gaze cueing effect (valid − invalid) and total memory for items independent of cue type appear to the right.

Cue Type	Valid	Invalid	Gaze cueing effect (valid − invalid)	Total memory
Experiment 3 intentional	4.90 (2.75)	4.00 (1.93)	.90*	8.90
Experiment 3 incidental	2.94 (1.93)	2.06 (1.41)	.88*	5.00
Experiment 4 intentional	5.30 (1.98)	4.80 (2.28)	.50	10.10
Experiment 4 incidental	3.10 (2.59)	2.45 (1.85)	.65	5.55

(e.g., Friesen et al., 2004). If the effects observed in the first three experiments are based solely on attentional shifts in response to a central cue, then we would expect to observe the same effects in the present experiment with arrow cues. If, on the other hand, the influence of central cues on memory is specific to direction of gaze then we would not anticipate observing differential memory for arrow-pointing-towards items and arrows-pointing-away from items.

6.1. Method

6.1.1. Participants

Forty undergraduate students from both the University of British Columbia and the University of Nebraska–Lincoln underwent individual 30-minute sessions, receiving course credit as remuneration for participating. All had normal or corrected-to-normal vision and were naïve about the purpose of the experiment. None of the participants had taken part in any of the previous experiments.

6.1.2. Materials, apparatus, procedure, and design

Experiment 4 was identical to Experiment 3 with the exception that arrow cues were presented at fixation rather than gaze cues. Intentionality of encoding was again manipulated between subjects with half of the participants taking part in the intentional memory condition and half taking part in the incidental memory condition. Cue direction (towards item or away from item) was manipulated within subjects. As in Experiment 3, participants were also required to press the spacebar on 4 trials when the word “target” was presented.

6.2. Results

Initial analyses indicated that participants did not differ in their ability to remember words presented on the left side of the screen vs. words presented on the right side of the screen so all data were collapsed across this variable. The mean number of items recalled overall and as a function of cue type (gazed at vs. gazed away from) for both the intentional and incidental encoding conditions can be found in Table 2 (reaction times for the target trials are not included as these trials were incidental to our primary interest in memory performance).

A 2 (Encoding Type: Incidental vs. Intentional) × 2 (Cue Type: Towards vs. Away) mixed ANOVA with encoding type as a between subjects factor revealed a significant main effect of encoding type, $F(1,38)=22.05$, $MSE=4.69$, $p<.01$, $\eta^2=.37$. As would be expected, participants recalled more items when encoding was intentional rather than incidental. Though participants were slightly more likely to recall items appearing at valid locations relative to invalid locations, neither the main effect of cue type ($F(1,38)=1.34$, $MSE=4.94$, $p>.25$) nor the interaction between cue type and encoding type ($F(1,38)<1$) approached conventional levels of significance. As such, it would appear that the influence of central cues on memory that was observed in the first three experiments is specific to gaze cues.

7. General discussion

The purpose of the present study was to determine whether gaze cueing manipulations – in which task irrelevant faces are presented at fixation – would influence memory on a later recall test. It has been demonstrated repeatedly that spatially nonpredictive gaze cues can influence target detection, such that targets appearing at a valid (gazed at) location are responded to more quickly than targets appearing at an invalid (not gazed at) location (e.g., Friesen & Kingstone, 1998; Friesen et al., 2004). The present study examined whether this effect would extend to memory.

The null hypothesis was that when gaze was directed to a peripheral location, it would have no effect on memory performance. The alternative position is that peripheral gaze would affect memory by drawing attention away from other locations toward the gazed-at location, resulting in better memory for words at the valid vs. invalid location. This converges with past studies that have demonstrated a tight link between attention and memory such that memory for unattended items is worse than for attended items. Additionally, recent work has demonstrated that the effects of gaze direction are not limited to spatial attention and can interact with additional factors to influence higher order cognitive processes (e.g., Bayliss & Tipper, 2006; Bayliss et al., 2007).

In Experiment 1 items were presented for 1000 ms at the gazed-at (valid) location or the not gazed-at (invalid) location. Supporting the null hypothesis we observed no influence of gaze direction on memory performance. In Experiment 2 item duration was shortened to 250 ms or 500 ms. Disconfirming the null hypothesis, we found memory performance was poorer for items at the invalid vs. valid location. Moreover, as item duration increased, memory at the invalid location improved while performance at the valid location remained stable. This suggests that the memory effect reflects a cost in performance due to attention being drawn quickly, and briefly, away from locations that are not gazed at. This dovetails with the view that gaze direction engages fast and transient reflexive shifts of attention away from the face toward a cued peripheral location. Experiment 3 demonstrated that that the influence of gaze cues on memory remains even when participants encode items incidentally and the final memory test is a surprise. Finally, Experiment 4 demonstrated that the interaction between central cues and memory is specific to gaze cues, as presentation of an irrelevant central arrow cue at fixation did not lead to differences in item encoding. In the Introduction we suggested that face memory studies are a good example of a line of investigation in which it is assumed that peripheral gaze direction has no effect on memory. That is, better memory for faces with central vs. peripheral gaze is due entirely to an enhancement of face memory attributable to perceived eye contact rather than a memory decrement when gaze is directed peripherally. The present study provided the first direct test of how gaze direction impacts memory for items and the present data speak to this larger body of work examining the influence of gaze on behavior in two important ways. First, we did observe a strong impact of gaze on subsequent memorability, however, this effect dissipates quickly, disappearing altogether for items that were presented for 1000 ms. In face memory studies it is often the case that the to-be-remembered face is presented for several (e.g., Mason et al., 2004; Vuilleumier et al., 2005). Thus, for studies of this kind, the present experiments reinforce the interpretation that the memory advantage for central gaze compared to peripheral gaze reflects a memory enhancement for perceived eye contact rather than a memory decrement for averted gaze. Second, and more importantly, the influence of gaze cues on memory for items was driven solely by a memory decrement that occurs when gaze is averted from the item location rather than a memory enhancement when gaze is directed towards the item location. Previously, we suggested that a valid gaze cue could enhance memory as real-world gaze is critical to determining the intent and interest of the observer meaning that gazed-at items could be considered more relevant and, as such, more memorable. Though gaze cues influenced memory, however, this effect was unrelated to gazed-at items. Rather, invalid cues removed attention from subsequent target locations, reducing the processing time for briefly presented items. So long as items were presented for 1000 ms, this initial processing deficit could be overcome. This finding is particularly relevant to fMRI investigations of to-be-remembered faces in which – contrary to the aforementioned behavioral studies of face memory – face stimuli are routinely presented for less than 1 s (e.g., George, Driver & Dolan, 2001; Puce, Allison, Bentin, Gore, & McCarthy, 1996). Our data suggest that in these neuroimaging situations it is possible that the advantage for central gaze compared to peripheral gaze reflects a memory decrement for averted gaze. It is also important to note that our failure to observe similar effects with central arrow cues suggests that the present results are gaze specific. This finding is in line with previous reports suggesting that gaze cueing effects appear to be more strongly automatic than arrow cueing effects (e.g., Friesen et al., 2004). Though these central cueing effects share a similar time course and magnitude, their influence on attention and memory critically differs. Taken together, the present results are particularly relevant for investigations that have sought to understand the neural mechanisms that subserve the relationship between perceived eye direction and face processing and memory as they suggest a processing dissociation that occurs as a function of presentation duration.

It is worth noting that the present study did not set out to test the interpretation of behavioral and neuroimaging investigations of gaze direction effects on face recognition. Any link between our study and those investigations is at present suggestive and turns on a number of factors that will require a great deal of future study (e.g., whether our findings for word memory extend to face memory, whether our memory effects for an invalid peripheral location applies to an invalid central location, and whether our effects for gaze direction apply to the stimulus that serves as the gaze cue). At present, what can be concluded is that the assumption that averted gaze direction has no detrimental effect on memory has been invalidated for stimuli that are presented briefly. This is a new and potentially rich finding on which investigators can build a new line of research.

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