Mixed hybrid search: A model system to study incidental finding errors in radiology.

Jeremy M Wolfe PhD
Department of Surgery, Brigham & Women's Hospital
Departments of Ophthalmology & Radiology, Harvard Medical School

Rationale:

When a radiologist examines an image with one goal in mind (e.g. Does this patient have lung cancer?), s/he is also asked to report any "incidental findings" – findings that might be clinically significant even if they are not the reason that the study was ordered (e.g. a broken rib). When such incidental findings are missed, there are can be negative medical consequences for the patient and negative legal consequences for the physician. If we want to reduce incidental finding errors, it would be useful to have a way to study the process that produces them without needing to use scarce radiologist time. Thus, our goal in this project is to develop a 'model system' that can be used to study incidental findings in non-experts.

Methods:

To this end, we have developed the "mixed hybrid search" task. In standard visual search, observers look for one type of target. In hybrid search, observers look for an instance of any of several specific targets held in memory (Find this rabbit, this truck, and this key). Hybrid search is so-named because it combines visual and memory search. Reaction times (RTs) in hybrid search increase linearly with the visual set size and linearly with the log of the number of targets held in memory. The same pattern is seen with search for categorical targets (e.g. find any cat, bottle, or dessert), though categorical targets produce longer RTs than specific targets. To simulate the incidental finding situation, in the mixed hybrid search paradigm, observers search for any of three specific and three categorical targets. Specific targets are the analog of the radiologist's specific task. Categorical targets are the analog of the incidental findings. They are known to the observer but are less well-defined than the specific targets. Observers memorize the targets for a given block of trials and then search through 300 displays, half of which contain one target. In a second experiment, the categorical targets appear on only 20% of target-present trials, mimicking the fact that incidental findings will be relatively rare.

Results:

When categorical and specific targets are mixed within a block, observers miss more than twice as many categorical targets as they do specific targets. Observers miss fewer

categorical targets if all targets in a block are categorical. Observers miss the fewest targets when all are specific. In Experiment 2, a mixed block with 4X as many specific targets as categorical targets produces a high miss rate for categorical targets (38%, > 7X the rate for the more common specific targets), mimicking the pattern of incidental finding errors in radiology.

Conclusions:

Mixed hybrid search has properties that make it a plausible model system for incidental findings. If further studies confirm that this paradigm captures important aspects of the problem, we can use mixed hybrid search to test interventions that could reduce the incidental error rate in the lab and in the clinic.