Platform Session 2: Semantics

42. The Influence of Phonological Competition on Lexical-Semantic Processing: Evidence from Aphasia

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Lexical-semantic access is affected by phonological competition. Younger normal subjects show a greater magnitude of semantic priming for words with onset competitors (Zwitserlood, 1989) and for words from low density compared to high density neighborhoods (Apfelbaum et al., in preparation). Recent lesion and neuroimaging studies suggest that parietal areas are involved in phonological processing and resolving phonological competition (Prabhakaran et al., 2006; Caplan et al., 1995), and frontal areas are involved in resolving semantic competition (Thompson-Schill et al., 1997).

This ongoing study used the visual world paradigm to examine how damage to parietal and frontal areas modulate the effects of phonological competition on the magnitude of semantic priming. It was hypothesized that damage to parietal areas would result in a loss of phonological competition effects, yielding an equal magnitude of semantic priming for high and low density words. In contrast, the presence of competitors for both high and low density words would result in a loss of semantic priming with damage to frontal areas. Eight age-matched control subjects, four left posterior and three anterior aphasics participated. In each trial, participants viewed four pictures, listened for a word, and touched the corresponding picture while eye movements were monitored. Critical trials consisted of a high or low density target word (e.g. “MOON”), a word semantically related to the target (e.g. “STAR”), and two phonologically and semantically unrelated controls (e.g. “TAIL”). Results for the age-matched control subjects showed normal modulatory effects of phonological competition on semantic priming. As hypothesized, posterior patients showed normal semantic priming but no effects of density, and anterior aphasics showed neither priming nor density effects.

The evidence that phonological competition modulates access to the lexical-semantic network in normal participants is consistent with cascade models of lexical processing (Rapp and Goldrick, 2000). The loss of this modulatory effect with parietal damage suggests that insensitivity to phonological competition has a cascading effect on the activation of the lexical-semantic network. The failure of the anterior aphasics to show semantic priming for either high or low density words suggests frontal areas are recruited in selecting among competing semantic alternatives irrespective of the source of the competition.

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Presented by: **Blumstein, Sheila**

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43. Contrasting Effects of Near and Distant Semantic Neighbors on Picture Naming in Aphasia

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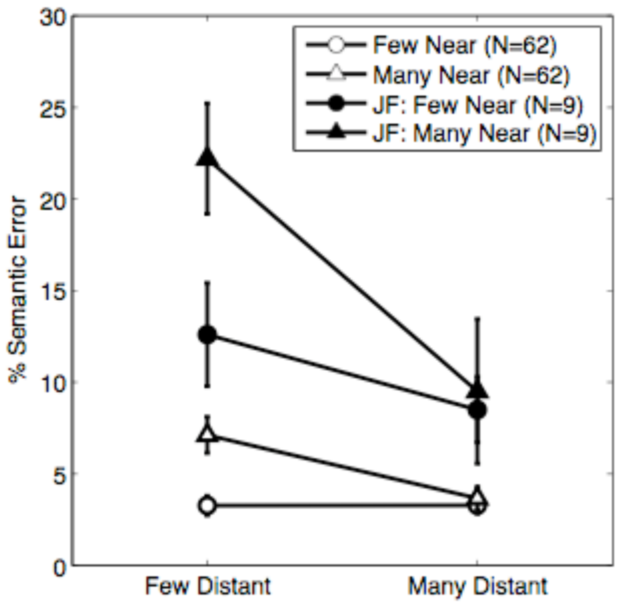
This study investigated the integrity of semantic processing in aphasia by examining the effects of semantic neighborhood density on picture naming. A recent study testing word recognition in college students found opposite effects of near and distant neighbors [Mirman, D., & Magnuson, J. S. (2008). Attractor dynamics and semantic neighborhood density: Processing is slowed by near neighbors and speeded by distant neighbors. Journal of Experimental Psychology: Learning, Memory, and Cognition, 34(1), 65-79]: distant neighbors speeded word recognition, but near neighbors slowed word recognition. This pattern was found to be consistent with an attractor dynamical model of semantic processing. The opposite effects of near and distant neighbors provide a novel way to examine whether and how semantic processing may be impaired in aphasia.

As in the earlier study, near and distant neighbors were defined based on distance between semantic feature vectors derived from a large feature norm corpus [McRae, K., Cree, G. S., Seidenberg, M. S., & McNorgan, C. (2005). Semantic feature production norms for a large set of living and nonliving things. Behavior Research Methods, 37, 547-559]. The picture naming data were drawn from a database of patient performance on the 175-item Philadelphia Naming Test (PNT). Ninety-five of the PNT words were in the feature norms; these words were divided into four sets that independently manipulated near and distant neighborhoods (few vs. many neighbors of each type) and were matched on all other criteria. Error rate data were analyzed using logistic regression. The first analysis examined a group of 62 patients with clinically diverse chronic aphasia as a result of a left-hemisphere cerebrovascular accident. The proportion of semantic errors was greater for targets with many near neighbors (B=0.816, X^2(1)=15.7, p<0.0001) and lower for targets with many distant neighbors (B=-0.002, X^2(1)=12.3, p<0.001). There was also a significant interaction (B=-0.841, X^2(1)=12.1, p<0.001), reflecting the particularly high rate of semantic errors for targets with many near and few distant semantic neighbors (Figure 1, open symbols). The semantic neighborhood manipulation had no effect on the proportions of phonological errors (all p>0.3), indicating that the pattern of semantic errors was not due to general difficulty differences between conditions.

A second analysis considered a different group of nine patients, for whom there was independent evidence of a core semantic deficit. This group exhibited an exaggerated version of the semantic neighborhood effect on semantic errors (Figure 1, filled symbols), with reliable opposite effects of number of near neighbors (B=0.685, X^2(1)=4.63, p<0.05) and number of distant neighbors (B=-0.433, X^2(1)=8.05, p<0.01), but no interaction (B=-0.566, X^2(1)=1.25, p>0.25).

The observed pattern -- increased semantic errors for targets with many near neighbors and decreased semantic errors for targets with many distant neighbors -- suggests that the dynamics of semantic processing are disrupted in aphasia. Previous computational modeling work has shown that the opposite effects of near and distant neighbors are consistent with an attractor dynamical model of semantic processing. Ongoing computational modeling work is investigating what kind of deficit would cause this particular pattern of errors.



Presented by: **Mirman, Daniel**

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44. Direct Evidence for Two Distinct Anatomical Circuits for Lexical-Conceptual Categories

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Introduction
Several studies have reported patients with specific lesions, disproportionately impaired in conceptual knowledge of objects from one category compared with others. Different theoretical accounts have been proposed, varying in the degree to which they assume domain-specificity as a major organizational principle of conceptual knowledge in the brain (Warrington and Shallice, 1984; Caramazza and Shelton, 1998; Tyler and Moss, 2001). We used direct cortical and subcortical stimulation to map naming of living/inanimate entities during surgical removal of gliomas in eloquent areas.

Methods
Thirty-eight patients were tested. Each patient was submitted to a specific intraoperative protocol designed according to pre-surgical performance. During surgical removal blocks of items (living, non-living, faces, verbs), counterbalanced across patients, were presented. The number of stimulated sites varied between 30 and 40 for each subject.

Results
Naming of living objects was disproportionately affected when DCS was delivered to the posterior part of BA 21 ($p=0.035$) and BA 45 ($p=0.028$), while naming of non-living things was selectively disrupted when DCS was applied over the posterior third of the supramarginal gyrus (BA 40) ($p=0.036$) and over the anterior part of BA 22 ($p=.023$). After having identified relevant cortical sites of dissociation, we further investigated whether the cortical areas differentially involved in lexical retrieval of living and non-living things are part of distinct networks connected by subcortical fibers. We used diffusion tensor tractography in five patients who showed the relevant dissociations. Two connection pathways were found: the first between T2-5 and BA 45; the second pathway

connected T1-3 to BA 40. In order to verify the selectivity of these systems, we examined the effect of direct stimulation to the fiber streams themselves in three additional patients. No disruption was found for non-living items when stimulation was applied over the fibers connecting T2-5 and BA 45, while there were 27.4% errors for living items (exact p=0.0004); when stimulation was applied to the connection between T1-3 and BA 40, naming of non-living objects was severely impaired (49.6%) relative to living objects (4.3%; exact p=0.043).

Conclusion

We have provided the first direct evidence for two distinct, distributed neural circuits involved in processing different lexical-conceptual categories, in line with the view that evolution has prompted the development of specific circuits dedicated to processing different categories of objects.

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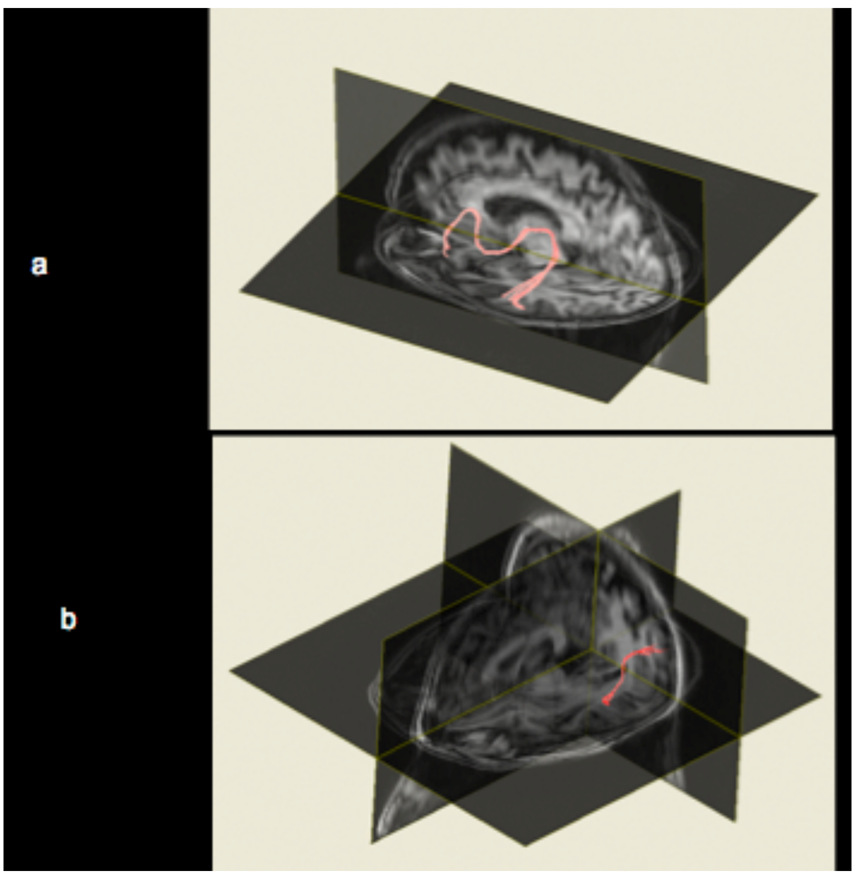

Figure - Tractography reconstruction: (a) T2-5 /BA45, (b) d T1-3 / BA40.

Presented by: **Papagno, Costanza**