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The Emergence of Bound Variable Structures

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1.0 Introduction*

Even for adults, quantifiers such as "all", "some", "every" seem to involve a difficult mapping between logic and grammar. A sentence like "every boy ate every food" requires a little concentration before the meaning comes through. One might think that there is no natural mapping of such sophisticated aspects of cognition onto grammatical structure. Current linguistic theory, however, reveals that syntax puts sharp limits on how quantification works. The study of quantifiers might reveal how cognition connects to grammar and how they are intertwined in the process of acquisition. We will try to present the acquisition problem in a manner

Anne Vainikka, Sabina Aurelio, William Philip, and Mari Takahashi, have been crucially involved in carrying out many of these experiments; several of their more extensive empirical and theoretical discussions will appear elsewhere. In addition, our whole wh-acquisition group has contributed advice at all levels. They include Bernadette Plunkett, Dana McDaniel, Tom Maxfield, Meike Weverink, Fei Xu, Ana Perez-Leroux, Anne Vainikka, Jürgen Weissenborn, and Juan Uriagereka. Anne Vainikka carried out the experiments on plurals. Jill Van Antwerp carried out the experiment on "who pulled everyone", drew wonderful pictures. We have also benefitted from comments at various presentations at BU, Groningen, Leiden, and UMass. Comments by S.Crain, B. Schein, B. Partee, P. Portner and Peggy Speas among others have been helpful.

slightly abstracted from the technical details of linguistic theory.

The following two types of structures involve a quantifier which takes wide scope over a variable:

(1)a. Every boy sat on a chair.
b. Dogs have a tail

The same interpretive option is available for wh-expressions which may be described in terms of bound-variables or in terms of pairwise connections at LF:

(2) a.Who is lifting his hat
b.Who brought what?

Each of these constructions involves a pairwise coupling, which can be called, descriptively, a bound variable reading (BV). In (2b) a pairwise answer is required. One cannot just say "people brought food" in reply, rather ,one is obliged to say " Roger brought wine, Sally brought dip and Bill brought the quiche". In (1a,b and 2a)) such a reading is optional: for instance in 1a) the boys could all be on one chair or each on his own. Each of the sentences in (1,2) must have access to the BV notion in some form, and each is subject to different interpretive constaints.

Virtually no acquisition research has addressed the question of when these interpretations emerge in children's grammars. At the very least, the interpretations seem dependent upon a cognitive achievement, namely an ability to make pairings, or construct isomorphic correspondences. Piaget has argued that this notion of correspondence in the non-verbal realm is a crucial ingredient of intellectual growth in the preschool years.However, the linguistic bound variable reading consists in more than correspondences provided by the non-verbal context, because for the adult grammar, syntax places significant constraints on the bound variable reading.

An example of a syntactic constraint on quantifier scope is provided by relative clauses:

(3) there is a horse for everyone
(=each person has a different horse
or one for everyone)

(4) there is a horse that everyone is riding on
(=one horse only)

One account of this difference is that, in order to produce the BV reading, "everyone" must move to a position (in Logical Form) outside of "a horse", which gives it "wide scope" over the NP "a horse". It is argued (May (1977), Chomsky (1986)) that the principle of subjacency which prevents wh-extraction from relative clauses in the syntax also prevents quantifier extraction at LF.[1] This constraint would then apply to (4), but not to (3), thereby eliminating the BV reading for adults for (3). In other words, a structure of Logical Form must be generated by the child and syntactic constraints must be applied to that structure in order for the child to realize the distinction between (3) and (4).

A second illustration of a syntactic constraint on BV interpretation comes from the domain of "strong crossover":

(5) a. whose hat is he lifting?
b. D-structure: he is lifting whose hat

In interpreting (5a) about a picture, a bound variable or paired reading is blocked: one cannot list the individuals who are lifting their hats, unlike the reading in (2a) above.It is possible to get accidental coreference if someone in the picture is lifting his own hat. But accidental coreference does not allow a set reading: a set of lifters and hat-owners that are connected. How can this block be explained? The wh-word functions like a name when it is c-commanded by a pronoun, preventing coreference, hence BV as well, as represented by (5b). But when do children know that the wh-word must be interpreted in its D-structure position?

A third illustration of a syntactic constraint is provided by the contrast (6a) and (6b) (May 1985):

(6) a.who did everyone in our class marry?
b.who married everyone in our class?
c.someone married everyone in our class.

The question (6a) asks about pairwise couplings, while (6b) either refers to a minister, bigamist, or frequent divorcee. So the sentence (6a), where the wh-

1. There is a good deal of controversy over this claim (See Lasnik & Saito (forthcoming) and references therein). Although there has been counter-evidence, recent work (Nishigauchi (1987) points again at subjacency effects. We take, at the minimum, the subjacency formulation as a description of restrictions on the interpretation of quantifiers in relative clauses.

object is moved forward, allows a one-to-one, pairwise reading while such a reading is excluded for (6b), where the object remains in-situ. In (6b) the "everyone" receives a "group" interpretation. Why should (6b) exclude the paired reading? It is not predictable from our ordinary understanding of events, that is, it is a syntactic block. It is notable that the restriction applies just to wh-words that have undergone movement: the example (6c) does not exclude the pairwise reading. How could a child learn to exclude the paired reading and allow only a group reading for (6b)?

In brief, May (1985) and Chomsky (1986) argue that the BV reading arises just when both variable elements are dominated by the same Maximal Projection. Universal Grammar requires that the wh-word automatically moves to the position Spec of CP and thereby automatically acquires wide scope. The quantifier "someone" in (6c) optionally moves, at LF, therefore it is possible for the object "everyone" to move into a wide scope position and generate the distributed or BV reading. The logical question is: at what stage in development does this UG-requirement on wh- words become operative? We will argue that the availability of Spec of C may be crucial. We return to these analyses once we have laid out the empirical data.

Finally, consider a constraint on (7). Adults will readily get a bound variable reading when the plural NP is in the subject position, as in

(7) Dogs have a tail.

In (7) we mean each dog has a separate tail, but we find it impossible when the plural NP is in object position:

(8) A dog has tails.

In (8) the only meaning is that one dog has several tails. Thus the availability of the notion of pairwise correspondence is subject to subtle syntactic constraints.

There is considerable debate about the proper formulation of these constraints. Do they require a sophisticated and separate semantics, or a syntactic notion of Logical Form, or can they be captured within syntax itself (see Chomsky, 1986; Heim, 1982; May, 1977; 1986)? These results must be addressed by any theory and therefore we pursue an exposition which, in part, abstracts away from particular formulations.

1.1 Acquisition Issues

There are three questions to address :

(9)a. When do children show evidence of bound variable readings of linguistic stimuli?
b. When do these bound variable readings become subject to syntactic constraints, and thus part of the child's grammar?
c. What empirical data and what grammatical decision triggers the shift?

In the evidence assembled so far, it is clear that children realize the constraints on, for instance, "whose hat is he lifting?" and "there is a chair that every cat is on" at vastly different points, a difference of three to four years. Once the results have been presented, we return to the question of exactly how these constraints should be formulated.

For just a glimpse of the magnitude of the acquisition problem, consider the points at which confusion could arise, given English data alone. A consideration of quantification cross-linguistically would further complicate the picture. For instance, one must have lexical knowledge of whether a quantifier is adverbial ("always") or nominal ("every"). In the following sentences it seems as if the two expressions are doing the same work:

(10)a.every person has a nose.
b.a person always has a nose.
c.some people have a nose
d.sometimes people have a nose

Suppose a child hearing (10a) mistakenly concludes that it was (10b), or hears (10c) and thinks it is (10d). Then "every" or "some" is an adverb which applies across a whole sentence and can appear anywhere in it. Why would she **not** come to this conclusion? Were she to come to this conclusion, she would then fail to see a distinction between: "Every official likes every talk" and "Officials always like always talking", or "Every cat likes every mouse" and "Cats always like mice". One could argue that there is a simple input which would work: a child could hear a sentence like "every boy likes every cereal" in a very clear context and determine from secure knowledge of the context that each quantifier must apply to each noun.[2] But such sentences, with clear contexts, are hardly frequent. A

2. See Roeper (1981) for discussion of this approach. Also see Hornstein & Lightfoot (1981) for discussion of "exotic triggers".

theory of acquisition must somehow guarantee that the child avoids confusion, and thus can lead to insight into the principles involved. It seems inevitable that the trigger is indirect: that the child learns to constrain the interpretation of "every" by locating it inside the NP determiner so that the scope restriction follows automatically. The child, in effect, must learn that articles and quantifiers are in complementary distribution in English (*"the every boy"). Then, of course, we must determine how the structure of the NP is acquired, given that the structure varies across languages.

In what follows, a variety of experimental results with young children are discussed to attempt to determine the point of emergence of the linguistic notion of bound variable interpretations. After an initial overview, we return to discuss how different aspects of grammar are entailed by different structures.

2.0 Experimental Studies

In the first set of studies we explored children's answers to double wh-questions such as:

(11) "Who ate which fruit?"

We contrasted that form with the subject wh-question (12a), and an echo-question (12b):

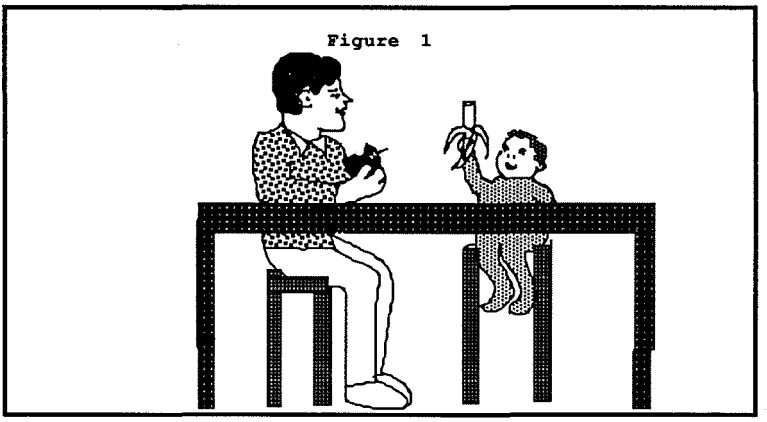
(12) a."Who ate fruit?"
b."The family ate what?"

Recall that (11a), for adults, requires a BV reading. And (12a) calls for either a group or variable answer of just the subject, although a BV reading is not ungrammatical. The echo-question (12b) calls for a literal repeat of the questioned word in the previous sentence.

We presented pictures to the child and a simple sentence such as: "The family ate fruit for dessert", then the question "who ate what?" or "who ate fruit?" or "the family ate what?".[3]

3. Each child received 4 BV questions, 2 subject and 2 object questions, but with no two questions about the same story.

Figure 1



In the picture it is clear that two individuals ate different things. We recorded what the child said and did, i.e. many of the responses were in the form of pointing, which we recorded as carefully as possible with a videorecorder. We encourage the reader (especially those who have not done experiments) to think through each example carefully (saying the introductory sentences aloud) and, in effect, to perform the experiment on himself.

There were various different logical responses that the subjects could make:

(13) a. give an **exhaustive paired interpretation** ("he ate this, and he ate that")
b. answer with **one pairing** (non-exhaustive) ("he ate that")
c. answer **generically** e.g. ("The family ate fruit" or "fruit")
d. answer with an **exhaustive variable** interpretation of a **single** wh-question ("this guy and this guy")
e. answer with a **non-exhaustive**, singular interpretation of a **single** wh-question. ("this guy" or "an apple")

Adult-like behavior would entail giving the (13a) response to the instance: "Who ate what?" but NOT the answers (13c,d,e). This assumption was confirmed by experiments which we carried out in our classes. We performed pencil-and-paper versions of these experiments with at least 25 undergraduate students in each

instance. The sentences were read aloud in the same fashion, but students would write the answer instead of saying it. We found that there was over 90% agreement on the adult answers.

Do children understand that a question word like "who" requires a variable response. Or is it treated like an empty name? (Equal to: "name a person that ate a fruit".) A response such as (13b) might indicate that the children failed to interpret the questions as variables, but it might also indicate a failure to master some pragmatic aspect of question/ answer situations.[4] An absence of the notion of variable could also lead to answering the subject ("who ate fruit?") and object ("the family ate what?") questions with (13c) -type answers.

On the other hand, a BV answer to (11) or (12a,b) is not a grammatical violation in any instance.[5] We were initially seeking environments where we could elicit BV interpretations. Our results led us eventually, as we shall see, to explore syntactic environments where that reading is excluded.

Table 1

17 "old" children aged 4-6 years, 10 "young" children aged 2-3.11 years.

	Who ate which fruit?.	Who ate fruit?	The family ate what?
a(bu)Old:	78.1%	32%	30.3%
Young:	32%	57.1%	9%
b(1-bu)Old:	1.5%	0%	3%
Young:	16%	7%	0%
c(gen) Old:	9%	35%	33.3%
Young:	0%	0%	0%
d(1/ex)Old:	9.4%	11.7%	20.5%
Young:	41%	27.3%	54.5%
e(1,nonex)Old:	1.5%	13%	3.%
Young:	9%	7%	18%

4. For instance, there are some, not so common, adult environments where it is acceptable to give less than exhaustive replies. If we ask "where can I sit" one does not have to name every chair. But, on the other hand, if we ask "who was in the car", we would err in failing to mention someone. We believe that the exhuastive reading for questions is clearly the grammatical requirement, with a few pragmatic exceptions.

5. In point of fact, we have found that full sentence responses are much more common among children than constituent responses (although more work is involved). Whereas adults prefer to answer the question "what did you eat" with "cookies", children generally respond with "I ate cookies". We are preparing a more extensive study of this question.

Table 1 gives the incidence of the various types of answer for 17 children aged 4 to 6, and 10 children aged 2.6 to 4 years. Notice that by 4, the paired, exhaustive interpretation is well established specifically for the double wh-question (78.1%), and only 6 of the 27 failed to give any paired interpretations to this question type. 4 of these children were among the 5 youngest in the group. Therefore it remains possible that at younger ages the BV reading is unavailable. On the other hand, the responses reveal that they seem to know the status of a wh-word as a variable. All but the 2 youngest children gave plural answers to questions at least some of the time, e.g. "the boy and the girl" or just "this one and this one".

In sum, by age four, the children have made a clear syntactic connection: the double- question structure must have a BV reading. However a surprising result appeared: the BV response occurred as one of the most frequent responses to a single wh-question (where adults would usually answer just the subject or object). It is clear that, when the BV reading is present, it is overgeneralized to contexts where it is, at least, pragmatically **unnecessary** for adults. For the group of children younger than four, the BV reading is linked equally to all three structures. What is the nature of such an overgeneralization? Does it imply that the bound variable readings are merely a cognitive strategy, or is there a syntactic representation in use by children that allows this extension?

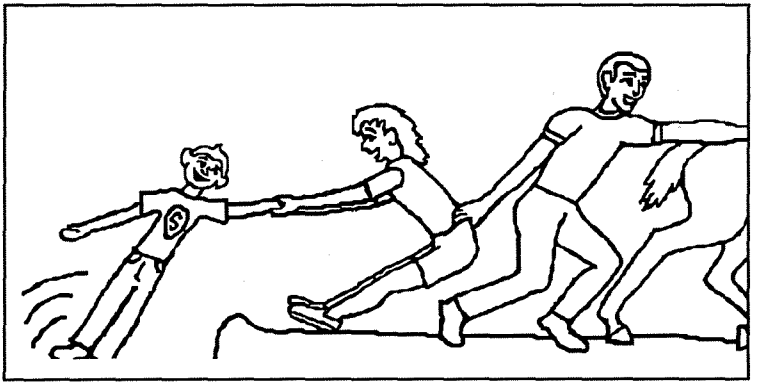
The results warrant a close look. Generic responses (type c above) by age 4 were established for the single questions and very rare for the double wh-questions, which is precisely where we would argue they are forbidden by adult intuitions. In other words, children gave BV readings where we regard them as obligatory for adults. But there remains a puzzle: why do they extend the BV reading to cases where it is not obligatory (even if they are not ungrammatical)? The reader might want to say out loud the BV response to "who ate fruit?" to get an impression for the pragmatic overexplicitness of that response , in comparison to giving the straightforward answer provided earlier, namely "the family".[6]

6. One might object that pragmatically new information is sought rather than the repeat of old information. This is just not true in the life of a small child. Large parts of the dialogue between parents and children are of the form: "this is a washing machine" followed by a test question "what is it", where the child says

Consider the other side of the coin: is there any domain where the BV reading is excluded? We sought a minimal pair for which the BV reading was obligatory in one case, and obligatorily blocked in the other. The pairs of sentences below (from May, 1985) were used to see if children would select (a) for a group reading. While our other sentences called for the contrast between individual and a BV set, this called for the distinction between a group and a BV set:

14)a who pulled everyone?
.b who did everyone pull?

As mentioned earlier in (6a,b), the paired reading is blocked for (14a), which has to mean: "who pulled the whole group?". In (14b) it is possible to get a distributed reading: "which person pulled each person?" We gave children 4 sets of pictures in which, for example, a series of people were pulling one another (see Figure 2) and asked two questions of type 14a) and two of type 14b) of each child.



We explored this contrast with several groups of children at the 3-4yr old range, varying the stimuli and the preamble in certain ways. The BV reading called for a pairwise articulation of what was happening (this one pulled this one, and this one pulled this one, etc), while the group reading called for the children to point to the one character (he's pulling all the people).We found that the BV interpretation was overgeneralized

"a washing machine". The child is showing not only that he "knows" the obvious answer but that he can pronounce the words, which may be a more significant and rewarding challenge.

again. The children were just as eager to take the BV reading for (14a) as for (14b). [See Table 2] This experiment therefore failed to find any syntactic limitation on the BV reading.

Table 2:

Responses to Procedure 1[7] as a function of question type
(N=16; ages 3;2 to 5;4)

	"group" answers	BV answers
Who pulled everyone?	25.5%	69.1%
Who did everyone pull?	11.2%	72.9%

Responses to Procedure 2[8] as a function of question type
(N=19, ages 3;4-5;2)

	"group" answers	BV answers
Who pulled everyone?	77.2%	15.2%
Who did everyone pull?	73.5%	23.9%

2.2 Wh- and Indirect Questions

Next we sought to see if the limitation would arise in contexts where indirect questions were asked. Indirect questions have the property that, being indirect, they do not seek answers, as in (8,10):

(15) Who did the father tell what to do?

(16) Who did the father tell to do what?

and

(17) Who did the father tell what to climb?

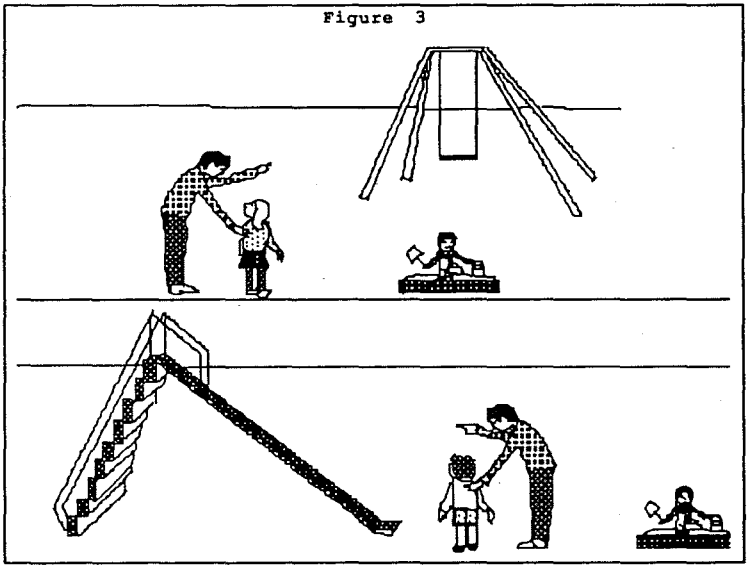
(18) Who did the father tell to climb what?

Answer Types (17,18):
a) bv: he told the girl to go on the swings and the boy to climb the slide.
b) single bv: he told the girl to go on the swings.
c) single, exhaustive wh: The girl and the boy.

7. The first procedure consisted in giving the full story: e.g. "This little boy was out in the country one day when he got stuck in the mud. His sister tried to pull him out but he was really stuck. Then the Dad came and tried to pull the sister but it was no use. Then a horse came along and pulled the Daddy and look! out came the boy!"
8. In the second procedure, we tried to balance the preamble to de-emphasize the pairings: we told the same story, and ended it with: "So the horse pulled this long line of people and this long line of people pulled the boy". Clearly we were too successful!

In contrast (16,18) are *in situ* questions which require a BV reading.Children were read a short story with accompanying pictures (See Figure 3), followed by one of the above questions. We imagined that in (15) the children should only answer the first wh-question, ignoring the question in complementizer position in the lower clause, as an adult would, because we do not answer indirect questions.[9] A wh- in COMP is not bound as a variable to the fronted wh-word. In contrast, (16) requires a BV reading, as the wh is not in COMP. Table 3 shows that the 16 children in this study, aged 3;9 to 6;5, most frequently gave BV readings to **both** sentences, 14 to (15) and 12 to (16) ,with no distinction observed. Responses were slightly more distinct for the specific sentences (17) and (18), which avoided the generic pro-verb "do". In this case, 14 children gave bv responses to (18) but only 8 gave them to (17). Hence the phenomenon may be encouraged by certain aspects of the semantics of the sentence in question, but it is still present when these factors are minimized.

Figure 3



9. The reader might note that there are contexts in which we answer the indirect question: do you know what time it is. However when asked a question like "can you always see what you want on TV?" there is no real answer to the wh-word. If children answered the wh-word, the question would have been noticeably misunderstood.

Table 3

Subjects: 16 children aged 3.9 to 6.5.

Results: #	**children giving each answer.**			
	a	**b**	**c**	
15)	14	1	1	(tell what to do)
16)	12	2	2	(tell to do what)
17)	7	7	2	(tell what to climb)
18)	2	6	5*	(tell to climb what)

(*3 children answered "the slide",i.e. the medial question)

Further experimentation with adults, however, revealed that a surprising number of adults give a BV answer to (18).In fact, in Spanish this BV interpretation is an available part of the adult language.[10] The reader may note that if the "what" is stressed, the BV reading emerges more readily. Despite this residual effect in adult behavior, the fact remains that children were again projecting a BV reading where it is not required and not preferred. What does this imply? In order for adults not to answer the lower clause question, they must understand the question to be a subcategorization of a particular verb in English. Thus we have the following contrast: "He knew what he wanted" but not "*He supposed what he wanted". We hypothesize that the children did not know that "ask" subcategorizes for an indirect question. This is in fact confirmed by searches through the naturalistic data (see de Villiers, Roeper and Vainikka (1990)). Not knowing the "what" to be a subcategorized indirect question, which calls for no response, the children treat it as a real question, calling for an answer. In that regard, it is equivalent to an *in situ* case like "He supposed that he wanted what"? which is perfectly grammatical without a special subcategorization. Under the broad assumption that lexical learning is slow, it is predictable that the children turn to the BV reading. We return to the question of how the subcategorization arises at a later point.

We argue that the BV interpretation in these cases is made possible by the child's grammars, in which the subcategorization has not yet been established for "ask"-Q. There is a further dimension of difference between medial and *in situ* questions which helps establish the precise syntactic limitations governing the children's interpretations. Sentences with *in situ* wh-words cannot have the wh-word function as a barrier.

10. Pointed out to us by Ana Perez-Leroux.

Consider a second important difference between (19) and (20).

(19) How did the girl choose t what to wear *t?

(20) How did the girl choose t to wear what t?

As mentioned, the first difference is the topic of discussion: wh-*in-situ* (20) calls for a distributed BV response. The second difference depends upon the theory of barriers: if an adjunct "how" is moved, it cannot pass through a CP with another wh-word present (19). (In technical terms, following Lasnik & Saito (1984) proper government is required for the intermediate trace which does not occur if there is a branching node present). This effect does not hold for (20) with wh-*in-situ*. Therefore we can interpret (20) as "how-wear" and not just "how-choose".

In fact we found very clear evidence that children do not allow "how" to move over "what" in CP: among a group of 16 4-6yr olds, 36% allowed long-distance interpretations for (20), while only 5% allowed them for (19).[11] If children are sensitive to this barrier effect, then it follows that they are aware that "what" is in the Complementizer position. But the results on "ask" questions indicate that they are apparently unaware that "ask" and now "choose" are also lexically subcategorized to allow an indirect question. If not an indirect question, then "what" must be interpreted as a real question. One way to make it a real question is to give it a pairwise multiple wh-interpretation together with "how".[12]

In sum, we have located a syntactic barrier effect, but failed so far to find a constraint on the BV interpretation. The importance of this result is that it shows that a very precise syntactic awareness is at hand: children are apparently not free to use ordinary inference in interpreting wh-questions in complex environments. Their interpretations are subject to tight syntactic constraints. This suggests (but does not prove) that if the BV reading is available, then a specific grammatical analysis must allow it. Our goal is to provide such an account rather than to assume that the children's interpretations fall outside of the grammar.

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11. See also de Villiers, Roeper & Vainikka, (1990).
12. Production data indicates that indirect questions are acquired verb by verb and wh-word by wh-word, see below.

However, if we find no context in which BV analysis is disallowed, then a grammatical explanation is weak. Roeper *et al* (1984) found just this kind of evidence: children reject the BV interpretation for single-clause strong-crossover sentences. Children between 3-9yrs were given a picture that had two possibilities: two Sesame St characters, each lifting their own hats, and one person lifting Big Bird's hat. The experiment was replicated a number of times with different age groups.They were then given sentences of the form:

(21)a. N1: who is lifting his hat? (36.9% = BV)
b. C1: whose hat is he lifting? (3.6% = BV)

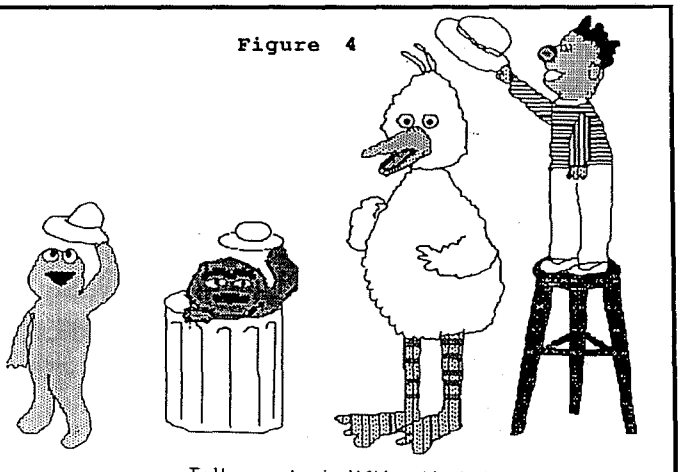
N= non-crossover, C =crossover
1= one clause, 2= two clause

(See Figure 4)

Neither sentence elicited large numbers of BV readings, particularly from the youngest children, while two clause sentences elicited around 30%:

(22)a.N2:who thinks he is lifting his hat (38.1% =BV)
b.C2:who does he think is lifting his hat (29.8% = BV)

Figure 4



The results above are from a group of 21 children 5-7yrs. In addition with a group of 22 children 3-5 years, we found comparable results from a set of 528 sentences, 63 of which received BV interpretation:

Table 4

	N	C
1 clause	7	4
2 clause	26	26

Again it is clear that the single clause cases strongly resist BV interpretation, and that two clause BV interpretations were in the minority.[13] The results suggest that children are able to reconstruct a trace in the single clause sentences which, as illustrated above in (5), rules out a coreferential reading. [14] If we combine this result with our extensive evidence of freely available BV readings, it suggests children in this age range are sensitive to at least one of the adult restrictions.

Let us now summarize what we have observed so far about BV in wh- contexts. We have examined three contexts where BV is disallowed for adults:

(24)a.Object quantifier: who pulled everyone?
b.Subcategorization: who did you tell what to do?
c.Cross-Over: whose hat is he lifting?

In the third, we find the constraint obeyed, suggesting that children are able to recognize a D-structure empty category and make the appropriate interpretation. In the second case, we have argued that subcategorization is missing. In the first case, note that a quantifier is present. Before interpreting the quantifier case, we turn to a detailed examination of quantification structures where there is more evidence of BV overgeneralization.

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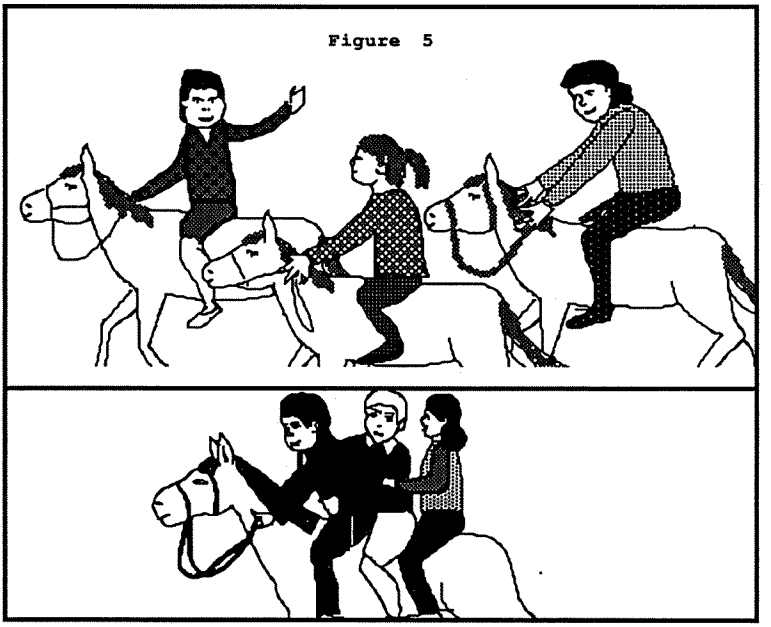
13. We refer the reader to Roeper *et al* (1984) for extensive discussion. The adult responses were found with a group of 8-10 year olds.
14. The fact that the strong crossover sentence (d) does not rule out the BV reading then leads to an interpretation of both cases in terms of small pro. The small pro in the single clause cases would rule out BV readings under Principle B, while BV would be allowed in for the two clause cases because Principle B no longer appies.

3.0 Quantifiers

3.1 Quantifiers and Subjacency

Do children respect the possibly clearer linguistic constraints on non-question quantifiers? We created pictures (see Figure 5) that depicted

Figure 5



several possible interpretations of sentences such as:

(25) Every child sat on a horse

(26) There is a horse that every child sat on

and we asked the child to choose the right picture to go with our sentence, from one depicting each child on a different horse, one depicting all the children on one horse, and one showing three children on their own horses and one without a horse. 21 children aged 3.7 to 7 years demonstrated that they allowed both interpretations readily for 25), and almost equally readily for 26). That is, 12 of the 21 children gave us a BV reading for 26), even asking on occasion, "Do you

one, or a lot of horses?" Once again, syntactic structure had no impact: the BV response was overgeneralized to include subjacency environments where it should be excluded.

We replicated that study using a slightly different methodology in which we ask the child a truth-judgement question about a single picture, for sentences such as:

(27) Is there a chair that every cat is on?

(28) Is every cat on a chair?

15 children aged 4.3 to 5.7 participated, and demonstrated the same intuitions as the previous subjects: 11 of them accepted 100% of the pictures for 27) in which each cat was on a different chair. In fact, three children rejected the reading of 28) for a picture in which all the cats were on one chair, saying:

"No, there's only **one** chair"

This is clear evidence that the notion of BV is overgeneralized, and often strongly preferred over the narrow scope reading of (28). Our results in this domain replicate similar findings by Lee (1986) who did comparable experiments in both English and Chinese.

In sum, we have failed to find syntactic limitations on quantifier interpretations, and this is reminiscent of the overgeneralization of bound variable readings for wh-questions.

3.2 Plurals

In a pilot study (carried out by Anne Vainikka) with 15 children ages 3;7 to 6;0, children were asked a variety of questions of the following sorts (no child received two questions with the same content):

(29) a. Do dogs have tails?
b. Does a dog have a tail?
c. Do dogs have a tail?
d. Does a dog have tails?

Animals and animal parts were varied (Does a cat have noses?). To our consternation, the children showed no differentiation among the four types: the answer was almost always "yes". We also explored the issue in more informal conversations. In the pre-school period, the answers are uniformly positive. In this domain too,

although we have yet to explore it systematically, the BV reading was overgeneralized.

3.3 Quantifiers and indefinites

These results are reminiscent of a famous, but never explained, result obtained by Donaldson and Lloyd (1970). They gave children a picture of four garages, three of which were filled with cars, with one empty. They asked the children:

(30) "Are all the cars in the garages?"

Surprisingly the children pointed to the empty garage and said "no, this is empty". The "all" appears to apply to both cars and garages and the goal seems to be, once again, an isomorphic (or BV-like) connection between cars and garages (See Philip and Takahashi (this volume) for discussion).[15] We have dubbed this phenomenon "quantifier-spreading":

(31) Q-Spreading: A quantifier attached to one NP applies to all NP's in a clause.

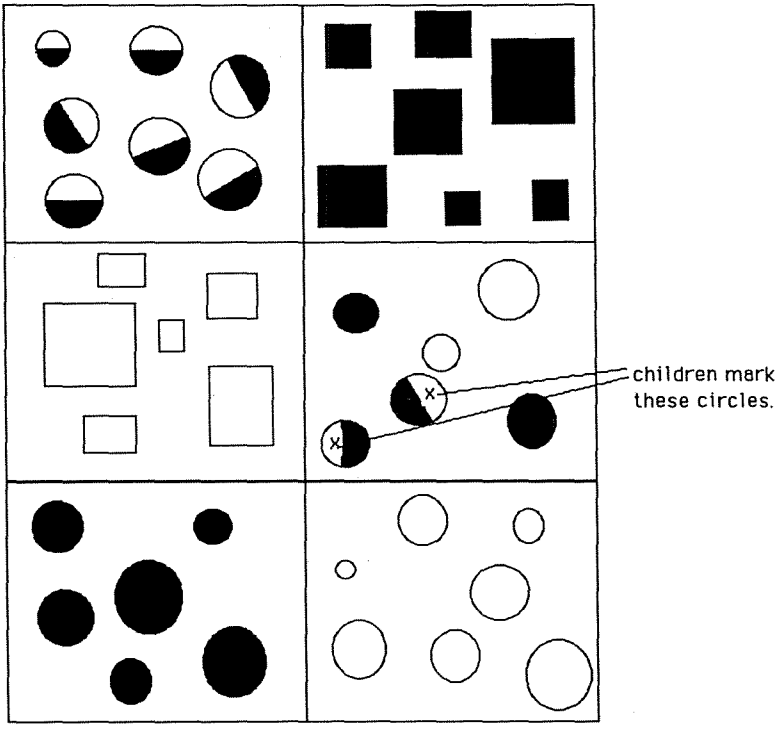
This result, in turn, finds support in work by Roeper and Matthei (1974) with the quantifiers "some" and "all", who suggested that quantifiers initially have an adverbial character. Children between the ages of four and six years were asked to interpret the sentence:

(32) Some of the circles are black

They were given a set of pictures to choose from (see Figure 6), and they frequently chose a picture where some of the circles were partially black (IV).

15. This phenomenon is the focus of work by Bill Philip, Sabina Aurelio, and Mari Takahashi, who provide a discussion of experiments and a more extensive theoretical interpretation. We present here our initial work on the topic with some references to their forthcoming work.(this volume Aurelio & Phillip, Philip & Takahashi)

Figure 6



Show me a box where some of the circles are black.

In other words, they interpreted one "some" as if it applied to both NP's, "some of the circles are some black", just as "all" does, and just as "every" apparently did for the children above. This is a crucial, but predictable, consequence of the hypothesis that children detach quantifiers from the nouns they appear with. What kind of input could support such an analysis?

3.3.1 Quantifier-Float

The kinds of "all" structures that children receive is worth a moment's reflection. Unlike "some", "all" undergoes what is called "quantifier-float",[16] moving like an adverb away from the noun it modifies:

(33) a. all boys like chocolate
b. boys all like chocolate
c. all boys are now here
d. boys are now all here

(34) a. some boys are now here
b.*boys are now some here

It appears then that it is a simple accident that some does not float, a possibility that warrants a careful cross-linguistic study.

3.4 Quantifiers and Blocked Spreading

Bill Philip and Sabina Aurelio replicated the Donaldson & Lloyd result with e.g. Figure 7 and the question:

(35) Does every boy have a milkshake?

Figure 7

74% of the time children between 2-5yrs responded "Not this one" while pointing at the extra milkshake. How general is this phenomenon? In particular, is this a linguistic or a cognitive phenomenon? By analogy with the arguments above for BV readings in the adult language, we would expect to find syntactic constraints

16. Sportiche (1988) and others have argued that it is not the quantifier that moves, but the N moves away from the quantifier. We use the terminology of "quantifier-float" although these results are equally compatible with the other view.

operating on "Q-spreading" if it were a linguistic phenomenon. The central question is this: what boundaries exist for spreading? There are three sentential contexts in which Philip and Takahashi have tested to see if children would still permit spreading.

A) If c-command ("every" over "a") is required for spreading in "every boy is drinking a milkshake", then no spreading should occur "backwards" (in "a" over "every" sentences):

(36) A cat is on every chair

If spreading goes backwards (36 = every cat is on a chair), then it does not obey c-command. Instead the quantifier can move forward to dominate all NP's, much like the movement of a PP in "into the garage I pushed the car".

B) If subjacency is a barrier, then spreading should not occur from an NP outside a relative clause to one inside (37= every whale is lifting every boat):

(37) Every whale that is lifting a boat smiled

or from inside a relative clause to outside (38 = every waiter is carrying a glass):

(38) A waiter who is carrying every glass is falling down.

If spreading occurs also into and out of relative clauses, then some feature of subjacency is not present.

(C) If no second NP is present then syntactic spreading should not be possible.

(39) Every dog is sleeping.

Such sentences were presented to children together with a picture involving dogs sleeping on beds, with an extra bed in the picture. If the beds go unmentioned in the intransitive sentence (39) then the children should not point to the extra bed and say: "not this one".

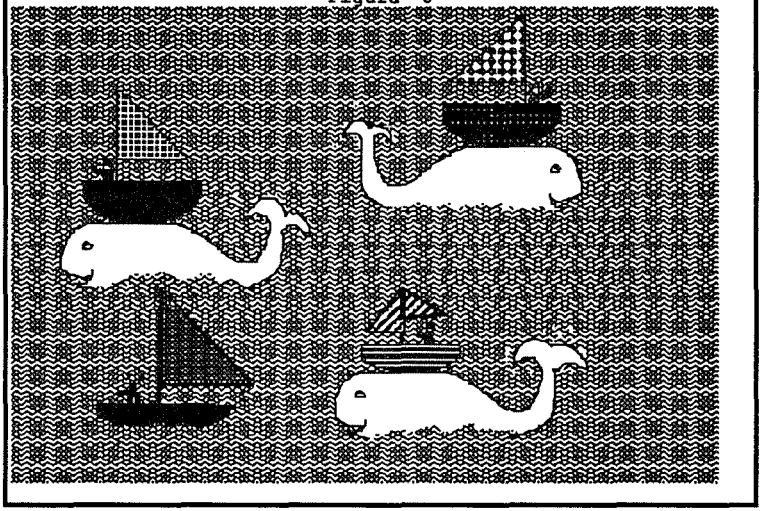
3.4.1 Backwards spreading:

In several studies, we have varied the position of the quantifiers to see if there is any effect of linear ordering on the spreading phenomenon. Quantifier spreading was just as likely in these contexts, suggesting that c-command is not a necessary constraint on its appearance.

3.4.2 Spreading and Relative Clauses

Pictures like Figure 8 were used with relative clause sentences.

Figure 8



Children again showed a strong inclination toward spreading over the relative clause boundary, just as we found with the "there"-insertion constructions in section 2.3 above. When asked "Is every whale that lifted a boat smiling", they answered "No, not that one", pointing to a boat.

The children were significantly less likely to spread in relative clause environments, showing that they did detect a difference in the structures, but the spreading phenomenon was still strong enough to represent a marked violation of subjacency as a barrier.[17]

17. Philip & Aurelio also constructed examples containing a discourse relation where quantifers were involved with indefinites, and not pronouns. This work is still undergoing refinement and, and though there is support for our view of the constraints on BV interpretation, we will only allude to their results here. They gave children a picture with chickens and eggs in baskets. They then asked the children to say if the following statement was true:
i) Every chicken stood up. An egg hatched.

3.4.3 Spreading and Intransitives:

If spreading were to occur to an unmentioned, but pictured object, then one could make an argument that the phenomenon was linguistically unconstrained. If however the spreading occurs only in environments where both NP's are mentioned, then it is clearly linked to what the child understands the language to allow. We refer the reader to Takahashi (this volume) where English and Japanese experiments are discussed in which children exhibit the spreading phenomenon for sentences like (40a) but not (40b):

(40) a. A cat was climbing every ladder
b. Every dog was sleeping
c. Every boy was driving. A truck was broken.

The children would say "no" to (40a) approximately 50% of the time and point to a cat climbing a tree and say "not this one". They would answer "yes" to (40b) even though one bed was occupied by a cat. Had they understood (40b) to mean "every dog was sleeping in every bed" to have the meaning [every [bed & dogs], then we would have expected a "no" answer. We take this as evidence that the phenomenon is minimally, sensitive to syntactic limitations and not just a function of a cognitive preference for isomorphism lying outside the grammar.

In fact, Philip & Takahashi (this volume) have uncovered a particularly subtle contrast between two kinds of intransitives (40b) and (40c). In (40c) there is the possibility of an implicit object, unlike (40b). They in fact find that children will overgeneralize with respect to the implicit object during a certain stage of acquisition: "every boy is driving (a truck)" and once again the quantifier spreads.

4.0 Quantifier-Spreading as Adverbial

How shall we analyze the phenomenon of quantifier-spreading? Our basic hypothesis is this:

(41) a. Quantifiers are analyzed as adverbs
b. Adverbs can be given sentential scope
c. Therefore all NP's within a clause are modified by the adverb.

In other examples, the direction of the quantifer was reversed:
ii) A dog got on a bed. Every cat jumped.
Only one child out of 12 exhibited spreading in these environments.

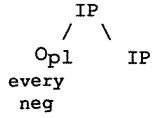
Two other studies point in the same direction. The well-known phenomenon of Neg-hopping is a comparable phenomenon:

(42) He doesn't think John ran = he thinks John did not run

In the current analysis of barrier-theory, Rizzi (1990) specifically argues that Neg functions as an adverb. Evidence from Phinney (1981) showed that children are more liberal than adults in allowing Neg-hopping. It is restricted to a few verbs for adults, but not for children. In an experiment she showed that children consider the sentence "the bears saw the children not eat honey" to be the equivalent of: "the bears did not see the children eat honey."[18] This is, once again, just as if the child allowed a negative-adverb to take scope over the entire sentence.[19]

Consider now the experiments with plurals in which we found that children consistently answered sentences of the form "Does a dog have noses" with "yes". The answer fits an analysis where plural and negation both receive a kind of "concord", the plural spreads from one NP to another just as negation spreads (suggested to us by B.Schein). We take this to be a description of a process whereby an adverbial operator is attached outside the highest node:

(43)



In current theory, it is often suggested that there is a NEGP position at the top of the IP. We would suggest that it needs to be defined more broadly as an AdvP node where all adverbs that modify any element below the CP are defined.

18. These results were obtained in a similar manner: an array of pictures depicting all logical possibilities was presented.
19. This fits the notion that verbs are initially underdefined so that they can function as bridge verbs more easily, which we have discussed elsewhere (de Villiers, Roeper & Vainikka (1990), Roeper & de Villiers (in press)). Verbs also fail to subcategorize properly, as we mentioned above: children do not initially see that ask takes an indirect question, and many other verbs as well. Therefore the broad phenomenon of how the meaning of verbs emerges, their potential subcategorization, and the potential for long-distance movement over clause boundaries all develop together.

The concept that plurality can function as an operator, and therefore allow movement, is built into the notion that plural agreement is possible. In effect, instead of saying that a plural marker, i.e. the AGR node, moves between an NP and a verb, this suggests that the Operator can be attached to the sentence as a whole initially. Growth consists in making a specific adjunction to a verbal head. It is notable that current theory has argued for a separate node for each of these elements: AgrP,NegPP, and QP under DP (though not for plurality). (See Pollock (1989), Speas (forthcoming) and references therein). We will not explore the theoretical implications of this observation at this time, but focus instead on the acquisition perspective.

Consider now the original scene: "every car is in a garage" means that a car is in every garage. Note, however, that we cannot simply copy the "every" into two Spec positions. The sentence does not have the impossible meaning (44):

(44) every car is in every garage.

It is some equivalent of the form "every car and garage has 'infulness'". It is not easy to characterize the translation of meaning here, but it is clear that "every" must apply to a joint vision of cars and garages in order to avoid the absurd reading in (44). Consider again the facts presented by Roeper and Matthei (1974) who proposed that quantifiers can be analyzed as adverbs. In fact the reading of "every" is very close to the adverbial reading linked to the word "always" and "some" to the meaning of "somewhere", each of which has sentential scope. Imagine the meanings for: "somewhere the circles are black".

4.4.1 Naturalistic Evidence

There is evidence from naturalistic data to support this hypothesis as well. A number of children have been recorded or reported as saying:

(45) Maria: "Only I want this one"
(meaning: I want only this one)
"Even I want you to drive me to school"
"I only can walk
"I just only have a hood
(=only I have a hood)"
"I can even not believe how hot my back is"
Adam:
"Only go dere"
"Only hit Adam"

(45') Sarah:
"Only people do this"
"Only take one"
"Only it doesn't have, like that.
"Only I see "R".
"Only if I put this...."
"Only start from the corner."
"Nope, just only hot dogs, too."

The expressions "just" and "even" will often show up misplaced in children's sentences, sounding comprehensible, but slightly odd to adults.[20]

4.2 Free Adjunction Hypothesis

Several kinds of evidence then point to the hypothesis that quantifiers may be analyzed as adverbs, and that adverbial quantifiers that are linked to NP's will be misplaced as sentential modifiers. The adverbial interpretation also fits the notion of "free adjunction" suggested by Lebeaux (1988) as a default property of grammars:

Default: Adjoin new material to the highest node possible

That is, children can freely attach adjuncts to higher nodes to represent new input. The concept of a default means that when new analyses arise, they are automatically preferred. Therefore, a revision in NP structure may create the possibility for a lower attachment. This will automatically eliminate the higher atttachment or make it a marked case. In this sense, **free adjunction** is a default operation. This theory of defaults fits the suggestion by Chomsky (1988) that the language-particular properties of grammar remain distinct from universal properties. Once again, if a language particular analysis arises, the UG default analysis is automatically abandoned.

4.3 Spec Variation

Some fundamental questions still remain unanswered: Why should quantifiers be analyzed as adverbs and how does the child find her way out of this false generalization? Before we proceed, let us cast our net wider, and see if there is relevant cross-linguistic evidence.

The quantifier-adverb hypothesis has recently received support from other work in linguistics. Work by K. Hale (pc) and E. Bach (pc) indicate that in widely

20. Nina Hyams (pc) has also noticed phenomena of this kind.

diverse languages, there is always an adverbial quantifier available, but not always a quantifier as a determiner.[21] Under the "default" approach one predicts that the adverbial reading may continue to be available in marginal constructions in English. One finds, in fact, such an implication in the sentence:

(46) John saw another hitchhiker down the street, so he went to a different corner.

The implication of the word "another" is that John is also a hitchhiker [another [John & hitchhiker]]. In some languages, according to Hale, all quantifiers are construed with this kind of sentential scope, just as we described for "every" above. Thus diverse evidence supports the view coming from acquisition that quantifier = adverb could be the unmarked hypothesis.

What must the child acquire in order to use quantifiers in English appropriately linked to an NP? Note that the behavior of quantifiers in NP's in English is not uniform. Consider just this variation:

(47) a. all the boys
b.*every the boys/*some the boys
c. some of the boys
d.*every of the boys
e. the boys all
f.*the boys every

It is clear that each quantifier has special lexical characteristics which must be learned: "all" can appear with a full NP in pre-NP or post-NP position, "some" can appear with a PP complement, "every" cannot co-occur with a determiner. It is possible that some of these differences are linked to semantic differences. Nevertheless, there are a number of distinctions that the child must correctly identify.

There are two possible rationales for a child's initial misanalysis: 1) an unmarked analysis is taken, and 2) the adult analysis is unavailable. These factors conspire in the acquisition process in a way that is not fully understood. In other words, the reason that a default analysis is chosen is not simply because it is unmarked, therefore preferred. The reason is that a logically prior decision has not been made. Once the language-particular analysis is secure, the default

21. See recent work in *Papers on Quantification* (Bach, Kratzer, & Partee (1989)) for some of the interpretive complexities of adverbs.

analysis disappears. In this instance, we argue that it is the absence of a full NP structure which pushes the child toward an adverbial analysis.[22]

The following hypothesis is advanced:

(48) Quantifiers are adverbs until the Spec of NP is fixed.

This hypothesis can be interpreted in at least two ways which need refinement in our future work. The first possibility is that the Spec of NP is absent at first, and only when it is triggered, can quantifiers be appropriately accommodated within the NP. (If we assume that there is a Determiner Phrase which dominates the NP, then it will be the Spec of DP which must be fixed, in order to allow quantifiers, which was suggested to us initially by William Philip.) In support of that claim would be the argument that Japanese, for instance, does not have any Spec of NP. If language variation exists, any particular Spec node must be triggered.

A second possibility is that the Spec of NP already exists, but that the lexical variation described above means that each quantifier has to be separately justified as belonging to some node in the NP, and before that, each quantifier is analyzed as an adverb. Obviously some combination is also possible: first no Spec, then separate justification quantifier by quantifier. We hope to examine the acquisition of each quantifier in order to approach this issue in a more refined way. Interestingly, these precise alternatives also present themselves in considering the wh-question analysis too (see below).

The adverb analysis we have presented does not differentiate the syntactic and semantic components. We have argued simply that the child makes an adverbial analysis of quantifiers because their syntax is incomplete.[23] It can be argued that properties of quantifiers come not from their syntactic categorial features, but from the fact that they can raise to sentential level (via QR) and bind NPs - just like adverbs.

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22. The difference between comprehension and production is important here. In effect, the child may primarily use the adverbial analysis in comprehension. Comprehension is forced not only in our experiments, but in many contexts where uiversiality is the essence of a conversation. "you ate all the dessert" has meaning in a situation where "you ate dessert" has no consequences.

23. We are indebted to John Frampton for discussion.

(49) If John sees a milkshake, he drinks it.

This has been analyzed by Heim as involving a quantificational adverb at the semantic level:

(50) ALWAYS$_j$ [John sees [a milkshake]$_j$] he drinks it$_j$

This semantic analysis does not depend on the presence of a real syntactic adverb. In other words, the entire analysis could be projected at the semantic level. We believe, however, that the child arrives at the correct, restricted analysis by virtue of an interaction between possible syntactic representations and their semantic representation. Shifts in the syntactic representation then entail shifts in the semantic representation. The discussions by Takahashi and Philip provide a careful description of a changing "restrictive" clause in a semantic representation which could lead to such an analysis. Their analyses, like this one, assume that it is changes in the syntactic representation which restructure the available interpretations.

Another way to view the phenomenon is to assume that the adverbial interpretation is limited to a comprehension representation. Takahashi (this volume) documents that while children are able to use nouns like "everybody" there is virtually no use of "every" in forms like "every boy". Could the child have access to the meaning of individual words and then directly to an LF structure without ever forming a syntactic structure? We could expect this response to remain available as a default even among older children who have begun to use "every" within the Determiner Phrase and therefore have the ability to project the needed syntax. It would remain in the child's grammar for a period of time as a fairly rare structure, just as in the adult language the adverbial interpretation of "another" remains as a marginal possibility.

5.0 Specifier as MP Trigger: Connecting Adverbs and Wh-Questions

So far we have provided an empirical discussion and a theoretical claim about how quantification emerges. Is there a way to unite this discussion with the observations about wh-interpretations? We turn now to a broader acquisition theory in proposing the following hypothesis:

(51) **Hypothesis**:
Heads do not automatically project Maximal Projection nodes.

(51') **Corollary**
the SPEC node must be specifically triggered for each MP.

Parametric variation: some SPEC nodes are optional.

In particular, the Spec node of NP and CP are our focus here. It is possible that similar arguments can be made about Spec of IP and VP.

Our hypothesis is a specific version of the general claim that functional categories are delayed in emergence in child grammar, proposed by Lebeaux (1988), Guilfoyle & Noonan (1988), Radford (1989), Platzack (1990). These claims, in turn, fit the claims in linguistic theory, e.g. Fukui and Speas (1986), that there is a wide proliferation of XP categories, with considerable variation. We provide here just a summary of the highlights of these arguments. The term 'delayed in emergence' is chosen carefully. The delay is often taken to be maturational, but we do not construe it in this fashion, although maturational factors could in principle also be involved. Given the diversity of languages, certain kinds of evidence will be differentially available at different times. Therefore it is not surprising if the CP node is available immediately in German, but not for a long time in English.[24]

Our proposal is simply that functional categories require specific triggers. Those triggers are more or less opaque depending upon the language. A language where all quantifiers are uniformly to the left of the NP will be easier to acquire than a language where a quantifier, like "all", can appear on both sides. Suppose the child projects a general phrase structure rule of the form: $[Q\text{-}N]_{NP}$. The quantifier appears

24. This point is perhaps due a moment's reflection. Consider the example of inflections. They are equally evident on a phonetic level in different languages. A child can hear the -s in he runs as easily as a German child hears the -t in er läuft. In English inflections are notoriously confused, while in languages with consistent inflections, they are not. Jaeggli & Hyams (1987) argue that there is a morphological parameter which, in the unmarked case, requires no inflections or a full paradigm of inflections. Languages with incomplete paradigms are hard to learn under their parametric definition because the child must assemble a fair amount of evidence to determine that they belong to neither class. What does this mean? It means that the data is clear in a minimal sense, but the parametric setting is more obscure in one language than another. The delay has to do with the obscurity of the parameter.

before the noun. However, she hears sentences like: "the boys all came". This sentence conflicts with the phase-structure rule. So what does she do? A) abandon the rule as wrong, B) add a new phrase-structure possibility, C) add a new transformation, D) avoid the phrase-structure rule until both that rule and a transformation are generated. Under any choice, the acquisition pattern will have to be more complex than in a language where all quantifiers behave identically and do not move.

5.1 Lexical Aspects of Spec

Roeper (1988) initially proposed that the Maximal Projections NP, VP, CP, and PP were each triggered by the emergence of a SPEC.[25] One can get a feeling for the general claim by considering PP's. Many languages allow wh-preposing in PP's. In German this a productive operation. Most of the starred cases below are acceptable. English allows wh-pre-posing in PP's in only a limited fashion, except for a few residual cases, usually with "where":

(52) *howunder, *whoin, *whenfor, *whyby

(53) whereby, wherein, whereto,
?wherefrom, ?wherefore,
*?whereunder,
*wherewith (but "wherewithal"),
*whereabout (but whereabouts),
*wherenear, *wheretoward, *whereamong.

One can argue that there is no Spec in PP's, but rather the acceptable forms have been lexicalized.[26] The child, despite hearing a few cases in (50) must not make the false generalization of SPEC in PP.[27] (See Roeper & Weissenborn (1990) for discussion of the problem of

25. We have not extended the argument to consider the range of new MP's currently proposed for the IP complex. In general, the more hypotheses there are that in some languages a particular notion is treated as an affix, while in others it is an MP, the more natural it becomes to argue that MP structure requires specific triggers. In effect, there is a three way variation: affix, head, MP. The potential status of affixes, of course, complicates this pciture and takes us far beyond the scope of this paper.
26. This argument, like most, has further complexities. One must account for intensifiers in PP's as well: "far under", "all the way out", "more near" etc Suffice it to say that the Spec of PP, should it exist, would require a definition that allowed a non-productive wh-preposing.
27. See Roeper & Weissenborn (1990) for discussion of how a child deals with contradictory data. Also Clahsen (1990)

avoiding false generalizations because of lexical exceptions).[28]

5.2 Absence of Spec = No Maximal Projections

Now let us consider two hypotheses: the Spec node is absent in CP and in NP. The absence of a SPEC node in the CP would mean that the CP was not a Maximal Projection. There are many consequences to this claim. We list a few here, which are discussed elsewhere in greater depth:[29]

(54)a. An absence of inversion of auxiliaries in children's wh-questions
b. Copying of the initial and medial wh-word in children's grammars
c. An absence of subcategorization of indirect questions.[30]

The absence of auxiliary inversion in acquisition is one of the most well-known phenomena that has been studied, e.g. children say

(55) "what you are doing?".

One feature of non-inversion has come in for less discussion[31]: it persists until six or seven with certain wh-words, generally "why" ("why he can't eat"), while it disappears with others. This, by itself, indicates that wh-words might be separately justified as belonging in spec of CP, and that only when they are in Spec of CP is there the opportunity for the auxiliary to move into the head of CP.[32]

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28. The structure and acquisition of IP is a topic of great controversy. Several authors have argued that the child's initial subjects are generated within VP (Pierce (1989), Clahsen (1990). One can, in fact, argue that initial stages of inversion in yes/no questions are merely apparent inversion, because the child leaves the subject in the VP. This stage would be supported if the child did not initially have a SPEC node for the IP. Clahsen (1990) advances just such an argument claiming that the child developmentally moves from X0 to XP. We argue that the shift has a very precise character: emergence of SPEC in each of the MP's.
29. See de Villiers & Roeper (1990a,b)
30. An absence of the movement of complex wh-phrases "which hat" in early stages would be a natural corollary of this prediction under the hypothesis that only Spec of CP allowed MP's. This is a theoretically controversial domain, however, since Lasnik & Saito operate without a Spec of CP and other languages with putatively no Spec must then allow MP's to occur in Comp.
31. But see Kuzcaj, 1980.
32. See de Villiers, this volume.

What feature of grammar allows optional movement until this point? Here we find the parallel options to the quantifier case above. One possibility is that the Spec of CP is absent at first[33], just as we argued that the Spec of NP may be initially missing. Second, the Spec of CP may be present but the wh-words each require justification as belonging in that position as opposed to some adjunct position, and until they are so justified, they remain as adjuncts to IP. A possible trigger for the reanalysis that we have suggested is the appearance of the wh-word appropriately subcategorized in the medial CP, which de Villiers (this volume) has reported as being strikingly coincident with the emergence of inversion in the matrix clauses for each wh-word. A third possibility, as before, is that these are stages: first no Spec, then Spec justified for each wh-word in turn. At the very least, it seems that the Spec node in CP remains optional for some period in childhood. As a consequence, the usual claim that the significant fact is when children begin using inversion (with some falling back to earlier grammars) is altered: the significant moment is when inversion becomes obligatory.

5.3 Quantifiers and There-insertion

Can we apply this notion of Spec as an optional node to clarify any of the findings above? Recall that adults, but not children, will block a BV reading for sentences like "there is a chair that every cat is sitting on". This restriction has been assimilated to the subjacency constraint on extraction. It is noteworthy, however, that Otsu (1981) demonstrates the presence of subjacency at the level of S-structure, namely for wh-extraction, as early as 3yrs:

(56) What is the woman painting a bird that flew with?[34]

That is, children will not misconstrue (56) as referring to the long wings the bird flew with. Yet even seven year olds are making mistakes with the quantifier case of extraction from relative clauses. The developmental difference, then, is enormous. It is, moreover, not the case that children do not have long-distance movement at this stage. Our evidence clearly indicates that

33. It may be argued that the whole CP is absent at first, but by the time this is occurring, there is overwhelming evidence for CP in children's grammar: all manner of embeddings and auxiliary inversion in yes/no questions.

34. We have recently explored adjunct wh-extraction from relative clauses and found even more striking obedience to subjacency with 3 year olds. See de Villiers & Roeper (this volume).

successive-cyclic movement must be present (see de Villiers *et al* (1990)), complete with barriers to movement. If another wh-word occupies the medial COMP, then that serves as a barrier to successive cyclic movement of the initial wh-word:

(55) How did the boy ask t when to jump *t?

Therefore a CP must be available. Why should children have this extra degree of freedom in quantifier extraction?

The optional-Spec concept leads to the prediction that children will allow quantifiers to move over CP barriers. If quantifiers are being analyzed as adverbs, they do not undergo Successive Cyclic Movement at LF, and hence do not cycle through the COMP. Nevertheless, they are subject to subjacency restrictions, namely, they cannot cross Maximal Projections. But on our analysis, If the Spec is not present, then the CP is not a Maximal Projection, just a C, hence, not a barrier. Therefore the adverb-movement is not blocked by a non-maximal C.

It is important to note that the above argument uses both the quantifier-as-adverb hypothesis and the optional-Spec hypothesis in order to account for all of the child's behavior. By the time the child is six or seven, they are generally able to use quantifiers within NP's. Therefore the quantifier is no longer an adverb. However, in the formation of an LF representation, the quantifier moves together with its N to determine scope. The absence of a Maximal Projection CP node would then allow the true quantifier to have wide scope over the NP which is directly dominating it:

(58) a. there is [a chair [C that every cat is sitting on t]
<==========|
[every cat [a chair]]

unlike the case in adult grammar with [CP:

(58) b. there is [a chair [CP that every cat is sitting on t]
<=/=========|

5.4 Copying and Spec

A striking finding about young children's interpretations of sentences containing two wh-words:

(57) How did the boy ask what to bake?

is that the children answer the medial wh-word almost as frequently as the initial wh-word (de Villiers, Roeper & Vainikka, 1990). The facts can be accommodated under the theory that the medial wh-word is not at first interpreted as belonging in the Spec of the medial COMP, and only when it is so interpreted is this co-indexation between the initial and medial wh-word disallowed, and long distance (successive cyclic) movement is then possible. The phenomenon is also consistent with the facts on subcategorization, discussed next.

5.5 Subcategorization and Spec of CP

There are two dimensions to subcategorization. 1) The child must decide which verbs take complements, and in particular, indirect questions. 2) The child must decide which wh-words are questions and which are adverbs, and which are both. Note that some wh-words have a referential function as well as a question function. A sentence with an adverbial conjunction "when" does not cause inversion because it is not a question: "when I came home, I had a sandwich".

If the Spec of CP is the ultimate position where indirect questions must be, then it is predictable that inversion, subordination, and the triggering of Spec of CP will all co-occur. This then fits the framework we have outlined.[35]

5.6 Wh- and Wide Scope

We turn now to the question of why sentences like "who saw everyone" initially receive a misanalysis, allowing wide scope for "everyone".[36] Movement to Spec of CP at LF guarantees wide-scope for "who" and narrow scope "everyone" which in turn produces the group reading (a):

(59) a. [CP [spec whoi [C +wh] [IP [spec ti [VP [V saw everyone]]]]
<=========/================|

b. [C[IP [spec whoi [VP [V saw everyone]]
<==============================|
< ==========|

If however, there is initially no Spec of CP (57b), then this would enforce the non-movement of wh- at S-structure and lead to the prediction that either wh- or "everyone" could receive wide scope at LF, just as we

35. Lebeaux (1988) has advanced the hypothesis that wh-questions could at first be generated *in situ* in the COMP position.
36. This is akin to Chomsky's initial argument (extended from George (1980)) that children might, at S-structure, fail to move a subject wh-expression. Such movement is obligatory at LF.

find with "someone saw everyone". All of these diverse arguments, summarized briefly here, point to the possibility that children would lack the Spec of CP.

We do not, of course, regard the current theory of CP as immutable. There are many cross-linguistic issues to be addressed before we can be confident of how complementation systems work. Our argument provides a particular slant on a general problem in linguistic theory. In brief, children allow a broader interpretation of quantifiers and a narrower interpretation of wh-extraction (copying) at the same time. Any future theory of constraints on complementation must address itself to these facts as well as the cross-linguistic ones.

6.0 Parameters and Primary Linguistic Data

Acquisition theory has two distinct tasks: 1) to explain the instantiation of UG, and 2) to trace the map of parametric choices. The latter task has been, recently, built into UG itself under the assumption that UG will describe a set of choice points addressed by the child. Therefore it is often asserted that Universal Grammar is equivalent to an acquisition device or equivalent to the initial state of the grammar.

The parametric problem has held the focus of attention during the last decade: how does the child select the one grammar, among all those defined by UG, that fits the language around him? The effort to make a parametric map has not been obviously successful. In each instance where a decision point is defined, one can point to acquisition data or language variation which could confuse the child and create precisely the indeterminacy which the parameter was intended to eliminate. This suggests that special principles of acquisition may be needed which define certain data as primary.

In Roeper and de Villiers (in press) we discussed the fact that certain decisions must be linked to a unique trigger.[37] For instance, the child must regard the sentence a) "what did he do?" as signalling a wh-movement language although he hears and uses routine forms like b) "you know what?" and hundreds of echo questions like c) "he did what?" Such facts (b,c) should trigger English as part of the wh-*in-situ* language family; or the combination (a,b,c) should leave the child in a state of utter indeterminacy. We have

37. See also Roeper & Weissenborn (1990).

some evidence which suggests that initially children do permit *in-situ* interpretations of echo-questions, which shows that rejection of the *in-situ* option is not straightforward.[38] One conclusion is that the parametric map by itself will not exhaustively define the principles needed for acquisition, but rather, acquisition principles that are not visible within synchronic grammars by themselves, will be needed to guarantee that available data does not mislead children.[39]

6.1 Conclusion:

A fundamental linguistic distinction - distributed (BV) versus non-distributed readings - in a variety of linguistic contexts, has been the focus of this study. The notion itself seems intuitively sophisticated from both a cognitive and linguistic point of view. Yet our studies have shown that it was cognitively available at a young age and initially overgeneralized. The operative assumption here is that children's behavior in this domain must be compatible with and licensed by their grammars, which therefore requires a linguistic rather than an extra-linguistic explanation.

The evidence from acquisition and cross-linguistic work argues, thus far, in behalf of one primary claim: children treat quantifiers adverbially. This claim, in turn, has been cast within a broader acquisition theory: the Spec nodes of certain categories are delayed in emergence. The delay arises because the combination of syntactic and semantic data the child encounters lends itself to misanalyses which, historically, has been regarded as the fundamental acquisition problem. The solution lies in identifying unique triggers: wh-movement to the clausal periphery (Spec of CP) may be such a trigger, affecting ultimately, not only wh-movement but quantification.

Much remains to be done. We need a detailed map of the emergence of quantification. It will undoubtedly lead to more insights into the Adverb-Hypothesis and recast our view of the Spec-hypothesis.

38. This work is still in preparation. See Takahashi (this volume) and Maxfield (this volume) for experimental results showing a variety of contexts in which children are sensitive to echo-questions.

39. This is, in effect, a translation of the original formulation of the acquisition problem which led Chomsky to formulate an evaluation metric and an instantaneous model.

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