

# Going Beyond the Visual in Visual Search: Semantic Search for Related Words

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## --- SEARCHING FOR TEXT ---

- Visual search is not just about looking for objects: Sometimes we need to hunt for text, as when scanning a website for keywords, or specific pieces of information.
- Similarly, there are times in which we look not for a specific word, but a piece of text that is semantically related to a topic. For instance, we may want to look for words related to the topic of “psychology,” such as “cognition,” “brain,” and so on.
- When searching through text, what happens when we encounter words that are visually and/or semantically similar to the word or topic of interest?
- Is it possible that related information may be activated by the keyword (e.g., through spreading activation), yielding facilitated search performance for semantically similar words?

## --- PREVIOUS STUDY ---

Godwin, Hout, & Menneer, *PB&R* 2014

- Examined search for numbers.
- Visual similarity derived from multidimensional scaling (MDS) and semantic similarity from numerical distance. For a review on this process, see Hout et. al, *APP&P* 2015.
- Fixation of distractors was guided not only by visual similarity, but semantic similarity as well.
- Visual similarity played a larger role than semantic similarity in guiding search.



## --- CURRENT STUDY ---

- Given that semantic similarity had an effect (albeit small) on search performance with numbers, is it possible that words (which have larger semantic weight) elicit similar behavior?
- Are people quicker to verify targets semantically similar to a cue, versus those less similar?
- It might seem unlikely that semantic similarity between the cue and target would influence attentional guidance for words, but it does seem likely that it will influence verification time.

## --- METHOD ---

- N = 19 native English speakers.
- People looked for a single word that was semantically related to a cue. All words were 4 or 5 letters long (50/50 prevalence)
- The target word was among distractors; participants made present/absent decisions (50/50 prevalence in 242 trials).
- Eye movements recorded using Eyelink 1000.
- Linear Mixed Effects modeling was used to analyze viewing behavior. To control for the effects of visual similarity, MDS ratings for stimuli were used as fixed effects in the models.
- Target words varied by semantic relatedness to the cue. Semantic relatedness was determined using the University of South Florida Free Association Norms; (E.g., “book” → “read”).

Cue= “bride”

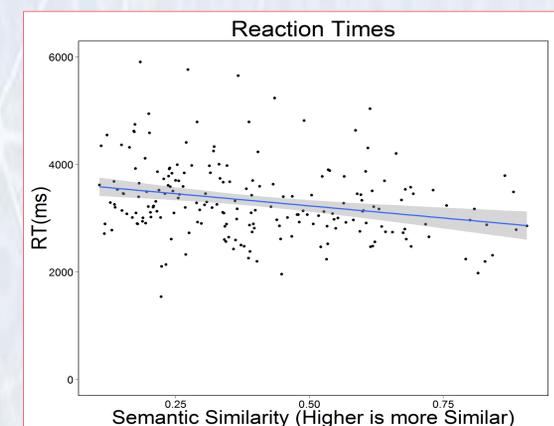
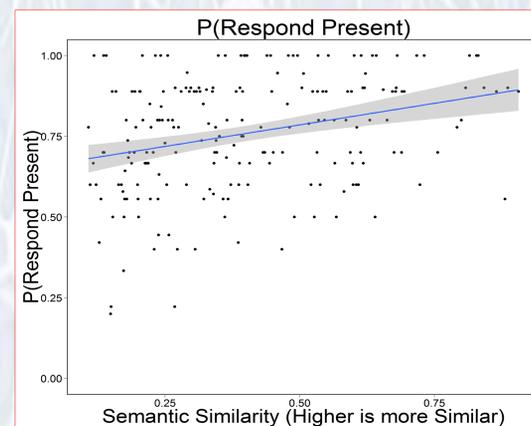


Sample visual search display. The target is bordered in blue. Note that it was not actually highlighted this way during a real search trial.

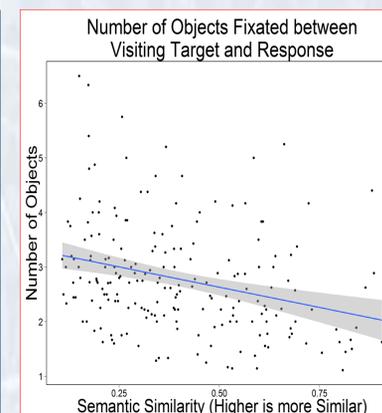
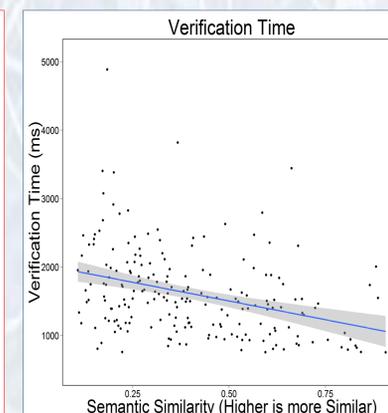
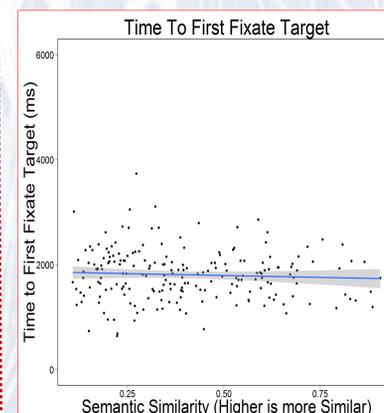
## RESULTS

- Behavioral responses:** Semantic similarity between cue and target had a clear effect. RTs decreased as semantic similarity increased. Additionally, the probability of responding present (when the target was indeed present) was influenced by semantic similarity – participants were more likely to respond present as similarity increased.
- Time to First Fixate:** This eye tracking measure examines attentional guidance. Our best fitting model had no effects here. Semantic similarity did not influence how long people took to fixate the target.
- Verification time:** There was a main effect of semantic similarity, increasing similarity shortened verification time.
- # of objects visited between 1<sup>st</sup> target visit and final target visit:** Main effect of semantic similarity - fewer objects were visited as semantic similarity increased.

## --- BEHAVIORAL MEASURES ---



## --- EYE TRACKING ---



## --- CONCLUSIONS ---

- Search for words was influenced by semantic similarity as participants were more likely to respond “present” as semantic similarity increased.
- Reaction times were influenced by semantic similarity, primarily due to time needed to verify the target. Decreasing semantic similarity yielded longer time to verify the target (as confirmed by eye tracking measures).
- Response data were highly variable, likely due to differences in response thresholds. The subjective nature of the task meant that responses were more variable, since the answers were ambiguous and open to interpretation.
- Likewise, confidence in responses (though not measured here) could also explain the variability, with more confidence causing faster responses: Participants who can be confident in their target-word choice are likely to look at fewer words. Also, targets that are more semantically similar to the cue are likely to create more confidence in responses and permit faster decisions.
- Despite understanding that there is only one target word, participants often completed an exhaustive search before returning to the target and responding.
- Future directions may include examining these phenomena with word search in applied settings (e.g. web browsing or reading), and examining the role of semantic similarity (and spreading activation from target templates) in complex stimuli.

