

## The Question–Answer Requirement for scope assignment

Andrea Gualmini · Sarah Hulsey · Valentine Hacquard ·  
Danny Fox

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**Abstract** This paper focuses on children’s interpretation of sentences containing negation and a quantifier (e.g., *The detective didn’t find some guys*). Recent studies suggest that, although children are capable of accessing inverse scope interpretations of such sentences, they resort to surface scope to a larger

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A. Gualmini (✉)  
Utrecht Institute of Linguistics, OTS,  
Janskerkhof 13, 3512 BL Utrecht, The Netherlands  
e-mail: andrea.gualmini@let.uu.nl

S. Hulsey · D. Fox  
Department of Linguistics and Philosophy, MIT,  
77 Massachusetts Avenue, Cambridge, MA 02139, USA

S. Hulsey  
Linguistics Program, Northeastern University, 360 Huntington Avenue,  
Boston, MA 02115, USA

V. Hacquard  
Department of Linguistics, University of Maryland,  
1401 Marie Mount Hall, College Park, MD 20742, USA

extent than adults. To account for children's behavioral pattern, we propose a new factor at play in Truth Value Judgment tasks: the Question–Answer Requirement (QAR). According to the QAR, children (and adults) must interpret the target sentence that they evaluate as an answer to a question that is made salient by the discourse.

**Keywords** Language acquisition · Negation · Scope ambiguities · Ambiguity resolution

## 1 Introduction

In recent years, a number of studies have investigated children's interpretation of sentences containing both negation and a quantifier. One observation which emerges from this work is that, in many cases, children seem to be limited to surface scope assignments in contexts in which adults access inverse scope interpretations. Musolino (1998) calls this the *Observation of Isomorphism* and interprets it as evidence that young children are unable to access inverse scope readings (see also Lidz and Musolino 2002; Musolino et al. 2000; Musolino and Lidz 2002, 2003, 2006; Musolino 2006). A different conclusion, however, emerges from a second line of research carried out by Gualmini (2004a, b), Musolino and Lidz (2006), Krämer (2000), Felber (2002), Miller and Schmitt (2004), and Musolino and Gualmini (2004). All of the latter studies demonstrate that, under certain circumstances, children do in fact access the inverse scope interpretation of scopally ambiguous sentences containing negation. In particular, the studies by Gualmini (2004a, b) show that the context may play an important role in scope assignment. This is the topic of the present paper.

We here present a specific model of how contextual information may guide scope assignment, which we call the *Question–Answer Requirement* (QAR). The QAR is based on a common assumption in theories of communication, namely that every assertion is understood as an answer to a question. The QAR thus holds that children, like adults, interpret statements as answers to a particular question. We refer to such a question as the *Question under Discussion*. This question may be overtly present, but most often needs to be inferred based on contextual cues. Our hypothesis is that, when it comes to sentences containing negation and a quantifier, there is a unifying key factor common to many—if not all—cases in which children do not select inverse scope when it is available for adults. In all such cases, the discourse created by the experimental setting makes a particular question salient. The sentence that is evaluated by the child constitutes an appropriate answer to that question only under its surface scope interpretation. This hypothesis allows us to develop an experimental paradigm with the opposite property, namely a paradigm in which the target sentence is an answer to the Question under Discussion only under its inverse scope interpretation.

Under the QAR, differences in scope assignment between adults and children (for scopally ambiguous sentences) do not lie in a difference in grammatical competence or parsing mechanisms. Rather, children and adults may have access to different ways of addressing the Question under Discussion, depending on (i) the availability to children of an interpretation that is unavailable to adults, (ii) children's inability to accommodate a question that is different from the Question under Discussion suggested by the context, and (iii) children's inability to compute scalar implicatures to construct an interpretation that would address the Question under Discussion.

The predictions of the QAR were explored in three experiments. Two experiments investigate the role of context for children's interpretation of sentences containing negation and the universal quantifier *every* or the indefinite *two*. We show that the contextual maneuver implemented by Gualmini (2004a) for sentences with *some* can be extended to both sentences containing *every* and sentences containing *two*. The results of these two experiments provide us with new data about the role of contextual information for scope resolution. The third experiment is directly motivated by the QAR and is designed to investigate the prediction that, in some contexts, children should resort to inverse scope interpretations to a larger extent than adults. We conclude the paper by discussing the relevance of the QAR for current studies of scope resolution in child language. In particular, we illustrate how the QAR might explain the data that are often used as evidence for a putative preference for surface scope interpretations by children and adults.

## 2 Previous accounts of scope in child language

Much of the current work on scope in child language attempts to figure out when children choose surface scope interpretations and when they choose inverse scope interpretations. In this section we discuss Musolino's (1998) perspective on this subject, as well as two subsequent revisions of his view.

### 2.1 The Observation of Isomorphism

Musolino (1998) ran a number of experiments on young children's interpretation of sentences containing a quantifier and negation and interpreted the results of his experiments as evidence that many 4- and 5-year-olds are limited to surface scope interpretations. That is, for children, a scope-bearing element which c-commands another scope-bearing element on the surface will necessarily take scope over it. This is what Musolino (1998) calls the Observation of Isomorphism (see also Musolino et al. 2000; Lidz and Musolino 2002).

To take one example, Musolino (1998) looked at children's interpretation of sentences such as (1).

- (1) Every horse didn't jump over the fence.

For English-speaking adults the sentence in (1) is ambiguous between the surface scope interpretation in (2) and the inverse scope interpretation in (3).

- (2) Every horse is such that it did not jump over the fence.  
 (3) Not every horse jumped over the fence.

In the experiment conducted by Musolino (1998), children were asked to evaluate (1) as a description of a story. In the story, two horses jumped over the fence, while a third horse also present in the context did not jump over the fence.

It is generally agreed that adults, when faced with an ambiguous sentence that is true on one reading and false on the other, will choose the interpretation that makes the sentence true. Moreover, the same assumption is usually extended to children (see Crain and Thornton 1998). We adopt the term *Principle of Charity* for this pragmatic preference (Grice 1975; Davidson 1984; among many others). Musolino's (1998) findings suggest that, even if children have access to both interpretations, their responses do not obey the Principle of Charity. In particular, children—unlike adults—consistently rejected (1) in the context we just described. Note that among the sentences investigated by Musolino (1998), sentences like (1) give rise to the clearest instance of non-adult behavior in children: children rejected the target sentences in the above context over 90% of the time.

The conclusion offered by Musolino (1998) and Musolino et al. (2000) is that, at the relevant developmental stage, children are incapable of accessing the inverse scope interpretation of sentences like (1). In particular, these studies attribute children's non-adult behavior to an incorrect setting of the relevant parameter; that is, children initially take English to be a 'rigid scope language'.

Another type of sentence tested by Musolino (1998) contains negation with *some* in object position:

- (4) The detective didn't find some guys.

As in the case of (1), we can consider two possible LF configurations of the quantifier and negation in this sentence. One is the surface scope interpretation in (5) and the other is the inverse scope interpretation in (6).<sup>1</sup>

- (5) It is not the case that the detective found some guys.  
 = The detective didn't find any guys.  
 (6) There are some guys that the detective didn't find.

Again, the research question addressed by Musolino (1998) was whether children have access to both interpretations.

<sup>1</sup> It is usually argued that, under a normal intonation pattern, (5) is not an available interpretation of (4) for adults, because *some* is a Positive Polarity Item (PPI) and cannot be interpreted in the scope of a downward entailing operator like negation (see Ladusaw 1979).

One story presented in Musolino’s experiment is about a detective playing hide-and-seek with four friends. The detective finds two of his friends, but the other two are too well hidden and are not found. In this story, (4) is false on the surface scope reading in (5), the reading unavailable for adults, and true on inverse scope reading (6). As expected, Musolino’s adult controls accepted (4) and similar sentences 100% of the time. Children behaved differently, however. In particular, 30 children ranging in age from 3;10 to 6;6 (mean 5;1) rejected sentence–story pairs like the one described above 50% of the time (60/120). Of those children, 14 children rejected the puppet’s statement 87.5% of the time (49/56), and 13 accepted the puppet’s statement 90% of the time (47/52). From this breakdown, Musolino (1998) again concludes that some children are limited to surface scope. More specifically, he interprets his data under the assumption that there are two child populations.<sup>2</sup> Some children are quite consistently adult-like in accepting (4). Another group, however, rejected (4), thereby indicating that they selected the surface scope interpretation of (4) despite the lexical properties of *some* (i.e., the fact that it is a PPI, see footnote 1) and, once again, seemingly in defiance of the Principle of Charity.

Having summarized two of the relevant experiments, it is important for us to be explicit about which children behaved differently from adults. The children who accept (1) and (4) should be treated, from the current perspective, like adults. Thus, along with other researchers, we focus on accounting for the children who, unlike adults, reject sentences like (1) and (4).

To sum up, Musolino (1998) interpreted the results of his experiments as indicating that children (in the relevant developmental stage) are limited to surface scope interpretations. Children who reject the puppet’s statements (1) and (4) do so because at that particular point of language development they are only able to access the isomorphic, surface scope interpretations, which are false in the contexts provided. The Principle of Charity applies vacuously: children’s grammar can generate only one interpretation, the surface scope interpretation, and that interpretation happens to be false in the contexts investigated by Musolino (1998) in the two experiments we just considered.

## 2.2 A challenge to the generalization of isomorphism: the role of context

The claim that English-speaking children cannot access inverse scope interpretations of sentences containing negation was challenged by Gualmini (2004a). That study sprang from the observation that a trial effect for sentences like (4) can be seen in Musolino’s experiment: children and adults differed in behavior most clearly in certain pragmatically implausible sentence–context pairs (see Sect. 7 below). This led Gualmini (2004a) to a novel account of the

<sup>2</sup> Throughout the paper, we will classify individual subjects based on the responses they give on most of the trials. For example, subjects who reject the target sentence three times out of four will be grouped together with subjects who reject the target sentence four times out of four trials (but see Gualmini (2004a, b) for a caveat).

facts, which was supported by an experimental investigation focusing on sentences containing negation and the indefinite *some*.

Expectations play an important role in Gualmini's account. Following Wason (1972), he argues that "subjects experience a difficulty in processing negative sentences in the absence of context, and in contexts that are arguably infelicitous for their use" (Gualmini 2004b, p. 129). Evidence from child language for this claim can be found in a study by de Villiers and Tager-Flusberg (1975) which suggests that young children are sensitive to the existence of a discrepancy between an expected outcome and the actual outcome when interpreting a sentence containing negation. Thus, Gualmini (2004b, p. 149) suggests that "the difficulty associated with negative sentences can be mitigated if the target sentence is ... used to point out that an expectation went unfulfilled." For Gualmini (2004b), this difficulty is due to a felicity condition requiring that negative sentences be used only as a denial of an expectation.<sup>3</sup>

To evaluate the role of expectations in children's interpretation of sentences like (4), Gualmini (2004a, b) tested children using four story-telling contexts, each matched with two target sentences. Of each pair of target sentences, only one was felicitous in the context provided (according to Gualmini's felicity condition).

To take one example, children were told a story in which Grover orders four pizzas from the Troll. The Troll is supposed to deliver all four of them, but is driving too fast and loses two pizzas on the way. According to Gualmini's analysis, the story sets up an expectation of what the outcome should be, namely that the Troll should deliver all of the pizzas. The puppet then utters either (7), whose surface scope and inverse scope interpretations are paraphrased in (8a) and (8b), respectively, or (9), whose surface and inverse scope interpretations are paraphrased in (10a) and (10b), respectively.

- (7) The Troll didn't deliver some pizzas.
- (8)a. The Troll didn't deliver any pizzas.
  - b. There are some pizzas that the Troll didn't deliver.
- (9) The Troll didn't lose some pizzas.
- (10)a. The Troll didn't lose any pizzas.
  - b. There are some pizzas that the Troll didn't lose.

<sup>3</sup> One formulation of this felicity condition is offered by Gualmini (2004b), who argues that a sentence containing matrix negation is felicitous only when it is logically equivalent to the negation of an expectation supported by the context. Thus, for instance, a sentence such as *It is not raining* is felicitous if the hearer had reasons to expect it to be raining. More generally, an interpretation of the form *It is not the case that P* is felicitous in contexts in which *P* was expected to be true. When it comes to an ambiguous sentence containing negation, Gualmini (2004b) argues that each reading can be felicitous or not, depending on whether that particular reading is logically equivalent to the negation of an expectation prominent in the context.

It is important to note that in this story, (7) and (9) have the same truth value for their surface scope readings (false) and the same truth value for their inverse scope readings (true): (7) is true on its inverse scope interpretation (8b) because there are some pizzas that the Troll didn't deliver, namely the ones he lost. Analogously, (9) is true on its inverse scope interpretation (10b) because there are some pizzas that the Troll didn't lose, namely the ones he managed to deliver. Thus, the inverse scope interpretation would not lead children to violate the Principle of Charity (because the sentences are true on this reading), while the surface scope reading would.

According to Gualmini (2004a, b), sentences (7) and (9) in the context of the pizza story differ in felicity, however. In particular, Gualmini (2004a, b) argues that (7) is felicitous in that context because it points out the discrepancy between what was expected to happen, i.e., that the Troll would deliver all of the pizzas, and what actually happened. Sentence (9), on the other hand, does not point out this discrepancy. Thus, in the context of the pizza story, (9) does not meet the felicity requirements for sentences containing negation. Gualmini found that children accepted (7) at a much higher rate than (9). Fifteen children, ranging in age from 4;1 to 5;6 (mean 4;10), accepted (7) and similar sentences 90% of the time (54/60). A different group of 15 children, ranging in age from 4;2 to 5;8 (mean 4;11), accepted (9) and similar sentences only 50% of the time (30/60).<sup>4</sup>

Let us now consider the significance of Gualmini's findings. From the data we summarized we can see that the strictest interpretation of the Observation of Isomorphism, whereby children are simply not able to interpret scope-bearing elements as having inverse scope, cannot be correct. The vast majority of responses to the puppet's statement (7) are acceptances. Gualmini's data show that, for children, scope assignment is not limited to surface c-command. In particular, all children can access the inverse scope interpretation of sentences containing negation and *some*.

By looking at the individual responses to sentences like (9), we can still see two distinct groups of children, one consisting of children who accept all or most of the trials and the other consisting of children who reject all or most of the trials. Again, the children who consistently accept target sentences like (9) should, in our view, be grouped with the adults who behaved similarly. What

<sup>4</sup> An anonymous reviewer raises the possibility that children's responses are due to different default strategies rather than to differences in the grammars they entertain. In particular, the reviewer makes reference to the work of Reinhart (2006), where it is argued that when confronted with privative ambiguities (i.e., ambiguities between interpretations that stand in an entailment relation), some children tend to select the weak reading of the relevant construction, while others tend to select its strong reading. We would like to offer two comments. First, it is not clear how default strategies could apply to the case of sentences containing negation and the numeral *two*, which we will discuss momentarily, since in this case the ambiguity is not privative. Second, if we analyze the group results documented by Gualmini (2004a), there is no sign of a default strategy. If indeed children's rejection of the relevant sentences follows from a strategy that privileges the strong interpretation of the target sentence, then one should see the effect of this strategy across contexts, contrary to fact. As the reviewer correctly points out, a more direct assessment of possible underlying strategies could come from a within-subject study comparing the two conditions used by Gualmini (2004a).

we need to explain is the behavior of children who consistently reject (9).<sup>5</sup> However, the question that now needs to be addressed is not why children in the relevant developmental stage cannot access inverse scope interpretations. Instead, the question that needs to be addressed is why children in the relevant developmental stage sometimes select the surface scope interpretation of an ambiguous sentence despite the fact that they are capable of accessing its inverse scope interpretation and despite the fact that only inverse scope makes the target sentence true.

Thus far, we have reviewed Musolino's original claim that, for children, scope assignment is constrained by surface c-command relations. We have also looked at one of Gualmini's experiments which challenged this claim by investigating whether the context has an effect on children's interpretation of sentences containing negation and a quantifier. As we saw, Gualmini's findings indicate that (i) children's scope assignment is not limited to surface c-command; (ii) context plays a role in scope resolution.

But what exactly is the role of context? Gualmini suggests that context must supply an expectation in order to satisfy a constraint on the felicitous use of a negative sentence. (The negative sentence must assert that the contextually salient expectation went unfulfilled.) Although we would like to adopt the basic insight, we will suggest that the relevant constraint is not specifically tailored to negative sentences, but is instead a constraint that applies to all sentences and follows from a general theory of communication. In addition to obvious conceptual considerations that favor a more general proposal, the notion of a 'negative sentence' invoked by Gualmini raises itself some further difficulties.

Under the relevant notion, a sentence such as (7), *The Troll didn't deliver some pizzas*, must be considered a negative sentence on both its surface- and inverse-scope interpretation. In other words, negation doesn't have to have matrix scope for the sentence to be considered a negative sentence. So what exactly is a negative sentence? Can we simply say that it is a sentence that contains negation? I.e., can we say that any sentence that contains negation (in any scopal position) is required to negate a contextually salient expectation?

That doesn't seem plausible, as the sentence in (11) illustrates.

(11) John said that Mary will not come to the party.

If this sentence has to be interpreted as the negation of a contextually salient expectation, the question is what that expectation would be. (11) is the negation of the claim that John didn't say that Mary will not come to the party. But the claim that this expectation must be salient for (11) to be uttered felicitously doesn't seem very plausible.

The only response we can think of is to define a negative sentence as any sentence that contains negation in an unembedded clause in any scopal position. This presupposes some definition of an embedded clause which we will not

<sup>5</sup> Recall from Sect. 2.1 that all researchers in this area take the interesting data to be the rejections by half of the children.

attempt to provide. Instead, we will introduce a challenge that will motivate our alternative proposal. Consider the sequence of sentences in (12).

- (12) Let me tell you something about how you should behave when you meet Mary. You should smile and shake her hand. Most importantly, you should not say anything impolite.

The last sentence seems to be a negative sentence by our (somewhat vague) definition. Yet, it doesn't seem to express the negation of any contextually salient proposition. The sentence, in which the modal *should* takes wide scope over negation, is the negation of the proposition that the addressee is allowed to say something impolite. But we see no reason to believe that this expectation must be contextually salient for the utterance of the sequence in (12) to be felicitous. We will thus try to capture Gualmini's intuition in a new way.

### 3 The Question–Answer Requirement

Our proposal draws upon a fairly standard assumption about the nature of communication (see, for example, Collingwood 1940; Groenendijk and Stokhof 1984; von Stechow 1994). We assume that any sentence must be understood as an answer to a question. We call this the Question–Answer Requirement (QAR). This requirement is always in place and holds for both children and adults, though we argue that children might be more restricted in how they can bring the target sentence to bear on the relevant question.

In a normal conversation, the topic of the conversation may jump around, and it may not always be easy to identify what the underlying question under discussion is. However, the assumption that each assertion is an answer to the question under discussion is crucial for communication to run smoothly. There is a thread to the conversation precisely because the conversation participants assume that each assertion is relevant to the general conversation. In the experimental context of a Truth Value Judgment Task, we have one story, with one central plot, whose outcome is brought to the forefront by the satisfaction of the *Condition of Plausible Dissent*, which we will discuss below. This environment seems particularly auspicious to naturally highlight a relevant question under discussion, against which the target sentence will be evaluated.

In a standard Truth Value Judgment task, children are presented with a story and a target sentence. Generally, it is assumed that if there is an interpretation licensed by the child's grammar and that interpretation is true, children will accept the sentence. However, we believe that there is an additional—and in fact higher ranked—condition that must be met by the interpretation that the child selects. This condition requires that the interpretation selected, whether true or false, be a good answer to the Question under Discussion. Thus, it is necessary to look at each individual experiment to determine just what this question might be. We begin here by considering Gualmini's experiments. Each trial included a story about a character who had a task to carry out, which

Gualmini argued would make a particular expectation prominent. We will recast this observation in terms of an underlying question.

Let us consider the pizza story described by Gualmini (2004a, b). Early on in the story, we are told that the Troll's task is to deliver four pizzas, and the plot from that point onward revolves around whether or not he will carry out this task successfully (i.e., whether he will deliver all of the pizzas). The two possible outcomes are (13a) and (13b), which correspond to the Hamblin denotation of question (14) (i.e., the set of its possible answers, cf. Hamblin 1973).

- (13)a. The Troll will deliver all of the pizzas.
- b. It is not the case that the Troll will deliver all of the pizzas.

(14) Will the Troll deliver all of the pizzas?

Once the story has been told, the question needs to be rephrased in the past tense:

(15) Did the Troll deliver all of the pizzas?

Henceforth we will use the past tense variation.

As we suggested above, it is possible that in a Truth Value Judgment Task environment, the Condition of Plausible Dissent proposed by Crain et al. (1996) plays a role in shaping the relevant question. The Condition of Plausible Dissent requires the presentation of a possible, alternative outcome to a story in addition to the actual outcome. One of these outcomes will make the target sentence true, while the other will make it false. Thus we can conceive of the Question under Discussion as any question to which only the possible outcome and the actual outcome are possible answers. For instance, in the pizza story told by Gualmini, the Condition of Plausible Dissent is satisfied by the presentation, early in the story, of the possibility that the Troll will deliver all of the pizzas. In the final outcome, however, the Troll fails to deliver all of the pizzas.

Note that the particular way in which the story is told is not the only way to make explicit the Question under Discussion. An obvious possibility would be for the experimenter to ask the question explicitly of the puppet at the end of the story. Similarly, as we will observe shortly, it is possible that real world knowledge plays a role in making some questions more plausible than others (see Gualmini 2004a, b). Once it is assumed that a particular question is made salient, we can ask whether that question is addressed by the various readings of the target sentence. In our particular case, the relevant readings are the surface and inverse scope readings.

In the case of the pizza story, the reasoning above would make (15) the Question under Discussion. We suggest that, for children, the target sentence must be interpreted as a good answer to this question. A good answer to a question can be defined as follows: an assertion constitutes a good answer to a 'Yes/No'-question if it entails either the 'Yes' answer or the 'No' answer to that question. This definition can be extended to other types of questions by requiring the assertion to entail at least one member of the Hamblin denotation

of the question. This formulation allows for “over-informative” answers, unlike a plausible alternative definition which would require an assertion to be identical to one member of the denotation of the Question under Discussion.<sup>6</sup>

A key factor in ambiguity resolution is given by whether or not a particular interpretation addresses the Question under Discussion. When both interpretations of the target sentence address that question, then children, like adults, will assume whenever possible that the speaker is speaking truthfully and choose an interpretation that makes the target sentence true, if there is such an interpretation (Principle of Charity). However, if only one interpretation addresses the Question under Discussion, children will evaluate the target sentence according to that interpretation, regardless of whether it makes the target sentence true or false. Thus, the Principle of Charity and the Question–Answer Requirement are both needed to explain ambiguity resolution in children (and adults). We hypothesize that these two principles can in fact entirely account for children’s (and adults’) behavior and leave little room for any purported preference for surface scope.

We claim that what is special about the ‘biased’ contexts in which children have been found to show a preference for surface scope is that, in these contexts, only the surface scope interpretation constitutes a good answer to the Question under Discussion. To illustrate, let us compare the contexts in which children access inverse scope with the ones in which they clearly don’t. We start with an example of the former, i.e. (7), repeated below as (16). The two interpretations of sentence (16) can be paraphrased as (17a) and (17b). Again, (17a) might be marginal for adults, given the PPI properties of *some*.

(16) The Troll didn’t deliver some pizzas.

(17)a. It is not the case that the Troll delivered some pizzas.

= The Troll didn’t deliver any pizzas.

b. There are some pizzas that the Troll didn’t deliver.

Both of the interpretations in (17) are good answers to question (15).<sup>7</sup> In particular, both interpretations entail a ‘No’ answer to the question in (15). Therefore, the QAR is met for both interpretations, and children are free to choose between them on other grounds. To decide between the two readings in (17), one determines which reading—if any—makes the target sentence true in the context. Gualmini (2004b) found that children accepted target sentences like (16) in 90% of the trials. Thus, when both readings satisfy the QAR, children adhere to the Principle of Charity and choose the true interpretation, which is (17b).

<sup>6</sup> For other types of questions, one would like to distinguish ‘complete’ from ‘partial’ answers, but this distinction is not relevant for our purposes. We will return to this point in the concluding section of the paper.

<sup>7</sup> In particular, both interpretations entail the ‘No’ answer to (15): *Did the Troll deliver all of the pizzas? No, he didn’t deliver any. Did the Troll deliver all of the pizzas? No, there are some that he didn’t deliver.*

On the other hand, consider sentence (9) repeated below as (18). If presented in the same context, we should assume that the same question will be entertained (i.e., (15)). Similarly, we must assume the existence of two possible scope assignments for the target sentence, (19a) and (19b).

(18) The Troll didn't lose some pizzas.

- (19)a. It is not the case that the Troll lost some pizzas.  
       = The Troll didn't lose any pizzas.  
    b. There are some pizzas that the Troll didn't lose.

Unlike in (16), in this case only one of the available interpretations addresses the question in (15), namely (19a). *The Troll didn't lose any pizzas* is a good answer to *Did the Troll deliver all of the pizzas?*, once we consider that, in the given context, saying that the Troll delivered a pizza is equivalent to saying that he did not lose it. Thus, (19a) entails the 'Yes' answer to (15). This is illustrated by the following dialogue.

- (20) Q: Did the Troll deliver all of the pizzas?  
       A: Yes, he didn't lose any of them.

Thus (19a) constitutes a good answer to the Question under Discussion in (15).

Interpretation (19b), on the other hand, does not address the Question under Discussion in (15). Saying that *There are some pizzas that the Troll didn't lose* (which is equivalent, given what is contextually assumed, to *There are some pizzas that the Troll delivered*) does not entail an answer to the question *Did the Troll deliver all of the pizzas?* Therefore, of the two readings of (18), only (19a) satisfies the Question–Answer Requirement. Again, it is important to note that constituting a good answer to the question is not the same as being a true answer (i.e., a true description of what happened in the story). As we have seen, children select (19a), despite the fact that it makes the target sentence false, because only that interpretation addresses the Question under Discussion. The role of the Principle of Charity for the resolution of the ambiguity is pre-empted.

Having illustrated how the Question–Answer Requirement and the Principle of Charity explain the behavior of children who accept (16), as well as the behavior of children who reject (18), it is important to stress that no other mechanism seems necessary. In particular, on this account, it is not necessary to assume that either children or adults have a preference for surface scope. It just so happens that the interpretation in (19a) corresponds to the surface scope interpretation of the target sentence. According to the QAR this is irrelevant. On this account, children do not choose (19a) because that interpretation is simpler (i.e., it does not involve covert movement, it is the first interpretation entertained by the psychological parser, etc.). Instead, children select (19a) because that interpretation is the only interpretation that addresses the Question under Discussion in (15).

Let us now consider two predictions of the QAR. First, the same contextual maneuver that has been shown to lead children to access inverse scope to the same extent as adults with *some* should also lead them to access inverse

scope interpretations with other lexical items. This prediction is tested in Experiment I, which investigates sentences containing negation and the indefinite *two* in object position, and in Experiment II, which investigates sentences containing negation and the universal quantifier *every* in subject position. Secondly, the QAR predicts that with particular sentence-context pairings, it should be possible for the *inverse scope* interpretation to be the only interpretation that constitutes a good answer to the Question under Discussion. This prediction sets the QAR apart from other theories of scope resolution and is investigated in Experiment III, where we further exploit the polarity properties of *some* in the adult language, to construct sentences that adults interpret on their surface scope interpretations. In such context, the prediction of the QAR is that children should access inverse scope interpretations to a larger extent than adults.

#### 4 The role of context for negative sentences containing *every* and *two*

In this section we report the results of two experiments. The experiments mirror one of the experimental conditions described by Gualmini (2004a, b). Our research question is whether the same experimental maneuver implemented by Gualmini (2004a, b) would lead children to access the inverse scope interpretation of other sentence structures, such as the ones investigated by Musolino (1998).

Both experiments employ the Truth Value Judgment task (Crain and McKee 1985; Crain and Thornton 1998) and employ stories that are modeled after the ones of Gualmini (2004a, b). The purpose of the experiments is to determine whether the experimental maneuver implemented in that study has an effect on children's interpretation of additional sentence types.

##### 4.1 Experiment I: Children's interpretation of the indefinite *two* in object position of sentences containing negation

An experiment was conducted to evaluate the role of context for children's interpretation of sentences containing the indefinite *two* in object position. The stories used the same format as those in Gualmini (2004a). The target sentences, however, contained *two* in object position, like some of the sentences investigated by Musolino (1998).

To illustrate, in one of the trials children heard a story in which Grover calls the Troll at the pizza store and asks for four pizzas. Grover promises the Troll a big tip if he manages to deliver the pizzas quickly. On the way to Grover's house, the Troll starts driving too quickly and accidentally drops two pizzas. Thus, the Troll arrives at Grover's house with only two pizzas. At the end of the story, children were asked to evaluate the following sentence.

(21) The Troll didn't deliver two pizzas.<sup>8</sup>

<sup>8</sup> The target sentence was preceded by the linguistic antecedent: *This was a story about the Troll who was delivering pizzas to Grover, and I know what happened.*

The experimental hypothesis, based on Gualmini's experiments, was that the context would affect children's interpretation of the target sentence. In particular, the experimental hypothesis was that children would access the inverse scope reading of (21) to a larger extent than documented in previous literature. The reason for this prediction is the following. As we suggested above, what we take to be relevant in Gualmini's stories is that they make prominent a particular question. In the case of the pizza story, the question, we assume, is (15), repeated below.

(15) Did the Troll deliver all the pizzas?

Notice that the inverse scope interpretation of (21), *There are two pizzas that the Troll didn't deliver*, would allow children to assume that the speaker is speaking truthfully and obeying the QAR. Thus, the particular context employed in our experiment should lead children to accept the target sentences. This is exactly what happened. Seventeen children participated in the experiment. The children ranged in age from 3;10 to 5;3; their mean age was 4;6. Each child was presented with four trials interspersed with an equal number of fillers to balance the number of 'Yes' and 'No' responses. Children accepted the target sentence 51 times out of 68 trials (75%).<sup>9</sup> Furthermore, following Gualmini (2004a), on the first two trials that elicited a 'Yes' response, children were asked to motivate their response. This was done by repeating the target sentence to the child and then asking "Which ones?". When this happened, children consistently pointed to the objects on which the main character had failed to perform his task (e.g., the pizzas that had not been delivered). Thus, children's rate of inverse scope interpretations is considerably higher than the rate of acceptance documented by earlier work for structurally equivalent sentences in 'unbiased' contexts (i.e., 50% in Musolino (1998) and 33% in Lidz and Musolino (2002)).

#### 4.2 Experiment II: Children's interpretation of the universal quantifier *every* in subject position of sentences containing negation

A second experiment was conducted to evaluate the role of context in children's interpretation of sentences containing the universal quantifier *every* in subject position (as in some of the sentences investigated by Musolino (1998), e.g. (1) above, *Every horse didn't jump over the fence*. The stories used the same format as Gualmini (2004a, b), with one modification: we varied the ratio of props that conformed to the expected outcome to the ones that didn't, so that the latter would amount to only one object (to be consistent with Musolino 1998; Musolino et al. 2000; Musolino and Lidz 2006).

To illustrate, in one of the trials children heard a story about Caillou and Rosie. Rosie is expecting four important letters, which Caillou is supposed to deliver. Rosie calls Caillou at the post office to inquire about the four letters and Caillou promises to deliver them right away. Caillou jumps in his mail

<sup>9</sup> The individual results are reported in the Appendix.

delivery truck and starts driving towards Rosie’s house. On the way to Rosie’s house, Caillou starts driving too fast and accidentally drops one letter. When Caillou reaches Rosie’s house, he realizes that one letter is missing. We assume that the story makes prominent a question like *Was every letter delivered?*. At the end of the story, children were asked to evaluate the following sentence, which was uttered with the intonation that is required by the inverse scope interpretation in adult English: stress on *every*, de-stressed *wasn’t*, and rising intonation on *delivered*.

(22) Every letter wasn’t delivered.<sup>10</sup>

Given that our experiment used a passive sentence, the target sentence is not structurally equivalent to the sentences used in previous studies. However, the relevant scope-bearing elements occur in the same surface word order in (22) and (1) (i.e., *Every horse didn’t jump over the fence*). The experimental hypothesis was that children would access the inverse scope reading of (22) because it alone addresses the Question under Discussion and makes the target sentence true in the context. This is exactly what happened. Nineteen English-speaking children participated in the experiment. The children ranged in age from 3;0 to 5;11 (mean age: 4;8). Children accepted the target sentence 61 times out of 76 trials (80%). Following Gualmini (2004a), children were asked to motivate their first two acceptances in the same way as in Experiment I. Thus, once again, children’s rate of acceptance was considerably higher than the rate of acceptance reported in the literature for similar sentences in ‘unbiased’ contexts (e.g., 7.5% documented by Musolino (1998) and 15% documented by Musolino and Lidz (2006) for sentences like (1)).

#### 4.3 Summary of the experimental findings on contextual manipulations

Let us sum up the experimental findings on children’s interpretation of scopally ambiguous sentences containing negation in contextually controlled contexts. The experimental results show that the contextual manipulation proposed by Gualmini (2004a, b) has an effect across different grammatical constructions. Our own account of the facts is that children access the inverse scope interpretation of a negated sentence containing a quantified NP if that interpretation addresses the Question under Discussion, and select that interpretation if it makes the target sentence true. In particular, if a character in the story embarks on the task of delivering all of the pizzas available in the context, but only manages to deliver some of those pizzas, children select the (true) inverse scope interpretation for each of the sentences below:

(23) The Troll didn’t deliver some pizzas.

(24) The Troll didn’t deliver two pizzas.

<sup>10</sup> Again, the target sentence was preceded by the linguistic antecedent: *This was a story about Caillou delivering some letters to Rosie, and I know what happened.*

(25) Every pizza wasn't delivered.

The results of Experiments I and II support the conclusion reached in Gualmini (2004a, b). The data show that children are able to access inverse scope interpretations for a variety of constructions. Furthermore, we now have one experimental maneuver that makes the inverse scope interpretation available to children across different quantified NPs.

To sum up, Musolino (1998) proposed a generalization about children's interpretation of scopally ambiguous sentences: the Observation of Isomorphism. Gualmini (2004b) showed that when it comes to sentences containing the indefinite *some*, the generalization proposed by Musolino (1998) does not hold. The experimental results documented in the present paper demonstrate that Musolino's generalization does not hold even when it comes to sentences containing the indefinite *two* in object position and sentences containing the universal quantifier *every* in subject position, the other quantifiers he studied.

Taken together, the data are consistent with both the QAR and (as we will see in the next section) some version of Isomorphism, namely one according to which children resort to surface scope as a default (see Musolino and Lidz 2006).

We now turn to a prediction of the QAR that is not shared by Isomorphism, the prediction that in certain contexts children will select the inverse scope interpretation of a scopally ambiguous sentence to a larger extent than adults. As we mentioned above, this should happen in contexts which make prominent a Question under Discussion that can only be answered by the target sentence on its inverse scope interpretation and in which children's grammars—but not the adults' grammar—can generate that interpretation. Interestingly, this prediction distinguishes the QAR from a recent proposal by Musolino and Lidz (2006). Before we illustrate the relevant experiment, we will consider how the view developed by Musolino and Lidz (2006) could attempt to account for the facts that we have just described.

## 5 Isomorphism-by-Default as an alternative to the QAR

We saw in the previous section that, under certain circumstances, children can access the inverse scope interpretation of sentences containing a quantifier and negation. However, in other circumstances, namely those that Gualmini (2004a, b) argues are infelicitous, some children seem to resort to surface scope. Similarly, we have seen that some children, unlike adults, access surface scope interpretations in experiments that do not explicitly manipulate the context. One possible interpretation of these facts is that surface scope arises as a default.

One might suggest that, in all of the experiments that we have considered thus far, there is competition between the Principle of Charity (the bias to be generous to the speaker and choose an interpretation under which the sentence is true) and the purported processing difficulty associated with accessing inverse

scope (see Musolino and Lidz 2003). According to this view, children who select a false surface scope interpretation over a true inverse scope one do so because the processing load in default contexts is so high that it outweighs the drive to satisfy the Principle of Charity. This general idea resembles many current proposals, such as Trueswell et al. (1999) and others, that take the relative difficulty of revising an initial parsing commitment to be a key factor in deriving children's interpretation of ambiguous inputs. On this view, the Observation of Isomorphism is the result of children's parsing mechanisms.

When it comes to scope resolution, the most detailed proposal about the role of the parser is due to Musolino and Lidz (2006). These authors claim that children's preference for surface scope is an exaggerated version of adults' preference: accessing inverse scope is inherently more difficult for both adults and children (independently of the particular mechanism that yields inverse scope). They also argue that when the parser is confronted with a scopally ambiguous sentence, it first commits to the surface scope interpretation. Thus, inverse scope always involves re-analysis, and re-analysis constitutes the problematic step for children.

According to Musolino and Lidz (2006), it is critical to look at the competition between the bias to choose the interpretation that makes the sentence true and the preference for surface scope interpretations. Adults and children differ in which factor carries more weight. This is how Musolino and Lidz (2003, p. 288) explain it: "One approach, inspired by recent models of sentence processing (Trueswell et al. 1999), would be to view relative processing difficulty and satisfaction of the principle of charity as probabilistic constraints exerting antagonistic forces: the greater the processing difficulty associated with a particular reading, the more likely it is that this difficulty will override the application of the principle of charity." This view interprets Isomorphism effects as the result of the processing difficulty of revising an initial parse outweighing the demands of the Principle of Charity.

We have seen from the work of Gualmini (2004a, b) and from Experiments I and II of the present study that context plays an important role in allowing children to access inverse scope interpretations. Our account of the data is the following. If the context makes salient a Question under Discussion that can be answered by the inverse scope interpretation, then children select inverse scope. However, if the Question under Discussion can only be answered by the surface scope interpretation of the target sentence, then children opt for surface scope.

An alternative way to capture these facts would be via a modification to Musolino's (1998) original claim. Under this new view, surface scope is the default interpretation because the processing difficulty associated with accessing inverse scope is generally too great to be overcome by young children, and outweighs even the Principle of Charity. We call this view *Isomorphism-by-Default*. *Isomorphism-by-Default* might account for all of the data discussed so far. Context (perhaps QAR) could be said to be a factor which, in conjunction with the Principle of Charity, helps children in overcoming their preference for surface scope interpretations.

Let us sum up. The experimental findings suggest that some English-speaking 4- and 5-year-olds differ from English-speaking adults in scope resolution of scopally ambiguous sentences. In particular, some children will select the surface scope interpretation of a scopally ambiguous sentence which makes the sentence false, despite the fact that the inverse scope interpretation, which is licensed by their grammar, would make the target sentence true. For these children, the speaker is not speaking truthfully. The question is why children arrive at this conclusion. The answer that Musolino and Lidz (2006) offer is that the Principle of Charity is overridden by children's preference for surface scope. Our proposal is that the Principle of Charity is preempted by the Question–Answer Requirement.

## 6 Testing QAR vs. Isomorphism-by-Default

The results of the experiments discussed thus far are consistent with both Isomorphism-by-Default and the Question–Answer Requirement. However, the two views make different predictions for certain sentences in which the surface scope of negation and the indefinite *some* is reversed.

Consider, first, a minor variation on previous experiments for which Isomorphism-by-Default and the QAR make the same prediction. Recall the context of Gualmini's (2004a, b) pizza story. In that story the Troll delivered two pizzas, but there were two other pizzas that were lost. Both Isomorphism-by-Default and the QAR predict that children will accept a sentence like (26) when presented in that context.

- (26) Some pizzas were not delivered.
- (27)a. It's not the case that some pizzas were delivered.  
       = No pizzas were delivered.  
       b. There are some pizzas that were not delivered.

According to the Isomorphism-by-Default view, the first interpretation accessed by children is always the isomorphic one. In the case of (26), the isomorphic interpretation (27b) is true; hence there is no competition between the bias to access the interpretation that makes the sentence true and any processing preference for isomorphic scope: both factors favor the isomorphic interpretation. Therefore, under Isomorphism-by-Default, children are predicted to accept (26).

From the point of view of the QAR, the passive sentence in (26) should be treated the same as the active (7), i.e., *The Troll didn't deliver some pizzas*. Since the context is identical, we must assume that the salient question is the same in this case. Both interpretations of (26) are good answers to the question in (15), repeated below as (28).

- (28) Did the Troll deliver all of the pizzas?

Since both interpretations are good answers to the Question under Discussion, children are free to select between them based on the Principle of Charity. Hence, they are predicted to choose interpretation (27b), which is true in the scenario, and accept (26). Surface syntax does not play a special role for children in ambiguity resolution. Thus children will respond in the same way to (26) as to (7) (i.e., *Some pizzas were not delivered* and *The Troll didn't deliver some pizzas*).

However, Isomorphism-by-Default and the QAR make different predictions for the cases illustrated in (29) below.

(29) Some pizzas were not lost.

- (30)a. It is not the case that some pizzas were lost.  
       = No pizzas were lost.  
       b. There are some pizzas that were not lost.

Isomorphism-by-Default predicts that all children will interpret (29) as (30b), the isomorphic interpretation. This prediction holds even if we attempt to incorporate Gualmini's (2004a, b) proposal into Isomorphism-by-Default. As in the active cases, the passive sentence containing *lose* is infelicitous in Gualmini's (2004a, b) sense, because it does not point out the discrepancy between the expected outcome, that the Troll would deliver all of the pizzas, and the actual outcome. Therefore, any expectations set up by the story cannot help the child to overcome his or her preference for surface scope interpretations. According to Isomorphism-by-Default, then, the choice of interpretation will come down to the interaction of the Principle of Charity with the lower processing load associated with a surface scope interpretation. Since the surface scope interpretation of (29) is true and the inverse scope is false in the context of the pizza story, the Principle of Charity should favor the isomorphic reading (30b). Likewise, any processing preference for surface scope should favor (30b). From the point of view of this approach, both factors favor the isomorphic reading of (29). Therefore, Isomorphism-by-Default predicts that all children will choose the isomorphic interpretation in (30b) and accept sentence (29). In short, according to the Isomorphism-by-Default view, there should be no difference in children's interpretation of the two passive sentences in (29) and (26).

The predictions of QAR are different, however. The Question–Answer Requirement does not assign any privileged status to the isomorphic interpretation. When a sentence is ambiguous, a listener must consider which interpretation (if any) addresses the Question under Discussion. What is important is the proposition expressed by each reading of an ambiguous sentence, not whether or not that interpretation differs from surface syntax. With a context identical to the one used with the active sentence (9), repeated below, the Question under Discussion will be the same, i.e., (28).

(9) The Troll didn't lose some pizzas.

As in the case of (9), the only interpretation of (29) that is a good answer to (28) is the interpretation in which negation takes scope over *some*. In the active

sentence, this is the surface scope interpretation, but in a passive sentence such as (29), it is the inverse scope interpretation (30a). Interpretation (30a) is false in the context provided, but this should not matter for the children we are targeting, since we claim that they privilege discourse congruence over truth. Therefore, the QAR predicts that some children will reject (29). More precisely, the QAR predicts that children will reject (29) to the same extent to which they rejected (9) and for the same reason that they rejected (9). In this context, some children should resort to the interpretation in which negation has scope over *some* because only that interpretation addresses the Question under Discussion. Again, the QAR holds that surface syntax does not play a special role in children's grammar. Thus children will respond in the same way to *Some pizzas were not lost* and *The Troll didn't lose some pizzas*.

### 7 Experiment III: children's interpretation of the indefinite *some* in subject position of sentences containing negation

To test the predictions of the QAR described above, we used the same contexts and methodology as Gualmini (2004a, b). The only change to the experiment was to use passive target sentences instead of active sentences.<sup>11</sup> Therefore, the crucial difference between these target sentences and Gualmini's was the surface order of the scope-bearing elements. (26) and (29) are sample targets in the *deliver* and *lose* conditions.<sup>12</sup>

(26) Some pizzas were not delivered.

(29) Some pizzas were not lost.

Recall that both Isomorphism-by-Default and the QAR predict that children will accept target sentences like (26). Not surprisingly, this prediction turned out to be correct. Fifteen children from ages 2;10 to 5;6 (mean age 4;6) accepted the target sentences 53 times out of 60 (88%). The rate of acceptance closely mirrors the rate of acceptance of sentences like *The Troll didn't deliver some pizzas* reported in Gualmini (2004a), i.e., 90% (54/60). A group of 10 adult controls accepted the target sentences 100% of the time.

Turning now to (29), we have seen that Isomorphism-by-Default predicts that all children will accept this sentence. In contrast, the QAR predicts that, as a group, children will accept it only to the same extent that they accepted the active counterpart: about 50% of the time. The prediction of the QAR was borne out. We found that children accepted (29) and similar targets to almost exactly the same extent as the active versions. In particular, 15 different children from ages 2;10 to 6;01 (mean age 4;9) accepted the target sentences 26 times out of 60 (43%). This rate of acceptance closely mirrors the rate of acceptance of

<sup>11</sup> The passives chosen were actional passives without a *by*-phrase, which have been shown to be unproblematic for children at this age (see Maratsos et al. 1985 and much subsequent work).

<sup>12</sup> All eight target sentences are given in the Appendix.

sentences like *The Troll didn't lose some pizzas* reported in Gualmini (2004a, b), i.e. 50% (30/60). When children rejected the target sentence, they were asked to explain ‘what really happened in the story’. Here are the motivations that accompanied children’s rejections of the sentence in (29).

- (31) “He lost them!”  
 “He was driving and these pizzas fell”  
 “Some were”  
 “Two pizzas got lost”  
 “Two pizzas were lost and these were not”  
 “Because two pizzas fell off”  
 “Two pizzas got lost”  
 “Some pizzas were lost”

A group of eight adult controls accepted the target sentences 93% of the time.

Let us stress, again, the significance of these findings. First consider children’s and adults’ responses to sentences like (29). The Isomorphism-by-default view was based on the finding that in certain context–sentence pairings children resort to surface scope interpretations to a larger extent than adults. We have found the exact opposite pattern: in certain context–sentence pairings children select inverse scope interpretations to a larger extent than adults do. In fact, children’s responses to sentences like (29) closely resemble the pattern documented by Krämer (2000), who found that Dutch-speaking children tend to select the inverse scope interpretation of negative sentences containing indefinite objects in scrambled position, whereas adults always select surface scope. What is common to the data that we collected and the ones discussed by Krämer is that, in both cases, children assign the relevant indefinite noun phrase scope under negation. Our hypothesis is that this move allows them to assume that the speaker is addressing the Question under Discussion. Just like our own results, Krämer’s findings are problematic for Isomorphism-by-Default. Contrary to the predictions of that view, children were found to access inverse scope interpretations even when doing so did not allow them to satisfy the Principle of Charity. This finding cannot be explained either by a putative preference on the part of children for surface scope interpretations or by the Principle of Charity; an additional principle must be assumed. One possibility would be to find a principle that both accounts for the new facts and also makes it unnecessary to rely on some other factor in the resolution of scope ambiguities. In our view, if that principle is the Question–Answer Requirement, then it is indeed unnecessary to assume a default preference for surface scope interpretations in children or adults.

Let us now compare children’s responses to (9) (*The Troll didn't lose some pizzas*) and (29) (*Some pizzas were not lost*). In Experiment III, the predictions of the Question–Answer Requirement were borne out. Children were found to accept the passive versions of Gualmini’s (2004a, b) test sentences to roughly the same extent as the active versions. In doing so, the children who rejected the sentences went against both the bias to choose the interpretation that makes the

sentence true as well as the putative processing difficulty associated with accessing an inverse scope interpretation. That is, even when the experiment was designed so that there would be no competition between the mechanisms proposed by Isomorphism-by-Default (the Principle of Charity and a preference for surface scope), children responded contrary to the predictions of that view. On the other hand, the data are consistent with the QAR hypothesis: children interpret an ambiguous sentence by choosing the interpretation that constitutes a good answer to the Question under Discussion, regardless of the relationship between that interpretation and surface syntax, and the Principle of Charity is only used to select between interpretations that satisfy the Question–Answer Requirement.<sup>13</sup>

As a group, children show no preference for surface scope. Further independent evidence for our proposal could come from an experiment adopting a within-subject design. According to the QAR hypothesis, a child who is the best possible candidate for an ‘isomorphic’ child, one who chooses the wide scope negation interpretation in the active sentences (i.e., surface scope interpretation), is predicted to choose wide scope negation for the passive sentences as well (i.e., inverse scope interpretation). The results of an experiment adopting the within-subject design are reported in Appendix II.

We would like to end this section by commenting on the relevance of our proposal for previous research. Even though we have concentrated on the experimental paradigm developed by Gualmini (2004a, b), we believe that our account also has implications for the interpretation of other studies. A natural hypothesis to make is that the QAR can help us in understanding children’s behavior as documented by previous research, to the extent that we can tell what the Question under Discussion would be. To illustrate, let us consider Experiment 3 from Musolino (1998). Gualmini (2004a, b) highlighted a trial effect of that experiment. Consider the following two trials from Musolino (1998).

(32) The old man didn’t hurt some guys.

(33) The detective didn’t find some guys.

Despite the similarity of the target sentences, the two trials yielded different response patterns from children. In particular, the 30 children interviewed by

<sup>13</sup> One challenge remains: Musolino (1998) tested children’s interpretation of sentences like *Some girls won’t ride the merry-go-round*, and found that children virtually always accessed the surface scope interpretation. In order to reconcile Musolino’s and our own findings, at the moment, we can only point to two differences between the experiments. First, Musolino’s (1998) stories did not readily suggest a specific question that could only be addressed by the inverse scope interpretation: they did not have a single plot line that makes one particular question salient. In the absence of a single, clear Question under Discussion it is very difficult to predict what question a child would hypothesize, much less whether an entire group of children would all assume the same question. Secondly, Musolino’s experiment employed the Prediction Mode of the Truth Value Judgment task (see Chierchia et al. 1998). It is possible that both of these factors made it easier for children to accommodate a question that could be addressed by the (true) isomorphic interpretation (see Sect. 8 for a discussion about how, in some instances, adults may be able to accommodate a different question than the one made salient by the context).

Musolino (1998) rejected the target sentence in (32) 20 times (67%), and they rejected the sentence in (33) 12 times (40%). Among all the trials of the experiment, (33) gave rise to the lowest number of non-adult responses, whereas (32) yielded the highest number of non-adult responses. On the account we have presented above, the difference should correlate with the likelihood that children converge on a question that is answered by the target sentence on its inverse scope interpretation. In turn, this means that it should be easier for children to converge on *Did the detective find all the guys?* when presented with the context that was used to test (33) than it would be for them to converge on *Did the old man hurt all of the guys?* when presented with the context that preceded (32). This seems to us to be rather plausible: (33) was presented after a story about hide-and-seek, whereas (32) was presented after a story about a man mowing the lawn. It seems reasonable to assume that children know that, when playing hide-and-seek, the goal is to find all the relevant characters, whereas hurting people is orthogonal to mowing the lawn. If anything, one is more likely to ask whether the old man ended up hurting any of his friends rather than whether he ended up hurting all of them. Indeed, if a child assumes that the relevant question is *Did the old man hurt any of the guys?*, he should reject the target sentence, since only the false surface scope interpretation entails an answer to that question.

## 8 The developmental path

In this section we would like to discuss how children and adults may differ. As we mentioned above, we believe that adults are subject to the QAR as well, but thus far we have not addressed the adult pattern of responses. Let's start with the behavior of the adult controls who participated in Gualmini's original experiment. Recall that Gualmini tested sentences (7) and (9) in a context in which the Troll delivered two pizzas and lost the remaining two.

(7) The Troll didn't deliver some pizzas.

(9) The Troll didn't lose some pizzas.

We will focus on (9). Under almost any view of scope assignment, adults are predicted to accept sentences like (9) for two reasons. First, under a normal intonation pattern, (9) is generally thought to have only the inverse scope interpretation for adults. As mentioned above, stressed *some* is a Positive Polarity Item and cannot be in the scope of negation. Secondly, even if *some* could be in the scope of negation, one would expect adults to adhere to the Principle of Charity, which would lead them to assent to any ambiguous sentence of which one interpretation is true. In this case, the inverse scope interpretation in (10b) happens to be true in the context provided, while (10a) is false.

(10)a. It is not the case that the Troll lost some pizzas.

= The Troll didn't lose any pizzas.

b. There are some pizzas that the Troll didn't lose.

For these reasons, adults should overwhelmingly accept (9) in the context presented to children.

Interestingly, the pattern is not as uniform as might be expected. Gualmini (2004a, b) tested 14 adult subjects on the same four *lose*-condition trials presented to the children in a video-taped version of the experiment. The results show that adults only accepted (9) and similar sentences 48% of the time (27/56). We conducted the same experiment with 10 adult controls and found that they accepted the sentences 79% of the time (31/40)—a higher percentage, but still not the near-uniform acceptance that was predicted.<sup>14</sup> It is interesting to consider what could explain adults' performance.

We first turn to the adults who accept (9). Recall that of the two (logically possible) interpretations of (9), only (10a) constitutes a good answer to the Question under Discussion (15), i.e., *Did the Troll deliver all the pizzas?* First, consider what an adult who accepts the sentence must do. Such an adult might recognize that (10b) is true and that the Principle of Charity requires that the true interpretation be selected. The adult may also be assisted by the fact that the alternative interpretation violates the licensing conditions of PPIs. However, the adult must also satisfy the QAR, and (10b) is not a good answer to the Question under Discussion. In this case, we argue that the adult is able to accommodate a different question, one to which (10b) is a good answer, and postulate that the speaker intended to address that question. Such a question could be a question like *Did the Troll deliver some pizzas?* On this reasoning, adults converge upon a question that is different from the background question. In their search for an alternative question, adults may be guided by the only interpretation that is available to them (or the only interpretation that is available to them and makes the target sentence true).

If, as we claim, an assertion is always understood as an answer to a question, then it should be possible for adults to accommodate a question in other conversational settings using various cues, among them perhaps the focus structure of the sentence. This needs to be assumed since most assertions are not preceded by overt questions. Since adults must be able to do this accommodation in cases where the Question under Discussion is not sufficiently clear from the context, we must consider the possibility that this ability can also be put to use in accommodating a question different from the one made salient by the context.

Before we consider adults' rejection of (9), we would like to mention another reason why an adult might accept (9). Thus far, we have argued that, of the two interpretations of (9), only (10a) constitutes a good answer to the question *Did the Troll deliver all the pizzas?* This claim rests on the assumption that whether a sentence is a good answer to a given question depends only on the semantics of the sentence. Thus, (9) under its inverse scope interpretation does not constitute a good answer to the question *Did the Troll deliver all the pizzas?* This is because the semantics resulting from inverse scope, (10b), is consistent with both a 'Yes' and a 'No' answer to that question. This indeterminacy, however,

<sup>14</sup> The lower acceptance rate found by Gualmini (2004a, b) might be due to the particular intonation used by the speaker who recorded the stimuli for that experiment.

disappears if scalar implicatures are taken into consideration (see Grice 1975; Horn 1989). A sentence with an existential quantifier normally licenses the pragmatic implicature that a stronger universal statement is false. If this implicature is taken into account, we can observe that the surface scope interpretation in (10b) does address the question *Did the Troll deliver all the pizzas?* because, factoring in the relevant implicature, we arrive at an interpretation that can be paraphrased as follows:

- (34) There are some pizzas that the Troll didn't lose, and it is not the case that, for every pizza, the Troll didn't lose that pizza.

Crucially, this interpretation warrants the inference that some pizzas were indeed lost by the Troll, an inference that would justify a negative answer to the question *Did the Troll deliver all the pizzas?*. On this view, adults might not even need to conjure up a new question in order to 'license' the inverse scope interpretation of (9). We will not pursue this possibility further. For the time being, we would like to point out that if a mechanism of this sort were in place, it would be natural to tie the differences between children and adults in the interpretation of scopally ambiguous sentences to independently attested differences between children and adults in the computation of scalar implicatures (see Guasti et al. 2005 for a recent review).

Let us now consider the adults who reject (9). From the point of view of the QAR, this response is not as puzzling as it may seem. The answer is puzzling, however, from the point of view of the Principle of Charity or the licensing conditions of PPIs. An adult in this experimental setting is faced with the following problem: either choose the true interpretation, even though doing so requires accommodating a question different from the Question under Discussion, or choose the interpretation that answers the Question under Discussion, even though it is false and violates the licensing conditions of the PPI *some*. An adult selecting the latter option must be choosing to violate the Principle of Charity in favor of sticking with the Question under Discussion conveyed by the context. However, how can we explain the violation of the PPI licensing conditions? Notice that (10a) is an available interpretation if *some* is phonologically reduced as in (35).

- (35) The Troll didn't lose *sm* pizzas.<sup>15</sup>

Thus, adults who reject (9) may not be choosing to accommodate a different question. Rather, they may be correcting the sentence so that it contains a different version of *some*, a move by which (10a) becomes available and can be selected to answer the contextually given question (for a study on adults' spontaneous correction of some kinds of ungrammatical sentences see Crain and Fodor 1987).

<sup>15</sup> We indicate with *sm* the unstressed variant of the indefinite *some*. A classifying property of that item, which does not seem to share the scope restrictions of stressed *some*, is the possibility of occurring in *there*-existential constructions (see Milsark 1977).

Thus, there seem to be two patterns of responses for adults. The following factors might account for the differences between them: (a) variations in willingness/ability to entertain a question different from the one made salient by the context; (b) variations in willingness/ability to allow pragmatic principles (scalar implicatures) to enrich the relevant interpretations in order to address the Question under Discussion; and (c) differences in sensitivity to the polarity properties of the relevant indefinite, perhaps due to its stress properties. Of course, a combination of these factors could be at work.

We would like to suggest that these factors could also be invoked to explain the differences between adults and children. Children in the developmental stage that we are considering reject sentences like (9) (i.e., *The Troll didn't lose some pizzas*) and (29) (i.e., *Some pizzas were not lost*) in the context we have been observing. In our view, the reason is that these children either (a) stick to the Question under Discussion conveyed by the context; (b) ignore scalar implicatures in determining whether a given interpretation addresses the Question under Discussion; or (c) consider a non-PPI version of *some*. We have already suggested how (b) would connect to previous research on language acquisition. We would like to conclude with a speculation that would support (a) from a broader perspective.

It is possible that the ability to accommodate a new question is tied to the development away from 'Egocentrism', a stage in which young children experience difficulties in postulating in other people certain motivations and thoughts different from their own (see, for instance, Maratsos 1976). The inability of those children who reject (9) to accommodate a new question could be explained if they are partially egocentric: once they have hypothesized a question, they are unable (or find it difficult) to realize that the speaker may have had in mind a different question. Under this scenario, one should find a correlation with children's behavior across some of the phenomena that can be tied to the existence of an egocentric stage (e.g., the use of the definite article in contexts in which an indefinite should be used, the use of pronouns in the absence of explicitly established referents). If such a correlation were to exist, it would lend further support to (a) as a primary factor in children's behavior in the experiments we have discussed.

## 9 Conclusion

It seems that sentences containing negation and a quantifier do not provide motivation for postulating a preference for surface scope in a theory of children's scope assignment. We have presented evidence that supports a new hypothesis, the Question–Answer Requirement. Under this hypothesis, an assertion must be the answer to a question, for both children and adults. Both children and adults prefer the scope assignment that allows them to address the Question under Discussion. Sometimes, this interpretation will happen to coincide with surface scope, giving rise to an illusion of Isomorphism.

We would like to end by highlighting one issue that needs to be addressed by future research. Despite the success of our account in explaining the data that are

available in the literature as well as the data that we have contributed, one particular scope-bearing element seems to pose nontrivial challenges. This is the case of the indefinite *two*. Our own experiment shows that when the context makes salient a particular question that can be addressed by an interpretation in which *two* has scope over negation, children can access that reading despite the fact that this amounts to an inverse scope interpretation. As we acknowledged above, this follows from the Question–Answer Requirement on the assumption that over-informative answers count as good answers. An issue that still remains to be addressed, however, is under what conditions the alternative interpretation counts as a good answer. In particular, it must be noticed that replacing the indefinite *some* with *two* may result in an interpretation that does not address the relevant question.

- (36)a. Question: Did the Troll deliver all the pizzas?  
 b. Answer: It is not the case that the Troll lost some pizzas.  
 c. Answer: #It is not the case that the Troll lost two pizzas.

Given the contrast above, the question is why children have been found to interpret *two* in the scope of negation to the same extent as the indefinite *some*—if not more often. From the point of view of the QAR, the answer to this question is not clear. One possibility is that sentences with numerals impose additional requirements on the questions that they can address: not only must they provide an answer to the Question under Discussion, but also that question has to be one about the numerosity of a given set. One question that could account for the data documented in previous studies is the following:

- (37)a. Question: Did the Troll lose two pizzas?  
 b. Answer: It is not the case that the Troll lost some pizzas.  
 c. Answer: It is not the case that the Troll lost two pizzas.

Of course, one would need to find some independent motivation to argue that (37a) is the relevant question. One way to test this hypothesis should be clear: if children have reasons to prefer interpreting numerals in the scope of negation because they tend to posit questions like (37a), then they should do so more often than adults even when this involves an inverse scope interpretation. Thus, the first step of future research should be an experiment investigating children’s interpretation of numerals in sentences similar to the ones in Experiment III. The results should give us a first indication of how we should approach the interpretation of numerals. Hopefully, this will allow us to refine the Question–Answer Requirement.

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## Appendix I

Test sentences and individual results from Experiment I

Trial #1: *The firefighter didn’t find two guys.*

Trial #2: *Chuckie didn’t put two bottles on the table.*

Trial #3: *The Troll didn't deliver two pizzas.*

Trial #4: *Bart Simpson didn't pick up two jewels.*

Subject	Age	Trial #1	Trial #2	Trial #3	Trial #4
Child 1	3;10;20	N	Y	Y	Y
Child 2	4;00;06	Y	Y	N	Y
Child 3	4;00;19	Y	Y	Y	Y
Child 4	4;01;07	Y	Y	N	Y
Child 5	4;01;16	N	N	N	N
Child 6	4;02;19	Y	N	Y	Y
Child 7	4;04;03	Y	Y	Y	Y
Child 8	4;04;18	Y	Y	Y	Y
Child 9	4;05;19	N	N	N	Y
Child 10	4;06;26	Y	Y	Y	Y
Child 11	4;07;05	N	N	N	N
Child 12	4;08;14	Y	Y	Y	Y
Child 13	4;09;15	Y	N	N	Y
Child 14	4;11;20	Y	Y	Y	Y
Child 15	5;00;05	Y	Y	Y	Y
Child 16	5;02;04	Y	Y	Y	Y
Child 17	5;03;07	Y	Y	Y	Y

### Test sentences and individual results from Experiment II

Trial #1: *Every letter wasn't delivered.*

Trial #2: *Every brush wasn't found.*

Trial #3: *Every crayon wasn't put away.*

Trial #4: *Every pet wasn't picked up.*

Subject	Age	Trial #1	Trial #2	Trial #3	Trial #4
Child 1	3;00;20	Y	Y	Y	Y
Child 2	3;03;25	Y	N	N	N
Child 3	4;00;08	Y	N	Y	N
Child 4	4;00;13	Y	Y	N	Y
Child 5	4;01;26	Y	Y	Y	Y
Child 6	4;03;02	Y	Y	Y	Y
Child 7	4;05;17	N	N	N	N
Child 8	4;06;09	Y	Y	Y	Y
Child 9	4;06;19	Y	Y	Y	Y
Child 10	4;07;25	Y	Y	Y	Y
Jared 11	4;09;10	Y	Y	Y	Y
Child 12	4;11;21	N	N	N	Y
Child 13	5;00;26	Y	Y	Y	N
Child 14	5;01;13	Y	N	Y	Y
Child 15	5;01;17	Y	Y	Y	Y
Child 16	5;01;26	Y	Y	Y	Y
Child 17	5;03;05	Y	Y	Y	Y
Child 18	5;03;07	Y	Y	Y	Y
Child 19	5;07;07	Y	Y	Y	Y

## Test sentences and individual results from Experiment III

*Deliver condition*

Trial #1: *Some jewels were not found.*

Trial #2: *Some kids were not found.*

Trial #3: *Some pizzas were not delivered.*

Trial #4: *Some plates were not put on the table.*

Subject	Age	Trial #1	Trial #2	Trial #3	Trial #4
Child 1	2;10;28	Y	Y	N	Y
Child 2	2;11;22	Y	Y	Y	N
Child 3	3;08;10	N	Y	Y	N
Child 4	3;11;01	Y	N	N	N
Child 5	4;03;25	Y	Y	Y	Y
Child 6	4;04;01	Y	Y	Y	Y
Child 7	4;09;14	Y	Y	Y	Y
Child 8	4;10;23	Y	Y	Y	Y
Child 9	4;10;29	Y	Y	Y	Y
Child 10	4;11;06	Y	Y	Y	Y
Child 11	5;00;18	Y	Y	Y	Y
Child 12	5;03;03	Y	Y	Y	Y
Child 13	5;03;14	Y	Y	Y	Y
Child 14	5;04;01	Y	Y	Y	Y
Child 15	5;06;16	Y	Y	Y	Y

*Lose condition*

Trial #1: *Some jewels were not lost.*

Trial #2: *Some kids were not missed.*

Trial #3: *Some pizzas were not lost.*

Trial #4: *Some plates were not dropped.*

Subject	Age	Trial #1	Trial #2	Trial #3	Trial #4
Child 1	2;10;16	Y	N	Y	Y
Child 2	3;09;06	N	N	N	N
Child 3	4;01;26	Y	Y	Y	Y
Child 4	4;02;13	Y	N	Y	Y
Child 5	4;03;17	Y	Y	Y	Y
Child 6	4;08;12	N	Y	N	N
Child 7	4;09;06	N	N	N	N
Child 8	4;09;07	Y	N	Y	N
Child 9	4;10;17	Y	Y	Y	Y
Child 10	5;02;04	N	N	N	N
Child 11	5;03;22	N	N	N	Y
Child 12	5;06;13	N	N	N	N
Child 13	5;08;29	Y	Y	Y	N
Child 14	5;11;26	N	N	N	N
Child 15	6;01;01	N	N	N	Y

## Appendix II

In this appendix, we report the results of an experiment adopting a within-subject design. Each child was presented with two sentences containing *some* in object position in contexts that would make the target sentence false but relevant to the Question under Discussion on its surface scope interpretation. These were followed by two sentences containing *some* in subject position in contexts that would make the target sentence false but relevant to the Question under Discussion on its inverse scope interpretation. The prediction of the QAR account is that children's non-adult behavior should predominantly take the form of rejection of both kinds of sentences (because only the false readings of the sentences were relevant to the QAR), whereas the prediction of Isomorphism-by-Default is that children's non-adult behavior should predominantly take the form of surface scope responses. This means rejection of the sentences containing *some* in object position, but acceptance of the ones containing *some* in subject position.

Unfortunately, the results revealed more variability than we could anticipate on the basis of previous research. In particular, in addition to three children who seem to have acquired the polarity properties of *some* (e.g., child 1), we found at least seven children who gave different responses across the two trials testing one of the sentence types (e.g., child 2). These children should not be used to reject either QAR or Isomorphism-by-Default, because of the inconsistency of their answers. A possible hypothesis is that these children are in transition from the initial state, regardless of whether that state can be accurately characterized by QAR or Isomorphism-by-Default, to the adult state, which includes knowledge of the fact that *some* is a PPI. The remaining children who do not show consistent knowledge of the PPI properties of *some* could be classified in the following way. Fourteen children always interpret *some* in the scope of negation and reject the target sentences (e.g., child 3). These are the children whose behavior is explained by QAR, but not by Isomorphism-by-Default. In addition, there are seven children whose behavior could arguably be predicted by Isomorphism-by-Default, since they reject the sentences containing *some* in object position but accept the ones containing *some* in subject position. However, when asked to motivate their acceptance of the sentences containing *some* in subject position, three of these children gave at least one justification that was inconsistent with their response (i.e., child 9, child 15, and child 32). It could be argued that these four children should not be classified as 'purely' isomorphic children, but should rather be grouped with the seven children who showed inconsistent behavior for one of the sentence types. This leaves us with only four children out of the initial 34 who can reasonably be said to show a preference for surface scope interpretations or, alternatively, who could have hypothesized that the scope-taking properties of *some* in subject position are different from the scope-taking properties of *some* in object position.

One reviewer raises an interesting concern about the within-subject variability that emerges from the present experiment. In particular, this reviewer writes that the individual data reveal more variability than one would expect if

we were only dealing with two groups of children (i.e., one group of children who treats *some* as a PPI and one group of children who has an ambiguity, which is resolved as specified by the QAR). The number of trials (for each sentence type) is too small to evaluate this issue. By looking at the data, one can find seven children out of 34 that respond differently to the first two trials of Experiment IV. Gualmini (2004b) elicited a non-uniform pattern from five children out of 15 (using four trials per child though), so it is not clear there is a difference between the two studies. Putting the numbers aside, as we stated above, some of these children might be ‘in transition.’ Notice that on some views of language development, individual variability is not so surprising. For instance, if we assume the model by Yang (2002), according to which children may entertain more than one grammar at any given time and then use each piece of input to either punish or reward the grammar they happen to select to analyze that piece of input, one would expect some variability even if children were trying to distinguish between two mutually inconsistent hypotheses (say, for sake of the argument, Option I: *some* is PPI, and Option II: *some* is an NPI). If, in addition to these options, we have a grammar that partially overlaps with both (i.e., Option III: *some* gives rise to an ambiguity, resolved by QAR), the amount of variability that can be expected is even greater.

#### Test sentences

Trial #1: *Pluto didn't lose some pizzas.*

Trial #2: *The pirate didn't drop some plates.*

Trial #3: *Some kids were not missed.*

Trial #4: *Some jewels were not lost.*

#### Individual data

Subject	Age	Trial #1	Trial #2	Trial #3	Trial #4
Child 1	3;02:01	Y	Y	Y	Y
Child 2	3;07:29	Y	N	Y	Y
Child 3	3;08:27	N	N	N	N
Child 4	3;11:00	N	N	N	N
Child 5	4;00:12	Y	Y	N	Y
Child 6	4;00:17	N	N	N	N
Child 7	4;03:24	Y	N	N	Y
Child 8	4;04:08	N	Y	N	N
Child 9	4;04:26	N	N	Y	Y
Child 10	4;05:17	N	N	N	N
Child 11	4;06:02	Y	N	Y	Y
Child 12	4;06:20	N	N	N	N
Child 13	4;07:24	Y	N	N	N
Child 14	4;08:06	N	N	Y	Y
Child 15	4;10:03	N	N	Y	Y
Child 16	4;10:18	Y	Y	N	Y
Child 17	4;11:03	N	Y	N	Y
Child 18	4;11:06	N	N	Y	Y
Child 19	5;00:14	N	N	N	N

continued

Subject	Age	Trial #1	Trial #2	Trial #3	Trial #4
Child 20	5;01:15	N	N	Y	Y
Child 21	5;01:21	N	N	Y	N
Child 22	5;01:27	N	N	N	N
Child 23	5;02:03	N	N	N	N
Child 24	5;02:08	Y	Y	Y	Y
Child 25	5;02:09	N	N	Y	Y
Child 26	5;02:14	N	N	N	N
Child 27	5;03:11	N	N	N	N
Child 28	5;03:24	N	N	N	N
Child 29	5;05:22	N	N	N	N
Child 30	5;07:11	Y	Y	Y	Y
Child 31	5;08:29	N	Y	N	N
Child 32	5;09:14	N	N	Y	Y
Child 33	6;00:28	N	N	N	N
Child 34	6;02:03	N	N	N	N

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