DEFICITS IN NAMING IN CONTEXT: THE ROLE OF SEMANTIC STM vs. CONTROL OF WORD 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.

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 and MP, 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 a left frontal and parietal operculum infarction. 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 or phonological STM 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

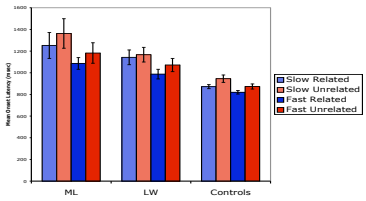
Rate and Semantic Blocking

Method

Materials consisted of 72 pictures (12 categories; 6 items/category) (Schwartz & Hodgson, 2002). Two rates of presentation were used: fast = 2 second inter-trial interval (ITI) and slow = 5 second (ITI). At each presentation rate, pictures were presented for naming either blocked by semantic category or mixed across categories.

Results

Controls and patient ML made relatively few errors (mean < 4%). Both ML and controls showed significantly faster reaction times for the related than unrelated trials and significantly faster times for the fast than slow presentation rate. Thus, ML was unlike the patients discussed previously on both dimensions.



EXPERIMENT 2

Composite Picture Naming

Method

Materials consisted of 12 composite scenes containing semantically related pictures and 12 composite picture scenes containing unrelated pictures (6 target items/scene). The target items were the same as in Experiment 1. Participants were asked to give the descriptions of the scenes, by saying in complete sentences the objects and the actions they were involved in.

Results

Controls made few errors in describing the scenes. ML's errors were somewhat higher than in single picture naming (Experiment 1) and slightly outside the range for controls. However, he certainly did not show anything like the 50% increase for MP between single picture naming and naming in composite scenes (Schwartz & Hodgson, 2002).

Percentage Errors

	Related	Unrelated
ML	6.94%	6.94%
LW	2.78%	5.56%
Controls	1.67%	2.50%

EXPERIMENT 3

Semantic Cyclic Naming

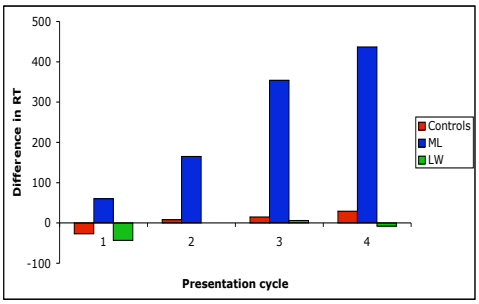
Belke, Meyer and Damian (2005) reported that young normal subjects showed increasing interference for semantic blocking as items were repeatedly sampled from the same category. Thus, although ML showed an advantage for semantically related pictures in Experiment 1, it is possible that he would display an exaggerated interference effect for semantic relatedness if items were repeatedly sampled from the same category.

Method

Materials consisted of 72 pictures from 12 categories (6 items/category). The procedure followed a cyclic naming paradigm in which semantically related or unrelated blocks of items were repeatedly presented over four presentation cycles (Belke et al., 2005).

Results

Mean onset latencies were computed for each presentation cycle. Controls showed significant facilitation for the related condition during the first presentation cycle, switching to increasing interference during subsequent cycles. ML, however, showed a non-significant interference effect for related items during the first presentation, subsequently displaying exaggerated and statistically significant interference effects during cycles 2 – 4.



EXPERIMENT 4

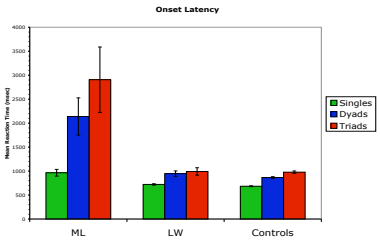
Naming Span

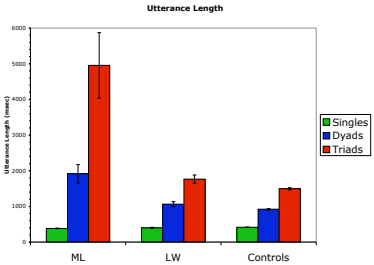
Method

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 5

Sentence Completion

Robinson, Shallice, & Cipolotti (2005) reported a left frontal patient CH who they described as a progressive dynamic aphasic. He showed preserved performance on comprehension and production of single words, but mild to severe impairment on tasks of phrase or sentence production. On a sentence completion task, CH's performance was relatively high (92% correct) for high-constraint sentences (those sentences with only a few completions given by controls), but his performance dropped dramatically as sentence constraint was lowered (53% correct for very low constraint sentences). They claimed that CH was having difficulty in producing a verbal response when many possible responses competed with one another. We tested ML on a similar sentence completion task to see if he would show more difficulty when there were several highly competing responses.

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. 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. 4) is consistent with the semantic STM hypothesis, suggesting a capacity deficit in production planning (Freedman et al., 2004). However, his difficulty in single picture naming 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. However, ML's pattern differs in important ways from other patients who are seemingly similar in that he is not affected by rate of presentation, nor does he have difficulty in describing composite pictures in which attention can be serially directed towards different parts of the scene. 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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