North East Linguistics Society

Volume 16
Issue 1 *NELS 16*

Article 8

1985

Acquisition of Structural Restrictions on Anaphora

Stephen Crain
University of Connecticut

Cecile McKee
University of Connecticut

Acquisition of Structural Restrictions on Anaphora*

Stephen Crain & Cecile McKee

University of Connecticut

In this paper we explore a number of issues relating linguistic theory and experimental studies of language acquisition. Recent studies have led some researchers to conclude that language acquisition is a gradual process characterized by long, discontinuous stages in which children adopt non-adult grammatical hypotheses. These studies pose a serious challenge to the expectation that would come most directly from linguistic theory, which envisions a rapid and effortless transition from the "initial state" to the "final state" (see, e.g., McNeil, 1971, p. 17; Chomsky, 1975, p. 138; Hornstein and Lightfoot, 1981, p. 10). The purpose of this paper is to take up this challenge.

We begin our response by setting out several reasons for supposing that one current framework, an unadorned version of parameter theory, predicts rapid acquisition of syntax with few wrong turns along the way. Following this, in section 2, we will focus more narrowly on the linguistic phenomena of "backwards anaphora", some cases of which are ruled out by Binding

Theory. (The particular cases we discuss are handled by Condition C.) Section 3 presents a review of empirical data which have been interpreted as evidence of slow, staged acquisition of the structural constraint governing backwards anaphora. We will argue, to the contrary, that the tasks used in that research are in principle unsuitable for probing children's grammatical knowledge of backwards anaphora. As a consequence, the usual interpretation of children's responses in these tasks is unwarranted. If our arguments are sound, the possibility reemerges that the predictions of linguistic theory are correct. Pursuing another tack in the final section, we report the findings of three experiments investigating children's knowledge of the structural constraint on backwards anaphora. These findings were obtained using a new experimental technique specifically designed to provide a more direct probe of children's linguistic competence. The results are interpreted as evidence for the position that children's grammatical development does conform to the strongest predictions of linguistic theory.

1. THEORETICAL ISSUES

Our first task is to point to some of the connections between linguistic theory and language acquisition. Following the logic sketched out in Hamburger and Crain (1984) and Lasnik and Crain (1985), we will argue that the linguistic framework known as parameter theory predicts neither slow nor staged acquisition.

It seems to be a common assumption that children do not rapidly advance in grammatical competence. Rather, they are assumed to settle at discrete stages for several months or even years. We find this assumption somewhat paradoxical. To illustrate the paradox, we will adopt the position that grammar formation consists of the setting of a limited number of parameters, each with only a few possible values. Parameter theory views acquisition as a sort of scavenger hunt for primary linguistic data. Recall that in a treasure hunt one proceeds from clue to clue or from place to place in a particular order, but in a scavenger hunt one can gather the requisite items in any order. Thus, parameter theory can be viewed as a model of what we will call Scavenger Acquisition, a model in which the child "knows" in advance what kind of

sentences to look for, namely, those that determine the settings of the various parameters. Parameter theory is usually augmented by a theory of markedness, which provides the ordering for values of the parameters. The theory of markedness is used to circumvent problems associated with the absence of negative data. To avoid these problems, the unmarked setting of the parameter is assumed to be the one which allows the narrowest set of sentences to be generated, making subsequent resettings responsive to positive data. For simplicity, let us assume in our discussion that each parameter is independent of the others.

What does parameter theory have to say about the course of language acquisition? Since parameters are sometimes reset from their unmarked value, it is conceivable that children could initially use an incorrect value (for a given natural language) and then reset it when the relevant data are encountered. We take it that this possibility has led some researchers to look for stages in the acquisition of certain syntactic constructions. This picture of acquisition will be discussed at length below. We focus on one putative parameter, the restriction on backwards anaphora (see Solan, 1983). But before we get down to cases, we want to pursue further the question of how long children should be expected to remain at any stage while awaiting the requisite data for resetting a parameter.

We can think of three circumstances in which children might have a long wait. First, children might remain at a stage for an extended period because the data that would permit them to advance beyond this stage are not readily available. This explanation is untenable for the following reason: if the relevant data were not readily available, then many children in a speech community would not encounter them at all, and would not advance to the adult grammar of that community. Since this does not happen, the necessary data for each parameter must be readily available. But if this is the case, children should not need to spend significant time at any intermediate stage because of a lack of positive data.

There is, however, a second reason a child might remain at some stage for an extended period. The relevant data might be structurally too complex, or too long for the child to process. Notice, though, that this argument for slow acquisition appeals to a

subsidiary mechanism of linguistic processing that is extraneous to the child's grammar (such as the maturation of the syntactic parsing mechanism or the short-term memory system). It should also be noted that it is the gradual development of the subsidiary mechanism that prolongs Scavenger Acquisition. But this means that the stage-like character of the subsidiary mechanism is responsible for the appearance of stages in language acquisition, not the parametric character of the grammatical system. The grammar contributes the successive states of the acquisition process, but there is nothing in the child's grammar that hinders the process.

A third possible reason for staged acquisition involves maturation. Children could have linguistic principles innately encoded, but these principles might be biologically timed to become effective only at certain maturational stages. However, unless motivated predictions can be made about when these principles become operational, this account of staged acquisition is compatible with a broader range of data than the hypothesis that children abide by the structural principles of Universal Grammar at all stages of development. These observations suggest, once again, that we should continue to investigate the veracity of the most straightforward connection between linguistic theory and language acquisition: rapid and continuous acquisition.

So far we have seen that according to parameter theory, a stage consists simply of resetting a parameter from its unmarked value, and that there must be abundant data to inform the child if a parameter should be reset. Consequently, children should rapidly advance through each intermediate stage of acquisition. If this line of reasoning is correct, it casts doubt upon another assumption of much research on language acquisition, namely that there is a correlation between stages and ages. Given a ready supply of relevant data, the results of Scavenger Acquisition will be cashed in immediately for some children. And since this would be true for each parameter setting, some children would rapidly advance to the correct grammatical hypothesis regardless of the number of settings. We conclude, therefore, that <u>rapid</u> acquisition is the null hypothesis, to be retained in the absence of clear counter-evidence to it.

2. EMPIRICAL ISSUES

The next task is to state the connections between linguistic theory and empirical research on language acquisition. It is clear from observation of children outside the laboratory that some of the basic theoretical claims of generative grammar have been substantiated. For instance, the fact that children are able to learn any natural language can be explained only by linguistic theories that make available a restricted number of grammars. If many grammars were available, each compatible with the primary linguistic data, then it would be a mystery how children universally succeed in converging on a correct grammar. Restricted linguistic theories take us some distance towards an explanation of this fact about language acquisition.

But to answer specific questions about children's grammatical knowledge, more analytical methods are needed. An experimental approach has been brought to bear on a variety of specific aspects of linguistic theory, including syntactic phenomena of considerable complexity (Pinker, 1984; Tavakolian, 1981). Given the considerations in the previous section, one might have expected the experimental research to have revealed rapid grammatical development with few errors along the way (assuming that current developments in linguistic theory, like parameter theory, are at least roughly correct). However, children haven't been very accommodating to the precepts of linguistic theory. Acquisitionists have uncovered apparent gaps in the syntactic knowledge of children as old as 5 or 6. For the most part, the gaps have been uncovered by a single paradigm -- the 'do-what-I-say' comprehension task, although other sources of evidence have been involved in support of staged acquisition, as we will see.

Some grammatical pitfalls that children have been observed to make do not seem to present serious problems from the standpoint of language learnability. There would be fewer problems in accounting for learnability, for example, where children undergenerate as a consequence of adopting a more restrictive linguistic rule than the rule adopted by adults, as advocated, for example, by Berwick's (1985) Subset Principle. In that event, children could avail themselves of positive data and ultimately converge on the correct grammar. Since undergeneration errors are correctable by positive data, the problems posed by the absence of negative data could be circumvented.

However, as we conceive of them, even the theories that predict undergeneration errors constitute an abandonment of the strongest hypothesis about the relationship between linguistic theory and language acquisition: the hypothesis that children adhere to all innate structural principles from the earliest stages of acquisition. For one thing, these theories require the postulation of additional machinery for the transition to the target grammar.

Besides a need to explain children's recovery from false starts, there are other grounds for questioning such "protogrammatical" accounts. Here we would raise the question of degrees of freedom in the kinds of mechanisms that are attributable to children. Some accounts of discontinuous acquisition attribute qualitatively different grammars to children and adults. A case in point is children's and adults' grammatical hypotheses about backwards anaphora. One of the crucial characteristics of the adult grammar is that it abides by structure-dependent principles. It is proposed in several recent papers, however, that children's responses to sentences that permit backwards anaphora (in the adult grammar) seem to demand an explanation in structure-independent terms. Before turning to the experimental evidence that motivated this move, we should ascertain the role linguistic theory plays in the matter.

2.1 A structure-dependent constraint on backwards anaphora

The area of linguistic theory that concerns us here is Binding Theory (Chomsky, 1981; 1982). This is the module of Universal Grammar devoted to the structural factors governing coreference relations. Within Binding Theory, we will be concerned with Condition C, which states that an R-expression must be free (equivalently, not bound). The term R-expression denotes NPs with inherent reference (e.g, names), in contrast to pronouns and anaphors. An expression A binds an expression B if they are coindexed and A c-commands B.

Sentences like (1) show that when a pronoun binds an R-expression, coreference is prohibited. By contrast, coreference is allowed in (2) and (3), where the pronoun "he" does not bind the R-expression "John".

Sentence (3) shows that there is not just a linear prohibition against backwards anaphora; coreference is prohibited only when the pronoun c-commands the lexical NP, as in (1).

(1) He thinks John is intelligent.
(2) John thinks he is intelligent.
(3) After he walked in, John said something intelligent.

It will be useful to introduce some further terminology. In what follows we use the term extra-sentential to identify the referent of a pronoun which is not coreferential with any R-expression in the same sentence. For example, the pronoun "he" can only receive an extra-sentential interpretation in (1). Finally, we are using backwards anaphora to refer to coreference between a pronoun and a following R-expression.

The question of children's acquisition of the structural constraint that allows coreference in (3) but not in (1) has received considerable attention. The conclusion reached by some researchers is that a structural constraint (involving c-command, as in Condition C) does not represent children's initial hypothesis about the restriction on backwards anaphora. It has been claimed that, in contrast to the adult grammar, young children first hypothesize a purely linear prohibition against backwards anaphora (Tavakolian, 1978; Solan, 1983). Thus, at some stage of development, it is supposed that children reject backwards anaphora altogether, making their grammars undergenerate at this stage. Children at such a stage would not allow coreference in sentences like (3). Rather, they would assign to it only the extra-sentential reading.

Since this outcome conforms to the Subset Principle, one might expect to find positive data readily available to jettison the structure-independent hypothesis from the child's grammar. What is required, however, is a special kind of positive data, consisting of <sentence, meaning> pairs. Grammatical utterances alone won't do, because the child's grammar already generates the sentences in question, although it assigns to them only a subset of the meanings assigned by the target grammar. Let us consider what positive data will suffice. Presumably, children must encounter a sentence like (3) in a context where the pronoun and the lexical NP are obviously coreferential. The necessary data,

then, seem quite exotic. It seems unlikely that examples such as these would be available for every child, as they must be to serve their putative function.

Having seen what may be at stake in opting for a protogrammatical account, we will proceed in the next section to scrutinize the evidence which has led some to a retreat from the (null) hypothesis that children's grammars and the adult grammar are both structure-dependent. We will argue, first, that the empirical evidence does not,in fact, support the claim that children initially fail to use a structural constraint on backwards anaphora. But beyond that, we will argue that the evidence commonly cited in favor of this account could not in principle demand such an explanation of children's linguistic performance. At most, the evidence is compatible with it. In the final section, empirical data are presented which suggest that previous research has seriously underestimated the amount of syntactic knowledge that is under the belts of children as young as 2 or 3 years old.

3. PREVIOUS RESEARCH

We now consider arguments based on language acquisition research against the view that a structural constraint on coreference guides children's decisions at every stage of language acquisition. On the one hand, it has been claimed that children's grammars do not initially assign coreference on the basis of structural properties of sentences, but rather that they restrict coreference solely on the basis of linear order. We will argue that, at least in the case of backwards anaphora, the evidence does not warrant the conclusion that hierarchical structure is irrelevant. Passing over many details, we describe three findings that have been invoked in defense of the view that a stage of acquisition exists at which hierarchical structure is irrelevant to children.

First, in a 'do-what-I-say' experiment by Tavakolian (1978), it was found that many 3 to 5-year-old subjects responded in a manner which has been taken to indicate a linear prohibition against backwards coreference. What happened was this: as the referent of the pronoun in sentences like (4), children frequently selected an animal which was not mentioned in the sentence, but one that was present in the experimental workspace.

(4) For him to kiss the lion would make the duck happy.
(from Tavakolian)

What can we conclude about the child's grammar from this kind of a response? Some researchers (e.g., Solan, 1983) have concluded that this response indicates that the grammars of some children contain a purely linear prohibition against backwards anaphora.

We would interpret these data differently. Suppose every child had chosen an unnamed referent on every opportunity for sentences of this type. At most this would indicate that children have a strong preference for extra-sentential reference over backwards anaphora. Sentences like (4) are ambiguous, after all, and even adults should not be expected to act-out more than one interpretation of an ambiguous sentence. It is surely too much to ask of children. One may ask, of course, why children favor the extra-sentential interpretation (assuming that adults don't). Such a preference might actually be expected, as Hamburger and Crain (1984) point out, due to children's limited processing capacity. But whatever the explanation of this fact might be, it is clearly orthogonal to the question of the availability of the alternative, backwards anaphora, interpretation of such sentences. In sum, children's proclivity to assign an extra-sentential interpretation is not conclusive evidence that they disallow backwards anaphora.

The results of a second experimental task have been taken as evidence for the claim that children's grammars initially incorporate a directionality constraint. In an elicited imitation study (Lust, 1981), it was found that children sometimes incorrectly repeated (5a), for example, as (5b). These findings, too, have been interpreted as revealing children's linear (and complete) prohibition against backwards anaphora. (We must point out though, that this was not Lust's interpretation.)

(5) a. Because she was tired, Mommy was sleeping.
b. Because Mommy was tired, she was sleeping.

Again, these data do not support the conclusion that children have a prohibition against backwards anaphora. The conclusion one might draw from children's incorrect repetitions is the exact opposite, that is, that children actually understood sentences like (5a) as involving backwards anaphora. Here we will cite an argument by Lasnik and Crain (1985, pp. 149-150):

> Imagine an experiment in which children were asked to imitate French sentences, and we found that some of them made the mistake of translating them into corresponding English sentences. We would surely conclude that children who made this error were in command of the rules of French. The repetition "errors" in Lust's study have precisely the same character as those in our gedanken experiment. Thus, the conclusion must be the same; children who translated [(5a) as (5b)] must have access to rules allowing backwards anaphora.

This brings us to the third source of data. Spontaneous production data have been cited as evidence that children have a predilection against all backwards anaphora. Few, if any, spontaneous utterances in which a backwards anaphora reading is clearly intended have been observed in the speech of young children. Once again, this is not a convincing argument that children's grammars disallow backwards anaphora. Where there are alternative ways of expressing the same message (e.g., using forward anaphora, as in (5b)), it is not unreasonable to suppose that children will generally choose the least effortful construction.

Another remark may illuminate this point. Even adults don't exhibit all the possible grammatical constructions; for example, adults typically omit triply-center-embedded sentences in their spontaneous speech. But this isn't taken as evidence that the adult grammar prohibits this construction. By the same reasoning, the paucity of instances of backwards anaphora in children's spontaneous speech does not entail a lack of grammatical competence with respect to backwards anaphora. One notable result in this regard was obtained at the University of Connecticut recently, where we found that we could reliably elicit passivized relative clauses in the appropriate circumstances from 3-year-olds (e.g., "the one that was flied over by Princess Leia"). We assume that this construction too is rare in the spontaneous speech of young children.

These negative comments about previous research invite us to ask if positive evidence can be gathered in support of the view that children are actually aware of the structure-dependent constraint on backwards anaphora. To answer this question, we need experiments which test for the availability of both interpretations

of sentences like (3), but which also test whether or not children correctly block the coreferential interpretation of sentences like (1).

4. EXPERIMENTAL EVIDENCE

The final task we set for ourselves was to provide evidence of children's syntactic knowledge of the structural constraint on backwards anaphora. This question was pursued in three comprehension experiments, using a new technique, a truth-value judgement task.

On a typical trial, a child heard a sentence following a staged event acted out by one of two experimenters, using toy figures and props. The second experimenter manipulated a puppet, Kermit the Frog. Following each event, Kermit said what he thought had happened on that trial. The child's task was to indicate whether or not the sentence uttered by Kermit accurately described what had happened. Children were asked to feed Kermit a cookie if he said the right thing, that is, if what he said was what really happened. But sometimes he would say the wrong thing, if he wasn't paying close attention. When this happened, the child was asked to make Kermit eat a rag. These procedures made it fun for children to reward or punish Kermit. (In pilot work without the rag ploy, we found that children were reluctant to say that Kermit had said something wrong.)

To test for the availability of both interpretations of an ambiguous sentence like (6), children judged some sentences twice during the course of the experiment, once following a situation that was appropriate to the extra-sentential interpretation and once following a situation corresponding to the backwards anaphora interpretation. The two scenarios for sentence (6) were as follows: in the scenario associated with the backwards anaphora interpretation, a lion stole some chickens from inside a box; for the extra-sentential interpretation, the scenario had a man steal some chickens while a lion was in a box.

(6) When he stole the chickens, the lion was in the box.

The alternative contexts were presented several minutes apart, and care was taken to ensure, as much as possible, that children were not being cued by the

experimenter's facial expressions or by Kermit's sentence intonation pattern.

All three experiments were conducted using the same procedures, but different sentences were presented in each experiment in order to investigate children's syntactic knowledge more exactly, and to supply appropriate controls. In the first experiment, we simply tried to see whether or not children would accept both the backwards anaphora and extra-sentential reading of sentences like (6). Four target sentences were presented, each one twice, following both types of contexts. Also included were simple sentences with c-command violations, like (7a), to make sure that children were not <u>over</u>accepting of backwards anaphora. All three experiments also included a number of simple "filler" sentences, both correct and incorrect, to ascertain that the children were attending to the task.

The two follow-up experiments were administered to replicate the positive findings in Experiment I and to rule out alternative accounts of children's responses -- accounts of their successful performance that are not based on their grammatical competence. That is, these additional experiments were designed to discover whether children had given the right responses for the wrong reasons. The follow-up experiments incorporated two target sentences like (6), but also included control sentences of one variety or another. An example of each kind of control sentence is given in (7). The alternative explanations related to the controls in (7) are summarized in (8), followed by the mean percentage of correct rejection for all sentences of each type. As these data show, these alternative explanations can be unequivocally rejected.

To illustrate one possible confound that was controlled for, consider sentence (7c). Sentences like this were introduced to address the objection that children only appeared to accept the backwards anaphora interpretations of sentences like (6), but were really attending just to the main clause. Sentence (7c) followed a context in which Strawberry Shortcake ate an ice cream, but not while she was outside playing. Therefore, children who rejected this sentence must have been attending to the subordinate clause.

(7) Examples of control sentences:

a. He washed Luke Skywalker.

b. He ate the hamburger when the Smurf was in the fence.

c. When she was outside playing, Strawberry Shortcake ate an ice cream cone.

d. When the Ewoks were in the tent, they jumped up and down.

(8) Children do <u>not</u>:

i) accept all cases of backwards anaphora
control a: N=50; 90% rejection

ii) accept complex sentences with backwards anaphora
control b: N=32; 84% rejection

iii) attend only to main clauses
control c: N=20; 95% rejection

iv) attend only to N-V-N sequences
control c: N=20; 95% rejection
control d: N=20; 95% rejection

v) attend only to the first clause of a sentence
control d: N=20; 95% rejection

vi) attend only to the last clause of a sentence
control c: N=20; 95% rejection

The main findings are summarized in Table 1. Children accepted the backwards anaphora reading for all the test sentences in all three experiments nearly 3/4 of the time. The extra-sentential reading was accepted slightly more often, but the difference was not significant. The percentage of correct rejections of control sentences like (7a) and (7b) is also given, under the label "c-command."

Type of context	% correct
Backwards Anaphora	73 'yes'
Extra-sentential	81 'yes'
C-command	88 'no'

Table 1
Results for all subjects
(N=62, mean age 4;2)

The results for the 7 youngest children appear in Table 2. This table shows that even 2 to 3-year-old children fairly consistently accept and reject backwards anaphora in the same circumstances as adults. Only two of the 62 subjects consistently rejected the backwards anaphora reading. This shows that most children find the backwards anaphora reading acceptable, although it might not have been preferred if they were forced to choose between interpretations, as in previous comprehension studies.

Type of context	% correct
Backwards Anaphora	86 'yes'
Extra-sentential	71 'yes'
C-command	79 'no'

Table 2
Results for the youngest subjects
(N=7, mean age 3;1)

One of the more striking findings was the following: even the youngest 2 and 3-year-olds correctly rejected coreference for examples like (7b). This sentence was presented in the context in which the Smurf was eating a hamburger inside the fence, but another character, Gargamel, was not eating his hamburger because he hates them. Several children volunteered to explain Kermit's misinterpretations of the staged events. Here is a sample of their criticisms of Kermit's assertion (7b).

(7b) He ate the hamburger when the Smurf was in the fence.

3;0 He didn't.
3;5 No, Gargamel didn't. He said "yuk, yuk."
3;6 No, he didn't like it.
3;9 No. (E: What did he do?) He kicked it.
3;9 No, Gargamel didn't like it.

As these comments show, children override whatever pragmatic biases might tempt them to allow coreference between "he" and "the Smurf" despite the structural constraint. It seems to us that these utterances constitute a compelling case for the autonomy of syntax from higher levels of processing in children's acquisition of language.

5. CONCLUSION

The findings reported here don't prove that there aren't stages of language acquisition, even for backwards anaphora. As pointed out at the beginning, current linguistic theories sometimes do admit of stages. But we also gave reasons for supposing that even if acquisition is staged, there is no cause to think that children will settle at a particular stage for a long time. What we can say right now is that there is no evidence that backwards anaphora is acquired in stages. With the development of a new experimental methodology, we have shown that children appear to have in place the structural constraint on backwards anaphora by the time they are three.

We interpret these findings as clear support for the hypothesis that children adhere to innate structural principles from the earliest stages of language acquisition. We have argued that for backwards anaphora, there is no contrary evidence, i.e., no evidence to require us to abandon this position. Finally, we have presented a new methodology which, in our view, gives us a more direct look at children's grammars, their mappings between utterances and meanings. In this experimental paradigm, both the utterance and the meaning of a sentence can be carefully controlled. It is our hope that the development of methodological innovations such as these will serve to bridge the gap between linguistic theory and language acquisition research.

*This research was supported in part by NSF Grant BNS 84-18537.

REFERENCES

Berwick, B. (1985) The Acquisition of Syntactic Knowledge. Cambridge, Mass.: MIT Press.

Chomsky, N. (1975) Reflections on Language. New York: Pantheon Press.

Chomsky, N. (1981) Lectures on Government and Binding. Dordrecht, Holland: Foris Publications.

Chomsky, N. (1982) Some Concepts and Consequences of the Theory of Government and Binding. Cambridge, Mass.: MIT Press.

Hamburger, H. and S. Crain (1984) Acquisition of cognitive compiling. Cognition 17, 85-136.

Hornstein, N. and Lightfoot, D. (1981) Introduction. In D. Hornstein and D. Lightfoot (eds.), Explanation in Linguistics: The Logical Problem of Language Acquisition. New York: Longman.

Lasnik, L. and S. Crain (1985) On the acquisition of pronominal reference. Lingua 65, 135-154.

Lust, B. (1981) Constraints on anaphora in child language: A prediction for a universal. In S. Tavakolian (ed.), Language Acquisition and Linguistic Theory. Cambridge, Mass: MIT Press.

McNeil, D. (1971) The capacity of the ontogenesis of grammar. In D. Slobin (ed.), The Ontogenesis of Grammar. New York: Academic Press.

Pinker, S. (1984) Language Learnability and Language Development. Cambridge, Mass.: Harvard University Press.

Solan, L. (1983) Pronominal Reference: Child Language and the Theory of Grammar. Dordrecht, Holland: D. Reidel.

Tavakolian, S. (1978) Children's comprehension of pronominal subjects and missing subjects in complicated sentences. In H. Goodluck and L. Solan (eds.), Papers in the Structure and Development of Child Language. University of Massachusetts Occasional Papers in Linguistics, vol. 4.

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