

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 patient BM was 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 a greatly exaggerated interference effect in producing conjoined noun phrases for semantically related vs. unrelated picture pairs (Freedman, Martin, & Biegler, 2004). We have attributed his difficulties to a semantic short-term memory (STM) deficit. In the present study, we investigated whether ML shows patterns similar to BM and MP, or a distinctive pattern attributable to a STM deficit. Results from all experiments are reported in Table 1. (All materials were courtesy of M. Schwartz.)

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.

Experiment 1: Rate and semantic blocking

Method

Materials consisted of 72 pictures (12 categories; 6 items/category) (Schwartz & Hodgson, 2002). Two presentation rates were used: 2 s

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(fast) and 5 s (slow) inter-trial intervals. 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

Twelve composite scenes containing semantically related pictures and 12 containing unrelated pictures (6 target items/scene) were constructed using the items in Experiment 1. Participants were asked to talk about all of the objects when describing the scenes.

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 did not show anything like the 50% increase for MP between single picture naming and naming in composite scenes (Schwartz & Hodgson, 2002).

Experiment 3: Repeated naming of related vs. unrelated pictures

Belke, Meyer, and Damian (in press) 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 if items were repeatedly sampled from the same category.

Table 1
Results for ML and Controls

	ML	Controls
Experiment 1 (RT)		
Rel/Fast	1086	832
Rel/Slow	1222	907
Unrel/Fast	1182	881
Unrel/Slow	1326	1013
Experiment 2 (percent errors)		
Rel	6.94%	1.67%
Unrelated	6.94%	2.50%
Experiment 3 (RT difference)		
P1: Rel-Unrel	64	-27
P2: Rel-Unrel	165	8
P3: Rel-Unrel	366	15
P4: Rel-Unrel	421	29
Experiment 4 (RT)		
(A) Onset latency		
Single	964	684
Dyad	2138	866
Triad	2905	977
(B) Utterance duration		
Single	382	415
Dyad	1915	920
Triad	4954	1493

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., in press).

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 semantically unrelated pictures 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 rates.

Discussion

ML's deficit for naming several pictures presented simultaneously (Experiment 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 naming 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; however, a variety of specific functions are involved that may be differentially affected in different patients.

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