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No iconic memory without attention

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ABSTRACT

The experiments reported extend the findings of our earlier paper, (Mack, Erol, & Clarke, 2015) and allow us to reject Bachmann and Aru's critique of our conclusion (2015) that IM requires attention. They suggested our manipulations, which diverted attention from a letter reporting task in a dual task procedure where the task-cue occurred after the array disappeared, might only have affected access to IM and not the "existence of the phenomenal experience". By further decreasing the probability of reporting letters to only 10% and adding a final trial in which the letter matrix was either completely absent or distorted, we found more than half our subjects were unaware of its absence, or distortion i.e., were inattentionally blind. We take this as powerful evidence against the existence of any phenomenal experience component of iconic memory and consistent with the view that iconic memory demands attention and that conscious perception does as well.

1. Introduction

Does iconic memory (IM) occur in the absence of attention? This question in isolation may seem unimportant, but placed in the context of the debate about whether attention is necessary for conscious perception, an issue central to our understanding both of consciousness and perceptual awareness, its importance becomes clear. Those who have argued that attention is not necessary have cited both gist perception and IM as evidence (see for example, Koch & Tsuchiya, 2007; Lamme, 2004). Recent research (Cohen, Alvarez, & Nakayama, 2011; Mack & Clarke, 2012) produced evidence that gist perception requires attention, eliminating gist as an example of attention-free perception, but the question of whether IM is attention-free is still debated.

Despite the recent experiments that provide data in support of the necessity of attention for IM, including our own recent study (Mack, Erol, & Clarke, 2015; Persuh, Genzer, & Melara, 2012), the conclusion that attention is necessary for iconic memory has not been fully accepted (see for example, Aru & Bachmann, 2013). Most recently Bachmann and Aru (2015) questioned whether the data reported in our 2015 paper, which we argued supported attention-free perception, did in fact support this conclusion. Although we were able to counter most of their criticisms (Mack, Clarke, & Erol, 2015), there was one objection they raised, namely that our manipulation of attention could just as easily only have affected *access* to IM, and not the formation of IM, which our data did not permit us to reject. If they are correct, then we would be mistaken in concluding that the data we reported is evidence that IM is attention-free and IM would stand as an instance of attention-free perception.

The explanation of our results offered by Bachmann and Aru (2015) is consistent with the widely discussed distinction, originally offered by Block (1995), between phenomenal and access consciousness, which for Block and others accounts for

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our sense of a rich perceptual experience beyond that which we can describe or report. The most frequently cited example of this comes from Sperling's classic work on IM (1960) in which he showed that observers could report almost all 4 letters in a single row of a 3 × 4 letter matrix when cued to do so after the matrix disappeared, although if they were asked to report all the letters, they still could only report 3 or 4 of them. This was taken as evidence that all the letters were available for report in an IM for a brief period of time after the array disappeared and seemed consistent with the impression that we see more than we can report. Thus supporting the distinction between phenomenal and access consciousness.

The question at issue then is whether our results can be explained by a sharp decrease in the ability to *access* items that are very briefly stored in IM as attention is diverted away from the matrix, without any change in the phenomenal awareness or iconic representation of all the matrix items. In other words, does attention only facilitate *access* to iconic representations, without affecting their formation, which, on this account, is preattentive. The supposition at the heart of this account is that there can be a phenomenal form of consciousness about which we can say nothing, an idea that we and others find troubling (see for example, Kouider, de Gardelle, Sackur, & Dupoux, 2010). Here we report data we think comes as close as one can get to enabling us to reject this hypothesis.

In our published paper on IM (Mack, Erol et al., 2015) and in the research we currently are reporting, we used a dual task procedure that allowed us to manipulate the probability of having to report the letters in a Sperling-like 3 × 2 letter matrix that was presented for 250 ms at fixation simultaneous with a surrounding set of 4 circles. On every trial participants were cued to perform either the circle or the matrix task by a signal that was presented after the stimulus array disappeared, so they never knew which task they were to perform until the array was gone. We varied the difficulty of the circle task as well as the probability of having to perform the circle or the matrix task. We used three different probability conditions: 40/60, where on 40% of the trials the participants were cued to perform the circle task and on 60% the matrix task, 60/40, and 80/20. As the probability of having to report the matrix letters decreased, we assumed that attention would be increasingly withdrawn from the matrix. Each probability condition was combined with an easy and hard circle task. The easy task entailed reporting whether all the circles were the same color (red or green) or whether one was different (red or green). The hard circle task again entailed reporting whether all the circles were the same or different, but now the circles were color bisected, half red half green, and the odd circle had reversed colors. We also included partial and whole report conditions in order to be sure that we were actually dealing with IM. We reasoned that the number of letters observers would be able to report would decrease as attention was more and more drawn away from the matrix and towards the circle task, which was most extremely the case in the 80/20 condition when it was combined with the difficult circle task and the data showed just that.

To briefly summarize as attention to the matrix decreased, so did the ability to report matrix items revealing, we claimed, the centrality of attention for IM. We took these results to be consistent with the hypothesis that IM requires attention. It is these results that Bachmann and Aru suggest might be evidence that without attention IM cannot be accessed and reported but not that IM itself is diminished or eliminated.

In the experiment we report now, we not only decreased the probability of having to report the letters in the matrix even further to 10% (a 90/10 condition), so that attention would be even more strongly diverted from the matrix in the experimental condition, but more importantly we also included an additional trial, the 101st, the data from which allow us to address the critical question about phenomenal awareness of the matrix. In the experimental condition in which the matrix task only was cued on 10 of the 100 trials and never cued on the last 10 trials, the 101st trial contained *no matrix at all* (Matrix Absent Condition). On this critical trial the circle task was cued, as it had been on the prior 10 trials, but now the computer screen that appeared immediately after the cue asked participants to "please enter the letters", which of course were not there. (Obviously whatever letters the participants entered were only guesses since there were no letters present.) Following this, if an observer entered letters in the response box rather than saying to the experimenter they couldn't since there were none, the experimenter asked the observer whether they noticed anything different on this trial. If they reported being unaware of anything different and were surprised when they learned from the experimenter that there had been no letters at all, we believed this would be strong evidence of the absence of phenomenal awareness or iconic memory of the matrix, since even if they could not report with any specificity what was there, based on phenomenal consciousness they at least should have been able to say that nothing was there. In fact, as pointed out above, the original basis for arguing that there is a phenomenal aspect of iconic memory is the often commented upon sense that we see more than we can describe.

It should be pointed out that the procedure we used here is a close approximation to a typical inattentional blindness procedure (Mack & Rock, 1998) in which observers are asked immediately after an array has disappeared and after they have completed their assigned task, e.g., reporting the longer line of a briefly presented cross, whether they were aware of anything different on that trial, when in fact there is an additional stimulus item present. Inattentional blindness is evidenced by the failure to see the unexpected, new stimulus. However, three things distinguish our current procedure from the typical inattention procedure. Here, inattentional blindness is not noticing the *absence* of a stimulus you expect to see, rather than failing to see a stimulus you do not expect to see. In addition, unlike typical inattention experiments in which the observers are doing a single task, the present experiment entails divided attention. If the observers in the current study fail to notice that there was no matrix present, they are doing so despite the fact that they are performing a task in which they know they might have to report the matrix, even if having to do so is very unlikely. Finally, since the observers have to report letters immediately following the cue to report whether there is an odd circle, the time between the disappearance of the array and their response is even briefer than it is in the typical inattention procedure thus allowing virtually no time for forgetting. We think that not being aware of the absence of the letters under these circumstances would be persuasive evidence of the lack of any phenomenal awareness, i.e. of any iconic memory at all.