

# Lexical Retrieval Behaviors of Subjects With Aphasia and Subjects Without Brain Damage on a Rebus Riddle Task

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This study compared the lexical retrieval behaviors of subjects with aphasia (APH) and subjects with no brain damage (NBD) on a Rebus Riddle task. Most differences between the groups were quantitative. APH subjects solved significantly fewer riddles (49%) than the NBD subjects (82%); their riddle-solving times were significantly longer ( $M = 27.47$  seconds) than those of the NBD group ( $M = 8.86$  seconds). Riddle-solving time differences resulted from relative absence of behaviors in the correct responses of the NBD group (73%) compared to the APH group (23%). Qualitative analyses revealed similar distributions of lexical retrieval behaviors across the correct responses, cuing successes, and cuing failures for both groups. The Rebus Riddle task was sufficiently difficult to evoke lexical retrieval behaviors by NBD subjects. APH subjects' riddle-solving efforts demonstrated an increase in the frequency of these behaviors, but the types of lexical retrieval behaviors exhibited by both groups were similar.

Subjects with aphasia (APH) exhibit a variety of behaviors<sup>1</sup> when attempting to retrieve specific lexical items. These reflect (a) self-correction and searching efforts to meet the phonological and semantic demands of the utterance (Farmer, 1977; Gainotti, 1987; Joannette, Keller, & LeCours, 1980; Marshall, 1976), (b) articulatory adjustments to compensate for motor speech problems (Berman & Peele, 1967), and

<sup>1</sup>The term "lexical retrieval behaviors" is used descriptively to refer to phenomena exhibited by the subject while attempting to retrieve or produce a word. However, it should be understood that many of these behaviors also reflect efforts to deal with problems besides lexical retrieval per se (e.g., apraxia).

(c) delays to gain time to retrieve a word (Farmer, O'Connell, & O'Connell, 1978; Marshall, 1976). Individuals with no brain damage (NBD) also exhibit word retrieval struggles akin to those of APH subjects. These are realized as tip of the tongue phenomena (Brown & McNeil, 1966), malapropisms (Fay & Cutler, 1977), slips of the tongue (Fromkin, 1971), and pauses or hesitations (Goldman-Eisler, 1961).

Although many studies show that both APH and NBD subjects manifest lexical retrieval behaviors when attempting to retrieve desired words, comparative data are not available. One reason for this is that the standard method for examining lexical retrieval skills, the confrontation naming task, poses problems when the investigator attempts to compare the performances of APH and NBD groups. It is difficult to find sets of pictured items for naming that will evoke behaviors from NBD subjects, yet provide some success for APH subjects. Assembling separate sets of items that are difficult but not too difficult for individual subjects to name is time consuming and does not permit a comparison of behaviors across the same stimuli.

This study used a pseudonaming task, the Rebus Riddle task, to compare the frequency and types of lexical retrieval behaviors of APH and NBD subjects. Obtaining comparative data is important because it has not yet been determined whether aphasia alters normal retrieval behaviors or simply exacerbates normal processes observed during instances of NBD subjects' inefficient or unsuccessful performance (Schuell, Jenkins, & Jiminez-Pabon, 1964). Accordingly, this study sought answers to two questions: (a) Do APH and NBD subjects exhibit

quantitative differences in lexical retrieval efforts on the Rebus Riddle task? (b) Do APH and NBD subjects exhibit qualitative differences in lexical retrieval performance on the Rebus Riddle task?

## Method and Procedure

Rebus Riddles express word combinations with sequences of pictures, letters, words, and pronounceable nonwords.

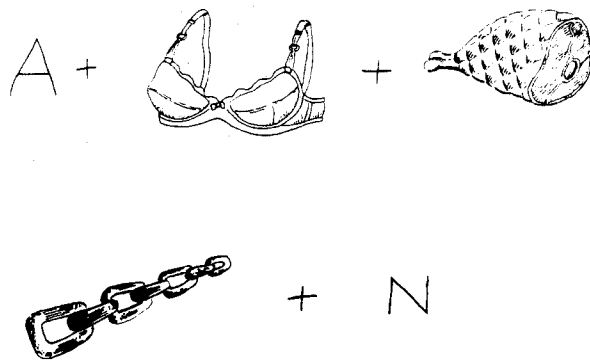
Symbols are connected with plus signs. The subject combines this information to solve the riddle. For this study, riddles depicted the names of 10 famous persons who would be familiar to adults living in Oregon (see Appendix A). The riddles were randomly selected from a larger corpus of items. Prior to the experiment, six NBD individuals equivalent in age to the experimental groups were shown the study riddles. They were told that the riddle depicted the name of a famous person but were not provided any other information. Without the benefit of any cuing, these individuals solved 55/60 riddles; those not solved were readily recognized when the examiner gave the riddle answer.

Figure 1 shows one of the study riddles (*Abraham Lincoln*). Solving this riddle requires picture naming (e.g., *bra*, *ham*), assigning phonology to sublexical units (e.g., *a*, *n*), and producing semantic associations of pictured stimuli (e.g., *link*).

## Subjects

Subjects were 10 APH and 10 NBD adults. The NBD group (eight men, two women) ranged in age from 44 to 74 years ( $M = 59.6$ ;  $SD = 9.8$ ), and had from 11 to 16 years of education ( $M = 13.2$ ;  $SD$

FIGURE 1. Rebus Riddle for Abraham Lincoln.



= 1.6); all were nonprofessional employees of the medical center or visitors. The APH subjects are described in Table 1.

**Procedure**

Subjects received a set of standard instructions (see Appendix A). Instructions were followed by a demonstration riddle and two practice riddles that were solved by the subject. Riddles were randomized for presentation across subjects. Each presentation was preceded by a short spoken phrase (e.g., "Next one") to aid later timing of responses. If the subject had problems in solving the riddle, an initial semantic cue was provided (e.g., "famous sports figure" for *Arnold Palmer*). If the subject continued

to have difficulty, a second semantic cue (e.g., "golfer") was provided, and the first cue was repeated. Cues assigned to riddles are shown in Appendix A.

**Scoring and Reliability**

All responses were audiotaped; no subject had problems fully understanding the riddle task. Responses were transcribed from the audiotapes and scored as correct, cuing successes, or cuing failures. Seventy-two responses were randomly selected and re-scored by an examiner blinded to the initial scores. Point-to-point agreement occurred on 97% of the responses. A stopwatch was used to time all correct responses to the nearest second from the introductory

phrase to the subject's production of the target name. Seventy-four responses were randomly selected and retimed by a second timer. The two timers agreed within one second 88% of the time. Finally, the audiotapes and transcripts were used to review all responses for the presence or absence of five lexical retrieval behavior types. Phonological searching (e.g., "Perry masent, masert, Mason"), semantic searching (e.g., "Boy Basie, finger Basie, oh he's counting, Count Basie"), and delay behaviors have been described earlier (see Marshall, 1976; Marshall & Tompkins, 1981). Articulatory compensations reflected a slowed, syllable by syllable production of the target utterance (e.g., "Toe - key - o — Rose") or what Brookshire (1992) termed a "reflective response style" ("A plus bra plus ham - Abraham; link plus n - Lincoln; Abraham Lincoln"). Other behaviors that the examiner felt reflected lexical difficulties (e.g., perseverations, "I don't knows," off-task behaviors) were deemed unclassifiable. A measure of interexaminer agreement for the occurrence and types of behaviors was obtained by comparing the independent classifications of the two authors on 75 randomly chosen responses. The overall occurrence of agreement for the two examiners was 85%.

**Results**

**Quantitative Differences**

Tables 2 and 3 summarize the performances of the APH and NBD subjects respectively. Percentages of correct responses were calculated for subjects and averaged to obtain group means. Percentages of cuing successes for subjects and groups were calculated using the following formula: Percentage Cuing Successes = First + Second Cue Successes / (Total Cuing Successes + Cuing Failures). Times (in seconds) for correct responses were summed and averaged to obtain individual means; individual means were averaged to derive the group means.

APH and NBD subjects solved 49% (*SD* = 17.32%) and 82% (*SD* = 11.66%) of the riddles, respectively. Group means were significantly different (*t* = 3.77; *p* < .01). Successes occurred more frequently following an initial semantic cue. Twenty of 26 of the APH subjects' successes (77%) and 9 of 10 of the NBD subjects' successes (90%) occurred after an initial cue. Successes after cuing did not differ significantly (*p* > .05) between the APH (*M* = 51%; *SD* = 24.4%) and NBD (*M* = 56%; *SD* = 39.3%) groups. APH subjects

TABLE 1. Summary of aphasic subjects.

Subject and Etiology	Age	MPO	PICA	Token	BNT	CPM
1. E	58	86	87	47	42	32
2. E	65	85	76	57	57	21
3. T*	57	50	71	35	47	36
4. H	72	200+	85	36	48	23
5. S*	35	200+	64	48	42	33
6. H*	46	200+	76	49	39	36
7. T	58	6	87	51	55	30
8. T	45	34	88	39	27	32
9. T*	62	39	91	44	49	n.a.
10. H*	51	108	86	52	48	35
Range	35-72	6-200+	64-91	35-57	27-57	21-36
Mean	54.4	100.8	81.1	45.8	45.4	30.9
SD	10.2	70.6	8.4	6.8	8.1	5.13

Key. Subject and Etiology: E = embolic; S = surgery; T = thrombotic; \* = mild apraxia; MPO = months postonset; PICA = overall percentile from PICA (Porch, 1981); Token = score on 62-item Token Test (DeRenzi & Vignolo, 1966); BNT = score on 60-item Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983); CPM = score on the 36-item Coloured Progressive Matrices (Raven, 1962).

**TABLE 2. Percentages of correct responses, number of responses cued successfully after initial and secondary semantic cues, mean percentages of cuing successes, and mean response times (in seconds) for correct responses of the subjects with aphasia.**

Subject	% Mean Correct	1st Cue	2nd Cue	% Cuing Successes	Mean Time
1	50	3	1	80	45
2	30	4	0	57	40
3	40	3	1	67	34
4	20	1	1	25	31
5	40	1	1	33	9
6	40	2	1	50	21
7	80	2	0	100	25
8	50	2	1	60	31
9	70	1	0	25	21
10	70	1	0	33	16
Mean	49	51	27		
SD	17	24	10		

**TABLE 3. Percentages of correct responses, number of responses cued successfully after initial and secondary semantic cues, mean percentages of cuing successes, and mean response times (in seconds) for correct responses of the subjects with no brain damage.**

Subject	% Mean Correct	1st Cue	2nd Cue	% Cuing Successes	Mean Time
1	70	3	0	100	8
2	70	1	0	33	10
3	70	2	0	67	13
4	90	1	0	100	11
5	100	0	0	0	12
6	80	2	0	100	7
7	80	0	0	0	5
8	80	0	1	50	13
9	90	0	0	0	5
10	90	0	0	0	11
Mean	82	57	27		
SD	11.6	24	10		

needed significantly more time to solve Rebus Riddles than NBD subjects needed ( $t = 6.15; p < .001$ ). On the average, APH subjects used 27.47 seconds ( $SD = 9.91$  seconds) and NBD subjects used 8.86 seconds ( $SD = 3.04$  seconds) per solved riddle.

In most cases, APH and NBD subjects' performance could be differentiated on the basis of the number of riddles solved and the time taken to solve them. There was, however, some overlap among the groups. Three APH subjects (Nos. 7, 9, and 10) solved as many riddles and had mean response times only slightly longer than those of the poorest performing NBD subjects. Table 1 shows that these subjects had relatively high CPM scores (not available for subject 7), whereas

those solving the fewest riddles (Subjects 2 and 4) also had relatively much lower scores on the CPM. It is possible that nonverbal problem-solving ability as manifested by CPM performance may be related to successful solving of Rebus Riddles; however, the small number of subjects and the lack of CPM scores for the NBD group make this premature.

### Qualitative Differences

**Correct Responses.** Table 4 shows the frequency with which lexical retrieval behaviors were absent (no behavior) or present, and the percentages of phonological and semantic searches, articulatory compensations, delay, and unclassifiable behaviors for correct responses,

and cuing failures. Only 31% of the APH subjects' correct responses did not contain lexical retrieval behaviors, compared with 73% of NBD subjects' correct responses. The three-fold difference in the mean riddle-solving times between the groups appears to be due to the high occurrence of lexical retrieval events accompanying the correct responses of the APH subjects. Table 4 indicates that for both groups, behaviors associated with riddle-solving successes were relatively equally distributed across categories and that articulatory compensation and delay occurred primarily on the correct responses. APH subjects produced 75% of their articulatory compensations and 77% of their delays on correct responses; NBD subjects produced all of their articulatory compensations and 77% of their delays on the correct responses.

**Cuing Successes and Failures.** Lexical retrieval behaviors accompanied all cuing successes and failures of both groups. Table 4 shows that the cuing successes of the APH subjects predominantly contained phonological (42%) and semantic (42%) searching behaviors. Semantic searching tended to be more prevalent on APH (52%) and the NBD (87%) cuing failures. Overall, cuing was more likely to be successful when both APH (79%) and NBD (67%) were exhibiting phonological searching behaviors. Conversely, cuing was less successful when APH (42%) and NBD (36%) were conducting a semantic search.

Table 5 gives the rank ordering of the percentages of correct responses for each riddle for the two groups. In general, riddles that were more frequently solved by the NBD subjects (e.g., *Perry Mason*) tended to be among those most frequently solved by the APH subjects; correspondingly, riddles that were least often solved by the NBD group (e.g., *Count Basie*) were also infrequently solved by the APH group.

## Discussion

One goal of this study was to determine the usefulness of the Rebus Riddle task in comparing the lexical retrieval behaviors of APH and NBD subjects. In this regard, the task provided a simple, rapid tool for obtaining these comparative data. It was sufficiently challenging for the NBD subjects but allowed for some success by the APH subjects.

Performance differences among APH and NBD subjects on the Rebus Riddle task were predominantly quantitative. APH subjects solved significantly fewer riddles and took significantly longer to

**TABLE 4. Frequency, percentages, and types of lexical retrieval behaviors for correct responses, cuing successes, and cuing failures for aphasic (APH) and non-brain-damaged (NBD) groups.**

	Lexical Retrieval Behavior Type					
	NB	PS	SS	AC	Delay	U
<b>Correct</b>						
APH (49)	15 (31%)	10 (20%)	8 (16%)	9 (18%)	7 (14%)	0
NBD (82)	60 (73%)	6 (7%)	3 (4%)	7 (9%)	6 (7%)	0
<b>Cuing Successes</b>						
APH (26)	0	11 (42%)	11 (42%)	2 (8%)	0	2 (8%)
NBD (10)	0	2 (20%)	4 (40%)	0	2 (20%)	2 (20%)
<b>Cuing Failures</b>						
APH (25)	0	3 (12%)	13 (52%)	1 (4%)	2 (8%)	6 (24%)
NBD (8)	0	1 (13%)	7 (87%)	0	0	0

Key. NB = no lexical retrieval behavior noted; PS = phonological searching; SS = semantic searching; AC = articulatory compensation; Delay = filled or unfilled delay; U = unclassifiable.

**TABLE 5. Mean percentages of correct responses and rank ordering of Rebus Riddle difficulty for aphasic and non-brain-damaged groups.**

Riddle	Aphasic		Non-Brain-Damaged	
	% Correct	Rank	% Correct	Rank
Perry Mason	80	1-2	100	1-2-3
Robert Packwood	80	1-2	80	7-8
Harry Truman	70	3	90	4-5-6
Abraham Lincoln	60	4-5-6	100	1-2-3
Lee Iacocca	60	4-5-6	100	1-2-3
Arnold Palmer	60	4-5-6	80	7-8
Mickey Mantle	30	7-8	90	4-5-6
Tokyo Rose	30	7-8	90	4-5-6
Count Basie	20	9	60	9
Bugsy Siegel	0	10	20	10

solve them than NBD subjects did. Longer riddle-solving times reflected the high occurrence of lexical retrieval behaviors in the correct responses of the APH subjects whereas NBD subjects solved most riddles silently.

Qualitative differences in performance on the Rebus Riddle task between the groups were minimal. The distribution of lexical retrieval behaviors in the correct responses across each group was similar. Interestingly, delay and articulatory compensation occurred primarily on correct responses of both groups. Seven APH subjects had at least one delay. All APH subjects' articulatory compensations were produced by subjects with mild apraxia. Articulatory compensations and delays may represent deliberately "slowing down" to avoid an articulation error or a reflective cognitive style characteristic of either the subject's premorbid state

or adjustment to aphasia. Findings support prior studies (Farmer, 1977; Marshall, 1976) that show successful lexical retrieval to be associated with delaying behaviors. Cuing successes occurred with equal frequency in both groups. For both groups, cuing was far more likely to be successful if the subject was exhibiting phonological rather than semantic searching behaviors. Finally, the same riddles tended to be difficult or easy to solve for both groups.

There is little evidence that the lexical retrieval behaviors generated by APH and NBD subjects on the riddle task constitute specific strategies to solve the riddle. Rather, when a riddle could not be solved immediately, most APH subjects and, to a lesser extent, some NBD subjects tend to initiate semantic or phonological searches in an attempt to combine the elements of the rebus symbol into a final product.

These efforts may indicate (a) lack of tolerance for silence, (b) activation of the phonological loop and rehearsal of the speech-based information needed to solve the riddle (Baddely, 1992), or (c) trial and error experimentation in the hopes that a critical element of the riddle will "trigger" its solution. For NBD subjects, most of these searches occurred on harder riddles (e.g., *Bugsy Siegel*). APH subjects, however, manifested searching behaviors on most riddles regardless of whether the end response was correct, successfully cued, or failed.

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**Key Words:** aphasia, lexical retrieval, behavior

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## Appendix A

### Cues Assigned to Rebus Riddles and Instructions Given to Subjects

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Harry Truman	politician	U.S. president
Robert Packwood	politician	Oregon senator
Mickey Mantle	sports figure	baseball player
Lee Iacocca	businessman	head of Chrysler
Bugsy Siegel	gangster	founder of Las Vegas
Tokyo Rose	Japanese Propagandist	World War II
Arnold Palmer	sports figure	golfer
Count Basie	musician	big band leader
Perry Mason	lawyer	Erle Stanley Gardner books
Abraham Lincoln	politician	U.S. president

### Instructions

"I want you to solve some riddles that contain letters, words, and pictures. You combine the letters, words, and pictures to make up a word. All words are the names of famous persons. The first name is on the top half of the page; the last name is on the bottom."

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