Neural correlates of treatment effects on abstract and concrete words in aphasia: A pilot study

Chaleece Sandberg & Swathi Kiran
Aphasia Research Laboratory, Speech Language and Hearing Sciences
Boston University, Sargent College

Background
- Behavioral data from both normal and brain-injured subjects suggests that abstract words and concrete words are processed differently (i.e., concreteness effect). For example, the Dual Coding Theory (Paivio, 1991) suggests that abstract words are encoded into the semantic system with only verbal information and concrete words are encoded into the semantic system with both verbal and multi-modal sensory information.
- Evidence from recent neuroimaging studies suggests the possibility of dissociable neural correlates for abstract and concrete word processing (Binder et al., 2009, Sandberg & Kiran, manuscript in preparation).
- Patients with aphasia exhibit an exaggerated concreteness effect behaviorally (Nickels & Howard, 1995; Barry & Gerhard, 2003) and concreteness has been successfully manipulated in treatment to increase effectiveness (Kiran, Abbott, & Sandberg, 2009).

Are there a connection between the dissociable neural correlates of abstract and concrete words and the beneficial effect of training abstract words, which are less concrete and therefore more complex?

Participants
- Patients with aphasia: N=3, 1 m, 2 f; age range: 55-67 (M=59); R-handed; monolingual English-speaking.
- fVQA in LH with subsequent difficulties in word retrieval.

Treatment Protocol
- Semantic Feature Analysis (variation of Boyle & Coelho, 1995)
  - Training set of 10 words
  - For each word, participant:
    - Chooses 6 features that belong to the word
    - Answers 15 yes/no questions about the word
- 3T Phillips; T1 structural: TR=26ms, 128 stimuli duration per ISI
- Patients scanned both before and after treatment.

Results
- All three patients improved on the trained abstract words; two patients also generalized to concrete words. Note that more perilesional activation occurred with abstract words and accuracy for abstract words improved during the synonym judgment (SJ) task.
- Notably, however, the trained structure (abstract words) showed more increased activation than concrete words. This matches the behavioral results seen both during treatment and while scanning.

Discussion
- All three patients showed increased activation in spared left hemisphere language areas after treatment. This supports the notion that better language recovery in chronic aphasia is associated with transfer of language function from compromised portion of the right hemisphere to spared language areas of the left hemisphere (Bauer et al., 2006).
- All three patients showed increased activation in spared left hemisphere language areas after treatment.
- Abstract and concrete nouns tended to overlap in activation both before and after treatment, which is consistent with age-matched controls (Sandberg & Kiran, unpublished data).
- Notably, however, the trained structure (abstract words) showed more increased activation than concrete words. This matches the behavioral results seen both during treatment and while scanning.

Conclusion
- These tentative results suggest:
  - Training abstract words increases activation in areas thought to process abstract words.
  - Generalization from abstract to concrete words during treatment may coincide with increased neural activation for concrete words from pre- to post-treatment.
- It is important to note that these patients were more highly functioning than the average aphasic patient with highly accurate responses on the fMRI task even before treatment.
- Future research should focus on a larger sample, with a wider severity range.

References