

\*This work was partially completed at the University of Texas at Austin

## 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 et al., 2009)
- An issue yet unaddressed in the current neuroimaging literature is the processing of abstract and concrete nouns in patients with aphasia. Additionally, this phenomenon has not been well-explored 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 typically fall into the category of older adults and are hypothesized to use the right hemisphere for semantic processing instead of the damaged left hemisphere
- Patients with aphasia exhibit an exaggerated concreteness effect behaviorally (Nickels & Howard, 1995; Barry & Gerhand, 2003; Kiran, Abbott, & Sandberg, 2009)
- Do patients process abstract and concrete words differently than age-matched controls?

## Methods

### Participants

- Neurologically healthy adults
  - N=13; 6 m, 7 f; age range: 50-75 (M: 61); R-handed; monolingual English
  - No history of neurological disease, trauma, or disorders. Normal cognitive and linguistic functioning.
- Patients with aphasia
  - N=4; 2 m, 2 f; age range: 55-67 (M: 59); R-handed; monolingual English
  - CVA in LH with subsequent difficulties in word retrieval

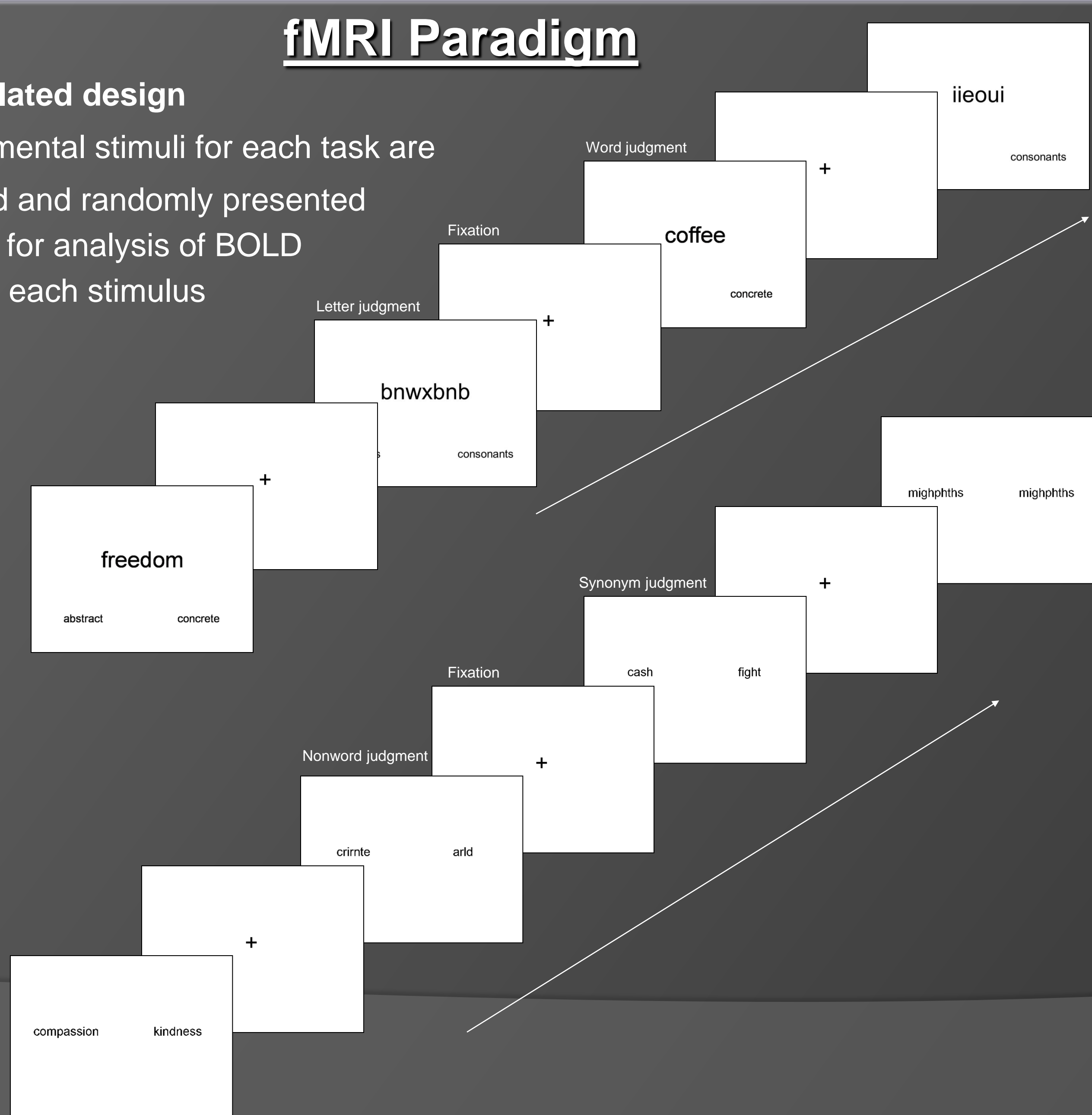
### Tasks

- Word Judgment
  - Judged whether a word was abstract or concrete
- Synonym Judgment
  - Decided whether or not a pair of abstract or concrete words were similar in meaning

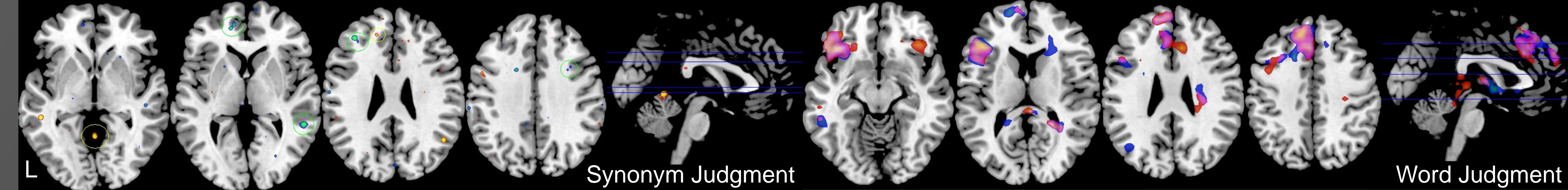
## fMRI Paradigm

### Event-related design

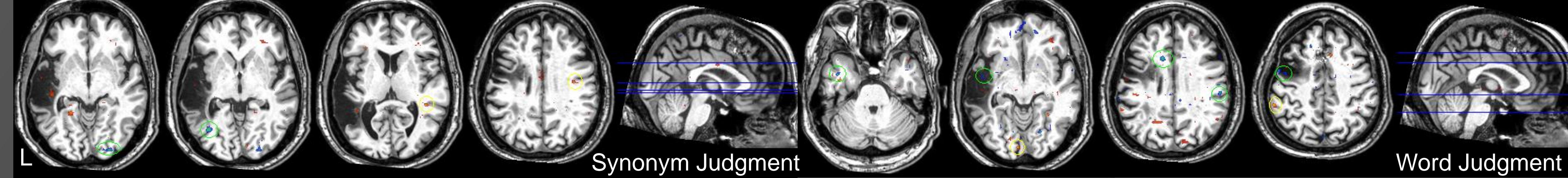
- Experimental stimuli for each task are combined and randomly presented
- Allows for analysis of BOLD signal for each stimulus



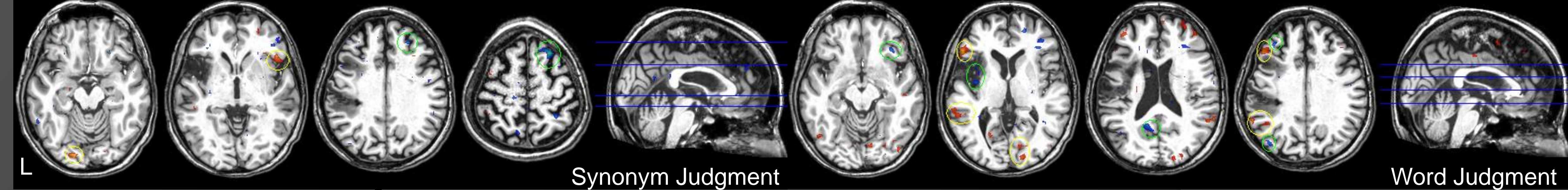
## Healthy Older Adults



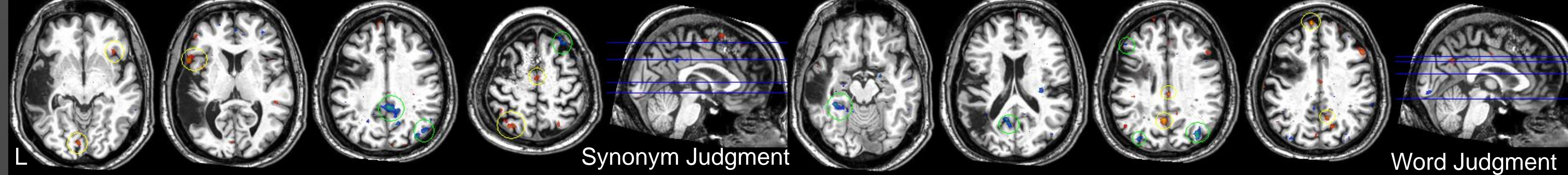
## Patient 1



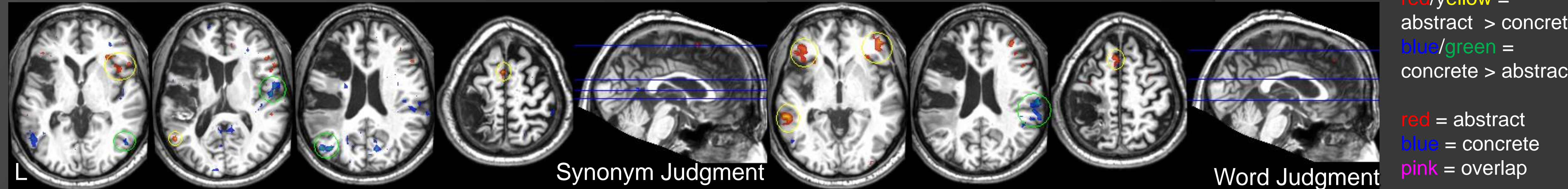
## Patient 2



## Patient 3

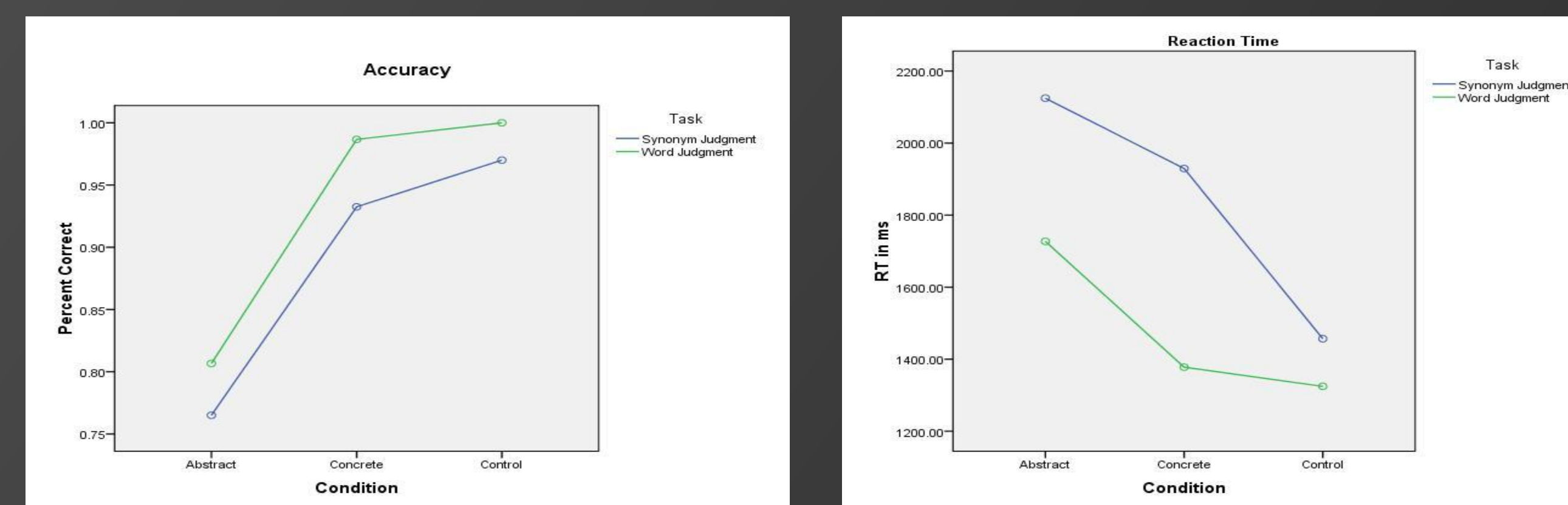


## Patient 4



red/yellow = abstract > concrete  
blue/green = concrete > abstract  
red = abstract  
blue = concrete  
pink = overlap

## Behavioral Results



Patient	Aphasia Type	Aphasia Severity (WAB AQ)	BNT
1	Transcortical Motor	82.2	83.3%
2	NA	96.7	93.3%
3	Conduction	77.7	86.7%
4	Transcortical Motor	78.6	66.7%

## Conclusion

- In general, this study agrees with previous neuroimaging studies exploring neural correlates of semantic processing.
- Additionally, this study has shown that patients with aphasia show similar patterns of activation and behavioral data as their age-matched counterparts
  - This supports the notion that better language recovery in chronic aphasia is associated with transfer of language function from compensation of the right hemisphere to spared language areas of the left hemisphere (Saur et al., 2006)
  - Future research should focus on a larger sample, with a wider age range and tasks that require deeper semantic processing in order to fully understand abstract and concrete word processing in aging and in aphasia.

## Discussion

- There was much overlap between abstract and concrete word processing in both neurologically healthy older adults and patients with aphasia.
  - These overlapping areas coincide with suggested areas of general semantic processing.
  - Differences between abstract and concrete words for both patients and healthy older adults included more instances of association areas for concrete > abstract words and more instances of language areas (and RH homologues) for abstract > concrete words.
  - There appears to be subtle differences between tasks such that synonym judgment appears to elicit deeper semantic processing.
- Activation in patients with aphasia was largely perilesional, but also in the language homologues of the right hemisphere.
  - If the tissue was spared and was normally activated in non-neurologically impaired older adults, then it was used in persons with aphasia.
  - This coincides with high accuracy on the task, showing the importance of spared tissue in language recovery in chronic aphasia.
  - The effects of normal aging may contribute to the pattern of activation seen in patients.

## References

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