DEFICITS NAMING IN CONTEXT: THE ROLE OF SEMANTIC STM vs. LEXICAL RETRIEVAL

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INTRODUCTION

Several case studies of aphasic patients with left frontal damage have reported preserved single picture naming but impaired naming with various contextual manipulations. McCarthy and Kartsounis (2000) and Wilshire and McCarthy (2002) reported that their patients FAS and BM were impaired naming pictures blocked by semantic category, particularly at a fast presentation rate. They hypothesized "refractory" lemma access that disrupted access to the same and related items. Schwartz and Hodgson's (2002) patient MP was affected by rate but not semantic relatedness, and showed reduced naming when describing a composite scene and when naming a series of simultaneously presented pictures. They hypothesized that MP's deficit arose from interference in lexeme retrieval when several corresponding lemmas were co-activated. Robinson, Shallice, & Cipolotti (2005) reported a left frontal patient CH, who showed preserved single word comprehension and production, but difficulty with phrase and sentence processing. On a sentence completion task, they found that his performance was good (92% correct) for high-constraint sentences (those which controls typically give one response very often), but did very poorly (53% correct) for low-constraint sentences (those which controls typically give several or many different responses). They claimed that CH was having difficulty when having to select from several competing responses.

Our lab has reported an aphasic patient, ML, who is similar in that he has left frontal damage and excellent single picture naming, but shows impaired onset latencies for producing conjoined noun phrases from semantically related picture pairs (Freedman, Martin, & Biegler, 2004). We have attributed his difficulties to a semantic short-term memory (STM) deficit (Martin & He, 2004). In the present study, we investigated whether ML shows patterns similar to BM. MP, and CH, or a distinctive pattern attributable to a STM deficit. We also tested patient LW, who has a phonological processing deficit, for comparative purposes.

Patient Information

ML is a 62 year-old right-handed male who suffered a CVA in 1990, resulting in lesion affecting the left inferior and mid-frontal gyri and the left parietal lobe. He performs at a high level on single picture naming tasks, scoring 98% correct on the Philadelphia Naming Task.

LW is a 71 year-old right-handed male who suffered a CVA in 2003. Lesion information has not been collected from him. His performance on various tasks is consistent with a phonological STM or phonological deficit. He performs also performs at a high level on single picture naming tasks, scoring a 96% correct on the Philadelphia Naming Task.

EXPERIMENT 1

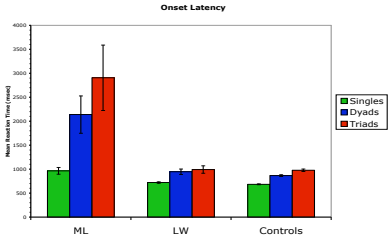
Naming Span

Method

Materials consisted of 12 pictures (from different categories) from Experiment 1. Pictures were displayed in single, dyad (2 items), and triad (3 items) presentations. Participants were asked to name the pictures from left to right.

Results

ML and the controls were highly accurate on this task. Onset latencies and utterance length were computed for single, dyad, and triad presentations. Controls displayed progressively longer onset latencies as the number of pictures increased, indicating planning of more than one word prior to speech onset. ML's onset latencies and utterance length differences for dyad – single and triad – dyad comparisons were greatly exaggerated compared to controls. Thus, ML displayed difficulty with naming span, but the difficulty was evident in latency measures rather than in error rate.



EXPERIMENT 2

Picture Array Production & Comprehension

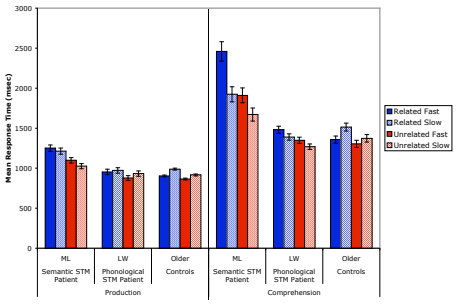
Method

Materials consisted of 72 pictures, 6 from each of 12 semantic categories. Items were presented arrays of 6 pictures, and each picture was probed 4 times. In the production task, a black box would surround one of the pictures, the subject would produce the name, then the experimenter would press a key to record whether the response was correct or not. In the comprehension task, the subject would hear the name of one of the pictures and then press a key corresponding to the correct picture. The arrays were either made of six items from the same semantic category (related) or from six different semantic categories (unrelated). Pictures were also presented at either a fast (1-second inter-trial-interval) or slow (4-second ITI).

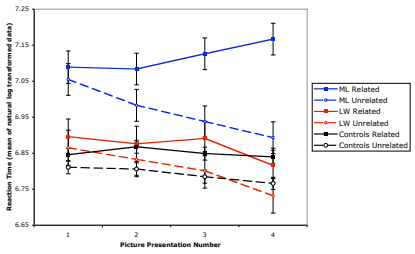
Results

All subjects were highly accurate on these tasks. All subjects were significantly slower in responding to items in related arrays, but for rate of presentation, only ML was significantly slower at the fast rate of presentation, whereas LW and the Controls were significantly faster at the fast rate of presentation. The relatedness effect was also larger for ML at the fast rate of presentation, but only in the comprehension task. ML showed increased relatedness effect across picture presentations. In the production task, his RTs increased in the related condition and decreased for the unrelated condition, whereas in the comprehension task, his RTs decreased for the unrelated condition but did not significantly change for the related condition.

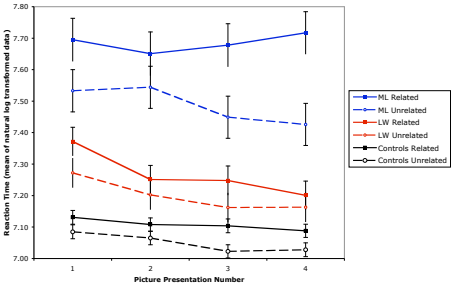
Picture Arrays Production and Comprehension



Picture Array Production-Relatedness by Picture Presentation



Picture Array Comprehension-Relatedness by Picture Presentation



EXPERIMENT 3

Sentence Completion

Methods

52 older controls were auditorily presented with 50 sentences selected from the Bloom and Fischler (1980) norms. Subjects asked to provide a single word as a completion for the sentence.

Results

Results from older controls yielded 18 high-constraint (0.70 - 1.00 Cloze prob.), 17 medium-constraint (0.30 - 0.70 Cloze prob.), and 15 low-constraint (<0.30 Cloze prob.) sentences.

ML performed well on this task, making no errors on any of the sentence types. However, although ML technically made no errors, some of his responses were very strange, and indicated that he was having somewhat unusual conceptual interpretations of the sentences. The percentage for these type of responses was well outside of the range of controls, and much higher than for LW as well. ML's responses were also of significantly lower frequency than the controls or LW. This may indicate that ML has difficulty in integrating different sources of information normally to form a response conceptually, though he has no difficulty in producing something that fits the sentence grammatically.

Percentage Errors by Condition and Error Type

		ML	LW	Controls
High-Constraint	Total	0%	0%	1.50%
	Nonsensical	0%	0%	0.53%
	Grammatical	0%	0%	0.11%
	Response Error	0%	0%	0.85%
	(Unusual)	11.11%	0%	0%
Medium-Constraint	Total	0%	5.88%	4.86%
	Nonsensical	0%	0%	1.13%
	Grammatical	0%	0%	0%
	Response Error	0%	5.88%	3.73%
	(Unusual)	0%	0%	0.68%
Low-Constraint	Total	0%	26.67%	7.31%
	Nonsensical	0%	6.67%	1.54%
	Grammatical	0%	0%	1.03%
	Response Error	0%	20.00%	4.74%
	(Unusual)	26.67%	6.67%	1.41%
All Sentence Types	Total	0%	10.00%	4.38%
	Nonsensical	0%	2.00%	1.04%
	Grammatical	0%	0%	0.35%
	Response Error	0%	8.00%	3.00%
	(Unusual)	12.00%	2.00%	0.65%

CONCLUSIONS

ML's deficit for naming several pictures presented simultaneously (Exp. 1) is consistent with the semantic STM hypothesis, suggesting a capacity deficit in production planning (Freedman et al., 2004). However, his difficulty in single picture production and comprehension with repeated sampling from the same category suggests a deficit in inhibiting highly active competitors. Other recent evidence converges in showing that ML has a deficit in inhibiting irrelevant verbal representations (Hamilton & Martin, 2005) – and the inhibition deficit may be the source of his STM deficit. Like other reported patients, ML is affected by the rate of presentation, but this exaggerates his relatedness effect only in comprehension. Also, he had no obvious difficulty with the sentence completion task. The results across patients suggest that the left frontal lobe participates in the control of lexical retrieval, but a variety of specific functions are involved that may be differentially affected in different patients.

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