Acquiring Restrictions on Forwards Anaphora: A Pilot Study*

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I. Introduction

This paper is designed to report on two parallel experiments on
English first language acquisition of definite noun phrase anaphora.
Under particular investigation were restrictions on coreference in
sentence types (1) to (6) and their "mirror image" forms in (7) to
(9). In each type of sentence subjects were asked whether the
underlined full noun phrase could act as an antecedent for the
pronoun.

    (1)   Near Barbie, she dropped the earring.

    (2)   Across Vicky's bed, she laid the dress.

    (3)   In front of Ken, on the bus which takes the children
         home from school, he saw a friend.

    (4)   Close to Ken's bike, which was parked in the bike
         rack, he found the ball.

    (5)   According to Barbie, she is pretty.

    (6)   Amongst Ken's friends, he is well liked.

    (7)   According to her, Vicky is the nicest girl in town.

    (8)   Near him, Wayne found the programme.

    (9)   Above her head, Vicky watched a spider.

Our research was primarily designed to test the viability of data
which might clarify some seeming disparities in the results of previous
experiments in this area. Before reporting our results, therefore, we
will provide a background of previous acquisition studies of definite
noun phrase anaphora. Having presented our findings, we will review
the methodological problems of our research and the implication they
have for our own as well as other experimentation. Finally, we will
discuss our results in terms of previous work in acquisition of
forwards anaphora.

II. Background to the Experiments

In 1969, Carol Chomsky did the first acquisition study of definite
noun phrase anaphora. She looked at the three structures illustrated
in sentences (10) to (12):

(10) Pluto thinks he knows everything.

(11) He found out that Mickey won the race.

(12) After he got the candy, Mickey left.

Coreference judgements were provided by children aged 5;0 - 10;0. The results suggested that by the age of 5;6 the majority of children would correctly block coreference in sentence type (11) while allowing coreference in types (10) and (12). Chomsky concluded that at about age 5;6 children must learn to use some structural principle which controls all forms of definite NP anaphora. She made no attempt to explain what that principle was.

In 1976, Lawrence Solan continued Chomsky's work with a specific theoretical framework in mind. He called the restriction which would control anaphora the Backwards Anaphora Restriction (BAR). The BAR has the effect of combining linear order with the dominance principles of Reinhart's (1976) c-command, and Lasnik's (1976) k-command.[1] The result is a restriction which is sensitive to clausal structure and linear order. Solan provides interesting research support for his proposal,[2] and ensuing work by Tavakolian (1977) and Lust and associates (1977, 1980 a & b) tends to corroborate the directionality constraints implicit in his approach. Lust et al. (1980) argue for an approach to anaphora which distinguishes production and interpretation. They suggest that production is controlled by a linear surface structure constraint which controls backwards anaphora in a manner similar to the BAR, but that interpretation is controlled by pragmatic constraints. They provide data which suggest that by age 8 children will correctly interpret type (2) sentences as blocked.

In 1981, David Ingram and Catherine Shaw reported on a study which tested our type (1) sentences. They discovered that children of the same age as those tested by Lust et al. rarely blocked coreference in these sentences. They point out that their 100 subjects aged 3;0 to 7;11 seem to manifest a stage by stage approach to learning anaphora. Five main stages are outlined, and each stage represents a restructuring of hypotheses of the previous stage into more sophisticated hypotheses with more precise restrictions. The final stage is a non-directional surface constraint like c-command.

Lust and Clifford (1983) appear to question this stage by stage developmental approach by arguing that a single non-linear structure (c-command) is controlling the child's use of anaphora much earlier, but that the essentially right branching pattern of English confuses the child. This results in faulty judgements on sentences like types (1) and (2). In spite of low levels of blocking they claim that children evidence "sensitivity" to c-command on these sentences and on types (13) and (14) illustrated below.

(13)   Under the foot of <u>Ernie</u>, <u>he</u> put the pillow.

(14)   Under <u>Big Bird</u>, quickly, <u>he</u> threw the choo choo train.

Evidence for their conclusions comes from a battery of imitation and act-out experiments with children aged 3;5 to 7;11. The act-out results on the type (1), (2), (13) and (14) sentences have a mean of .85 of 2 correct, or less than half. Mirror image forms of these sentences act as the comparative models, and a mean of 1.08 of 2 are correctly interpreted.

The data appear somewhat inconclusive, and given the previous results of Lust <u>et al</u>. (1980) and Ingram and Shaw (1981), there does seem to be a conflict. We assumed that this conflict might be resolved if the precise age at which children mastered these forms could be established.

III   Experiment One

1.   <u>Materials</u>: A list of twenty-seven sentences was made from the nine sentence types listed in Section I. In addition, two tokens each of type (10) and (11) sentences were included as baseline/distractor items. The sentences were developed to include the names of two male and two female dolls we felt the children would recognize: Barbie and Ken; Wayne Gretzky and his girlfriend Vicky. The names were used across the tokens and the final list was randomized. The resulting list was recorded on a Uher 4000 tape recorder to ensure that the subjects would all hear the same reading for each token. One sentence, the first on the tape, was discarded from the scoring.[3] The final list, first by type and token and then in random order, appears in Appendices I and II.

To be noted is the fact that several of the sentences have verbs subcategorized to take NP, PP whereas the remainder have no such subcategorization. This results from our original design which had contained many more sentences. This design had to be severely restricted by the time constraints we encountered in doing the experiments.[4] The subcategorized forms are indicated in both Appendix I and Appendix III by the addition of a lower case "s" beside the token number.

2.   <u>Procedure</u>:   We used the same technique employed by Carol Chomsky and Ingram and Shaw. The subjects were interviewed individually in the presence of two experimenters. They were asked to identify the four dolls, and, if they did not know all the names, they were familiarized with them. They were told that they would hear some sentences played on the recorder, and would be asked a question about each sentence. Examples followed:

Sentence: Before Wayne went out, he read the newspaper.
Question: Who read the newspaper?

Sentence: Across Ken's chair, he threw the jacket.
Question: Who threw the jacket across the chair.

The subjects were told their responses could be:

(1)   The person (doll) mentioned in the sentence,
(2)   The other doll of appropriate gender,
(3)   Either.

Several trial sentences followed to ensure that the children knew the dolls' names and understood the task. They were assured that the tape would be replayed if they wished to hear any sentence again.

The introduction, playing of the tape, and the questioning was done by the experimenter whose voice was on the tape. The second experimenter recorded answers on a key which listed the question, the possible answers and a place for comments. All the original group of subjects were also tape recorded.

Throughout the entire experiment the subjects were regularly probed with the question "Could it be anyone else?" We also encouraged them to explain their responses if they could.

3.   Scoring: In the original data the responses were recorded as follows: N = non-coreferential, R = referential, E = either, and ? = incorrect for gender or other idiosyncratic response. These answers were simplified to + blocked. Any response of E was considered to be -blocked. Two sets of figures were made to account for ? responses. One considered the response as + blocked, the second eliminated the response altogether. Tables and graphs show the mean of these possibilities. The proportion of blocked responses was tallied in raw numbers and percentages.

A 60% criterion was used to group the performance of the individual subjects. This criterion was that established by Ingram and Shaw after they discovered that adult subjects blocked only 84% of type (1) sentences.

4.   The Subjects: The original group was made up of thirty children: ten from Grade one, ten from Grade three and ten from Grade four. They were pupils in a public elementary school in Calgary, Alberta.

The age range had been established on the basis of a pre-test of two eight year old and two ten year old children. The eight year olds consistently allowed coreference in the obligatorily blocked

forward cases; the ten year olds rarely did so. We assumed that by testing a close range of ages from eight to ten, we would see an adult response pattern emerge. The Grade one group was included to capture any developmental sequence.

As our testing progressed, we discovered that the majority of children were not blocking necessary cases even at age ten. Consequently we included a small group of Grade six pupils.

Although we had requested that all the children be native speakers of English, we discovered that several were not. These were eliminated from the sample, leaving our numbers unbalanced.

Approximately half of each group have considerable exposure to French in their school programme; the others receive instruction almost exclusively in English.[5] We could see no trends resulting from this difference but we note this distinction in our Appendices III and IV. Groups were roughly balanced for sex, but we saw no differences arising from this factor. Table I provides a breakdown of the final four groups.

Table I - Subjects by grade, school programme, age range & sex				
	Group I	Group II	Group III	Group IV
Grade	1	3	4	6
Total Number	10	8	9	6
Age Range	6;2 - 7;3	8;1 - 8;9	10;0 - 10;5	11;6 - 12;2
Sex) M	5	5	5	3
) F	5	3	4	3
French Prog.	4	5	5	3
Age Range	6;8 - 7;3	8;2 - 8;9	10;0 - 10;3	11;6 - 11;9
Regular Prog.	6	3	4	3
Age Range	6;2 - 7;0	8;1 - 8;9	10;0 - 10;5	11;10 - 12;2

5.   Results: Table II presents the eleven constructions with numbers of blocked responses given in percentages across the four groups. Table III shows the numbers of subjects who attained the 60% criterion for the sentences considered to be blocked. Our judgement of which sentences are blocked comes from Reinhart's (1981) notion of c-command.[6] Complete results for all subjects are contained in Appendix III while Appendix IV gives raw numbers and percentage tallies by group and school programme.[7]

Table II - % of blocked constructions by group				
Sentence Type	Group I	Group II	Group III	Group IV
1	12%	35%	26.7%	70%
2	25%	18.8%	27.8%	58.3%
3	35%	31.2%	16.7%	58.3%
4	20%	12.5%	8.3%	33.3%
5	12.5%	9.3%	11.1%	8.3%
6	21.5%	15.6%	13.9%	12.5%
7	35%	25%	44.4%	50%
8	23%	31.2%	38.8%	58.3%
9	10%	25%	16.7%	16.7%
10	0%	0%	0%	0%
11	76.5%	93.8%	88.9%	100%

Table III - Number of subjects reaching 60% criterion				
Sentence Type	Group I	Group II	Group III	Group IV
1	1 = 10%	2 = 25%	3 = 33%	4 = 67%
2	1 = 10%	1 = 12%	2 = 22%	2 = 33%
3	0	1 = 12%	0	2 = 33%
4	0	1 = 12%	0	1 = 17%
11^8	3/5 = 60% (7) = 70%	7 = 88%	8 = 89%	6 = 100%
No. in Group	10	8	9	6

These data would suggest that until Grade six, there is no consistent pattern of restriction being used by the majority of children on any of the blocked forwards types. It would appear that only type (1) sentences are blocked even at that age.

These very low scores motivated us to attempt the same experiment with adult subjects. We felt that few conclusions could be drawn from the child data without an adequate idea of adult responses.

IV.   Experiment Two

The method, procedure and scoring were identical for the adults except that only one experimenter was present.

1.   The Subjects: The subjects were ten University of Calgary
students. Four were graduate students in Political Science; the
remainder were undergraduates in various disciplines. None had
anything more than a passing knowledge of linguistics or fluency
in a language other than English. They were evenly balanced by sex.

2.   Results: Table IV presents the results for each sentence type.
Table V shows the number of subjects who reached 60% criterion for
the predicted blocked cases. Complete results appear in Appendices
III and IV listed under Group V.

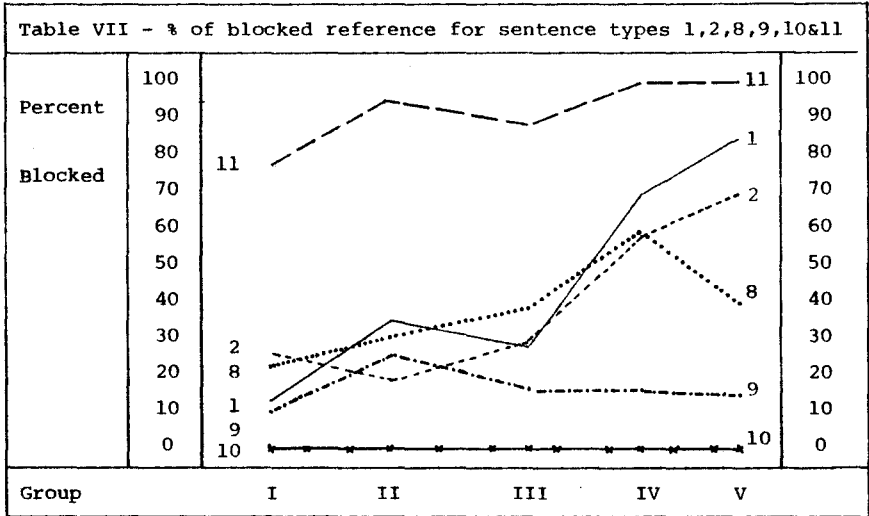| Table IV - Adult responses in percentages	
Sentence Type	Percentage Blocked
1	84%
2	60%
3	60%
4	45%
5	46.8%
6	35%
7	90%
8	40%
9	15%
10	0%
11	100%

Table V - Adults reaching 60% criterion	
Sentence Type	Number of 10
1	9
2	5
3	3
4	3
11	10

We can see that with the exception of types (1) and (11) there is
little evidence that a clear majority of adults correctly control
the necessary restrictions, if the c-command predictions are
correct. Factors such as depth of embedding of the noun in the
noun phrase, and the distance between the noun and the pronoun
are not covered by the c-command notion. However, as the graph
in Table VI illustrates, these factors do seem to have some effect
on the responses of the various groups.

Table VI - % of blocked reference for all groups on sentences (1)-(4)
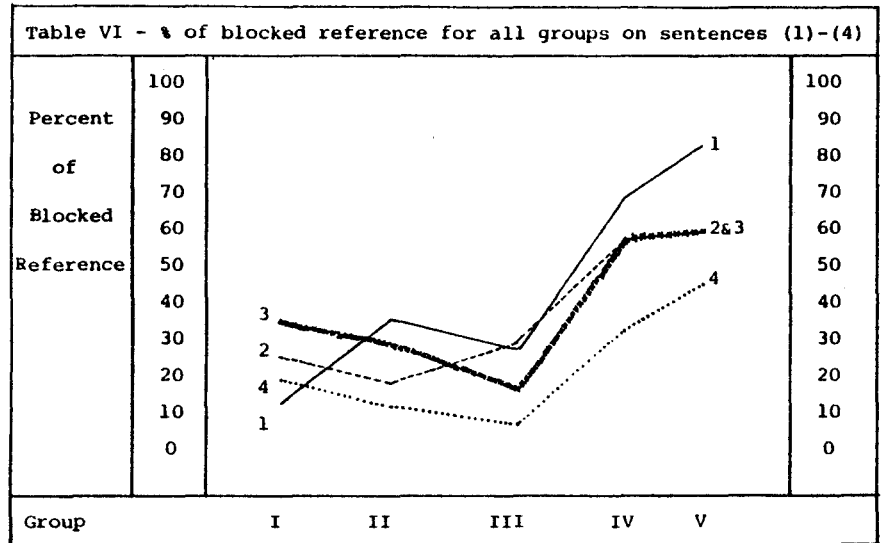
Sentence (3) is a distanced form of sentence type (1). Similarly type (4) is a distanced form of type (2). The increased distance between the full noun phrase and the pronoun would appear to result in a lower level of blocking for the adults and for the Grade six group. The younger children have very random patterns of response. The factor of distance does not appear to act alone, however. In types (2) and (4) the antecedent is genitive. This gives it both distance and greater depth of embedding in the NP. If distance were the only factor operating, we would assume that sentence types (3) and (4) ought to have the same level of blocking. Our results suggest that for groups IV and V this is not the case in spite of the fact that the average number of syllables between the genitive noun and the pronoun is smaller than the distance between the regular noun and the following pronoun. This would tend to support a view that depth of embedding may be a factor independent of distance and of importance to a correct theory of anaphora.
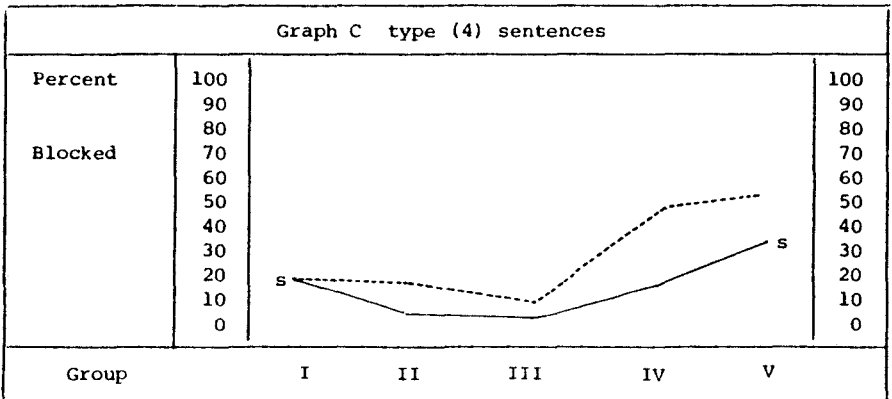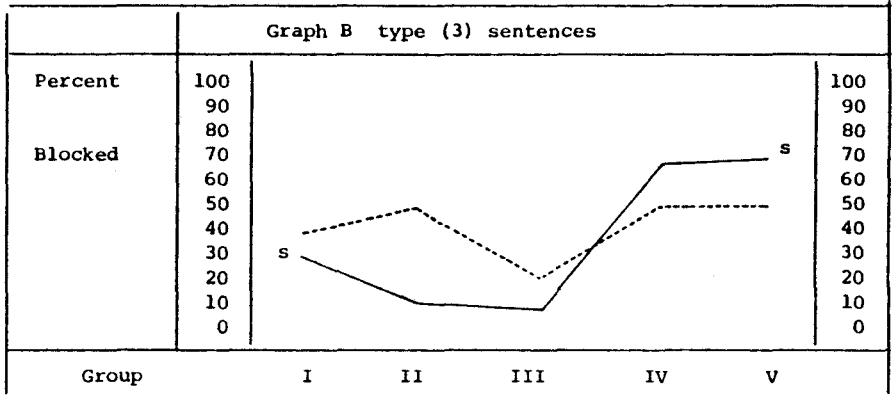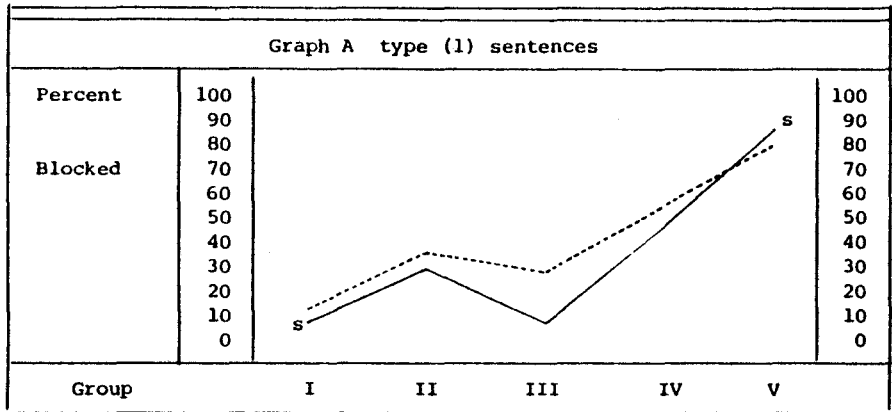
A factor which has been discussed in the literature, but which is not relevant to the c-command hypothesis is direction. In the graph in Table VII we show the relationship between sentence types (1), (2), (8), (9), (10) and (11). Type (8) is the mirror image of type (1) and type (9) mirror images type (2). Only the adult group shows a dramatic mirror image effect for all the types. Group IV blocks coreference in type (8) sentences at almost 60%. The younger groups show very random responses. The youngest groups block sentence type (8) more frequently than the obligatory blocked form (1). Types (9) and (2) fluctuate across the three youngest groups with the results of group II being particularly interesting: They block type (9) more than type (2). This would suggest that the directional factor is somewhat uncertain at these younger ages.

Table VII - % of blocked reference for sentence types 1,2,8,9,10&11							
Percent	100					11	100
	90						90
Blocked	80	11				1	80
	70					2	70
	60						60
	50						50
	40					8	40
	30	2					30
	20	8					20
	10	1				9	10
	0	9 10				10	0
Group		I	II	III	IV	V	

        Comparing the results of the baseline forms (10) and (11) with
those of the preposed prepositional phrase forms we see a dramatic
difference. Type (10) is consistently allowed by all groups, and
type (11) is blocked at a very high level by all groups with groups IV
and V blocking 100%. We realize that some of these sentences had
pragmatic clues, but these do not appear to create any marked dif-
ferences in blocking. The differences which appear to be most
fundamental exist for all preposed prepositional phrase types, and
we would conjecture that this is caused by their more marked nature.

        Another factor present in our design is that of verbal sub-
categorization. Unfortunately, in eliminating sentences from our
original design, we inadvertently eliminated all uncategorized forms
of type (2) sentences. Looking at the various tokens of types (1),
(3) and (4) we cannot discover any clear pattern of response based
on the verbal type. The graphs in Table VIII illustrate the
differences.

Table VIII- % of blocked responses for sentences subcategorized with
verbs taking NP, PP compared with those without subcategorization

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Graph A   type (1) sentences

Percent

Blocked

	I	II	III	IV	V

Group   I   II   III   IV   V

Graph B   type (3) sentences

Percent

Blocked

Group   I   II   III   IV   V

Graph C   type (4) sentences

Percent

Blocked

Group   I   II   III   IV   V

Because we have such a small number of tokens, we feel it is impossible to make any claims about the effect of subcategorization. It does not seem to have a significant influence on the blocking patterns across the various sentence types used in our experiment. To suggest that we can, as a result, ignore semantic properties is not justified when we look at the differences in responses to type (5), (6) and (7) sentences across the groups. Table IX lists the tokens and the response patterns.

Table IX - Type (5), (6) and (7) sentences: number of blocked responses by token				Group			
Type	Sentence	I	II	III	IV	V
5	In Vicky's opinion, she is very popular.	0/10	1/8	2/9	0/6	6/10
	As far as Barbie is concerned, she knows everything.	2/10	0/8	0/9	1/6	1/10
	As for Wayne's sister, he took her skiing.	1/10	0/8	1/9	1/6	4/10
	According to Barbie, she is pretty.	2/10	2/8	1/9	0/6	8/10
6	Around Vicky's house, she becomes very rude.	1/10	2/8	2/9	1/6	6/10
	Beside Ken's sister, he looks like a giant.	4/10	0/8	1/9	0/6	1/10
	In Barbie's neighbourhood, she is considered friendly.	2/10	0/8	2/9	0/6	1/10
	Amongst Ken's friends, he is well liked.	2/10	3/8	0/9	0/6	1/10
7	According to her, Vicky is the nicest girl in town.	3/10	2/8	4/8	3/6	9/10

Although the differences between the adults and children on some of these sentences is striking, we would not wish to suggest that the contrast results strictly from the semantic categories. Rather, we feel that pragmatic reasons may control the responses. This was illustrated quite pointedly by one of the adult subjects who said "I think I'll be meaner to Barbie." after blocking reference in 5_1 and then allowing it in 5_2. Such a statement suggests that the subject imputes considerable egotism to anyone making positive statements about themselves, and that such a demonstration is not usual. Children may not be aware of this distinction. In order to determine

exactly which factors would affect judgements, we would need considerably greater control of the tokens used.

3. Possible Strategies for Processing: Amongst those subjects who blocked all type (1) to (4) sentences, there were one or two who quickly identified different tokens as belonging to a specific type of sentence. One also related types (1) and (3), and (2) and (4). She stated that the extra material made no difference to the fact that these were preposed prepositional phrases. She did not use these words, but simply rehearsed the sentence with the prepositional phrase at the end of the sentence before making her judgement. This subject was an English minor who had never had a course in linguistics. The other subject who blocked all these forms had received an English public school education.

Another less sophisticated analysis was used by some adults and a few of the older children. It involved the use of reflexive pronouns. Several subjects said that if the pronoun represented the noun, one would say "himself" or "herself". Those subjects who used this strategy were unable to rephrase the sentence using a reflexive when we asked them to do so.

Both these strategies suggest some awareness of phrase structure. At the same time, they were explained by the more gregarious of the subjects, and one might require significantly greater probing to discover whether these strategies were related to general trends in the whole population, or whether these were isolated instances. We might also conjecture that the ability to analyze and respond to these tasks might vary with the type of education or the general exposure to language of the individual subjects. As our study had made no provisions for questioning the subjects on their background, we can have no clear picture of the relationship between such factors and the type of responses on the task. This leads us to a general evaluation of the study.

V.   Deficiencies of the Study

The most obvious problems with this study comes from the uneven and limited numbers of tokens used for the various sentence types. We realize that reasonable statistical reliability can only be achieved by providing an eight by eight matrix of tokens and subjects for each sentence type. Without these numbers we cannot judge whether the tokens are reliable, whether ordering of tokens creates response differences or whether subcategorization plays an important role in subject judgement. In addition, we risk making hypotheses based on inadequate evidence, or evidence which can easily be the product of numerical chance.

A second limitation was the inadequate provision for extensive probing of the subjects. The strategies we did see being used might represent only the intellectualization of a minority of the subjects.

Closely related to the latter problem was the fact that we had very little background information about our subjects. With detailed studies of reading habits, we might readily determine whether different response patterns on the more marked forms could be related to literary exposure or educational level.

A relatively simple problem to solve was that presented by using dolls of different sex. Many of the questionable responses related to incorrect gender response. Such gender problems would not arise with dolls of the same sex. However, this difficulty might actually relate to pragmatic or general knowledge considerations. Our sentences did not rule out differences based on semantic or pragmatic considerations. Future research would require very careful pre-testing to diminish these effects.

Despite these problems, we feel that our study provides insights for the improvement of methods in general. Fundamental amongst these is the need for careful evaluation of adult responses to experimental tasks. We cannot expect children to know something that adults do not. By using our own judgements of grammaticality we may completely overlook problems which adults untrained in linguistic theory may reveal. We cannot hope to learn how children acquire structures if we do not know what the majority of adults have acquired.

VI. Discussion

In presenting our results, we note that with the exception of sentence type (1), the majority of our adult subjects did not block a convincing number of those sentences predicted to have blocked reference. We acknowledge that our adult subjects had a mean of 60% blocking on the limited numbers of type (2) and (3) sentences. However, considering the fact that the subjects were university students, one would expect that their control of standard English might be superior to that of the population at large. This being the case, we might go so far as to assume that a truly representative population would block less than 50% of these sentence types. Such a low level of response creates an apparent, if not real, problem for any theory of language acquisition based on c-command. Before any condemnation of c-command could be made, however, we might be wise to consider several factors; foremost amongst these is the rarity of the construction under investigation.

The preposed prepositional phrases we have looked at, do appear to be highly marked. If they are sufficiently rare, we might assume that the majority of people would never encounter enough instances to "trigger" the acquisition of the c-command restrictions. If a relationship could be found between literary exposure and the control of these forms, this defense of c-command would have some validity. Before this could take any reliable form, we would also need to know how frequent such forms are in literature, and exactly how many instances constitute a sufficient number for acquisition. This would appear to be a long and arduous process.

Another defense of the c-command hypothesis also relates to the rarity of these forms. It may be that the majority of people would consider them to follow the topicalized pattern of type (5) and (6) sentences. If one considers the prepositional phrase as being topicalized, then the c-command restriction would no longer prevent co-reference between the elements in the topicalized phrase and the following pronoun. However, if the defense of c-command relates to such an analysis, we would need to prove that the subjects were aware of factors such as verbal subcategorization since such characteristics would determine the place of attachment of the phrases. This would appear a less difficult task than the previous defense demands.

Finally we might suggest that an entirely different theory is needed. The elements of depth of noun phrase embedding and the distance between the referents would be amongst the elements such a theory would need to encompass.

VII. Conclusion

Although our research has little statistical significance, it does suggest several things. Primary amongst these is the fact that our knowledge of adult grammars must be considerably increased before we can effectively use child subjects to prove or disprove theories of grammar. The adult subjects we use in this study illustrate very different patterns of understanding than that imputed to children in previous studies. This being the case, it is difficult to suggest a specific age of acquisition of a particular structural restriction controlling anaphora. What we do see, however, is that an adult-like pattern of response is attained at about age eleven.

Given previous demonstrations that backwards anaphora is controlled much earlier than this, we would assume that a stage by stage theory of acquisition is reasonably well founded. Exactly how many stages children pass through in acquiring the necessary restrictions is not readily revealed by our work although at least three are present amongst the subjects we used: (1) all forms of forwards

anaphora are accepted, whereas the blocked backwards forms are
controlled; (2) blocked backwards and blocked forwards forms which
are not examples of preposed prepositional phrases are correctly
controlled; and (3) blocked backwards and straightforwards cases
of blocked forwards types are blocked, but additional forms of
preposed prepositional phrase forms are added to the repertoire of
most people, if, within the sentence containing the preposed prep-
ositional phrase, the noun and pronoun are immediately adjacent.
Whether a fourth and fifth level can be defined is beyond the
bounds of this study.

Footnotes

[i]The BAR is stated as follows:

$(Pro_i \ldots NP_i)$ is impossible if

a) Pro and NP are clausemates and
    Pro governs NP; or

b) Pro and NP are not clausemates and
    Pro c-commands NP.

Govern is a restatement of Lasnik's k-command and is formulated:

A k-commands B if the nominal cyclic node dominating
A also dominates B.

C-command is stated as:

A c-commands B if the branding node a_1 almost immediately dominating A either dominates B or is immediately dominated by a node a_2 which dominates B and a_2 is of the same category type as a_1.

[2]One aspect of Solan's which raises doubt is his lack of explanation of the high co-reference for sentences like "The horse hit him in the sheep's yard." For the 7 year old children this sentence type had 44% co-reference judgements: the highest of all the sentences tested. For the 8 year olds it had 22%, a rate much closer to the sentences Solan felt might be grammatical in some dialects than to the 14% scored on the next lowest sentence type.

Also of interest is the fact that "govern" seems somewhat unnecessary as the sentences used in Solan's work either operate at the level of c-command or at s-command.

[3]The discarded token was "on Barbie's bed table, she laid the necklace." We felt that the response pattern for adults was quite different for this token and for several subjects who re-read it as the last time as well as the first. We found the judgement was reversed, and decided that the position was affecting judgements. This not have shown up with the children, we feel it illustrates the importance of including enough tokens of each type to later analyze the importance of positioning and token reliability. By deleting this token we realized that the 60% criterion level in fact became 100%. This is the case with all sentence types with few tokens and is one of the most severe limitations of this study.

[4]Our original design had included 10 examples of type 1 sentences, five with verbs subcategorized for NP, PP and five without. We had five each of types 2,5, and 6 and five much shorter forms of 3 and 4 combined. In order to increase the numbers and length of type 3 and 4 sentences and include types 7 and 11 we were forced to abandon the original test. We realized this would create statistical problems but felt it better to include the extra types for a pilot study. We were additionally restricted by the fact that this experiment was immediately followed by another on reciprocal and reflexive acquisition. We had been allowed access to our subjects at the personal discretion of the school principal and had promised not to detain any subject more than 15 or 20 minutes. Consequently our experiment could not exceed 10 minutes.

[5]All children in the Calgary Public Schools receive some French instruction beginning in Grade 4.

[6]See footnote 1 above.

[7]The double scores for some sentence types results from the fact that we have made two calculations of responses. Those children who responded with questionable answers were scored as if the questionable answer was a blocked response and then as if they had not responded at all. Final percentage calculations were the mean of these results.

[8]The two series of numbers for Group I represent the difference between children whose answers were scored as questionable (i.e., totally unrelated to the task referents) and those who gave reasonable answers for both tokens.

References

Carden, G. 1981. Blocked forwards coreference. Paper presented at the Linguistics Society of America, N.Y.C. Winter Meeting, December, 1981.

Chomsky, C. 1969. The Acquisition of Syntax in Children from 5 to 10. Cambridge, Mass.: MIT Press.

Ingram, D. and C. Shaw. 1981. The comprehension of pronominal reference in Children. Unpublished manuscript.

Lust, B. 1980a. Constraints on anaphora in child language: a prediction for a universal. Language Acquisition and Linguistic Theory. Ed. by S. Tavakolian, p. 74-97.

Lust, B., Loveland, K. and R. Kornet. 1980b. The development of anaphora in first language: syntactic and pragmatic constraints. Linguistic Analysis 6.4:359-90.

Lust B. and C. Clifford. 1983. The 3D study: effects of depth, distance and directionability on children's acquisition of anaphora. To be published in Studies in First Language Acquisition of Anaphora: Defining the Constraints. Ed. by B. Lust, Reidel Press.

O'Grady, W. 1982. A computational approach to pronominalization. Unpublished manuscript.

Reinhart, T. 1981. Definite NP anaphora and c-command domains. Linguistic Inquiry 12.4:604-36.

Solan, L. 1978. Anaphora in Child Language. Ph.D. dissertation, University of Massachusetts, Amherst.

Solan, L. 1981. The acquisition of structural restrictions on anaphora. Language Acquisition and Linguistic Theory. Ed. by S. Tavakolian, p. 59-74.

Tavakolian, S. 1977. Structural Principles in the Acquisition of Complex Sentences. Ph.D. dissertation, University of Massachusetts, Amherst.

Tavakolian, S. (ed.) 1981. Language Acquisition and Linguistic Theory. Cambridge, Mass.: MIT Press.

Appendix I

Sentences by Type and Token

Type 1: Simple preposed PP: NP precedes Pro.

    1. Near Barbie, she dropped the earring.
    2. In front of Wayne, he saw a dog.
    3. Behind Wayne, he heard a noise.
    4. Beside Barbie, she found a quarter.
s 5. In front of Wayne, he stood the pop bottle.

Type 2: Preposed PP with possessive NP preceding Pro.

s 1. Across Vicky's bed, she laid the dress.
s 2. Under Wayne's desk, he put the lunch box.

Type 3: Preposed PP with heavy NP. NP precedes Pro.

    1. In front of Ken, on the bus which the children take
       home from school, he saw a friend.
s 2. Beside Barbie, on the couch in the living room, she stood the
       box of chips.

Type 4: Preposed PP with Possessive NP and heavy NP. NP precedes Pro.

    1. Close to Ken's bike, which was parked in the bike rack,
       he found the ball.
    2. Near Ken's goal, which was at the sunny end of the rink,
       he dropped the glove.
s 3. On top of Wayne's desk, which was covered with papers,
       he put the new book.
    4. Under Ken's model plane, which was on the bedroom shelf,
       he carefully placed the stand.

Type 5: as for/according to NP precedes Pro.

    1. In Vicky's opinion she is very popular.
    2. As far as Barbie is concerned, she knows everything.
    3. As for Wayne's sister, he took her skiing.
    4. According to Barbie, she is pretty.

Type 6: Background information plus copular verb.

    1. Around Vicky's house, she becomes very rude.
    2. Beside Ken's sister, he looks like a giant.
    3. In Barbie's neighbourhood, she is considered friendly.
    4. Amongst Ken's friends, he is well liked.

Type 7: as for/according to Pro precedes NP

    1. According to her, Vicky is the nicest girl in town.

Type 8: Preposed PP. Pro precedes NP.

    1. Near him, Wayne found the programme.
    2. Beside him, Ken dropped the wallet.

Type 9: Preposed PP with possessive Pro. Pro precedes NP.

    1. Above her head, Vicky watched a spider.
    2. On her hanger, Vicky hung the coat.

Type 10: Good Forwards Anaphora

    1. Ken's mother said that he was sick.
    2. Wayne knows that he has the most points in the league.

Type 11: Blocked Backwards.

    1. She waited outside while Vicky was changing.
    2. He was glad that Wayne was coming.

Appendix II

Sentences in Order of Presentation

1. Near him, Wayne found the programme.

2. Around Vicky's house, she becomes very rude.

3. She waited outside while Vicky was changing.

4. Near Barbie, she dropped the earring.

5. Beside him, Ken dropped the wallet.

6. Across Vicky's bed, she laid the dress.

7. Close to Ken's bike, which was parked in the bike rack, he found the ball.

8. Above her head, Vicky watched a spider.

9. Ken's mother said that he was sick.

10. In Barbie's neighbourhood, she is considered friendly.

11. On top of Wayne's desk, which was covered in papers, he put the new book.

12. In Vicky's opinion, she is very popular.

13. Beside Barbie, on the couch in the living room, she stood the box of chips.

14. In front of Wayne, he saw a dog.

15. As far as Barbie is concerned, she knows everything.

16. He was glad that Wayne was coming.

17. Near Ken's goal, which was at the sunny end of the rink, he dropped a glove.

18. Under Wayne's desk, he put the lunch box.

19. As for Wayne's sister, he took her skiing.

20. Beside Ken's sister, he looks like a giant.

21. According to her, Vicky is the nicest girl in town.

22.   Behind Wayne, he heard a noise.

23.   In front of Ken, on the bus which takes the children home from school, he saw a friend.

24.   Wayne knows he has the most points in the league.

25.   In front of Wayne, he stood a pop bottle.

26.   On her hanger, Vicky hung the coat.

27.   Beside Barbie, she found a quarter.

28.   Under Ken's model plane, which was on the bedroom shelf, he carefully placed the support stand.

29.   According to Barbie, she is pretty.

30.   Amongst Ken's friends, he is well liked.

APPENDIX III

Group		I										II							
Subject Age		1 4;2	2 4;5	3 6;6	4 6;8	5 6;10	6 6;11	7 6;11	8 7;0	9 7;2	10 7;3	1 8;1	2 8;2	3 8;2	4 8;5	5 8;5	6 8;8	7 8;9	8 8;9
Type	Token	M-Re	F-Re	M-Re	F-Im	M-Re	M-Im	M-Re	F-Re	F-Im	F-Im	M-Re	F-Im	M-Re	F-Im	M-Im	M-Im	F-Im	M-Re
1	1	R	N	R	R	R	R	R	R	R	R	R	N	R	N	N	R	R	R
	2	N	R	R	R	R	R	N	R	R	R	R	N	R	R	N	R	R	R
	3	N	R	R	R	R	R	R	R	R	R	R	N	R	R	N	R	R	R
	4	N	R	R	R	R	R	R	R	R	R	R	N	R	N	N	E	R	N
	5 s	N	R	R	R	R	R	R	R	R	R	R	N	R	R	N	E	R	N
2	1 s	N	N	R	R	R	R	R	N	R	R	R	N	R	R	N	R	R	R
	2 s	N	R	R	R	R	R	N	R	R	R	R	N	R	R	R	R	R	R
3	1	R	N	N	N	R	R	R	P	R	R	N	N	R	R	R	P	N	R
	2 s	N	N	R	R	R	R	R	R	N	R	R	N	R	R	R	R	R	R
4	1	R	R	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R
	2	N	N	N	R	R	R	R	R	R	N	R	N	R	R	R	R	R	N
	3 s	N	R	R	R	R	R	R	R	R	R	R	N	R	R	R	R	R	R
	4 s	R	N	R	R	R	R	N	R	R	N	R	R	R	R	R	R	R	R
5	1	R	R	R	R	R	R	R	R	R	R	R	R	R	R	N	R	R	R
	2	N	R	R	R	R	R	R	R	N	R	R	R	R	R	R	R	R	R
	3	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	4	N	N	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
6	1	N	R	R	R	R	R	R	R	R	R	R	N	R	N	R	R	R	R
	2	N	?	N	R	R	R	R	N	R	R	R	R	R	N	R	R	R	R
	3	N	R	R	R	R	R	R	R	N	R	R	R	R	N	R	R	R	R
	4	R	N	R	R	R	R	R	R	R	N	R	R	R	R	N	R	R	N
7	1	N	?	E	N	R	R	R	R	E	N	R	R	R	N	R	E	N	R
8	1	N	?	N	R	R	R	R	R	R	R	R	R	R	R	R	N	R	R
	2	N	R	N	R	R	R	R	R	R	R	R	N	R	R	N	N	N	R
9	1	N	R	N	R	R	R	R	R	R	R	R	N	R	N	N	R	R	R
	2 s	R	R	R	R	R	R	R	R	E	R	R	N	R	R	R	R	R	R
10	1	R	?	R	R	R	R	R	R	R	R	E	E	R	R	R	E	E	R
	2	R	?	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
11	1	N	?	?	N	?	R	?	R	N	N	N	N	N	N	N	N	N	N
	2	?	N	N	N	N	R	R	N	N	N	N	N	R	R	N	N	N	N

Legend

M = male
F = female
Im = French immersion
Re = regular
S = verb subcategorized for NP, PP
R = coreferential
N = non-coreferent
E = either
? = curious answer

APPENDIX III (cont'd.)

Group		III									IV						V									
Subject		1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10
Age		10;0	10;0	10;0	10;1	10;1	10;1	10;2	10;3	10;5	11;6	11;7	11;9	11;10	12;0	12;2	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult
Type / Token		M-Re	F-Im	F;Im	F;Im	M-Re	F-Im	M-Re	M-Re	F-Re	M-Im	F-Im	F-Im	F-Re	M-Re	M-Re	F	M	M	F	M	M	F	F	M	F
1	1	R	R	N	R	N	N	N	R	R	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	2	R	R	R	R	N	N	N	R	R	N	N	N	N	R	N	N	N	N	N	N	N	N	N	R	R
	3	E	R	R	R	N	N	N	R	R	R	N	E	N	R	N	N	N	N	N	N	N	E	N	E	R
	4	R	R	R	R	E	N	E	R	R	N	N	R	N	E	N	N	N	R	N	N	N	N	N	E	N
	5	E	R	R	R	R	N	E	R	R	R	N	R	R	R	N	N	N	N	N	N	N	N	N	E	N
2	1	R	R	R	R	N	N	N	R	R	R	N	N	N	N	N	N	N	N	N	N	N	E	N	E	R
	2	E	R	R	R	N	E	N	R	R	R	E	N	N	R	N	N	R	R	N	N	N	R	N	E	N
3	1	R	N	R	R	E	E	R	R	N	N	E	R	N	R	N	N	N	R	R	E	N	N	N	E	R
	2	R	R	R	R	N	E	R	R	R	N	N	N	N	R	E	N	N	N	N	N	E	E	N	E	N
4	1	E	R	R	R	N	N	R	R	R	N	N	R	R	R	N	N	N	N	R	R	N	E	N	E	R
	2	R	R	R	R	R	E	R	R	E	N	R	R	N	E	N	N	N	R	R	N	N	R	N	E	N
	3	E	R	R	R	N	E	R	R	R	R	E	R	E	E	E	N	R	R	R	R	E	E	N	E	R
	4	R	R	R	R	E	R	R	R	R	R	R	R	N	R	N	N	N	R	R	N	E	N	N	E	R
5	1	R	R	R	R	N	N	E	R	R	R	E	R	R	E	E	N	R	R	N	N	E	N	N	E	N
	2	E	R	R	R	R	E	R	R	R	N	E	R	R	E	E	R	R	N	R	E	E	R	E	E	R
	3	E	R	R	N	R	N	R	R	R	R	R	R	R	R	N	E	N	R	N	N	E	R	N	E	R
	4	R	R	R	R	E	N	R	R	R	R	R	R	R	E	E	N	N	N	N	N	E	N	N	N	R
6	1	E	R	R	R	N	N	R	R	R	E	N	N	E	R	N	N	N	N	R	N	N	E	N	R	R
	2	R	R	R	N	N	R	R	R	R	R	E	N	R	R	N	N	N	N	N	E	E	E	N	N	N
	3	E	R	R	R	R	N	R	R	R	R	R	R	R	R	E	R	N	R	R	R	E	R	R	R	R
	4	R	R	R	R	E	E	R	R	R	R	R	R	R	R	E	E	N	R	R	R	E	R	R	E	R
7	1	R	R	R	E	E	N	N	N	N	N	E	R	R	N	N	N	N	N	N	N	E	N	N	N	N
8	1	R	R	R	R	N	N	N	R	R	R	N	R	R	N	R	N	R	N	R	N	R	N	R	E	R
	2	E	N	R	R	N	N	N	R	R	N	N	N	N	N	R	N	E	N	N	E	N	N	E	E	R
9	1	R	R	R	R	N	N	R	R	R	R	N	R	R	N	E	N	R	E	R	R	N	N	E	E	R
	2	R	R	R	R	R	N	E	R	R	R	E	R	N	R	E	R	R	R	R	E	E	R	R	R	R
10	1	R	R	R	R	E	E	R	R	R	R	R	R	R	R	E	E	R	R	R	E	E	R	R	E	R
	2	R	R	R	R	R	E	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
11	1	N	N	N	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	2	N	N	N	E	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

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Group	T I				II				III				IV				V	
Type	Im	Reg.	Total	%	Im	Reg	Total	%	Im	Reg	Total	%	Im	Reg	Total	%	Total	%
1	0/20	6/30	6/50	12	12/25	2/15	14/40	35	6/25	6/20	12/45	26.67	10/15	11/15	21/30	70	42/50	84
2	0/8	5/12	5/20	25	3/10	0/6	3/16	18.75	1/10	4/8	5/18	27.78	2/6	5/6	7/12	58.3	12/20	60
3	2/8	5/12	7/20	35	4/10	1/6	5/16	31.2	1/10	2/8	3/18	16.67	4/6	3/6	7/12	58.3	12/20	60
4	2/16	6/24	8/40	20	3/20	1/12	4/32	12.5	1/20	2/16	3/36	8.3	3/12	5/12	8/24	33.3	18/40	45
5	1/16	4/24	5/40	12.5	3/20	0/12	3/32	9.3	3/20	1/16	4/36	11.1	1/12	1/12	2/24	8.3	19/40	47.5
6	2/16	6(7)/23(24)	8(9)/39(40)	21.5	4/20	1/12	5/32	15.6	3/20	2/16	5/36	13.89	2/12	1/12	3/24	12.5	14/40	35
7	2/4	1(2)/5(6)	3(4)/9(10)	36.7	2/5	0/3	2/8	25	2/5	2/4	4/9	44.4	1/3	2/3	3/6	50	9/10	90
8	0/8	4(5)/11(12)	4(5)/19(20)	23	5/10	0/6	4/16	31.2	3/10	4/8	7/18	38.8	4/6	3/6	7/12	58.3	8/20	40
9	0/8	2/12	2/20	10	4/10	0/6	4/16	25	2/10	1/8	3/18	16.67	1/6	1/6	2/12	16.67	3/20	15
10	0/8	0/12	0/20	0	0/10	0/6	0/16	0	0/10	0/8	0/18	0	0/6	0/6	0/12	0	0/20	0
11	6/8	10(5)/12(7)	11(14)/15(20)	80	10/10	5/6	15/16	93.8	8/10	8/8	16/18	88.89	6/6	6/6	12/12	100	20/20	100

Im = French Immersion   Reg. = Regular Programme