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Comprehension of Three-part Commands by Aphasic Subjects: Analysis of Error Location

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Auditory comprehension has been called the veiled disorder of aphasia. While the most dramatic and obvious signs of aphasia are to be found in production, the link between perception and production has been documented in human communication and degradation of auditory processing and comprehension has been implicated by many observers not only as a primary deficit in aphasia but perhaps also as the occult, indirect cause of production deficits.

Understandably, auditory comprehension has attracted a good deal of research focus, but as Reidel (1981) has observed, in spite of much investigation it is difficult to know whether the adequacy or inadequacy of an aphasic person's response to controlled spoken units reflects actual comprehension ability or something else. Both theoretical and clinical issues have spawned controversy in the realm of auditory processing or comprehension disorders and a great deal of effort has been afforded to the analysis of clinical measures of this modality.

While early efforts to test comprehension concentrated on measuring the understanding of single words and short utterances, recent effort appears to be directed increasingly toward connected discourse and sentence comprehension. Since sentence comprehension can interact with a host of cybernetic, processing, and nonlinguistic variables, it is not surprising that some researchers and clinicians have turned their research efforts to these complex interactions. Examples of this direction were evident in a symposium organized for the 1985 Academy of Aphasia meeting that reviewed new findings and implications of short term memory (STM) deficits and sentence processing. As Berndt (1985) observed, several cases have been reported with inordinately poor comprehension of lengthy or syntactically complex sentences, and this has led some investigators to suggest that syntactic information might be selectively vulnerable to disruption in individuals who present limited or reduced short term verbal memory. Martin (1985) and Saffrin (1985) reported data on sentence processing and short term memory deficits and, among other findings, failed to confirm a causal relationship between the two.

Relatedly, a number of studies have explored sentence comprehension from the perspective of morphosyntactic variables. Researchers reasoned that certain grammatical forms would be more difficult to understand for Broca's than for Wernicke's aphasic individuals, but early studies have been relatively unsuccessful in isolating selective deficits among classical subtypes of aphasia. However, certain researchers appear to suggest that selected aphasic subjects have inordinate difficulty with verbs as opposed to nouns. Shevan (1976), for example, found that subjects with posterior damage had higher error rates on verb phrases than on noun phrases. Others have suggested that aspects of case grammar or a "verb as core" framework would be applicable to aphasia treatment. Loverso, Selinger, and Prescott (1979) reported on the application of verbing strategies to aphasia treatment.

Loverso et al. (1979) stated that they believed that functional communicative ability was enhanced by utilization of the verb as the pivotal training unit.

Despite the flurry of recent research on comprehension, the precise nature of the relationships between sentence processing and such variables as predominant location of errors, differential performance on actions and objects, and relationship to performance on immediate digit recall remains unclear. The primary purpose of this study was to further our understanding of patterns of errors in sentence processing.

Specific questions included the following:

1. Are there any group or individual predominant patterns of error in terms of location (beginning, middle, end) in three-part commands?
2. Are there any group or individual error patterns on the grammatical classes of actions versus objects?
3. With a subset of subjects, does a relationship exist between performance on comprehension of three-part commands and performance on both auditorily and visually presented immediate digit recall?
4. Do any relationships exist between aphasia type (fluent vs. nonfluent) and positional location of error, action vs. object performance, or immediate digit recall?

METHOD

Twenty-five aphasic male subjects who ranged in age from 35-86 ($\bar{X}$ = 58.8) and ranged in months post-onset from 1-240 ($\bar{X}$ = 28.8) were tested. Subjects were selected from the caseloads of two Veterans Administration Medical Centers, one located in a large metropolitan area in the Southwestern United States and one from a small metropolitan area in the Southeastern United States. All subjects suffered left-hemisphere cerebrovascular disorders and ranged in aphasia severity on the Porch Index of Communicative Ability from the 27th to the 89th overall percentile ($\bar{X}$ = 55.84 OA percentile). Using operationally defined criteria (phrase length, total output, words per minute) or clinical judgments of verbal performance, subjects were judged to be either Fluent (n = 15), Nonfluent (n = 6) or unclassified (n = 4).

All subjects were administered the Porch Index of Communicative Ability (Porch, 1981), and the Functional Auditory Comprehension Task (LaPointe and Horner, 1978). A subset of six subjects were administered a task of immediate digit recall presented both auditorily and visually. All testing was carried out in a sound-treated therapy room, and all subjects presented no inordinate hearing acuity difficulty which would have prevented participation in the study. Subjects' responses were recorded on suitable forms and submitted to a number of appropriate univariate descriptive, multivariate inferential, and correlational statistics.

RESULTS

Position. Table 1 presents performance of all 25 subjects on Part III (Three-Part Commands) of the Functional Auditory Comprehension Task (FACT). A total of thirty positional opportunities for error exist on this section.

Table 1. Individual patterns of position error on three-part commands.

	POSITION					
SUBJECT	BEGINNING		MIDDLE		END	
	Errors	%	Errors	%	Errors	%
1	2	6	5	17	5	17
2	2	6	2	6	3	10
3	8	27	8	27	9	30
4	1	3	2	6	6	20
5	1	3	4	13	3	10
6	3	10	3	10	4	13
7	9	30	6	20	9	30
8	10	33	13	43	10	23
9	14	47	12	40	15	50
10	4	13	2	6	3	10
11	0	0	1	3	1	3
12	3	10	4	13	4	13
13	6	20	8	27	5	17
14	4	13	2	6	2	6
15	5	17	2	6	1	3
16	6	20	8	27	1	3
17	12	40	10	33	9	30
18	5	17	6	20	5	17
19	2	6	6	20	8	27
20	2	6	3	10	3	10
21	12	40	14	47	8	27
22	7	23	10	33	12	40
23	1	3	7	23	8	27
24	9	30	12	40	10	33
25	4	13	1	3	6	20
	R=(0-14)(0-47)		R=(1-14)(3-47)		R=(1-15)(3-50)	
	$\bar{X}$=5.28 (17%)		$\bar{X}$=6.04 (20%)		$\bar{X}$=6 (20%)	
	SD=3.9		SD=4.01		SD=3.7	

As can be seen from the summary of the group performance at the end of Table 1, the mean number of errors by position (30 possible) for all subjects was 5.28 (Beginning), 6.04 (Middle), and 6.0 (End). A one-way analysis of variance revealed no statistically significant interactions among positions. However, closer inspection of Table 1 reveals performances by several individual subjects that could be interpreted as a predominant pattern of performance. Four subjects (#'s 14, 15, 16 and 21) appeared to have inordinate difficulty at the beginning of three-part commands; and six subjects (#'s 1,

4, 5, 19, 22, and 23) had greater difficulty at the end of three-part commands. In most of these individual cases, inordinate difficulty in either the beginning or end position was paralleled by nearly equal difficulty in the middle position. Two subjects (#'s 7 and 25) had trouble on both ends and not in the middle. No subject appeared to have difficulty only with the middle sections of three-part commands.

Action-object performance. Table 2 presents a summary of group performance on actions and objects within three-part commands.

Table 2. Action-Object error patterns on three-part commands for all subjects.

	Range	Mean	SD
Action	3-37	11.84	7.7
Object	0-36	9.32	9.1

As can be seen on Table 2, greater error rates were generated on action segments of three-part commands than on segments comprised of objects. However, this difference in mean error rates failed to reach statistical significance when subjected to a one-way analysis of variance.

Digit recall. In order to explore the notion that deficits in three-part sentence comprehension may be related to a more general deficit in immediate recall, a subset of six subjects was administered a digit recall task which was presented both auditorily and visually.

Table 3 presents performance by these six subjects. A total of twelve errors was possible on this measure (6 Auditory; 6 Visual).

Table 3. Performance by six subjects on immediate digit recall.

	Total Errors	Auditory	Visual
Range	5-10	2-5	2-5
Mean	7.67	3.83	3.83

As can be seen from Table 3, subjects performed at an error mean rate of 7.67 for the overall digit span measure and mean performance was identical for both the auditorily and visually presented digits ($\bar{X}$ = 3.83 for each). To explore the relationship between performance on the digit recall with performance across positions on three-part commands, correlations were run between all possible pairs (total recall errors, auditory errors, visual errors, Beginning errors, Middle errors, End errors). Correlational r values

were weak to moderate and ranged from r = .35 to r = .73, none of which reached significance.

No significant relationships were found between aphasia type (fluent vs. nonfluent) and any of the dependent variables in this study.

DISCUSSION

We found no predominant pattern of error performance across positions (Beginning, Middle, End) of three-part commands for our 25 subjects. For the group data from this sample, errors were equally likely to occur in the beginning, middle, or end positions. However, as is true with many studies in aphasia, inspection of individual performance revealed several subjects who performed unlike the group. Four subjects performed much less accurately on the beginning of three-part commands, and six subjects performed with considerably greater error rates at the end of three-part sentences. No subject characteristic or correlate could explain these differential patterns of performance, underscoring the necessity of careful individual evaluation of subjects if differential sentence processing patterns are to be uncovered.

Analysis of grammatical error rates (action vs. object) revealed no differential performance on actions vs. objects for this sample. The literature on this issue is somewhat equivocal, but our results fail to support the conclusion that aphasic subjects of either type (fluent or nonfluent) have inordinate difficulty with verbs (action items).

We also found no conclusive relationship between digit recall performance and three-part command error rates for our subset of subjects. This supports the recent suggestion by Saffrin (1985) that we must reconsider the supposition that the relationship between STM and sentence comprehension impairment is causal in nature.

The contributions of this study are essentially twofold. First, it lends no support to the assumption that group positional errors in sentence comprehension will parallel some preconceived notion of "primacy" or "recency." Errors are equally likely to occur in any position, but individual analysis may reveal some subjects who contradict group trends. Secondly, no apparent pattern exists related to action-object performance, and this may have implications for the selection and balancing of stimulus materials for aphasia treatment.

Sentence comprehension and processing is a complex act with a web of linguistic and nonlinguistic interactions. The FACT, in fact, may or may not appropriately represent the processes occurring in real-life sentence discourse that often involve a variety of speech acts. The FACT is comprised of a series of serial requests (and by serial requests, we don't mean, for example, "Get me the Cheerios!"); and no doubt natural lengthy discourse taps more than simple requests strung together. Perhaps differences in grammatical class (i.e., noun-verb differences in relative impairment) would be apparent in these other types of speech acts. But this speculation awaits further research. Analysis of error location is a necessary start, with the hope that further questions can be generated and explored to reveal additional insights as to how to deal with both the evaluation and remediation of this veiled disorder.

ACKNOWLEDGMENT

We would like to acknowledge the contribution of Jennifer Horner, Ph.D., who tested some of the subjects used in this study.

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DISCUSSION

Q: What was your performance mode on the digit recall task? Did they respond verbally or did they point?

A: They pointed to a number of 3x5 cards with digits.

Q: Did you explore the relationship between severity of auditory comprehension deficit and the various patterns that you found for subjects?

A: We ran correlations on a whole variety of subject variables and performance variables, in fact, 26. We found no significant relationship in this particular sample.

Q: You reported that there is no difference between action and object for the group as a whole. Now, if you look at individual subjects, you find differences.

A: I can't recall from our correlational analysis our looking at individual ... I guess the head nodding in the back row suggests that there were no predominant patterns that were apparent in individual subjects.

Q: You found that there is only a weak correlation between the two digit spans and the occurrence of the serial errors, but I just wonder if on a patient-by-patient basis the patients who showed a primacy or recency effect in digit span were also the patients who seemed to preserve or lose the last or first position in the three-place task.

A: We looked at that, and no, it wasn't apparent that those were the patients that seemed to stand out in terms of losing it.

Q: You dealt with variables and issues and questions that are very similar to what's involved with Shewan's auditory test, the ACTS. In other words, we purchase forms that enable us to do a front half and last half

analysis and verb and so forth analysis. Do you think your data have any implications for how we should regard those variables with Shewan's test?

A: She found something that was a bit different from what we found. The differences could probably be explained in a number of different ways, maybe differences in the types of sentence comprehension stimulus items she used.

Q: I don't understand why there wasn't a stronger relationship between auditory digit span and your auditory comprehension task. It can't be explained by memory deficit, because both are comprehension and memory tasks. Do you have any thoughts on why they didn't relate more strongly?

A: I don't know. We went over it and tried to consider any kind of explanatory or interpretive grain or nugget that we could find and I don't think we came up with anything that was real startling, unless there's anybody else who has an idea or suggestion.

A: I wonder if it could be explained by the fact that you don't have much distribution of scores on your digit span tests. You have to have quite a range to get a correlation, and it looks like it's probably pretty restricted, so that you may not have a correlation because you have no distribution for the digit recall tests.

A: You have to recall, that the digit span wasn't administered to the whole 25, the n of 25, just to a subset of 6. In fact, there <u>was</u> kind of a closed distribution on it.

Q: I have a question about the action-object data. There were different numbers of possible errors for actions and objects. Is that right?

A: Yes.

Q: You report means. I think on the slides you reported the actual number possible. I wonder if you looked at it in terms of proportions of possible correct, or errors, you might see a difference that you don't see when you look at means.

A: It could be. Let's examine first what the difference was in possible errors. Can you remember, Lisa or Pat, how much disparity we had there and the possibility between action and object?

A: We had 60 possible action errors total and only 45 possible object, because of segments of the FACT where there's only one object and you're asking, obviously, different things to do, and when we ran those correlations, we ran them with those numbers in mind. We were working on the actual possibilities, not the total number of errors for any one of those.

Q: I'd like to return to my question earlier. When you have a range of performance from 3 to 37, or 0 to 36, on action-object error pattern, and the correlation is not significant, that's fine. If it were to turn out to be the case, say, that one of the patients has a score of 25 on the action part and 0 or 2 on the object part, I would think that would be very exciting, and very interesting.

Q: Did you look to see whether there was any difference in performance on verbs when they were contextually appropriate with the nouns as opposed to when they were contextually irrelevant?

A: No, we didn't look at that. The 3-part commands in the FACT really don't go through a variety of those types of contextual and syntactic

differences, so we didn't analyze that.

A: We didn't have anything in our design that allowed contrast of contextual versus less contextual items. I pointed out in the discussion, though, that is certainly another direction folks might go because the FACT doesn't tap all the things that are possible in terms of sentence comprehension in the real world.

Q: I think that the last three papers have been excellent examples of how group studies may give us no information or even may obscure differences between aphasic patients, while series of single case analyses may reveal real differences between the patients. You all three pointed out that classifying patients by the WAB or by fluent versus nonfluent told us nothing about their auditory comprehension deficits. Do you think that if we try to group patients differently in terms of people who have difficulty with syntax versus people having difficulty with length, that you might find patterns of performance on your task?

A: I think there are so many interacting variables and directions that we can go in that it's a real fruitful area for programmatic research. We can never exhaust some of the possibilities of exploring some of these changes.