Abstract and concrete noun processing in healthy older adults using fMRI
Chalee Sandberg\textsuperscript{a} & Swathi Kiran\textsuperscript{b}
Aphasia Research Laboratory, Department of Communication Sciences and Disorders
\textsuperscript{a}The University of Texas at Austin; \textsuperscript{b}Boston University, Sargent College

Background
- Behavioral data from both normal and brain-injured subjects suggests that abstract words and concrete words are processed differently.
- Dual Coding Theory (Paivio, 1991)
- Suggests two systems for encoding words into semantic memory
  - Verbal (linguistic): Abstract words are encoded into the semantic system with only verbal information.
  - Nonverbal (sensory): 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, 2007)
- An issue yet unaddressed in the current literature is the processing of abstract and concrete nouns in normal, healthy older adults, although neural activation corresponding to different cognitive processes has been shown to change as a function of age (Cabeza, 2001)
- Patients with aphasia, who typically fall into the category of older adults, are hypothesized to use the right hemisphere for semantic processing instead of the damaged left hemisphere.
- If concrete words are processed bilaterally, then patients with aphasia will exhibit preference for concrete words, which has been shown behaviorally (Nickels & Howard, 1995; Barry & Gerhard, 2003; Kiran, Abbott, & Sandberg, 2009).
- In order to test these hypotheses, we must establish a healthy older adult neural activation baseline against which to compare neural activation in patients with aphasia.

Methods
- Participants
  - 10 females, 5 males, age range: 50-63
  - Right-handed, monolingual English speakers
  - No history of neurological disease, trauma, or disorders.
  - Normal cognitive and linguistic functioning.
- Tasks
  - Lexical Decision (replicated from Binder et al., 2005)
  - 50 abstract words, 50 concrete words, 100 pseudowords
  - Word Judgment
    - 50 abstract words, 50 concrete words, 50 same symbol strings, and 50 different symbol strings
- Event-related paradigm
- Experimental and control stimuli for each task are combined and randomly presented.
- Allows for analysis of BOLD signal for each stimulus.

Results
- The areas of overlap obtained in the lexical decision task (angular gyrus bilaterally and left posterior circular gyri) agree with suggested areas of general semantic processing.
- These areas did not show a preference for either abstract or concrete word processing.
- Overall, more areas of activation were found bilaterally for concrete words during the lexical decision task. This may be reflecting:
  1. A bilateral network for processing concrete words
  2. Similarities in processing between abstract words and pseudowords (see behavioral data)
- The areas of overlap obtained in the word judgment task (left inferior frontal gyrus, left posterior middle temporal gyrus, and left superior frontal gyrus) also agree with suggested areas of general semantic processing as well as areas of specific semantic processing.
- These areas also did not show a preference for either abstract or concrete word processing.
- Overall, more areas of activation were found for abstract words bilaterally during the word judgment task, specifically in the IFG. This may be due to the effects of healthy aging.
- Bilateral activation of PFC in healthy older adults versus left-lateralized activation in healthy younger adults during semantic tasks may be due to a compensatory mechanism to counteract age-related cognitive decline (Bergerbets et al., 2009).

Conclusion
In general, this study agrees with previous neuroimaging studies exploring neural correlates of semantic processing. However, the left-lateralized processing of abstract words and bilateral processing of concrete words was only supported for the lexical decision task. The word judgment task appeared to have the opposite pattern. This may be due to differences in processing demands of the two tasks and/or the effects of normal aging. Future research should focus on a larger sample, with a wider healthy older adult age range.

References