SCOPE ASSIGNMENT IN CHILD LANGUAGE: ON THE ROLE OF THE QUESTION UNDER DISCUSSION*

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This paper focuses on recent work on children's interpretation of scopally ambiguous sentences. We review current literature on the topic and we discuss two theoretical notions, namely the notion of surface scope and the notion of Question under Discussion (QUD). We argue that both notions are theoretically motivated but pertain to different domains. In particular, in agreement with current literature, we acknowledge that notions defined over the syntax-semantics mapping play a role in determining the number of interpretations that are available for any given sentence (see Fox, 2000). However, we propose that inverse scope and surface scope are equally available to the psychological parser. In particular, we argue that ambiguity resolution is guided by contextual congruence rather than by considerations about the syntax-semantics mapping.

1. *Scope Resolution in Child Language*

One of the most investigated topics in semantic theory is the interpretation and the interaction of scope-bearing elements (see Aoun and Li (1993), Fox (2000), May (1985) and Reinhart (1997)). In recent years, scope ambiguities involving negation have also been the subject of many investigations of child language. In particular, much current research on this topic starts from the seminal work of Musolino (1998), which documented children's non-adult behavior with sentences such as the ones reported below.

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

(2) The detective didn't find some guys

(3) The detective didn't find two guys

Each of the sentences above contains two operators: negation and a quantified noun phrase. This yields two logically possible scope assignments for each sentence. To illustrate, (1) is ambiguous between the two interpretations in (4) and (5).

(4) Every horse is such that it did not jump over the fence
$\forall x$ [horse (x) $\rightarrow$ $\neg$ jump over the fence (x)]

(5) Not every horse jumped over the fence
$\neg \forall x$ [horse (x) $\rightarrow$ jump over the fence (x)]

The two interpretations of (1) listed in (4) and (5) result from the relative scope assignment to negation and *every*, as suggested by the order of the logical operators ¬ and ∀ in the logical formulae. In the semantic literature, the interpretation in (4) is referred to as the 'surface scope' interpretation of (1), while (5) is referred to as the 'inverse scope' interpretation of (1). This is because in the interpretation in (4), the scope bearing elements *every* and *not* are interpreted in the same order with which they appear in the overt syntax, whereas in (5) they are interpreted in the opposite order.

The research question that Musolino (1998) and many others following him have addressed is whether the two interpretations of a scopally ambiguous sentence have equal status in children's grammars. More generally, Musolino (1998) wanted to find out whether young children are capable of accessing both the surface scope and the inverse scope interpretation of sentences containing negation and another scope-bearing element.

To address this question, Musolino (1998) conducted a series of experiments employing the Truth Value Judgment task that tested children's interpretation of sentences like (1)-(3). The experimental evidence collected by Musolino (1998) suggests that inverse and surface scope interpretations of negative sentences are not equally accessible to young (4- and 5-year-old) children. In fact, the experimental evidence collected by Musolino (1998) suggests that for the sentences in (1)-(3), children resort to their surface scope interpretations, paraphrased below.

(6) Every horse is such that it did not jump over the fence
∀x [horse (x) → ¬ jump over the fence (x)]

(7) It is not the case that the detective found some guys
¬∃x [guy (x) → detective found (x)]

(8) It is not the case that the detective found two guys
¬∃x [two guys (x) → detective found (x)]

To review the experimental findings briefly, Musolino (1998) showed that 4- and 5-year-old children would consistently reject a sentence like (1) in a context in which two horses had jumped over the fence and one horse had stayed behind. Furthermore, Musolino (1998) found that children as old as 5;9 rejected sentences like (2) or (3) if the detective found two of the four guys available in the context, whereas a group of adult controls consistently accepted the target sentences. More precisely, many of the children tested by Musolino (1998) claimed that (2) was incorrect because the detective had indeed found some guys.

Children's failure to access the inverse scope interpretation of the relevant sentence, even though that interpretation would have made the sentence true, was taken as evidence that children's semantic scope is limited to overt syntactic scope. This is the Observation of Isomorphism proposed by Musolino (1998).

As extensively discussed by Musolino (1998), Musolino (2006) and Musolino, Crain and Thornton (2000), children's non-adult behavior as described above can be approached in two different ways. As a first possibility, children might not have access to the same range of interpretations as adults. On this scenario, children's non-adult behavior might ultimately be due

to a problem with any of the factors that determine what interpretations are available to adults. For instance, as we will review momentarily, Fox (2000) has observed that when inverse scope interpretations are indistinguishable from surface scope interpretations, only the latter option is available. Thus, surface scope plays a crucial role, in that it provides a 'baseline' against which inverse scope interpretations are evaluated. Given Fox's account, one might put forward the hypothesis that inverse scope is subject to even more stringent grammatical constraints in child language. As a second possibility, children and adults might have access to the same interpretations, but they might differ in which interpretation they take to be the speaker's intended interpretation.

As it turns out, the evidence documented by subsequent research speaks in favor of the second scenario. In particular, recent studies have shown that children's interpretation of sentences like (1) - (3) is affected by the context. For present purposes, an interesting pattern emerges once we consider a study by Gualmini (2004). This investigation included stories in which a character had a task to carry out. In one of the trials, children were told a story about a troll who was supposed to deliver four pizzas to Grover. On the way to Grover's house, two pizzas fell off the truck, and the troll only managed to deliver two of the four pizzas. Children were then asked to judge either (9) or (10).

(9) The troll didn't deliver some pizzas

(10) The troll didn't lose some pizzas

The results documented in Gualmini (2004) show that children respond differently to the two sentences. Thirty 4- and 5-year-olds participated in the experiment. Children accepted the inverse scope interpretation of (9) to a higher extent than they did for (10) (i.e., 90% and 50% respectively).

A further study by Gualmini, Hacquard, Hulsey and Fox (2005) showed that, just as in the case of (9), the same context used by Gualmini (2004) also leads children to access the inverse scope interpretation of sentences equivalent to (1) and (3), namely (11) and (12), respectively (for data on sentences containing the universal quantifier *every*, see also Musolino and Lidz (2006)).

(11) Every pizza wasn't delivered

(12) The troll didn't deliver two pizzas

In other words, the experimental manipulation discovered by Gualmini (2004) leads children to access inverse scope interpretations for all the scope-bearing elements that had yielded non-adult behavior in Musolino's (1998) investigation.

Let us sum up. We started with children's non-adult behavior as documented by Musolino (1998). Following previous work, we noted that children's behavior could follow from a problem in the generation of the adult interpretation(s) or from a problem in the selection of that interpretation (out of the available options). We then noted that the data suggest that children's grammars generate all the relevant interpretations, and the source of the problem

seems to lie in how children go about selecting the intended interpretation. The question we would like to address is whether this change in the phenomenon under investigation also calls for a change in the theoretical machinery that is needed to explain the facts. Now that the problem seems to lie in the scope interpretation which children choose (rather than the ones they can generate), we need to consider whether theoretical notions other than the notion of surface scope are needed to explain the facts.

2. *On the relevance of surface scope*

In this section, we focus on one notion that has attracted much attention in the debate on scope resolution in child language, namely the notion of surface scope. In agreement with much current research in theoretical linguistics, we acknowledge the importance of this notion. In particular, the surface scope interpretation is used in explaining why logically plausible interpretations are often unavailable (see Fox (2000)). However, contra much child language literature, we also argue that the notion of surface scope does not explain how children go about selecting the intended interpretation (out of the alternatives that are available to them).

Let us first consider one phenomenon for which surface scope plays a crucial role. Compare the following examples, discussed in Fox (2000):

(13) A girl admires every teacher

(14) Every boy admires every teacher

If we consider (13), one can think of truth-conditional evidence for the existence of the inverse scope interpretation. In particular, one can think of situations in which only the inverse scope interpretation holds. For instance, sentence (13) is true in a situation where Mr. Sumner is admired by Jenny, Mrs. Townsend by Zoe and Miss Linklater by Lucy (and there are no other girls who admire the teachers). In such a situation, only the inverse scope interpretation of (13) is true. Due to the entailment relations that hold between the two readings, the issue remains whether the surface scope interpretation is also available, an issue that will be resolved shortly, but at the very least one knows that the inverse scope interpretation needs to be posited. When it comes to (14), however, the surface and inverse scope interpretations happen to be true in exactly the same range of situations, that is, where Marc admires Mr. Sumner, Mrs. Townsend and Miss Linklater, and so do Robert and John. In other words, the two putative scope assignments of (14) are truth-conditionally indistinguishable. The consequence is that we do not know which scope assignments are possible.

To make up for the shortage of truth-conditional evidence for the existence of both scope assignments, Fox (2000) shows that one can turn to other tests. For instance, Fox (2000) makes use of a constraint on ellipsis. Consider (15).

(15) A girl admires every teacher. Every boy does, too

What is interesting about (15) is that the antecedent sentence, which is identical to (13), can only receive a surface scope interpretation. Thus, the sentence now seems to require that there be a

single student, say Jenny, who admires all the teachers, that is, Mr. Sumner, Mrs. Townsend and Miss Linklater. The question is why the inverse scope interpretation, which is available for (13), disappears when the same sentence is used in the antecedent sentence of an ellipsis construction. In other words, we need to explain why whereas (13) is true even in a situation in which every teacher is admired by a different girl, for (15) to be true, it must be the case that the very same girl admires every teacher (and, of course, that every boy admires every teacher, too).

According to Fox (2000), an explanation emerges once we notice that ellipsis constructions are subject to a Parallelism constraint: the elided verb phrase needs to be identical to a phonologically-realized verb phrase in the antecedent sentence. A consequence of Parallelism is that the scopal relationship of the elided sentence must be identical to the one of the antecedent sentence. In short, the antecedent and the elided sentence must receive parallel scope assignment. On this view, the explanation for the interpretation of (15) is quite simple: knowing that the antecedent sentence and the elided sentence must receive parallel scope, and seeing that in this particular case the antecedent sentence can only receive a surface scope interpretation, it must be the case that the sentence containing ellipsis must be interpreted on its surface scope interpretation. In a sense, the antecedent sentence takes the only scope assignment which is available for the elided sentence. For present purposes, however, what is crucial is not the fact that the antecedent sentence must have the same scope assignment as the elided sentence, but rather that this provides us with a window into the scope assignment of the elided sentence itself. And what we see is that only the surface scope interpretation is available.

The consequences of Fox's (2000) investigation are far reaching. The generalization proposed by Fox (2000) is that whenever the two logically possible interpretations of a sentence are truth-conditionally indistinguishable, only surface scope needs to be posited. In turn, this means that inverse scope interpretations – but not surface scope interpretations - are subject to a constraint: they must yield an interpretation that is truth-conditionally distinguishable from the surface scope interpretations. This is a generalization that Fox (2000) attempts to derive from the non-economical nature of scope-shifting operations (see also Reinhart (2006)).

Let us take stock. The relevance of the notion of surface scope is indisputable. The preceding discussion highlights one constraint on the generation of inverse scope interpretations. At first glance, one could hypothesize that Musolino's original findings follow from children's grammar encoding a yet stronger constraint than the one discussed by Fox (2000), maybe even a total ban against inverse scope interpretations. Under this scenario, surface scope would define the hypothesis space available to children. Nevertheless, the results documented by Gualmini (2004) and Gualmini, Hacquard, Hulsey and Fox (2005) falsify this hypothesis. We now know that children's grammars can generate both scope interpretations of sentences like (1) - (3).[1] The next question is whether the notion of surface scope can be invoked in any other way to explain children's non-adult behavior. This is the strategy followed by Musolino and Lidz (2006), who argue that a parsing preference for surface scope, together with a preference for true interpretations, accounts for children's non-adult behavior. We, however, would like to pursue a different strategy. In fact, there are at least two pieces of evidence suggesting that the notion of surface scope is not useful in approaching this last phenomenon.

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The first piece of evidence against the role of surface scope assignment in children comes from Dutch-speaking children. Consider the Dutch example in (16), taken from Krämer (2000).

(16) De jongen heeft een vis niet gevangen
The boy has a fish not caught
'There is a fish the boy hasn't caught.'

Children's interpretation of sentences like (16) was investigated by Krämer (2000). The experimental results show that 38 Dutch-speaking children from 4;0 to 7;7 rejected (16) as a description of a story in which a boy had caught two fish out of the three fish available in the context, whereas adults always accepted it (see also Unsworth (2005)). Children, unlike adults, apparently interpreted the indefinite *een vis* ('one fish') in the scope of negation, which corresponds to the inverse scope interpretation of (16). Even if we simply take Isomorphism as a descriptive generalization about how differences between children and adults can manifest themselves, the challenge posed by the Dutch data is quite clear: unlike many of the previous findings with English-speaking children, Dutch-speaking children select the *inverse scope* interpretation more readily than the surface scope interpretation.

An additional piece of evidence against Isomorphism comes from English-speaking children and is reported in a study by Hulsey, Hacquard, Fox and Gualmini (2004). These authors designed an experiment to tease apart the relative contribution of a putative preference for surface scope and contextual information. We will return to their particular model of how context guides ambiguity resolution momentarily. For now, we consider the relevance of their experiment for the role of surface scope in ambiguity resolution. Basically, Hulsey et al. reasoned as follows. If a preference for surface scope plays a crucial role in explaining children's non-adult behavior, a manipulation of the surface syntax of the stimuli should have an effect on children's behavior. In an experiment, Hulsey et al. (2004) tested children's interpretation of sentences such as (17) and (18).

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(17) Some pizzas were not delivered

(18) Some pizzas were not lost

If we compare sentences (17) and (18) with the sentences used by Gualmini (2004) (i.e., (9) *The troll didn't deliver some pizzas* and (10) *The troll didn't lose some pizzas*), we see a different surface syntax, namely passives versus actives, respectively. Thus, if surface syntax dictates children's responses, children should respond to (17) differently from the way they respond to (9) and they should respond differently to (18) and (10). This prediction turned out to be incorrect, however. Hulsey et al. discovered that children in the relevant developmental stage interpret (17) like (9) and (18) like (10). In other words, children's responses are not dictated by by structural form.

To illustrate, let us focus on children's interpretation of sentences like (18). The finding documented by Hulsey et al. (2004) was that adult speakers of English always accepted sentences such as (18) in the context under investigation, thereby consistently selecting its true surface scope interpretation (i.e., there are some pizzas that were not lost). By contrast, children rejected the target sentence about half of the time. In particular, about half of the time, children's responses were indicative of the inverse scope interpretation (i.e., no pizza was lost). Thus, some of Hulsey's et al findings resemble Krämer's (2000) and Unsworth's (2005) findings, in that children select the inverse scope interpretation for sentences that adults seemingly must interpret

according to surface scope. In our view, this undermines the hypothesis that surface scope plays a crucial role in determining which interpretation of a scopally ambiguous sentence children select.

To sum up, in this section we have discussed the notion of surface scope. We do not dispute the importance of such a notion in explaining which interpretations are generated in the grammar of children or adults. However, in our view, the data suggest that the notion of surface scope is of little use in explaining which interpretation is ultimately selected by children's (or adults') parser. To answer this question, we would like to invoke a different notion.

3. *On the relevance of the Question under Discussion*

We concluded the previous section by arguing that the notion of surface scope, though theoretically useful, does not help us in solving the problem outlined in Section 1, namely why children and adults sometimes select a different interpretation of scopally ambiguous sentences. In this section, we turn to an independently motivated notion that we believe can be used to answer this question. This is the Question under Discussion (QUD).

The relevant study is due to Hulsey, Hacquard, Fox and Gualmini (2004). These authors developed a new model of scope resolution in child language that makes reference to independently motivated principles of communication. According to this model, which Hulsey et al. (2004) call the Question-Answer Requirement (QAR), children select the scope assignment that allows them to address the Question under Discussion. In turn, according to Hulsey et al. (2004), a good answer to a question is a proposition that entails an answer to that question.

According to Hulsey et al. (2004), what is relevant in the pizza story used by Gualmini (2004) is the troll's task. At the end of the story, one wants to know whether the troll has carried out his task or not. This amounts to asking the 'yes/no' question "*Did the troll deliver all the pizzas?*". Let us recall the relevant target sentences.

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(9) The troll didn't deliver some pizzas

(10) The troll didn't lose some pizzas

Notice that both inverse and surface scope interpretations of (9) entail an answer to that question. On the surface scope interpretation, the troll didn't deliver any pizzas, hence the answer to the Question under Discussion is negative. On the inverse scope interpretation, there are some pizzas that the troll didn't deliver and therefore the answer to the Question under Discussion is also negative. Thus, as far as the Question-Answer Requirement is concerned, either scope assignment is viable, and children can make use of the Maxim of Charity (see Grice (1975)), which essentially means that they will select the interpretation that makes the target sentence true (i.e., inverse scope). By contrast, in the case of (10), only the surface scope interpretation addresses the contextually relevant question. In a context in which delivering and losing pizzas are the relevant alternatives, the surface scope interpretation of (10) is equivalent to the proposition paraphrased in (20), which is false in the context, but answers the QUD.

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(19) The troll delivered all the pizzas

By contrast, the inverse scope interpretation of (10) in the present context is equivalent to (20), which implicates an answer to the QUD, but does not entail it. In particular, (20) is true both if the troll delivered all of the pizzas and if he only delivered some of them. Thus, by simply knowing that (20) is true, one does not know the answer to the question whether the troll delivered all the pizzas.

(20) The troll delivered some pizzas

Given that only one interpretation satisfies the Question-Answer Requirement, the Maxim of Charity ends up being violated. In other words, Hulsey et al. (2004) argue, if only one interpretation addresses the Question under Discussion, that interpretation is selected regardless of whether it makes the target sentence true or false. Moreover, whether an interpretation corresponds to surface or inverse scope of the target sentence does not play a role in determining whether that interpretation is selected.

A prediction of this model is that, for any given context and for any given predicate, children will prefer the same interpretation, regardless of whether it amounts to surface scope or inverse scope. As we saw above, this prediction was corroborated by Hulsey et al. (2004) in an experiment testing children's interpretation of the following sentences:

(21) Some pizzas were not delivered

(22) Some pizzas were not lost

The crucial case is given in (22). As we saw above, if surface scope figures prominently in scope resolution, children should consistently interpret (22) on its true surface scope interpretation. The predictions of QAR are different, however. This model does not assign any privileged status to surface scope in ambiguity resolution. When a sentence is ambiguous, the listener must consider whether any interpretation 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. Within the present context, the Question under Discussion is whether the troll delivered all the pizzas. As in the case of (10), the only interpretation of (22) that is a good answer to that question 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 (22), this is the inverse scope interpretation. Therefore, the QAR predicts that some children will reject (22). More precisely, the QAR predicts that children for whom the sentence is ambiguous will reject (22) to the same extent to which they rejected (10) 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.

The results show that English speaking 3- and 4-year-old children always accepted (21), but many of them rejected (22). In particular, half of the subjects tested by Hulsey et al. (2004) rejected (22) on the grounds that some pizzas were indeed lost, thereby accessing the inverse scope interpretation of (22) (i.e., it is not the case that some pizzas were lost). As predicted by the QAR model, the rate of rejection for (22) (i.e., 57%) closely mirrors the rate of rejection found by Gualmini (2004) for (10) (i.e., 50%).

An additional prediction of the QAR account proposed by Hulsey et al. (2004) pertains to other constructions investigated by Musolino (1998). Having seen how the QAR account can explain children's documented non-adult behavior for sentences containing the indefinite *some* in object position, we can ask whether the QAR account can also explain children's non-adult behavior for sentences containing the indefinite *two* in object position or the universal quantifier *every* in subject position. As we saw above, this question was addressed in a later study by Gualmini et al. (2005). In particular, these authors showed that the same contextual manipulation discovered by Gualmini (2004) leads children to access the inverse scope interpretation of sentences containing negation and the indefinite object *two* (e.g., *The troll didn't deliver two pizzas*) as well as sentences containing the universal quantifier *every* and negation (e.g., *Every pizza wasn't delivered*) to a higher extent than observed in previous literature (see Gualmini (2005/2006) for a summary of the data and Gualmini (2007) for further discussion about how the QAR can explain previous data by Musolino (1998)).

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The QAR account also invites a fresh look at the putative cross-linguistic difference that emerges once we compare English- and Dutch-speaking children. As we wrote in Section 2, Dutch-speaking children's behavior provided us with the first piece of counterevidence to the Observation of Isomorphism, in that English- and Dutch-speaking children's non-adult behavior seemed to surface in such different ways. Recall the Dutch example in (16) repeated below as (23).

(23) De jongen heeft een vis niet gevangen
The boy has a fish not caught
'There is a fish the boy hasn't caught.'

As we saw above, Krämer (2000) found that children as old as seven interpreted (23) on its inverse scope interpretation, whereas adults consistently resorted to surface scope. This gives the illusion of a puzzle, as Dutch- and English-speaking children's non-adult behavior seems to take different shapes. The puzzle disappears, however, once we abandon Isomorphism and we consider the predictions of the QAR. One possibility is that the question conveyed by the story in Krämer's original experiment is something like "*Did the boy catch some fish?*". This question would only be addressed by the inverse scope interpretation of the indefinite, i.e. it is not the case that the boy caught a fish. The surface scope interpretation, namely that there is a fish which the boy did not catch, does not address this question because knowing that there is a fish which the boy did not catch does not tell us whether there are any fish which he *did* catch. The prediction of the QAR is that the acceptance of the target sentence should increase if the context makes prominent the following question: "*Did the boy catch all the fish?*". As it turns out, this prediction was borne out.

In a series of experiments, Unsworth and Helder (2007) and Unsworth and Gualmini (2007) show that making the same experimental manipulation discovered by Gualmini (2004) leads Dutch-speaking children to access the surface scope interpretation for sentences such as (23) more readily than observed in previous research. In Krämer's original experiment, the experimental scenario introduced a boy and some fish which the experimenter suggested the boy was going to catch, which, as noted above, might lead to the QUD "*Did the boy catch some fish?*". Unsworth and Helder (2007) and Unsworth and Gualmini (2007) modified this scenario such that the boy had a particular task to carry out, that is, he had to catch all the fish in order to

win a fishing competition. As a result, the Question under Discussion was "*Did the boy catch all the fish?*". Both the surface and inverse scope interpretations of the sentence in (23) answer this question.[2] On the surface scope interpretation, there is a fish which the boy did not catch and so Question under Discussion receives an answer. Similarly, on the inverse scope interpretation the Question under Discussion is answered because if it is not the case that the boy caught a fish, then it is also not the case that he caught all the fish. Assuming that children follow the Maxim of Charity, they should select the interpretation which makes the test sentence true, that is, the surface scope interpretation. This is exactly what they did.

Unsworth and Gualmini (2007) tested monolingual Dutch-speaking 5-year-olds using a Truth Value Judgment task using stories (five in each condition) in which the main character had to carry out a task involving all of the objects of a given set, such as catching all the fish as part of a fishing competition. In the first condition, the boy caught two out of the three available fish. As indicated above, in this condition both the surface scope and inverse scope interpretations answer the QUD. Seventeen children (5;0 – 6;0, M = 5;6) were tested in this condition. They accepted the surface scope interpretation 71% (57/80) of the time. This contrasts starkly with the 23% acceptance rate which Krämer (2000) observed for similarly-aged children.

In a second condition, similar to Gualmini (2004) and Hulsey et al. (2004), the boy caught just one of the available fish and fourteen children (5;4 – 5;11, M = 5;7) were presented with sentences such as (24).

(24) De jongen heeft een vis niet laten zwemmen
The boy has a fish not leave swim
'There is a fish the boy didn't leave.'

The surface scope interpretation of this sentence fails to answer the QUD: if we know that there is a fish which the boy has left swimming in the pond, we do not know whether he has caught all the fish. It is only the inverse scope interpretation which answers the QUD here: if we know that it is not the case that the boy left a fish, then, based on the contextual alternatives, we also know that he must have caught them all. The QAR thus predicts that children will accept the surface scope interpretation in this condition much less frequently than in the first condition. This prediction was borne out: the surface scope prediction was accepted for sentences such as (24) just 45% (38/85) of the time. The difference between the two conditions is statistically significant (t = 2.032, p = .051). The acceptance rate for adult controls was 100% (50/50) and 95% (38/40) in the two conditions, respectively.

In a similar experiment, Unsworth and Helder (2007) replicated an experiment originally carried out with English-speaking children by Miller and Schmitt (2004). By employing experimental changes similar to Gualmini (2004), Miller and Schmitt (2004) showed that, in contrast to earlier results such as those discussed in Section 1, English-speaking 4-year-old children consistently selected the inverse scope interpretation of sentences like (25) to the same extent as adults.

(25) Timothy didn't blow out a candle

These authors attribute this finding to their use of objects belonging to a pre-defined set, e.g. the candles on a birthday cake, the drawers in a chest, etc. in the experimental scenarios. It is

possible, however, that a second change which these authors implemented, namely requiring the protagonist in the story to carry out an action on all the objects (e.g. candles, drawers, etc.), may also have contributed to this result. Interpreted from the QAR approach, the fact that the protagonist had a particular action to carry out highlights the relevant QUD, that is, whether the task (e.g. blowing out all the candles, closing all the drawers, etc.) was carried out successfully. In doing so, this may warrant children's selection of the inverse scope interpretation as this is the only one which provides a true answer to the QUD.

Unsworth and Helder (2007) demonstrate that implementing the same experimental changes with Dutch-speaking children achieves a similar result. A Dutch version of Miller and Schmitt's (2004) original experiment was presented to two groups of children: 4-year-olds (n=15; 4;2 – 4;11, *M* = 4;6) and 6-year-olds (n=15; 6;5 – 7;0, *M* = 6;8). In each of the four trials, children were presented with stories in which a protagonist had to carry out an action on all members of a group of objects belonging to a pre-defined set (cf. Krämer's (2000) original experiment, replicated in Unsworth (2005), where this was not the case). Both groups of children were found to readily accept the inverse scope interpretation of sentences such as (23): 4-year-olds at a rate of 76.8% (46/60) and 6-year-olds all the time (80/80).

Taken together, the results from Unsworth and Helder (2007) and Unsworth and Gualmini (2007) suggest that although Dutch- and English-speaking children may differ in how quickly they acquire (and unlearn) an ambiguity, once we look at how scope ambiguities are resolved, Dutch- and English-speaking children behave in the same way: they select the contextually relevant interpretation, regardless of whether this amounts to surface scope or inverse scope.

We would like to conclude by commenting on the notion of Question under Discussion (QUD), which figures prominently in the QAR account by Hulsey et al (2004). In particular, we would like to stress that although such a notion did not enter the debate on scope resolution until recently, the Question under Discussion has been invoked to explain many other phenomena. Among others, the QUD seems indispensable in theories of focus and theories of implicatures (see van Rooij (2003; Roberts (2004) among others for theoretical work).

A recent psycholinguistic investigation that makes use of the QUD was carried out by Zondervan (2007). This study contains the results of two experiments investigating the role of the Question under Discussion for adults' computation of scalar implicatures (see Grice (1975) and Horn (1989)). The importance of contextual information in the computation of scalar implicatures is a widely discussed phenomenon, most often invoked in the Relevance Theory literature (see Carston (1998)). Zondervan (2007) focused on a different issue, namely whether the notion of QUD can be used to model the role of contextual information for the computation of scalar implicatures. Building on work by van Kuppevelt (1996) and van Rooij (2002), Zondervan (2007) set out to test the hypothesis that implicatures arise if and only if the scalar term is in a constituent that answers the QUD. In one of the experiments, the QUD was presented overtly. To illustrate, subjects heard the target sentence (e.g., *Harry brought bread or chips*), which was offered as a response to two different kinds of questions as illustrated below.

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(26) A: Who brought bread or chips?[3]
B: Harry brought bread or chips.

(27) A: What did Harry bring?

B: Harry brought bread or chips.

In both experimental conditions, the final outcome included Harry bringing both bread and chips. Thus, if subjects calculate the relevant implicature (i.e., Harry brought bread or chips *but not both*), the final outcome would warrant the rejection of the target sentence. However, the results show a significant difference in the calculation of implicatures: 55% for (26) and 73% for (27). Thus, when the scalar item *or* occurs in the constituent that is being questioned, subjects are more likely to compute the implicature and reject the target sentence than when the same scalar item occurs outside of the constituent being questioned. Interestingly, the same pattern emerges in a second experiment, in which the QUD is not presented overtly but rather needs to be evinced by the context. This suggests that the notion of Question under Discussion can be independently motivated, thereby making it possible to ask whether that notion can be useful in explaining other phenomena. As should now be clear, we believe that in the case of scope resolution, the answer to this question is affirmative.

An anonymous reviewer invites us to comment on the relationship between the Question-Answer requirement (QAR) and the Question under discussion (QUD). As this paper demonstrates, both theoretical and psycholinguistic evidence can be used to underpin the notion of Question under Discussion. Nevertheless, it is not the case that this notion alone explains children's behavior with scopally ambiguous sentences. In particular, assuming that every sentence which children (and adults) hear needs to be evaluated against the contextually relevant QUD, the next issue which needs to be addressed is which criteria guide such an evaluation. One hypothesis is that the parser filters the relevant interpretations by appealing to the notion of entailment: the parser privileges the interpretations that entail an answer to the QUD. This is the claim of the QAR model put forward in Hulsey et al. (2004). This is not the only possibility, however. In principle, it is possible that when it comes to other phenomena, the parser adjudicates among alternatives interpretations making use of weaker notions, such as implicature. Indeed, Hulsey et al. (2004) speculate that the difference between children and adults might ultimately boil down to them adopting different criteria to determine what counts as a good answer to the Question under Discussion. On this scenario, children first and foremost select the interpretation that entails an answer to the Question under Discussion, whereas adults might even make use of interpretations that implicate an answer such question (but see Zondervan, Meroni and Gualmini (2008) for discussion). In other words, the QUD and QAR are two distinct notions: the QAR puts forward a hypothesis about how the QUD can be used in ambiguity resolution.

To conclude, in this section we reviewed previous studies that make use of the notion of Question under Discussion (QUD). We have started from the question of how scopal ambiguities are resolved and we have showed how the QUD can be used in explaining the findings documented in the literature on child language and motivated further experimentation. Furthermore, we illustrated how the very same notion can be useful in explaining a seemingly unrelated phenomenon, namely the calculation of scalar implicatures in adults.

4. *Conclusion*

In this paper we have discussed two theoretical constructs: surface scope and Question under Discussion. Although we agree with much previous literature on the importance of surface scope, we also showed how its relevance needs to be circumscribed. In particular, surface scope interpretations provide the baseline against which logically possible interpretations are evaluated. For instance, in the case of a sentence like (13) (i.e., *A student admires every girl*) the inverse scope interpretation is available, because it is semantically distinguishable from the more economical surface scope interpretation. However, as far as ambiguity resolution goes, whether or not a given interpretation is a surface scope interpretation is irrelevant. Thus, once we focus on the task of selecting which interpretation of (13) could be intended in a given context, both interpretations are on equal footing. The so-called computational system might care about the mapping between syntax and semantics, but the parser apparently does not. Within the domain of scope resolution, the parser seems to be guided by other considerations, in particular by the truth and – above all – by the discourse congruence of each interpretation.

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[1] In fact, some data we review shortly suggest that children can even select inverse scope interpretations more freely than adults (see also Sano, T. (2004). Scope Relations of QP's and Scrambling in the Acquisition of Japanese. Proceedings of GALA, 421-431. and Yamakoshi, K. & Sano, T. (2007). Children's Interpretations of Some/every Interaction in Mono-clausal and Bi-clausal Structures in Japanese. Proceedings of the 2nd Conference on Generative Approaches to Language Acquisition North America (GALANA), 471-482.).

Unknown
Field Code Changed

Unknown
Field Code Changed

[2] Following Krämer (2000: 106), the sentences in (23) and (24) were pronounced with the most natural intonation for the expected adult interpretation, that is, with the NP destressed and a

slight stress on negation, and the indefinite article was pronounced in its unstressed form, i.e. *een* instead of *één.* Whilst it is true that in production, native speakers tend to produce scrambled indefinites as *één* (Unsworth 2005), the results for the native controls here demonstrate that this difference does not affect comprehension: scrambled indefinite objects are consistently interpreted as taking wide scope over adverbials such as negation when pronounced in their unstressed form.

[3] The experiment was conducted in Dutch with adult speakers of Dutch.