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Where the item still rules supreme: Time-based selection, enumeration, pre-attentive processing and the target template?

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Abstract

I propose that there remains a central role for the item (or its equivalent) in a wider range of search and search-related tasks/functions than might be conveyed by the article. I consider the functional relationship between the framework and some aspects of previous theories, and suggest some challenges that the new framework might encounter.

Main text

H&O make a convincing case that researchers have tended to study and model search from either a covert attention- or an eye movement- (EM) only perspective and that if the field is to move forwards there needs to be a concerted effort to combine the two – a sentiment with which I agree fully. The message is that we should abandon the idea of the item, replacing this notion with a combination of EMs and the extraction of information from fixations via a Functional Viewing Field (FVF) mechanism/perspective. EMs guide the FVF sequentially to regions from which information is extracted in parallel until the target is found. The size of the FVF changes as a function of target discriminability; hence there is no role for the 'item' within this framework. H&O argue that even when the task is to localize a target, the search process itself need not be item-based. Nonetheless,

this of course still leaves (some) room for the item in visual search (it is the product of the search, and the target 'template' will likely always be item-based).

In response, I will first present the preview benefit (Watson & Humphreys, 1997) as just one potential example in which I will argue that item representations play a central role in the search process. In preview search, one set of distractors is presented (previewed) before a second set which contains the target. We find that people can ignore the previewed items and restrict their search to the second set of stimuli. According to the inhibitory visual marking account, with stationary stimuli, this is achieved by developing a template of the locations of the old items and applying inhibition to those locations. This biases attention (and eye movements) away from those items, creating a search advantage for newly arriving stimuli. Granted, the localization of the initial items might not need to proceed via an item-by-item process (see above). However, because the inhibitory template is item- (location) based, and influences the subsequent search process, I would suggest that here 'the item' (and its location) continues to play a crucial role in the subsequent search process itself. Indeed, if the locations of the old items change when the new arrive, the preview benefit disappears (e.g., Zupan, Watson, & Blagrove, 2015). In contrast, with moving preview items, inhibition is applied mostly to feature maps (Watson & Humphreys, 1998; Andrews et al., 2011), removing the need to track, localize, or process individual items (an example of part of a search theory in which the item is explicitly not important).

A second example in which the item probably remains special can be found in enumeration tasks. Here people do not search for a single target but have to search for all targets (with or without the annoyance of distractors; Trick & Pylyshyn, 1994) and report how many are present. In contrast to absent/present search, it is essential that items are not revisited because re-counting an item will lead to an error. With relatively coarse FVFs and an overlapping sequence of FVFs, ensuring that items are not recounted could be difficult. Perhaps here FVFs would be so small that search would effectively be item-by-item. Indeed, beyond four items enumeration appears to be especially reliant on EMs (Simon & Vaishnavi, 1996; Watson, Maylor, & Bruce, 2007). These are just two possible but broad (selection in time and counting things) examples of where the item might remain central to the task, but there are others (e.g., I wonder how contextual cuing, Chun, 2000, will work without the spatial configuration of 'items').

Moving on, does the FVF implicitly maintain the notion of an item? H&O argue that theories such as Attentional Engagement Theory (AET) are item-based because individual stimuli are grouped and rejected until the target is found. However, the FVF argument proposes that a stimulus emerges from the FVF which presumably is the result of some kind of competition between visual entities within the FVF. Is it possible that one episode of FVF processing equates to an entire search process in AET? So have we simply replaced the 'item' from AET with more abstract visual entities within the FVF? Presumably there needs to be some individuation of 'things' within the FVF for a target to emerge — aren't these 'things' still just items? Notably, even though just a proof of concept, the entities fed into H&O's simulation are discrete 1s and 0s. Are we really just arguing about how we define an item? Have we just replaced competition between items with competition between more abstract entities within the FVF?

H&O rightly state that the majority of studies have focused on relatively efficient search and this is perhaps because of the preoccupation with using small display sizes and easily separable stimuli. However, I would suggest that a focus on eye-movement-based measures could also bring with it disadvantages. For example, Watson, Maylor, and Bruce (2005) have argued that tasks that require eye movements can obscure interesting covert attentional differences because eye movements are relatively slow and noisy. In their case, the need to make EMs in a task appeared to wash out/obscure age-related attentional differences. Thus a focus on EM measures, or worse, an encouragement to design studies that force EMs to be made, might lead to interesting effects being missed.

Finally, if we abandon the notion of the item, then what should we use to evaluate search? Will we rely just on EM frequency, or will we estimate the size of the FVF, and if so how? Do we run the risk of the circularity that H&O warn against: a search is difficult because it produces a small FVF; a small FVF is needed because target discrimination is difficult? Rather than abandoning the idea of an item altogether, perhaps we need a better way of defining what an item is.

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