A Model of Visual Search Termination with an Age-related Factor

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A reliable finding in many studies of visual search is the difference in reaction time (RT) between trials in which a target is present (target trials) and those in which there is no target (blank trials). Commonly, RTs for blank trials are twice as long, on average, than those for target trials (e.g., Chun & Wolfe, 1996). This suggests a possible difference either in the mechanism used in the two trial types, or in the way a common mechanism is applied.

Another reliable finding in this literature is the large differences in RT between younger and older adults on blank trials. While both age groups produce the common difference described above, an age by trial type interaction is also usually seen, with older adults exhibiting much greater slowing from target to blank trials than do young adults (e.g., Plude & Doussart-Roosevelt, 1979).

Recently, a model of visual search has been suggested that accounts for the basic difference in RT between target and blank trials (Chun & Wolfe, 1996). In this model, the items within a visual display are subject to an activation threshold, set automatically by the individual doing the search task. Search of a display terminates either when a target is found (target trials) or when none of items remaining to be searched exceed the pre-set activation threshold (which is based on the perceptual features of an item). The activation threshold is sensitive to feedback given immediately after a trial, such that a correct blank trial would increase the activation threshold, causing fewer items to be searched and, therefore shorter RTs. A missed target trial, on the other hand, would cause the threshold to be lowered and RTs to lengthen.

This model provides not only a mechanism by which search can be terminated when no target is present, but also a means by which the searcher can become more efficient across trials. Chun and Wolfe suggest that as the typical visual search experiment proceeds, and more and more trials are encountered, the searcher develops a sense of how much search time it should take to detect a target in a given display. As that time approaches, with no target yet identified, the searcher will be more likely to guess about the presence or absence of a target. Note that this suggests that as an experiment proceeds, variation in RT should decrease as the searcher estimates the "average" search time needed for any given display.

Our study attempts to modify Chun and Wolfe's model to account for the age differences explained above. Specifically, we suggest that a change in the ability to use feedback and set the activation threshold may cause older adults to overcorrect after missing a target trial. This would lead to a significantly lower activation threshold and much longer RTs in blank trials, particularly those following a missed target trial. This change would be consistent with other changes noted in older adults, particularly in the ability to chose and apply cognitive strategies. The setting of an activation threshold can be thought of as a search strategy, that is modified over time to yield the most efficient search. Just as older adults have been found to have more difficulty employing memory (e.g., Craik & Rabinowitz, 1984) and problem solving (e.g., Hornblum & Overton, 1976) strategies, they may be more inaccurate than young adults in adapting the activation threshold in the face of negative feedback. In a sense, the older adults may be perceiving the missed target trial as having a greater "cost", becoming much more conservative on subsequent search trials than their younger counterparts.

Our study presents a model, based on that of Chun and Wolfe, that includes a developmental variable affecting the setting of an activation threshold. We compare the performance of the model at two developmental stages with the performance of younger and older adult participants in a visual search task, to determine the usefulness of the model at predicting age differences in blank trial search times.

References

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