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Learning Scope Economy: Why Children Will QR out of a Tensed Embedded Clause, but Adults Won't*

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1. Introduction

Quantifier Raising (QR) differs from other forms of A-bar movement in that it appears to be subject to stricter locality conditions than other A-bar movement operations. (Beghelli and Stowell 1997, Farkas 1981, Reinhart 1997). For example, while the *wh*-movement in (1a) is not clause-bounded, the universal quantifier in (1b) has obligatory narrow scope:

- (1) a. What_i did a technician say [that John inspected t_i]?
b. A technician said [that John inspected every plane] (**every*>*a*)
(Cecchetto 2004)

It is claimed the difference lies the trigger for movement. While *wh*-movement is syntactically driven, QR is primarily semantically driven and guided by principles of interpretation and economy (Chomsky 1993, 1995, Fox 1995). Economy has two components. First, movement cannot be semantically vacuous (Scope Economy). Second, the moved Quantifier Phrase (QP) must target the closest landing position in which it is interpretable (Shortest Move). QR therefore requires looking ahead and performing a comparison between the resulting derivations and their interpretations. A question that immediately arises is whether or not QR is obligatorily local. That is, in the absence of economy, or permitting violations of economy, could a QP raise out of a tensed clause?

A natural testing ground is child language. There is independent evidence that children can perform QR, assigning adult-like interpretations to sentences that require QR

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(e.g., Kiguchi and Thornton 2004, Lidz et al. 2004, Syrett and Lidz 2005). We now ask if the QR employed by children is clause-bounded in the same way that adult QR is. Given children's variable responses to scopally-ambiguous sentences in which QR is optional for a grammatical interpretation, it is necessary to use a construction in which QR is obligatory. Antecedent-contained deletion provides us with an ideal case study. As a preview of our results, the current work demonstrates that while adults are generally unwilling to QR out of a tensed embedded clause, children freely do so, often in striking contrast to the interpretation favored by the experimental context. In the discussion section, we entertain possible explanations for this developmental difference.

2. Antecedent-Contained Deletion

2.1 ACD and the Clause-Boundedness of QR

Antecedent-contained deletion, (2a), is a special case of Verb Phrase Ellipsis (VPE) in which the site of ellipsis is contained in its antecedent (2b). The elided VP is represented by the italicized material surrounded by $\bar{}$.

- (2) a. Kollberg recognized every suspect Beck did. (Bouton 1970)
 b. Kollberg [$\bar{\text{VP}}$ recognized every suspect Beck did [$\bar{\text{VP}}$ *recognize*]]

Two well-known problems result from such a configuration. First, if the elided VP is interpreted *in situ*, then the ellipsis site remains internal to the antecedent, and is continually generated as the elided VP is spelled out. Second, the elided VP and antecedent VP cannot be parallel (identical) as long as the former is contained in the latter. A solution for one or both of these problems comes from QR (Fiengo and May 1994, Kennedy 1997, May 1985, Sag 1976). Through QR, the QP is adjoined to and interpreted in a VP-external position (e.g., νP or IP) (May 1985, Fox 1999, Merchant 2000), as illustrated in (3).¹

- (3) Kollberg [QP every suspect Beck did [$\bar{\text{VP}}$ *recognize t*]]_i [$\bar{\text{VP}}$ recognized t_i]

When ACD is embedded in a non-finite clause, as in (4a), the QP can raise either within its own clause or into the matrix clause, and the sentence is (at least) two ways ambiguous.² The available interpretations correlate with the landing sites targeted by QR: short QR generates the *embedded* reading (4b), while long QR out of the non-finite clause and past the matrix verb generates the *matrix* reading (4c).

¹ Evidence that the landing site targeted is below the matrix subject comes from the observation that Condition C is obviated in (ii), but not in (i).

- (i) a. ?He_i bought me everything that John thought he should.
 b. ?He_i [everything that John thought he should *buy me t*] bought me t.
 (ii) a. I bought him_i everything that John_i thought I should.
 b. I [everything that John_i thought I should *buy him_i t*] bought him_i t.

² Such sentences are more than two ways ambiguous, taking into account *de re* and *de dicto* readings.

- (4) a. John wants to visit [QP every city Bill does].
 b. ... visit *t* . (embedded reading)
 c. ... want to visit *t* . (matrix reading)

By contrast, when ACD is embedded in a tensed clause, only the embedded reading is available. Movement from the embedded *v*P to the embedded CP is blocked by Scope Economy, since no distinct interpretation arises from such a move. Movement from the embedded *v*P to the matrix *v*P is blocked by Shortest Move, since such a move bypasses a potential landing site (CP).

- (5) a. John said that Mary visited [QP every city Bill did].
 b. [_{IP} John [_{vP} said [_{CP} that [_{IP} Mary [_{vP} visited [QP every city Bill did *t*]]]]]]
-

2.2 Children's performance with ACD

There is independent evidence that children assign adult-like interpretations to ACD sentences like (2a) (Kiguchi and Thornton 2004, Lidz et al. 2004) and access both interpretations of sentences like (4a) (Syrett and Lidz 2005). The question that remains is how children will interpret sentences like (5a). Will they treat this type of sentence as ambiguous, similar to (4a), thereby indicating they are willing to QR out of a tensed clause? Children's performance should shed light on the nature of the grammar: if they freely QR across clause boundaries, then economy considerations may not be a necessary part of QR. Speaking more theory-neutrally, if children do not obey the locality conditions on QR, then it follows that these locality conditions are independent of the operation itself.

3. Experiment 1: ACD in a Tensed Embedded Clause

3.1 Participants and Method

24 children (13 M, 11 F; age M 4;8, range 4;1-4;11) and 24 adults (Northwestern undergraduates from the Linguistics Department subject pool fulfilling an experimental requirement) participated in this experiment. The methodology employed was the Truth Value Judgment Task (TVJT) (Crain and McKee (1985). Participants were shown a series of short stories acted out by an experimenter. A puppet played by a second experimenter watched the stories alongside the participant. At the end of each story, the puppet made a statement about the events in the story using the target construction. The participants were asked to assess the validity of this statement, offering justifications.³

In one story, three dogs (Clifford, Goofy, and Scooby) stand in front of two sets of books, small ones and big ones. After Scooby reads the small ones, Goofy proposes a

³ Children rewarded the puppet accordingly and provided explanations to help him learn. Adults completed a response sheet and provided written justifications for each story.

game: the other two dogs will leave the room, Goofy will read some books, and when the dogs return, they will guess which books Goofy read.⁴ Scooby and Clifford leave, and upon their return, Scooby says that Goofy read the big books (the ones Scooby did not read). Now, at this point, the context was manipulated so that Clifford's response favored one of two potential readings of the target construction. The puppet's statement (6a) referred back to Clifford's response in the story.

- (6) a. Clifford said that Goofy read every book that Scooby did.
 b. ... *read t* . (embedded reading)
 c. ... *say that Goofy read t* . (*matrix reading)

Participants were randomly assigned to one of two conditions. In the embedded condition (6b) was true and (6c) false (Clifford disagrees with Scooby and guesses that Goofy read the small books). In the matrix condition, (6c) was true and (6b) false (Clifford agrees with Scooby about the big books). Participants were shown four such test stories, pseudorandomized along with three control sentences containing VPE, such as (7).

- (7) The dinosaur said that the shark ate a lobster before the lizard did.

The order was counterbalanced across participants. All target sentences are included in the Appendix.

3.2 Predictions

Recall that the matrix reading of (6a), (6c), should be ungrammatical if QR is subject to economy conditions and is clause bounded. If adults are guided by Scope Economy and Shortest Move, they should strongly resist long QR out of the finite embedded clause, and regardless of the experimental condition, prefer the embedded reading (the interpretation that results from targeting a closer, clause-internal landing site). What children will do is not certain. If child QR is also subject to strict locality, children should pattern with adults. However, if they are unrestricted in their QR and can freely target any landing site, children should accept both the embedded and matrix readings. The percentage of their acceptance of the puppet's statement is likely to correlate with the reading favored in the test stories.

3.3 Results

Because participants' willingness to accept the matrix reading was the key factor in determining whether their QR was constrained by economy, the dependent measure was the percentage of matrix readings. The results are presented in (8).

⁴ The stories for Experiment 1 were filmed and edited with video software so that participants never actually saw Goofy reading any books.

Learning Scope Economy

(8) Percentage matrix readings by age group and experimental condition

Age Group	Embedded condition	Matrix condition
adults	13%	19%
children	65%	27%

The proportion of matrix readings was entered into an Analysis of Variance. We found a main effect of age ($F(1, 47) = 12.28, p = 0.001$), a marginally significant main effect of condition ($F(1, 47) = 3.24, p = 0.079$), and an age X condition interaction ($F(1, 47) = 6.41, p = 0.015$). Adults generally resisted the matrix reading in both conditions. Whereas children patterned with the adults in the matrix condition, they were surprisingly more likely to access the matrix reading in the embedded condition. These results provide much-needed empirical support for the locality of QR in ACD for adults, but raise the question of children's sensitivity to locality considerations for QR. Note that children provided well-considered and articulate justifications for their responses to the puppet:

- (9) a. Scooby read the small books, but they [Clifford and Scooby] guessed Goofy read the big books. (accepted statement, matrix condition)
b. Clifford chose the small ones. Scooby chose the big ones. (rejected statement, embedded condition)

There are two possible interpretations of these results. The first is that they indicate something about the QR operation in adults and children. The second is that they reflect a difference in the baseline preference for resolving VPE. That is, it is possible that the size of the elided VP, and not the landing site of QR, accounts for the differences seen across age groups. Notice that the elided VP in (6c) is larger than the VP in (6b). Perhaps the amount of elided material matters when selecting an interpretation for an ambiguous sentence. To rule out this second possibility, we ran a second experiment, removing QR as a factor, and focusing only on VPE.

4. Experiment 2: VP Ellipsis without QR

4.1 Participants and Method

24 children (12 M, 12 F; age M 4;4, range 4;3-4;5) and 24 adults (Northwestern undergraduates from the Linguistics Department subject pool fulfilling an experimental requirement) participated in this experiment. As in Experiment 1, participants took part in a TVJT. The target construction was a sentence whose ambiguity arose from the scope of a *because*-clause, as in (10).

- (10) a. Clifford asked Goofy to read the big books because Scooby did.
b. ... read the big books .
c. ... ask Goofy to read the big books .

To make such a statement felicitous, following every story, the experimenter asked the puppet a question, as in (11), which the puppet answered using the target construction. As before, the participant’s task was to evaluate the puppet’s statement.

(11) Experimenter: Why did Clifford ask Goofy to read the big books?

In the corresponding story, Scooby reads the small books, which are appropriate for his reading level, but asks Goofy to read the big books, reasoning that they must contain some very impressive big words. Goofy asks Clifford what he would like. As before, Clifford response favors one of two readings, allowing for two experimental conditions. In the embedded condition, Clifford asks Goofy to read the small books, and says that if Scooby liked them, they must be good (making (10b) true and (10c) false).⁵ In the matrix condition, Clifford asks Goofy to read the big books, and says that Scooby always has good ideas, so these books must be good (making (10c) true and (10b) false). Again, there were four such test stories and three control sentences with VPE, all of which are included in the Appendix.

4.2 Predictions

Recall that the motivation for conducting this experiment was to pin down the source of the differences observed in the results of Experiment 1. While adults consistently resisted a matrix reading, children were willing to assign a matrix interpretation, but more often in the condition that did not favor it. If the results of Experiment 1 can be attributed to a baseline preference in the interpretation of VPE – adults prefer a smaller VPE, whereas children are willing to assign a larger one – then the results of Experiments 1 and 2 should be similar. However, if the results of Experiment 1 arise from something unique to QR, then in Experiment 2, child and adult responses be similar. For both age groups, the percentage of matrix readings in each condition should reflect the reading favored by the condition.

4.3 Results

The results of Experiment 2 provide evidence that the QR operation, and not VPE alone, is the source of the differences seen in Experiment 1. Both children and adults in Experiment 2 were likely to accept a matrix reading in the matrix condition, but reject it in the embedded condition, a pattern that is captured in (12).

(12) Percentage matrix readings by age group and experimental condition

<u>Age Group</u>	<u>Embedded condition</u>	<u>Matrix condition</u>
adults	19%	94%
children	31%	71%

⁵ In this condition, the question from the experimenter and the puppet’s statement made reference to Clifford asking Goofy to read the small books, not the big books, as in (10)-(11).

Learning Scope Economy

There was no main effect of age ($F(1, 47) = 0.58, p = 0.450$), a highly significant main effect of condition ($F(1, 47) = 76.04, p < 0.001$), and an age X condition interaction ($F(1, 47) = 7.26, p < 0.01$) driven by adult responses being closer to ceiling.

5. Discussion

It has been claimed that the apparent clause-boundedness of QR can be accounted for by grammatical economy principles. While the embedded reading of (6), repeated here as (13), is licensed, the matrix reading is not readily available.

(13) Clifford said that Goofy read every book that Scooby did.

As expected, in Experiment 1, we observed that adults strongly preferred the embedded reading across both experimental conditions. Interestingly, while children also resisted the matrix reading in the matrix condition, they allowed it in the condition favoring the embedded reading. The results of Experiment 2 demonstrated that this divergent pattern is not due to interpretation of VPE in general; rather, it seems to be indicative of the QR operation.

Children's performance in Experiment 1 is somewhat surprising given their attested lack of willingness to QR beyond what is necessary to assign an interpretation in previous tasks. For example, Musolino (1999) and Lidz and Musolino (2002) found that children prefer the surface to the inverse scope of scope-shifting operators (SSOs) in sentences involving negation, and Kiguchi and Thornton (2004) demonstrated that children do not target a landing site above the subject position in ACD sentences involving binding conditions.⁶ These data also lie in stark contrast to what has been observed cross-linguistically: while scopal ambiguity of SSOs is found in various languages, there appears to be no language in which QR is free to cross clause boundaries. What then could account for the pattern of results observed in Experiment 1?

One possible factor is children's limited computational capacity. Grodzinsky and Reinhart (1993), and more recently, Reinhart (2005) have argued that children's limited working memory puts them at a disadvantage when a comparison of abstract outputs is involved. Specifically, they have proposed that constructing an interpretation for a potentially ambiguous sentence involving covert movement requires the comparison of two or more <derivation, interpretation> pairs. Given the difficulty of holding this information in one's memory and computing the comparison, children basically throw up their hands and either guess or adopt a default strategy.

If this is what children are doing in the current set of experiments, then we can easily make predictions about the pattern of responses that should be observed. Adults,

⁶ Although Roeper and De Villiers (1994) argued that children's willingness to assign inverse scope to sentences such as (iii) indicated that children performed QR out of a relative clause and therefore ignored syntactic barriers to A-bar movement, such results seem more in line with the contextual isomorphism phenomenon known as quantifier spreading (cf. Philip 1995) than with children's willingness to freely QR.
(iii) There is a horse that every child is on.

unencumbered by a limited working memory, should pattern as expected, accepting an interpretation that is favored by the experimental condition, but resisting a matrix reading that would violate principles of economy. The distribution of children’s individual responses should cluster around 50% matrix readings, because children are performing at chance, or because they choose one of two different default interpretations – either the embedded or the matrix reading. This is not the pattern we observe. The tables in (14) and (15) capture the distribution of participants’ responses across the experimental conditions in both Experiments, read as the number of participants assigning a certain percentage of matrix readings across the four test stories. Arrows in each column represent the expected distribution of responses, and an “X” indicates divergence from this trend.

(14) Distribution of ADULT responses in the two conditions in Experiments 1 and 2

<u>% of stories with Matrix Reading</u>	<u>Experiment 1: ACD</u>		<u>Experiment 2: VPE</u>	
	<u>Embedded condition</u>	<u>Matrix condition</u>	<u>Embedded condition</u>	<u>Matrix condition</u>
0%	7	9	7	0
25%	4	0	1	0
50%	1	1	4	0
75%	0	1	0	3
100%	0	1	0	9
Total N	12	12	12	12

(15) Distribution of CHILD responses in the two conditions in Experiments 1 and 2

<u>% of stories with Matrix Reading</u>	<u>Experiment 1: ACD</u>		<u>Experiment 2: VPE</u>	
	<u>Embedded condition</u>	<u>Matrix condition</u>	<u>Embedded condition</u>	<u>Matrix condition</u>
0%	0	6	4	0
25%	3	2	3	1
50%	2	2	3	3
75%	4	1	2	5
100%	3	1	0	3
Total N	12	12	12	12

As noted in the Experiment discussions, adult responses were in the expected direction for both Experiments. Where children pattern differently from adults in the embedded condition of Experiment 1, their responses are neither clustered at 50% nor split between 0% and 100%. Interestingly, the percentage of matrix readings by adults observed by Syrett and Lidz (2005) did cluster around 50% for test sentences such as (16) when presented in a context favoring the matrix reading.

(16) Clifford asked Goofy to read every book that Scooby did.

Learning Scope Economy

It therefore appears that while children's limited computational capacity may play a role in their performance in these Experiments, this alone cannot account for the difference between children and adults with respect to QR out of a tensed clause.

These sets of data also reveal to us something interesting about the adult grammar. While adults generally resisted assigning and accepting the matrix reading to sentences like (13), the percentage of matrix readings was not as close to 0% as might have been expected if that reading were unquestionably ungrammatical for adults. In fact, four of the twenty-four adults in Experiment 1 were willing to assign a matrix reading to at least two of the four test sentences, and overall, adults assigned a matrix reading 15.6% of the time, providing justifications corresponding to this reading, as in (17).

- (17) a. Clifford thought that Goofy read the big books, just like Scooby guessed, too.
(accepted statement, matrix condition)
- c. Clifford thinks Goofy read the smaller books and Scooby said the big books.
(rejected statement, embedded condition)

This pattern of responses may indicate that while such readings are not generally acceptable, there may be factors that positively affect their acceptability (cf. Wilder 1997) and that economy is a violable constraint, rather than a strict grammatical principle.

6. Implications and Future Research

The current work raises the question of how and when children become fully adult-like in their treatment of QR. If at four years of age children are willing to QR out of a tensed clause, what kind of input or context could provide them with the evidence they need to recognize that such movement is barred, and at what point does their pattern of responses align with that of adults? To answer these questions, we must first determine how to interpret the adult data.

Recall that while adults generally resisted the matrix reading, at least some adults did allow it as a grammatical alternative. This set of findings leads us to question the status of economy. If, as Chomsky (1993) and Fox (1995) have argued, economy is part of the grammar, then QR should be consistently subject to strict locality conditions, and the QR that is part of the child grammar should be the QR of adult grammar. If so, then we could argue that computational limitations, aside from the inability to conduct comparisons of abstract alternatives at LF, may mask the adult-like status of child QR. Recall, too, that economy has two components, Scope Economy and Shortest Move. It is possible that children have Scope Economy, and so will perform long QR as long as the resulting interpretation is distinct from the one generated by short QR, but lack Shortest Move, and so will bypass a closer landing site in favor of accessing the interpretation resulting from targeting the further landing site. This long movement may be licensed for children by the same mechanism that allows D-linked wh-phrases to escape weak islands (cf. Rizzi 1990, Cinque 1990).

If economy is not housed in the grammar, but is part of more general language processing (Tunstall 1998, Anderson 2004) or discourse interpretation strategies, then other alternatives arise. The interpretation resulting from QR out of a tensed clause may not be strictly ungrammatical, but dispreferred because other interpretations are, for example, either more probable given a particular context, easily interpretable, or more rapidly processed. The consequence of taking this approach is that we would have to say that the children are not non-adult-like in performing QR out of a tensed clause, but are patterning with the small subset of adults who are willing to do so. On this view, this population would differ in their sensitivity to the processing factors that contribute to economy.

A third explanation for the child-adult difference exists, which is not based in economy and QR. It is possible that children are treating the tensed embedded clause as a non-finite clause, and therefore do not have reason to think that the matrix reading should be barred. If this is the case, then we might expect that children's performance in Experiment 1 would correlate with their performance with ACD embedded in non-finite clauses. This is the type of test sentence was presented to participants in Syrett and Lidz (2005). The table in (18) presents the percentage of matrix readings for the two experimental conditions in Syrett and Lidz (2005) and the current Experiment 1.

(18) Percentage matrix readings by children in two experiments with ACD

<u>Position of ACD</u>	<u>Embedded condition</u>	<u>Matrix condition</u>
Embedded in non-finite clause (Syrett and Lidz 2005)	54%	38%
Embedded in tensed clause (current work)	65%	27%

While the overall percentage of matrix readings in the two conditions is similar in direction, the distribution of responses (not presented above) is somewhat different. Children in Syrett and Lidz (2005) were more categorical in their acceptance or rejection of the matrix reading in the embedded condition than they were in the current work, and were more likely to reject the matrix reading in the matrix condition in the current work. Further research on other forms of A-bar movement out of embedded clauses should shed more light on the status of children's non-adult-like performance.

7. Appendix

Experiment 1

Test Sentences

- (19) a. Clifford said that Goofy read every book that Scooby did.
 b. Miss Piggy said that Fozzy drove every car that Kermit did.
 c. The Genie said that the cowgirl jumped over every frog that the cowboy did.

Learning Scope Economy

- d. Winnie the Pooh said that Piglet tasted every treat that Tigger did.

Control Sentences

- (20) a. The lion said that the monkey pushed the rock further than the elephant did.
b. The dinosaur said that the shark ate a lobster before the lizard did.
c. Ernie said that the rhino rode the motorcycle, [and the hippo did, too/but he said that the hippo didn't].

Experiment 2

Test Sentences

- (21) a. Clifford asked Goofy to read the [big/small] books because Scooby did.
b. Miss Piggy wanted to drive the [red/black] cars because Kermit did.
c. The cowgirl needed to jump over the [small/big] frogs because the cowboy did.
d. Winnie the Pooh invited Piglet to taste the [cookies/cupcakes] because Tigger did.

Control Sentences

- (22) a. The monkey pushed the rock further than the elephant did.
b. The shark ate a lobster before the lizard did.
c. The rhino rode the motorcycle, [and the hippo did, too/but the hippo didn't].

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Syrett & Lidz

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