COMPREHENSION OF D-(ISCOURSE) LINKED QUESTIONS BY APHASICS: NEW EVIDENCE*

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This paper presents the results of a study of comprehension of D-(iscourse) linked questions by aphasic patients. We argue that difficulty in comprehending discourse linked questions is neither as severe as suggested in previous work, nor is it confined to Broca's patients.

1. Background

In a study of two Broca's aphasics, Hickok and Avrutin (1996) found that their subjects performed well with subject and object questions when the question word was non-D-linked (such as *who*), and with subject questions with a D-linked question phrase (such as *which horse*), but did badly with object questions with a D-linked phrase. Performance was thus good with questions such as (1a-c), but dropped to chance with questions such as (1d),

(1) a. Who kicked the pig?
     b. Which horse kicked the pig?
     c.   Who did the pig kick?
     d. Which horse did the pig kick?

The same result has been was found for 4-5 year old children (Avrutin 2000). However, Thompson et al (1999) found this pattern for only one of the four agrammatic subjects they tested, and Goodluck (2005) reports that the difficulty of D-linked object questions for pre-school children disappeared when the question phrase is less specific, i.e. *which animal* rather than, for example, *which horse.*

2. This Study

We tested aphasic patients using the same type of test employed by Hickok and Avrutin. The experimenter acted out scenarios with toy animals and then asked questions of types (1a-d). For the examples in (1), the scenario acted out would be that a horse kicks a pig and then the pig kicks another horse. See Diagram A. In our first experiment, the questions were of the type in (1); in our second experiment the D-linked phrases were replaced with *which animal*.
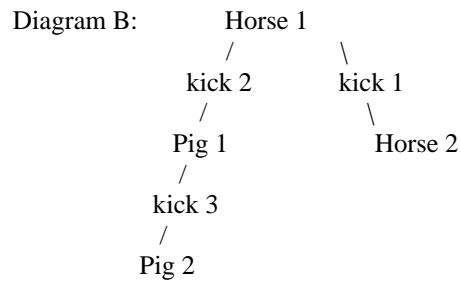
Experiment 1 also tested object questions following a more complex scenario, in which an animal of type A first performed an action on an animal of the same type, then the same action on an animal of type B, following which the type B animal performs the action on another type B animal. See Diagram B.

The goal of the more complex scenarios was to discourage use of pointing strategies (pointing to the leftmost, middle or rightmost animal in the scenario).

Each subject responded to four tokens of each sentence type in each experiment. Both left-to-right and right-to-left orders of presentation of the scenarios were used for all subjects.

Diagram A: Horse 1 -> kick -> Pig -> kick -> Horse 2

Diagram B:
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                  Horse 1
                /           \
            kick 2        kick 1
            /                    \
          Pig 1              Horse 2
          /
        kick 3
        /
      Pig 2
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Subjects also did an act-out test of their comprehension of active and passive sentences (2a,b) and subject and object cleft sentences (3a,b) and the Boston Diagnostic Aphasia Examination – Third Edition (Goodglass 2000).

(2)   a.   The woman kisses the man
        b.   The man is kissed by the woman

(3)   a.   It's the boy that knocks over the girl
        b.   It's the boy that the girl knocks over

3. Results

In total, eight patients were tested. Of these, the results of four patients are reported here. One of the subjects eliminated had no errors, and three used pointing strategies in the D-linking question test (for example, one subject pointed almost invariable to the last animal moved by the experimenter), and thus produced no informative data concerning difficulty with D-linking. Of the four patients whose performance on the D-linking experiments we report here, only one clearly presented as a Broca's aphasic on the act-out of the passive and object clefts. Two had perfect or near perfect comprehension on the act-out (one error on the passive by one subject), and the remaining subject had poor performance on all conditions. The two high scoring subjects on the act-out also showed better, but not perfect, performance on the comprehension components of the Boston Diagnostic Battery.

The results for subject and object questions using the Hickock-Avrutin scenarios are given in Table 1, in terms of mean percentage correct for the four

subjects combined. Appendix 1 gives the scores for individual subjects.

Table 1
Mean Percentage Correct

	Subject questions		Object questions	
	- DL	+DL	-DL	+DL
Experiment 1 (Which horse)	88	62	75	38
Experiment 2 (Which animal)	81	81	62	75

In experiment 1, all four subjects performed better on non-D-linked object questions than on D-linked object questions**.** As can be seen from Table 1, the switch in experiment 2 from a specific D-linked phrase to the phrase *which animal* led to an improvement in performance with object questions, as it did for Goodluck's child subjects. Three out of four subjects improved their performance on D-linked object questions in Experiment 2 (one subject, who was one of the two subjects who made errors on passive and clefts remained at 50% correct). For the new scenarios included in Experiment 1 (Diagram B), performance on D-linked object questions rose to 62% correct (as compared to 80% correct with non-D-linked object questions). This improvement was due to two subjects, one of whom had near perfect scores on the act-out.[1]

4. Discussion

The results of this study, together with those of Avrutin (2001), Thompson et al (1999) and Goodluck (2005), point to problems with the Hickok and Avrutin's analysis. Hickok and Avrutin proposed that binding (as opposed to syntactic movement) chains are impaired in Broca's aphasia. They adopt the analysis of Cinque (1990), in which D-linked question phrases enter into binding chains. Drawing on Grodzinsky (1990) and subsequent work, they propose that the asymmetry between subject and object D-linked questions can be accounted for by the fact that a first NP = agent strategy will yield the correct result for D-linked subject questions, even if the grammar (binding chains) is impaired. Such a strategy will produce a conflict for object questions, since the question phrase will be assigned the role agent by the strategy and the subject will also be assigned the role agent by the verb. Hickok and Avrutin argue that this conflict will lead to the

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[1] Our study had a smaller number of test items per condition that those of Hickok and Avrutin and of Thompson et al, requiring us to rely on descriptive statistics, given the small number of subjects whose data we present here.

chance performance they observed on D-linked object questions.[2]

The first problem for Hickok and Avrutin's account is that the two subjects who did not show the typical act-out comprehension pattern of Broca's aphasics, still had difficulty with D-linked object questions. Thus the difficulty with D-linking may not be specific to Broca's. Nor, as Thompson et al. point out, is it characteristic of all Broca's aphasics. Similarly, the performance of Avrutin's and of Goodluck's child subjects with D-linked object questions undermines the idea that difficulty with D-linking is restricted to Broca's patients, and that it is associated with a deficit with binding chains. Although the matter is far from settled in child language studies, if a deficit for children exists, it is argued to be with syntactic movement rather than with binding (see Goodluck 2007 for a summary of some of the literature).

Second, the improvement our subjects show with the new format scenarios (Experiment 1) and when the D-linked phrase is *which animal* (Experiment 2) argues against a generalized problem with D-linking.[3]

Avrutin (2000) proposes that children's difficulty with D-linked object questions may be rooted in a non-adult ability to integrate discourse information with sentence level syntax, a deficit that Goodluck (1990, 2007) suggests may follow from the structure of the sentence processing device. This position will gain ground if a deficit is found for D-linked subject questions as well as D-linked object questions, since both involve consulting the discourse to identify the referent of the wh-phrase. One of our subjects did (Subject N in Appendix 1 did show such a pattern and Goodluck (in preparation) finds that preschool children show a small deficit for D-linked subject questions. In addition, perceptual factors as well than linguistic factors may drive the patterns of performance. Specifically, the use of a more specific D-linked phrase may trigger a visual comparison that impairs performance, when combined with relatively long (i.e. object) extraction. Similarly, the use of more complex scenarios in Experiment 1 may have discouraged non-reflective responding.

5. Conclusion

Thompson et al. conclude their article with a plea for the need for additional data

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[2] Thompson et al (1999) suggest that X^0 movement may be easier than XP movement, non D-linked phrases involving X^0. This, Avrutin points out, cannot account for the subject-object asymmetry; nor can it account for the improvement in performance we observed when *which animal* is used instead of a more specific D-linked phrase. In addition, Thompson et al. suggest that D-linked phrases may involve more complex semantic computations than non-D-linked phrases. Goodluck (2005) argues against this analysis.

[3] In an initial report of the study by Thompson et al., Tait et al. (1995) reported that the object D-linking effect was not found when the question phrase was *which one*, as might be expected given our results with *which animal*. However, this turned out not to be the case in the fuller 1999 report, which included extra data.

concerning the ability of agrammatic patients to comprehend questions. The child language results of Avrutin and of Goodluck and the data from aphasics presented here go some way towards meeting that need. Overall, at this point it seems that the most likely explanation of the subject - object asymmetry with respect to D-linked questions is that it is the result of a performance deficit that is not particular to one type of aphasia or to aphasics alone.

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Appendix 1

Individual subject scores
Number correct (out of four)

	Act out			
Subject #	Active	Passive	Subject cleft	Object cleft
1	4	4	4	4
2	4	2	4	2
3	2	1	1	1
4	4	3	4	4

Experiment 1

	Subject questions		Object questions	
Subject #	-DL	+DL	-DL	+DL
1	3	2	2/3*	2
2	4	0	3/3	1
3	3	4	2/3	2
4	4	4	2/3	1

	Object questions: new format (diagram B)	
	-DL	+DL
1	3	2
2	3	1
3	4	3
4	4	4

Experiment 2

	Subject questions		Object questions	
Subject #	-DL	+DL	-DL	+DL
1	3	3	3	4
2	3	2	3	2
3	3	4	1	2
4	4	4	3	4

*Due to an error in the questionnaires the scores for this condition are
 out of three.