Expertise fine-tunes mental representations of targets during challenging visual search

Michael C. Hout \(^1\), Alexis Lopez \(^1\), Arryn Robbins \(^1\), & Megan H. Papesh \(^2\)

\(^1\) New Mexico State University; \(^2\) Louisiana State University

EXPERTISE IN VISUAL SEARCH

- We all know what it means to be an expert on something, even if that something is a hobby.
- However, acquired knowledge and skills are often hard to articulate.
- Professional visual search requires considerable training and expertise, but relatively little has been done to quantify what makes professionals different from novices.
- To develop efficient training protocols requires a fundamental understanding of the underlying cognitive processes – and oculomotor behaviors – that are affected during the acquisition of expertise.
- Challenges faced by TSA screeners: 1) Imprecise definition of “weapons.” 2) Must look for many things at once. 3) Targets show up with unequal frequency.
- Our study: 1) Categorically-defined targets. 2) Looked for 20 categories at once (0-3 on any given trial). 3) Targets appeared with varying frequency.


PROCEDURE

- Recorded eye-movements over (up to) 23 experimental sessions (n = 5).
- Selected items highlighted in black. “Stop sign” indicated searcher was finished.
- 5 blocks of 40 trials, per session. Equal number of 0-3 target trials.
- Participants acquired points for accuracy (hits +1; misses/false-alarms -1).
- Block-level feedback was provided regarding performance.

RESULTS, BEHAVIORAL

- Largely qualitative analysis, given the small sample size. Each dot is one participant, one session.
- Participants approached perfect performance (300 points), arguably acquiring near-expert skill levels.
- Over time, they more quickly located any/all targets, and hastened their decision-making regarding when to stop searching.

RESULTS, EYE-TRACKING

- Despite spending more time searching, participants actually became more likely to directly fixate the targets, particularly those of higher frequency.

RESULTS, FREQUENCY EFFECTS

- Frequency (aka “prevalence”) effects on accuracy diminished, but did not disappear over time; more frequent targets were still more likely to be found.
- Viewing failures: missed target because it was never examined. Recognition failure: missed target despite directly fixating upon it.
- Low-frequency targets suffered more recognition failures, relative to higher-frequency targets. \(\chi^2(3) = 50.47, p < .001\), replicating prior work (Hout et al., JEPHPP, 2015).

CONCLUSION

- Data are consistent with previously published findings regarding the “low-prevalence effect.”
- Data are also consistent with diminishing (but not eliminated) frequency effects among collaborative search partners (Lopez et al.; OPAM 2016).
- Taken together, our findings suggest that, as expertise is acquired, searchers learn to refine their mental representations for target categories, particularly common ones, and become more effective at restricting attention to the most relevant features.