

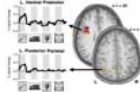
## Introduction

- A prominent theory of distributed semantic representation claims (Allport, 1985):



The semantic representation of concrete objects reflects the extent to which the sensorimotor systems are involved during initial acquisition and further elaboration.

- Consistent with this, neuroimaging studies have found increased neural activations in sensory-motor areas during the retrieval or recognition of manipulable objects such as tools and utensils (e.g., Chao & Martin, 2000):

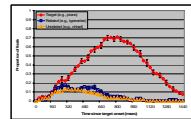


Tool-selective activations in the left ventral premotor (BA6) and posterior parietal (BA40) cortices when viewing and naming tools

- Studies on apraxia, a specific deficit of object-related movements, showed that apraxic patients are impaired at making an explicit judgment on object manipulation features, suggesting a relationship between physical object-related movements and knowledge about them (e.g., Buxbaum et al., 2000).

However, in this task patients were asked to *explicitly* access manipulation knowledge. Their impairment might reflect a failure to appropriately use heuristic information.

- Using an eye tracking method with normal subjects in which the aspect of manipulation of objects is not task-relevant, Myung et al. (2006) found a competitor effect based on manipulation features during lexical-semantic processing:



More looks to **manipulation-related items** (e.g., *typewriter*) than the unrelated **distractors** (e.g., *bucket*) when asked to identify an auditory target and touch on it (e.g., *piano*).

- The current study examines the manipulation knowledge of apraxic patients in an *implicit* task to assess whether they have a deficit in conceptually processing manipulation features regardless of the type of a task.

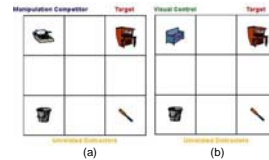
## Questions

- Would apraxic patients show a deficit in the lexical-semantic processing of manipulation features in an implicit task?
- Would there be a difference between the apraxic patients' performances for the same stimuli in implicit and explicit tasks on manipulation features?

## Experiment 1a

### Method

- 5 apraxic aphasic patients, and 5 non-apraxic aphasic controls, both groups with left frontoparietal lesions.
- Neuropsychological and language tests:
  - Aphasia: Boston Diagnostic Aphasia Examination (BDAE), Western Aphasia Battery (WAB)
  - Apraxia: Florida Apraxia Battery (FAB), Naturalistic Action Test (NAT)
- Two conditions:
  - Experimental Condition (Fig. 1a): **Target, manipulation-related competitor and distractors**
  - Visual Control Condition (Fig. 1b): **Target, visual control and distractors**



Patients were presented with four pictures on a 3 x 3 array and asked to touch the target picture matching the concurrent auditory input.

Figure 1. Example display of each condition

- 10 trials in each condition for controls; 14 trials for the apraxics; 40 fillers
- Eye movements and screen touches recorded using EyeLink I/II and an Elo Entuitive touch screen monitor

### Results

- Later emergence of a manipulation-related effect in the apraxics than in the controls (1060 ms vs. 830 ms) (Fig. 2).

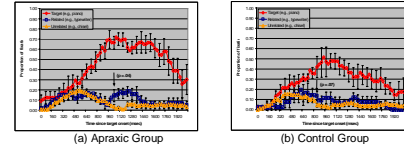


Figure 3. Proportion of fixations on each picture type in Experimental Condition

- Effect of visual similarity in both groups (Fig. 4).

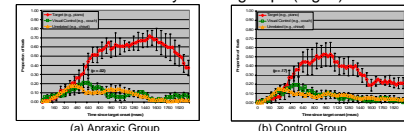


Figure 4. Proportion of fixations on each picture type in Control Condition

## Experiment 1b

- To assure that the results of Exp. 1a were not due to a deficit in accessing the semantic features of words.

### Method

- 5 apraxic patients
- Stimuli: **Target** (e.g., *pants*), **semantically-related stimulus** (e.g., *shirt*) and **distractors** (e.g., *bricks/salt*).

### Results

- The apraxics showed an effect around 640 ms (Fig. 5a), comparable to effects found by Yee for non-apraxic aphasics (Yee, 2005) (Fig. 5b).

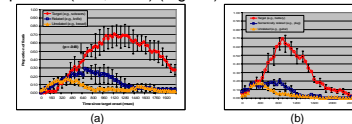


Figure 5. Proportion of fixations on each picture type in Semantic Condition

- Thus, apraxics have a specific deficit of manipulation features, indicated by a delayed time course. This delay may be due to either delayed access to or reduced activation of manipulation features. Do these apraxic patients, like those reported in Buxbaum et al. (2000), have a deficit in explicit access to manipulation knowledge?

## Experiment 2

### Method

- The same patients and stimuli as in Experiment 1a
- The same judgment task as Buxbaum et al. (2000) (Fig. 6)



Fig. 6 Example display

"Pick two objects which are similar to each other in terms of how you use or act on them."

### Results

- Apraxics performed sig. worse than control patients (Fig. 7).

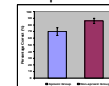


Fig. 7 Percentage correct

Although far better than chance, the apraxics performed sig. worse than non-apraxic aphasic patients (71% vs. 86%;  $p = .03$ ).

## Dissociation between Exp. 1a and Exp. 2

- We looked at patterns of eye movements from Exp. 1a for those stimuli which apraxics made errors on in the explicit judgment task (Exp. 2).

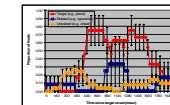


Fig. 8 Proportion of fixations in trials in which the apraxics failed to make a correct judgment.

- Apraxics showed an indication of a manipulation-related effect in the eyetracking study for the same stimuli they failed to make correct semantic judgments on.

## Summary & Discussion

- Apraxic patients showed a deficit in both implicit and explicit tasks. Although they showed a manipulation-related effect in the eyetracking experiment, it was extremely delayed.
- If the delayed effect is solely due to slowed access to manipulation features, giving sufficient time in Exp. 2 should have improved apraxic patients' judgment performance. Yet, they failed to make a correct decision on the same trials in which they showed an implicit manipulation-related effect. Thus, the delayed effect appears to reflect a deficit in accessing manipulation features, perhaps due to reduced activation of manipulation features.
- Following Buxbaum et al.'s findings, the results suggest that apraxia is not simply a perceptuomotor deficit of movements, but results in a concomitant impairment in conceptually processing manipulation features. These findings are consistent with the view that perceptual and motor processes share resources and/or mechanisms with cognitive processes (e.g., Barsalou, 1999).
- The visual similarity effect occurred far earlier than the manipulation-related effect, suggesting different sources of these effects (perceptual vs. semantic).

## References

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