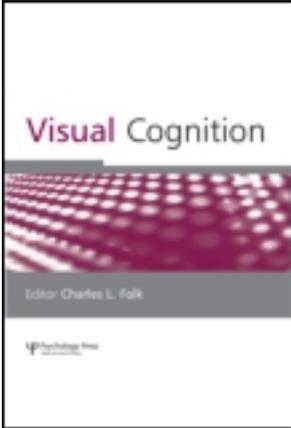


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Lions or tigers or bears: Oh my! Hybrid visual and memory search for categorical targets

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Lions or tigers or bears: Oh my! Hybrid visual and memory search for categorical targets

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In many real world visual search tasks, we search for any of several targets (Are any of my Facebook friends at this party?). Such tasks are “hybrid” visual and memory searches where observers look for any of N several possible targets (the memory set size) in a visual array containing a number of items (the visual set size). Wolfe (2012) showed that RTs in hybrid search increased linearly with visual set size and linearly with the logarithm of memory set size. Previous hybrid search tasks didn’t see this log function probably because they used relatively small numbers of alphanumeric items (e.g., Schneider & Shiffrin, 1977), although Burrows and Okada (1975) reported logarithmic RT function in a rather different memory task and Hick’s law proposes a log function for choice among multiple actions (Hick, 1952; Schneider & Anderson, 2011)

Wolfe (2012) had observers searching for N discrete items. More typical would be a search for members of N categories. Thus, an airport screener might be searching for *any* gun, bomb, or knife, rather than *this* gun, *this* bomb, or *this* knife. Ten observers (Mean age = 23.7, $SD = 6.83$, four females) were asked to memorize one, two, four, or eight categories. Twenty categories were available: Animals, cars, clothing, electronic appliances, flags, masks, shoes, fruit, furniture, jewellery, kitchenware, money, musical instruments, picture frames, plants, rocks and minerals, signs, sweets, time pieces, and weapons. No category was a target category in more than one block of the experiment for any one observer. Once they passed a memory test, observers searched visual displays where one and only one of the items in the display was drawn from one of the target categories. Distractors were drawn from *all* of the remaining categories. For example, a memory set size of four might consist of fruit, furniture, jewellery, and sweets. Observers searched through displays with visual set sizes of 4, 8, 16, or 32, and were instructed to find the target item that was a member of one of their memorized categories as fast as possible. There was always only one target item in each display and, when they found the item, they were told to click on it. They were tested on 400 trials per memory set size. We also did the present/absent version of this experiment (without visual set size 32), where observers were asked to press the appropriate key if one of their category items was present (never more than one item).

Results show (see Figure 1) that searching for categories is markedly slower than searching for objects; slopes for the categories experiment were on average about 32 ms/item slower than the object version in Wolfe (2012) where the slopes were on average 58 ms/item.

This is a fairly difficult task, with miss errors at 25% at the largest visual set sizes. A miss error in the localization experiment occurred when the observer clicked on anything that was not the target item. Observers were

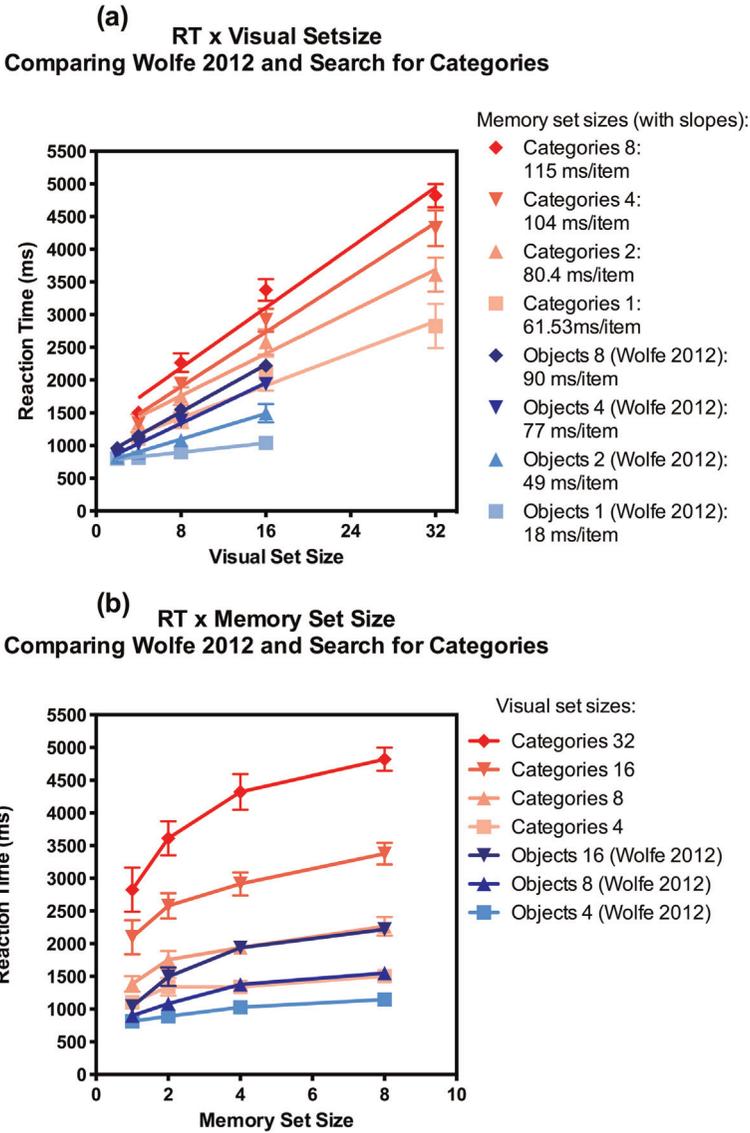


Figure 1. (a) RT as a function of visual set size with separate functions for each memory set size. Data are from correct trials only. Red lines are from the current experiment. Blue lines reproduce data from Wolfe (2012). (b) A replot of the same data as a function of memory set size with separate functions for each visual set size. Note the logarithmic shape of the functions. Overall, it takes longer to search for categories than for specific objects in memory. To view this figure in colour, please see the online issue of the Journal.

always forced to click on the target item before they advanced to the next trial. Error rates are comparable to those from Wolfe (2012) for comparable conditions. Thus, our observers missed 15% for a memory set size of 8 at visual set size of 16. The error rate for that cell in the Wolfe data was 16%.

Because target categories from previous blocks could serve as distractors on subsequent blocks, interference from previously memorized categories probably contributed to errors. This hypothesis is supported by an increase in the error rate over the course of the experiment. Moreover, under rather different circumstances, multiple categories have been shown to interfere with each other (Evans, Horowitz, & Wolfe, 2011). Whatever the cause, the high miss error rate probably produces a speed–accuracy tradeoff that will distort the $RT \times \text{Visual set size}$ functions and the $RT \times \text{Memory set size}$ functions. Nevertheless, despite the relatively high miss errors, $RT \times \text{Visual set size}$ functions remained essentially linear and, more importantly, $RT \times \text{Memory set size}$ increased logarithmically.

The original Wolfe (2012) finding of logarithmic memory search could have been a property of retrieval from our massive memory for specific scenes and objects (Brady, Konkle, Alvarez, & Oliva, 2008; Standing, 1973). The present finding suggests that logarithmic search is more generally characteristic of search through what can be called temporary long-term memory.

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