A NEW PRAGMATIC ACCOUNT OF QUANTIFIER-SPREADING

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1. Introduction

1.1. The Errors

In the study reported here, I have investigated the nature of certain interpretive errors children make with respect to universally quantified sentences well documented cross-linguistically. The aim of this line of research is to gain a better understanding of the relationship between semantics and pragmatics in children's knowledge of quantification with a broader goal of establishing what type of knowledge is available to children from early on and what type of competence undergoes development.

It is well attested in a variety of languages that children exhibit non-adult-like behavior with respect to interpretation of sentences like (1) and (2) under certain experimental conditions. In particular, it has been found that while children consistently judge (1) true when it is presented in the context of a picture, in which every boy is paired with a wagon and every wagon is paired with a boy, if an extra wagon is added to the picture, as in (3), children often reject (1) as false. Similarly, while they usually accept (2) when the sets of boys and of wagons pulled by them fully overlap, children may reject it in a situation with an extra, non-wagon-pulling boy, as in (4) (Philip 1995).

(1) Every boy is pulling a wagon.

(2) A boy is pulling every wagon.

(3) 

(4) 

This error has been labeled "quantifier-spreading" or q-spreading, the term I will continue to use for convenience. In looking for the solution to the puzzle presented by such errors, I will propose that by focusing entirely on the universal quantifier we had overlooked the role of indefinites and their ability to change the meaning of a universally quantified sentence in triggering such errors. Verifying sentences like (1) and (2) involves making

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judgments about relative quantifier scope. Furthermore, this judgment does not have to include any covert scope altering movement operations. The meaning of the sentence changes depending on how the domain of the indefinite is restricted, namely whether a "plural" or a "singleton" indefinite is chosen. If the singleton option is chosen, then (1) and (2) receive the 'wide scope' indefinite interpretation and would be false in the context of (3) and (4) respectively. I will suggest that children from early on have the knowledge of the semantics of quantification including scopal ambiguities, but are less good than adults at coping with deficient context when resolving them.

1.2. Previous Accounts

1.2.1. Contextual Symmetry Requirement as a Cognitive Property

The research that first brought to light children's errors triggered by contextual asymmetry was conducted by Inhelder and Piaget (1964). They discovered that when Swiss French-speaking children were presented with a visual array of geometric shapes consisting of blue circles as well as blue and red squares and asked "Are all the circles blue", they often responded 'no' and as an explanation pointed to the blue squares. Inhelder and Piaget called this response "symmetrical", and concluded that for young children ("stage II" in Piaget's developmental classification), sentences with the universal quantifier require symmetry between the set denoted by the predicate and the set denoted by the common noun of the subject. As Inhelder and Piaget put it, "It … looks very much as if the true explanation is that at stage II children extend the quantifier 'all' to the logical predicate of the sentence as well as to its logical subject" (Inhelder and Piaget 1964, pp. 70-71).

I&P attributed the errors to the immaturity of logical reasoning, namely the child's inability to construct hierarchical systems or operate in terms of a schema of class inclusion. Thus, they claimed that children at this stage, when presented with a question: 'Are all Xs Ys?', where Xs are individuals and Ys are properties, construct two non-graphic collections (as opposed to the more primitive graphic collections "stage I" children operate with), one of Xs and one of Ys. According to I & P, the child, unable to cope with the problem of the quantification of the predicate, is limited to ascertaining whether or not the collection of Xs coincides with that of Ys. This amounts to reducing the question 'Are all the Xs Ys?' to 'Are all the Xs all the Ys?' instead of the correct 'Are all the Xs some of Ys?' Thus, according to this view, the source of non-adult-like responses in children of this developmental stage is their replacement of class inclusion with equivalence.

Following this explanation, this type of error became known in the literature as the "symmetrical interpretation" error. More contemporary views attributing symmetrical interpretation to children amount to a claim that there is a fundamental difference between the

adult and the child semantics of the universal quantifier: adults require the truth conditions in (5) (simplified), while children require (6):[1]

(5) ||every||(A, B) = 1 iff A ⊆ B

(6) ||every||(A, B) = 1 iff A = B

I&P's theory offered an elegant explanation of the child data by positing a developmental path from the child to the adult interpretation as a transition from being able to handle a logically simpler operation to a more complex one. However, further research complicated the picture by revealing new conditions that give rise to non-adult responses inconsistent with (6). Thus, after expanding this line of research to sentences with two-place predicates, it was found that the lack of symmetry between the members of the agent-set (e.g. a set of boys) and that of the predicate (a set of wagon-puling individuals) is not what triggers the highest rate of symmetrical errors for most children, as would be predicted by (6). Rather, it is triggered by the lack of symmetry between the members of the agent-set (a set of boys) and that of the theme-set (a set of wagons).

One major study, Philip (1995), reports that for his so-called 'symmetry' group, the high error rate of 56% was obtained on the condition in which the scenario paired with the sentence 'every boy is riding a pony' contained three ponies ridden by boys and one rider-less pony. On the other hand, when the scenario contained three pony-riding boys and a pony-riding girl, this group gave adult-like yes-responses close to 100% of the time, showing that they do not require symmetry between boys and pony-riders, as would be predicted by I&P's account.[2]

Much subsequent research focused on this type of errors. However, I&P's hypothesis about children's symmetrical interpretation was adopted (in a modified form) as the basic descriptive generalization for which a new theoretical explanation was sought, one rooted in children's grammar, not in their general cognitive capacity.

1.2.2. Contextual Symmetry Requirement as a Property of a Non-Adult Grammar

Linguistic accounts that followed the influential work of I&P attempted to find a grammatical mechanism that would lead to the "symmetrical" interpretation, which has subsequently been referred to as 'exhaustive pairing' (to emphasize the child's now

[1] The Inhelder and Piaget study involved the French equivalent of the English 'all'. Most current research with English-speaking children centers on 'every', which is why I use 'every' in the formulas in (5)-(6). Since I&P did not discuss lexical differences between 'all' and 'every' and spoke generally about children's logical abilities with respect to universal quantification, I will assume that the formula they used for 'all' would also apply to 'every'.

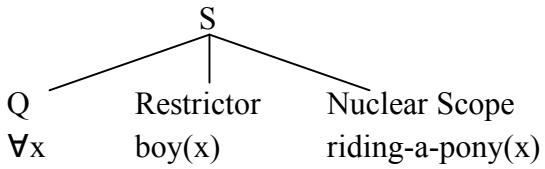
[2] Similarly, Philip's 'perfectionist' children rejected this sentence at a high rate of 85% in the context where an extra individual was a rider-less pony. The same group of children exhibited a much lower rejection rate in the context of an extra pony-riding girl at the rate of 58%.

established requirement for every member of the agent-set to be exhaustively paired with a member of the theme-set). Various proposals regarding the grammatical origin of the 'exhaustive pairing' have been made. Roeper and Matthei (1974) suggested that the errors arise because quantifiers *all*, *some*, and *every* are treated by children as adverbs and that children allow quantifiers to "spread" from their syntactic position as a determiner to the adverbial positions in the sentence (hence another term for this behavior, "q-spreading"). Similarly, Bucci (1978) suggested that children could not restrict the quantifier to its domain and allow the domain to spread to other parts of the sentence (cf. also Roeper and de Villiers 1993, Roeper et al. 2004 for extensions).

The adverbial view was further developed by Philip (1995) as the Event Quantification account. He maintained that in child grammar the universal quantifier "alone occupies a position of sentential scope, rather than the whole quantifier phrase", and hence is an adverb of quantification rather than a quantificational determiner (Philip 1995, p.3). According to this idea, for children, the universal quantifier does not quantify over individuals, as it does for adults, but quantifies over events. The events forming the restrictor are the sub-events of The contextually relevant event that meet a particular restriction, namely that an individual of either the agent-type or the theme-type is a participant in the sub-event.[3] Thus, a sentence like that in (7), which for adults has a semantic structure as given in (8), for the child has the meaning paraphrased in (9) and the semantic structure shown in (10):

(7) Every boy is riding a pony.

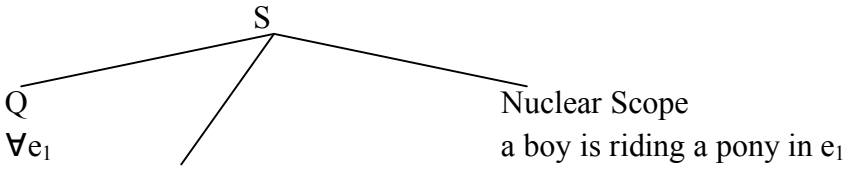
(8)



(9) 'For every event e_1, such that e_1 involves a boy or a pony (or both) as a participant, and e_1 stands in the part-whole relation to an event e_2, in which a boy is riding a pony: e_1 is an event of a boy riding a pony.'

[3] This analysis covers the cases of "classic spreading," i.e. rejecting (7) in contexts with an unpaired pony. It does not cover another type errors, namely the 'perfectionist' responses, i.e. sentences like (7) rejected in contexts with unmentioned individuals. In Philip's theory, to cover this type of error, an additional component had to be added to the restrictor. In addition to stating that participants in the sub-events are boy, or pony, or both, another type of participant had to be added, namely 'any perceived individual'. This addition had the desired result by requiring every sub-event of the event under consideration that involves any participant to satisfy the truth conditions of the nuclear scope. In other words, for the perfectionist child, *every boy is riding a pony* is true if and only if for the event under consideration every sub-event that involves any participant is a sub-event in which a boy rides a pony. Roeper et al. (2004) investigated this type of errors further and gave it an informal name 'bunny-spreading.' The name comes from the responses when children rejected the sentence 'every dog is eating a bone' paired with a picture containing a number of dogs eating bones plus a bunny eating a carrot, often accompanied with pointing to the bunny and saying, 'no, not the bunny."

(10)



$\exists e_2$ [$e_1 \leq e_2$ &ride(boy, pony, e_2) & PART(boy, e_1) or PART(pony, e_1)]

Roeper et al. (2004) argued for a similar analysis, in which children's universal quantifier develops from being an adverb to Floating Quantifier before reaching the adult stage when it becomes a determiner. In the acquisition path they proposed, the child moves from what they call the "bunny-spreading" (analogous to Philip's "perfectionist") stage, when the child does not project a DP above the NP and interprets subject quantifiers as adverbial elements in Focus Phrase, to the "classic spreading" stage with *every* behaving as a Floating Quantifier, to the adult stage, when *every* is reanalyzed as rooted in the DP. The final transition occurs in some children as late as the age of 12.

One alternative approach attributes the errors to children's treating the strong quantifier *every* as weak (Drozd and van Loosbroek 1998, Geurts 2003). Despite their claims of acknowledging children's full grammatical competence, these theories still posit certain non-adult-like properties in child grammar. Essentially, they amount to a claim very similar to the one made by the earlier theories (e.g. Roeper and Matthei (1974), Bucci (1978), etc.), which explained the errors in terms of children's failure to find a correct restrictor for the universal quantifier. However, unlike these earlier theories, for the Weak Quantification theories, "spreading" of a quantifier domain is not due to children's incorrect lexical semantics of *every* or a failure to construct correct semantic representations, but to factors outside of semantics proper. Thus, for Geurts, children are said to differ from adults in the following respects:

(i) weak construal of a strong quantifier, resulting in non-canonical parsing at the independent level of syntax-semantics mapping he assumes;

(ii) allowing the domain of the universal quantifier to be left underdetermined until after the syntax-semantics mapping occurs;

(iii) allowing pragmatic factors alone, namely the perceived salience of sets of individuals and information structure, to determine quantifier domains disregarding the syntactic relations such as sisterhood or constituency.

Even though theories of this type capture the "symmetrical" responses, one may argue that they underestimate children's competence since they don't account for the adult-like responses researchers have obtained from young children (Crain et al. 1996, Crain et al. 2000, Gualmini et al. 2001, Meroni et al. 2000, Gualmini et al. 2003, etc.). Another reason for skepticism with respect to 'partial competence' accounts is that the available experimental data clearly shows that the symmetrical errors are limited for the most part to certain types of

experimental conditions. The tasks resulting in high rates of errors are those in which the test sentences are given without or with a very limited linguistic context. Instead, children are shown a visual array of individuals and asked whether the truth or falsity of the test sentence holds of these individuals. In contrast, when the test involves a rich linguistic context, the error rate is dramatically reduced (Crain et al. 1996, Drozd and van Loosbroek 1998). These factors provided a motivation for a new explanation, one that considers the errors to be a function of the experimental design masking children's full competence of universal quantification.

1.2.3. Theory of Plausible Dissent

One of the most influential accounts attributing the errors under consideration to a flawed experimental design is the theory of Plausible Dissent first proposed by Crain et al. (1996), and argued for in subsequent work by Meroni et al. (2000), Gualmini et al. (2003), etc. According to this view, the appearance of spreading errors in the contexts of visual asymmetry is purely coincidental. The errors are claimed to be not a response to the extra individual in the picture, as assumed by all other theories, but children's reaction to the pragmatic infelicity of how the tests are typically administered. According to Crain et al. (1996), in order for a truth value judgment to be felicitous, the context has to meet certain pragmatic conditions, the relevant one for the issue at hand being the condition of Plausible Dissent. It requires for the addressee to be able to conceive of an alternative outcome in order to judge the proposition as true or false in a particular context. While adults and older children are capable of constructing potential alternative outcomes, young children, according to Crain et al., lack the ability to do so and need the context to represent them explicitly. Since the picture-based tests do not suggest an alternative outcome (e.g. all boys are simply shown riding ponies, but it is not shown that some of them first had an option of riding an elephant or not riding at all), children cannot judge the truth or falsity of the sentence reliably.

This approach successfully showed how experimental design affects children's performance, and demonstrated that given optimal experimental conditions, children are capable of dramatically improving their performance. This supports the idea of the errors being a matter of performance and not that of competence. The condition of Plausible Dissent, however, has been criticized as unnecessary because researchers have been successful in improving children's performance by contextual manipulations that did not involve the condition of Plausible Dissent (Drozd and van Loosbroek 1998, Phillip and Lynch 2000, Sugisaki and Isobe 2001).

One interesting manipulation was done by Sugisaki and Isobe (2001). In this experiment, two groups of Japanese-speaking children were tested using picture contexts only, mirroring the conditions of the typical q-spreading experiments. Group 1 was presented with pictures with one extra object (e.g. three cats each bouncing a ball plus one extra ball), and Group 2 with pictures with at least 4 extra objects (three cat-ball pairs plus a group of extra balls). They found that by increasing the number of extra objects in the picture scenarios given to children, they were able to elicit a much higher percentage of adult-like responses: 37.5%

correct for Group 1, in contrast to 87.5% for group 2, a result quite mysterious for the theory of Plausible Dissent', as well as for the theories discussed in section 1.2.2.

If we look closer at the reported studies, an interesting picture emerges. First observation is that rich linguistic context (with or without explicitly suggesting potential alternative outcomes) helps raise the rate of adult-like responses. Secondly, what seems to be playing a role in reducing the rate of errors is a manipulation of the relative visual salience of the sets. Thus, children's performance improves under such a wide variety of conditions – satisfying Plausible Dissent (Crain et al. 1996), creating picture-contexts with multiple rather than single extra individual (Sugisaki and Isobe 2001), back-grounding of the extra individual (Philip and Lynch 2000), de-emphasizing the extra object (Gordon 1996), emphasizing it (Crain et al 2000), and emphasizing the restrictor set of the universal quantifier (Drozd and van Loosbroek 1998).

In the next section, I will present my proposal, in which I will argue that the Full Competence approach is correct in insisting that children's semantics for universal quantification is fully adult-like; however, I will reject the assumption that children's apparent reaction to the asymmetry in the visual context is merely coincidental. Nor will I rely on Plausible Dissent as the primary explanation for the divergent results obtained by various researchers.

2. A New Pragmatic Account of Q-Spreading

2.1. Hypothesis

In order to explain the pattern of responses reported in the literature, I would like to suggest that we look at the ambiguity of sentences like (11), due to the interaction of the two quantifiers, the universal and the indefinite, as a potential cause of the 'q-spreading' responses.

(11) Every boy is pulling a wagon.

I propose that the crucial source of difficulty lies not in the interpretation of the universal, but in the "free" nature of indefinites with regards to how their domain restrictions can be set - in addition to being permitted to have either a singleton or a non-singleton set as their domain without any morphological clues about which option has been chosen, indefinites permit an information gap between the speaker and hearer in having access to the domain (Schwarzschild 2002, Kratzer 1998). I would like to argue that children have the semantic knowledge of both the universal and the indefinite; hence, from early on they have the knowledge of the ambiguity. However, they are less good than adults at resolving it in a minimal context. What appears to be 'q-spreading' is not grammatical errors. These responses are a manifestation of a strategy children use to resolve the sentence ambiguity by restricting the domain of the indefinite to a singleton set if the situation contains a salient single object. The presence of the latter, which may be taken as a 'referent' for the 'wide scope' indefinite,

often leads the child to assign 'wide' scope to the indefinite when adults wouldn't. In order to understand how this works, let's take a closer look at the semantics of indefinites.

2.1.1. Quantifier Domain Restrictions

As has been pointed out, an important semantic feature of quantifiers is that they range over relevant individuals. Thus, (12) does not say that every boy in the world rode a pony. If it did, there would be very few situations in which it were true.

It has been argued that this notion of relevance in quantification is part of the semantics of quantification and hence has to be part of the formal semantics of quantifiers. Quantifier domain restrictions have been posited as a formal mechanism of expressing the notion "relevant" (Westerstål 1984, von Fintel 1994, Marti 2003). Under one common view, they are expressed as silent pronoun-like elements (e.g. a sister to the common NP argument of the quantifier), a common notation for which is shown in (12) and its abbreviated semantics given in (13):

(12) Every boy_C rode a pony.
↑
*context supplies its value: e.g. "**those who came to Sam's birthday party**"*

(13) Every [C & boy][rode a pony] or
Every [λx.C(x) & boy(x)] [λx.rode-a-pony(x)]

This context-dependency is a property that indefinites share with other quantifiers. If this is correct, interpreting (12) involves not only choosing relevant boys (the value of C), but also relevant ponies (the value of C'):

(14) ∀x [x is in C & x is a boy →∃y [y is in C' & y is a pony & x rode y]] ,
↑
context: **"*the ponies Sam's parents hired for the birthday party*"**
or narrowed to a singleton set: **"*the white pony*"**

Furthermore, choosing one relevant pony instead of multiple ponies has important consequences for the relative semantic scope of the indefinite and the universal quantifier: it creates an interpretation identical to the one in which the sentence has the inverse scope interpretation: If C'= $\{P_1, P_2, P_3 \ldots\}$, this yields a non-specific indefinite and allows co-variation of boys and ponies. If C'= $\{P_1\}$, it yields a specific indefinite, truth-conditionally identical to the wide scope indefinite resulting in (14) being equivalent to (15):[4]

(15) ∃y [y is in C' & y is a pony and ∀x [x is in C & x is a boy and x rode y]]

[4] I assume the presuppositional 'every' (i.e. it presupposes a non-empty set of boys in (12)).

What this demonstrates is that if the restriction of an indefinite is true of exactly one individual (what Schwarzschild 2002 calls "singleton indefinites"), it behaves logically like a referential noun phrase. In such a case, in order for the sentence to be true, all of the boys are required to ride the pony included as the singleton restriction.

Indefinites are notorious for their 'irregular' behavior: the seemingly varying quantificational force, when they appear to be existential quantifiers in certain syntactic contexts but not in others (Lewis 1975, Kamp 1981, Heim 1982, among others), and their ability to take island-free wide scope (Fodor and Sag 1982, Reinhart 1997, Kratzer 1998, among others). There have been various approaches proposed to account for the behavior of indefinites, reviewing all of which is outside the scope of this paper. Although multiple theories of indefinites may be able to handle the child data under consideration here, for concreteness I will adopt Schwarzschild (2002), who argues that indefinites are unambiguous existential quantifiers with their scope derived in a regular way. According to this proposal, the exceptional wide scope of indefinites can be derived simply by manipulating the cardinality of their domain restrictions. In the next section, I will review this theory and discuss how this approach sheds light on q-spreading.

2.1.2. Deriving the Scope of Indefinites

It has long been assumed that ambiguities observed with sentences with multiple scope-bearing elements, such as quantifiers, are derived through a covert movement operation (QR), which creates operator-variable structures by moving and adjoining the operators to the left of clausal boundaries (e.g. adjoining to IP), with the operator binding the variables from its raised position (e.g. May 1977, 1985):

(16) [IP … QP …] → [QP [IP … t …]]

Thus, a sentence with an indefinite and universally quantified NPs has the readings with either the universal or the indefinite taking wide scope, paraphrased in (18) and (19) and whose abbreviated LFs are given in (20) and (21).

(17) A boy tasted every dish.

(18) For every x, such that x is a boy, x tasted a dish.

(19) There is an x such that x is a boy and x tasted every dish.

(20) [Every dish$_2$ [a boy$_1$ [IP t$_1$ … t$_2$…]]]

(21) [a boy$_1$ [Every dish$_2$ [IP t$_1$ … t$_2$…]]]

An important argument for the movement theory of scope comes from the data showing that QR obeys locality constraints on movement, barring wide scope from within extraction

islands.[5] Thus, Hornstein (1984) observed that while the universally quantified NP can take wide scope from the embedded subject position in the ECM construction, as in (22), it takes obligatory narrow scope in a tensed clausal complement, as in (23).

(22) A professor expects every student to pass the exam. (a reading with co-varying professors and students).

(23) A professor expects that every student will pass the exam. (no co-variation)

It has also been observed that the movement theory of scope runs into problem with indefinites, which do not obey island constraints. Consider the example from Fodor and Sag (1982) given in (24), which has a reading in which the indefinite takes wide scope out of an adjunct island:

(24) If a relative of mine from Texas dies in a fire, I will inherit a house.

One can imagine that the speaker has multiple relatives from Texas. If this is the case, two interpretations are possible. Under one reading, a death in a fire of any one of the speaker's relatives from Texas would result in the speaker's inheriting a house. Under another scenario, one specific relative must die in a fire in order for the speaker to inherit a house. Accounting for this reading with a wide scope indefinite construed as the existential quantifier is problematic since such scope taking would be exceptional (moving out of a syntactic island) and is disallowed for other quantifiers. To see the contrast, we can look at a minimally different sentence, e.g. with the universal quantifier instead of an indefinite in an adjunct clause, as in (25), which is unambiguous: 'every' is not permitted to scope above the conditional (the reading under which every relative of the speaker's is such that the speaker will inherit a house in case that relative dies in a fire). The only available reading is the one in which death of all of the relatives in a fire is required for him to inherit a house.

(25) If every relative of mine dies in a fire, I will inherit a house.

An even more serious problem is presented by sentences with indefinites that have intermediate scope readings, as in (26):

(26) Every author here despises every publisher who would not publish a book that was deemed pornographic.

[5] Among semantic arguments for QR are not only that movement creates a transparent structure off which to read the relative quantifier scope, but also the considerations of interpretability (to avoid type mismatch between the transitive verb and the quantifier as its internal argument), deriving inversely-linked readings: structures in which the more embedded QP takes wide scope (e.g. *One apple in every basket is rotten*), ACD constructions, quantifiers that bind pronouns, etc. (see Heim and Kratzer 1998 for a review).

(27) Possible readings:

a. ∀x (author x) >∀y (publisher y) > ∃z (book z): For every x, if x is an author, then x despises every publisher y who refused to publish some book z or another that was deemed pornographic.

b. ∃z (book z) >∀x (author x) >∀y (publisher y): There is a z, such that z is a book that was deemed pornographic and for every x, x is an author, x despises every y, y is a publisher who refused to publish z.

c. ∀x (author x) > ∃z (book z) >∀y (publisher y): For each x, x is an author, there is a book z that was deemed pornographic – possibly different books for different authors – such that x despises every publisher y who would not publish z.

The existence of the intermediate indefinite readings as in (27c) presents a problem for both the 'naïve' quantificational view of indefinites (Russell 1919) because, as discussed above, unlike other quantifiers in this configuration, they do not respect islands in their scope-taking, as well as the ambiguity view (Fodor and Sag 1982). While the latter theories can handle the widest-scope reading in (27b), the intermediate reading is problematic for this approach.

The analysis of indefinites proposed by Schwarzschild (2002) successfully solves the problem of exceptional scope including intermediate scope using a mechanism that affects domain restrictions of all quantifiers.[6] It also provides a mechanism that can be used to explain q-spreading behavior of children, as I will show in section 3.

2.1.3. Singleton Indefinites

Schwarzschild's insight was that the ambiguity of the indefinites is not lexical but can be derived simply by adjusting the size of their domain restriction, which may consist of a set of any cardinality (except zero) including one. The reason why exceptional 'wide scope' is permitted with indefinites is because of their freedom to have singleton domains, not true of other quantifiers. If the domain restriction of the indefinite is a singleton set, it appears to have wide scope regardless of its surface c-command domain without applying covert movement. In order to have this reading, the context must provide a unique relevant individual to fill the value for the covert domain restriction.

This elegant solution to the puzzle of indefinites allows us to account for all of the exceptional scope readings, including the intermediate scope, without any additional syntactic or semantic mechanisms. If we correctly construct the restricted domain for the indefinite as a

[6] Another solution to this problem suggests that exceptional wide-scope indefinites are interpreted as choice functions (Kratzer 1998, Winter 2001, Reinhart 1997, etc.). A choice function takes as its argument the set of individuals satisfying the descriptive content of the indefinite NP and returns an element from this set. This approach is also compatible with the analysis of q-spreading I am proposing. The problems with the choice function approach were discussed in Chierchia (2001), Schwartz (2001), Geurts (2000), but these objections do not bear on the data discussed here.

singleton set and fill in the implicit domain-narrowing restriction, we get the desired truth-conditions without having to move the indefinite out of an island, hence avoiding the need to account for its apparent exceptional scope. According to this proposal, different readings that we saw in (27) are due to a differently constructed domain of the indefinite. All of the readings therefore are narrow scope readings, but in two of them the scope relations are masked by the fact that the indefinite is a singleton.

In order to illustrate how this works more explicitly, let's suppose that the set of relevant authors includes three individuals as shown in (28). Let's also suppose that for each of these individuals x there is a distinct single book (e.g. a book that x wrote) that was deemed pornographic, and that each author x despises every publisher who refused to publish that book (i.e. the domain restriction of the indefinite contains a bound variable). The formula in (29) shows that even though the indefinite occupies the lowest position, we get the desired co-variation between authors and books seen in the 'intermediate' reading.

(28) Authors: {Lawrence, Miller, Nabokov}, Books: C_L={Lady Chatterley's Lover} C_M={Tropic of Cancer} C_N={Lolita}, Publishers: …

(29) ∀x [author(x) → ∀y [publisher(y) such that ∃z [z ∈C_x and z is a book and z was deemed pornographic and y refused to publish z]→ x despises y]] where C_x={z: z is a book **x had written** and z was deemed pornographic}

Another reading, the regular narrow scope reading, is derived with the domain of the indefinite consisting of multiple books, as shown in (30):

(30) Authors: {Lawrence, Miller, Nabokov}, Books: C={Lady Chatterley's Lover, Lolita, Tropic of Cancer, …}

(31) ∀x [author(x) → ∀y [publisher(y) such that ∃z [z ∈C and z is a book and z was deemed pornographic and y refused to publish z] → x despises y]] where C={z: z is a book that has been deemed pornographic};

Here the domain may contain all books that have ever been deemed pornographic, or it may be contextually narrowed to a subset containing multiple relevant ones. Finally, the widest scope reading can be derived in the same way as a narrow scope indefinite, but with its domain restricted to a single book:

(32) Authors: {Lawrence, Miller, Nabokov}, Books: C ={Lolita}

(33) ∀x [author(x) → ∀y [publisher(y) such that ∃z [z ∈C and z is a book and z was deemed pornographic and y refused to publish z] → x despises y]]

In this example, the domain also contains an implicit restriction. The implicit restriction in this case, as with any other singleton indefinite, may contain any conceivable property narrowing the set to a unique book and may be asymmetrically available to the speaker and

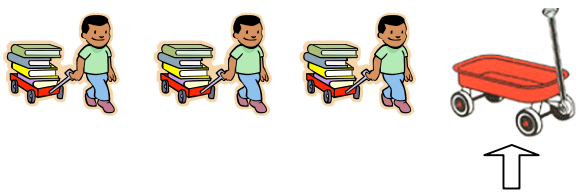
not to the listener. What this means is that when uttering a sentence with an indefinite, the speaker has no expectation that the listener should be able to reconstruct from the context the indefinite's domain restriction with any specificity (beyond figuring out that it contains a single individual, whose identity is known to the speaker). In other words, the speaker may felicitously utter the sentence with a single individual in mind and have no expectation that the listener would infer from context what individual it is.

2.2. Implications for 'Quantifier-Spreading'

The observation about the role of the domain restriction in the interpretation of sentences with indefinites has important implications for the question we are considering. I have reviewed arguments for the importance of the domain restrictions for quantifiers in general and indefinites in particular. I have established that in order to evaluate a sentence containing an indefinite NP with respect to its truth conditions, we need to know not only the relative syntactic scope of quantifiers, but also the value of the restricted domain for both the universal and the indefinite.

The latter presents difficulty because any indefinite can in principle have a domain restriction of the cardinality of one. The difficulty is magnified by allowing the restriction to be expressed implicitly, making it asymmetrically available to the speaker, but not the listener. This creates a possibility of interpreting any indefinite as singleton or non-singleton and is a reason behind the intuition for the specific/non-specific ambiguity of indefinites in an out-of-the-blue context. Importantly, this suggests that a sentence that contains an indefinite NP presented in a relatively poor context is ambiguous regardless of the availability of a genuine inverse scope, and a relatively rich context is necessary for the listener to resolve the ambiguity.

If the grammar allows for singleton restrictions in cases like we have discussed in the previous section, then we have to admit this possibility for simpler cases like those with which children typically produce q-spreading responses. Let's suppose our context contains a set of three boys and four wagons: Boys = {B_1, B_2, B_3}, Wagons = {W_1, W_2, W_3, W_4}, as shown in (24). When the child hears the puppet uttering (25) in this context, she has to make a decision about how to restrict quantifier domains. While it is straightforward for the domain of the universal (the child has no reason to consider anything but the entire set of boys shown in the picture because of their visual uniformity), there are at least two equally plausible options for the domain of the indefinite, one of which is restricting it with the salient single wagon:

(24) 

(25) Puppet: Every boy is pulling a wagon.
Child: Is he be talking about all of them or just this one?

(26) C'=  or 

Under the surface scope construal, the sentence would have the meaning as in (27). If the child constructs C' to include multiple wagons, then the truth conditions would require that for each boy x there exist a (possibly different) wagon y, such that x pulled y.

(27) $\forall x$ [boy(x) & x $\in$C $\rightarrow$ $\exists y$ [wagon(y) & y $\in$ C' & x pulled y]]
"For every contextually relevant boy x, there is a wagon y in C' and x pulled y."

However, if the domain is narrowed to a singleton set, then the truth conditions for the sentence under the universal wide-scope construal would be effectively the same as under the indefinite wide-scope as in (28); and each boy x would be required to pull the same wagon y.

(28) $\exists y$ [wagon(y) & y $\in$C' & $\forall x$ [boy(x) & x $\in$C $\rightarrow$ x pulled y]]
"There is a wagon y in C' such that every contextually relevant boy x pulled y."

This allows us to explain why children sometimes judge universally quantified sentences like that in (25) false in the context of a picture analogous to the one in (24): unless sufficient linguistic context is given, the salient single wagon in the picture leads the child to construe the expression *a wagon* as a singleton indefinite, the interpretation under which (25) is false in this context.

2.3. Discussion

If we adopt this explanation for children's responses, we are able to explain a large number of previous empirical findings. One observation has been that children are not limited to 'spreading error' responses, but rather produce them (in minimal-context tasks) only around 57% of the time (Philip 1995). This is not surprising under this analysis because both a Yes- and a No-response are grammatically available alternatives. Thus, the "q-spreading" ("No") responses are those given when the child focuses on the perceptually salient single wagon and interprets the indefinite as singleton, resulting in the "collective" reading, when every boy is required to pull that particular wagon. The adult-like ("Yes") responses are those given when the child chooses the multiple wagons as the domain restriction for the indefinite, hence getting the distributive reading.

This approach also provides a straightforward explanation for the contrast in the rate of q-spreading errors between picture-context and rich context tasks. Since with the former, the child receives no clues as to what reading the experimenter is expecting, she is left to choose either option. On the other hand, experiments that provide rich linguistic context, as in the Truth Value Judgment task, provide the child with pragmatic clues that are used in natural

discourse to interpret and verify a scope-ambiguous sentence, thus limiting the interpretive possibilities and resulting in much lower error rates.

Finally, we can also account for the finding that the one-extra-object condition is harder for children than the multiple-extra-object condition. This is because in the former there is a perceptually salient candidate for the singleton restriction for the indefinite, while in the latter there isn't. Hence, in the former, the child may be biased towards the singleton reading, while in the latter she isn't and would more consistently choose the distributive reading. This can also explain why the extra-object-condition is harder than other conditions, such as those in which the picture contain an alternative agent.[7] This is because according to this proposal, the source of difficulty is the interpretation of the indefinite object and not the universal subject.

The question arises why adults would almost never give a No-response in the situations when children do. The difference between adults and children may be due to the differences in their pragmatic and in their processing flexibility. I suggest that on-line adults go through the same calculations as children entertaining the same options, but, due to their greater pragmatic flexibility, they are more efficient in selecting the correct readings (and/or in rejecting pragmatically implausible readings). Children, on the other hand, have a weakness in handling information gaps between them and others (cf. Wimmer, Hogrefe, and Perner 1988, Wimmer, Hogrefe, and Sodian 1988, Ruffman 1996, etc.), which makes it difficult for children to manage contextual information. Therefore, it is not surprising that children would frequently fail to construct the target interpretation for sentences with indefinites, particularly in those situations when the context given to them is less than optimal.

Another factor that may be causing the difference between adults and children is in their respective use of the Principle of Charity (Grice 1975, Davidson 1984). According to this principle, when given a choice between assigning a reading compatible with the presented situation or the one incompatible with it, adults select the former due to their expectation that the speaker is being truthful. It is possible that for a certain reason children do not observe the Principle of Charity (cf. Hulsey et al. 2004).

Yet another factor from which the difference between adult and children's behavior may stem is their different degrees of processing flexibility. It allows adults to switch from one reading to another more easily compared with children, who may have difficulty revising their initial parse because they lack computational resources to evaluate multiple options. As a result, they select the first grammatical interpretation they access and stay with it (cf. Viau, Lidz and Musolino 2007, Conroy and Lidz 2007). Thus, the difference between adults and children is likely to be due to interplay between various performance factors – both pragmatic and processing, and not in their knowledge of formal semantic.[8]

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[7] For example, the sentence *Every boy is pulling a wagon* paired with a picture containing a girl pulling a wagon in addition to boy/wagon pairs.

[8] Although without additional research it is impossible to separate children's pragmatic inflexibility from their processing inflexibility and to say definitively what is a greater factor in 'q-spreading' –

There is independent evidence concerning on-line behavior of adults, which comes from an eye-tracking experiment conducted by Meroni et al. (2001) with English-speaking adults. Their results indicate that adults evaluate alternative domains for the indefinite.[9] This study examined the on-line patterns of fixation duration by adults in response to the extra objects in a picture verification task. Their results indicate that adults not only gazed at the single extra object, which is irrelevant for the calculations of truth conditions of the sentence under the distributive reading, but that the duration of their gaze was significantly longer if the picture contained a single extra object compared with the condition in which there was another object next to it. This result is reminiscent of the Sugisaki and Isobe (2001) child study, in which the number of extra objects in the picture was manipulated. It shows a parallel between adults' on-line and children's off-line behavior. For adults, the gaze duration on the extra object decreases, while for children the error rate decreases if the visual salience of the single extra object is decreased.

3. Experimental Evidence

3.1 Predictions

I have proposed that instead of focusing on the universal quantifier, as has been done previously, the so-called q-spreading responses should be explained by children's interpretation of indefinites, particularly by their choosing 'singleton indefinites' influenced by the perceptual salience of the 'extra' object. As I discussed in the previous section, my approach relies on the theory of indefinites by Schwarzschild 2002, in which indefinites are always quantificational, but can appear referential simply because of their ability to have singleton domain restrictions. Singleton domain restrictions affect the semantic scope relations independently from any syntactic mechanism of reversing scope. In particular, those indefinites that combine with singleton domains, even when syntactically taking narrow scope and therefore normally receiving the non-specific interpretation, would have the appearance of being 'wide scope' or 'referential' and essentially render the sentence scope-neutral (in Schwarzschild's terminology), thus obscuring the surface syntactic scope relations.

One issue raised in the literature on the acquisition of quantification is whether

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children's inability to cope with sub-optimal pragmatic conditions, their ignorance of the Charity Principle or their inability to revise their initial parse, I believe the totality of the available data suggests that children's pragmatic inflexibility does play a role. Thus, since pragmatic manipulations, such as manipulating the visual salience of the extra object or providing enriched linguistic context, trigger changes in children's performance, it suggests that we cannot account for all of children's behavior by saying that the errors are due solely to their selecting one interpretation (at random) and not being able to revise it. Since the experimental data I am reviewing here does not deal with children's on-line behavior, I will leave the role of processing in children's quantification errors for future research and discuss only their pragmatic weakness.

[9] Although the authors themselves do not make this connection, I believe that their results are consistent with this explanation.

syntactically inverse scope readings are available to children from early on. This issue is relevant for the 'q-spreading' debate because it is an issue in which the Full Competence theories diverge from 'adverbial' theories, such as Event Quantification (Philip 1995). The former are consistent with the claim that children know all and only those scope readings that are allowed in adult grammar. The latter, on the other hand, maintain that at the initial stage, the universal quantifier should obligatorily take wide scope since under their proposal the universal quantifier occupies the position in which it scopes over the entire sentence. It has even been suggested that the basic underlying reason for q-spreading is children's difficulty with QR. Thus, Philip (1995) suggests that the reason why children interpret the universal quantifier as an adverb instead of as a determiner may be that the children have difficulty with the operation of QR. According to Philip, applying QR may be problematic for children since it is an abstract relation (since the movement occurs post-syntactically) and because it results in establishing a discontinued dependency between the moved constituent and its trace. Under this view, because of their difficulty with adult LF, children resort to event quantification, which is not derived via QR, but with a mechanism described in Heim's terms as a "Quantifier Construal Rule" (Heim 1982), and does not require maintenance of an abstract discontinuous dependency. As Philip put it, "all that matters for semantic interpretation of the universal quantifier in such a representation is that this quantifier has scope over the entire sentence; its original position in the surface structure is completely irrelevant" (p.50).

Hence, under this theory, sentences (30) and (31) for children should have identical semantic form derived from an LF in which the universal takes scope over the whole sentence and hence over the indefinite.

(30) Every farmer rode a donkey.

(31) A farmer rode every donkey.

This predicts that any unpaired individual – a non-donkey-riding farmer or a donkey not ridden by a farmer should equally result in a spreading response for either (30) or (31). Furthermore, if the two sentences have the same LF, distinct from its surface syntax for both of them, there is no obvious reason why the rate of q-spreading should be different for the two sentence types. In addition, if the adverbial theory is correct and children always require distributivity and exhaustive pairing between farmers and donkeys for both (30) and (31), both should be rejected in collective contexts, where all farmers ride the same donkey or all donkeys are ridden by the same farmer, as frequently or more frequently as in distributive contexts, as long as there are unpaired farmers or donkeys.[10]

In contrast, my approach makes different predictions. If children have adult-like knowledge of quantification, we must at least allow a possibility that they have both surface and inverse scope interpretation for both sentences, given that pragmatic conditions in which

[10] For (31), children presumably should allow for one specific farmer to ride all of the donkeys, but only in case there are no extra farmers. Similarly, for (30) the collective context with no extra donkeys should result in a "true" response, but a donkey should falsify it.

the test is administered do not inhibit some reading. In experiment 1, I will test this prediction with respect to the inverse scope for sentences like (31).

Normally, when sentences of this type are used in 'q-spreading' studies, children are shown a picture with a number of farmers each riding a different donkey and an extra farmer. When, in this context a child rejects (31) as false and points to the extra farmer, it is taken as evidence that she assigned the sentence universal wide scope reading, in accordance with the event quantification semantics, and the unpaired farmer under such reading made the sentence false for the child (Philip and Aurelio 1991, Philip and Takahashi 1991). However, since in these studies there are no controls insuring that the sentence does in fact receive universal wide scope reading for children, we cannot conclusively say what causes them to reject the sentence in that context. It is quite plausible that they reject the sentence because they interpret it under the surface scope and look for one specific farmer to be riding every donkey, and since the context does not contain such a farmer, they reject the sentence. This is especially plausible given the preponderance of experimental evidence showing that the inverse scope reading is harder to elicit from children than the surface scope and that the former must be facilitated by more carefully designed experimental conditions (Hulsey et al. 2004). Therefore, it is important to tease apart the surface and the inverse scope interpretation of sentences like (31) and to study whether there is a difference in "q-spreading" rate for each reading in a better-controlled environment. I will address this issue in experiment 1.

If children in fact prefer the surface scope for (31), we can expect to see a difference in the rate of 'q-spreading' responses between (31) presented in the context consistent with its surface scope interpretation (e.g. one farmer-multiple donkeys group plus extra farmers) and in the context consistent with its inverse scope reading (a number of farmer-donkey pairs plus an extra donkey). Children should reject (31) significantly more frequently if it's presented in a distributive context than when it is presented in the context consistent with the group reading. Furthermore, just as the presence of extra farmers shouldn't matter for increasing errors for the group contexts, the absence of an extra donkey shouldn't matter in reducing the rate of errors for distributive contexts. In other words, I predict that sentence like (31) would be accepted by children at a high rate in "group" contexts regardless of the presence of extra agent-type individuals, and rejected by children at a relatively high rate in a distributive context even if the context contains no extra theme-type individuals.

There is another scope related issue that leads to the same predictions. If children have adult-like knowledge of quantifier scope, as I propose, one element of this competence should be their knowledge of asymmetric entailment relations between the surface and inverse scope readings in sentences like (30) and (31). In these examples, the wide-scope indefinite reading entails the wide scope universal reading. This means that if the sentence is true under the indefinite wide scope, it would necessarily be true under the universal wide scope in the same context as well. On the other hand, in those contexts that make the sentence true under the universal wide scope reading, the sentence would be false under the indefinite wide scope construal.

This amounts to a situation, when (30) presented in a context consistent with the wide scope indefinite reading (henceforth "collective contexts") is unambiguous – true under either surface or inverse scope configuration. When, however, it is given in contexts consistent with the universal wide scope (henceforth "distributive contexts"), the sentence is ambiguous – either true if construed under the surface scope, or false if construed under the inverse scope. The same applies to (31), for which the sentence is true under both readings if presented in collective contexts, but only under the distributive reading if presented in distributive contexts.

Thus, if my hypothesis is correct in claiming that q-spreading is children's reaction to the sentence ambiguity and the use of the perceptual salience of the extra object in resolving the ambiguity, this state of affairs should result in a distinct error rate for universally quantified sentences in collective vs. distributive asymmetric contexts. Since in a collective situation, where every farmer rides the same donkey, there is no possible interpretation of (30) that would give a "false" response in that situation, children's decision of which reading to select should not be affected by the visual asymmetry and hence, they should exhibit a low rate of q-spreading errors. On the other hand, children should exhibit a higher error rate with sentences like (30) in distributive asymmetric contexts, particularly in the single extra object condition since in this situation they are giving truth-value judgments in a situation that requires them to resolve ambiguity. The same pattern should hold for (31), which should be accepted at a higher rate in the contexts of one farmer riding all of the donkeys even if there are extra farmers present in the situation, and at a lower rate if there is co-variation between farmers and donkeys given that there are extra donkeys. On the other hand, 'adverbial' theories do not make these predictions since according to them such sentences are unambiguous for children. These predictions will be tested in experiments 1 and 2.

Finally, if the main culprit in q-spreading is not the universal quantifier, but the indefinite, we can ask ourselves whether children will respond in a "q-spreading"-like manner to sentences containing an indefinite and a quantifier of another type, instead of the universal, given that the sentences are presented under the typical "q-spreading" inducing conditions, e.g. visual context with a salient single "extra" individual. The approach advanced here predicts that spreading-like errors can indeed be elicited using sentences without the universal quantifier if such sentence contains an indefinite and the context contains a salient single individual to be a potential candidate for a singleton domain restriction for the indefinite. We also predict that the error rate can be manipulated by controlling the degree of visual salience of the extra individual. This prediction will be addressed in experiment 3.

3.2. Experiment 1

3.2.1. Goal, Participants and Procedure

Goal: To test whether English-speaking children can correctly interpret sentences like (32) under both surface and inverse scope and whether their success in this task is affected by conditions of contextual asymmetry between the number of individuals in the agent and

theme sets and and/or satisfaction of the Condition of Plausible dissent.

(32) A girl tasted every cake.

Participants: 21 English-speaking preschool children (median age 4; 6) recruited at the nursery school run by the University of Connecticut. Five children, who failed the training, were excluded, bringing the sample to the total of 16 children. We also tested 16 adult controls, who were University of Connecticut undergraduate students. The adults were given the same materials as the children, but in a paper and pencil form – the written stories were presented in the same randomized order as the children, and each was followed by the target sentence, which the subjects were asked to judge as true or false.

Materials and Procedure: the standard Truth-Value Judgment Task (Crain and Thornton 1998). The materials consisted of sentences like (32). The two possible interpretations for this sentence are given in (33) and (34):

(33) ∀y [cake(y) → ∃x [girl(x) and x tasted y]]
'For each cake y, there was a (possibly different) x, such that x was a girl and x tasted y.'

(34) ∃x [girl(x) & ∀y [cake(y) → x tasted]]
'There was an x, x is a girl and x tasted every cake.'

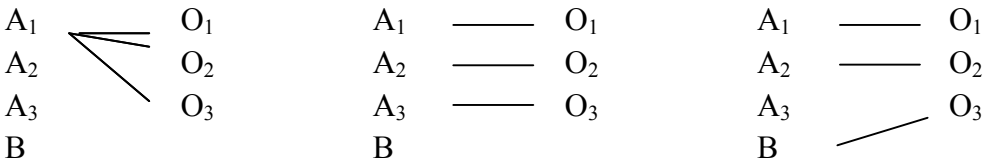
Sentences were presented in contexts that satisfied one of the following three conditions, schematically represented in (35):

(i) compatible with the surface-scope, as well as the inverse scope by entailment;

(ii) compatible with the inverse scope, but not with the surface scope;

(iii) incompatible with either the surface or inverse scope

(35) a. Surface scope context b. Inverse scope context c. False on both readings



Under the scenario of type (35a), compatible with both readings, there was one girl who tasted every cake, while two other girls did not taste any cake. In the situation (35b) compatible only with the reading in (33), the story contained three girls, each of whom tasted a different cake. Finally, in a situation of type (35c), there was neither a single girl who tasted every cake, nor an exhaustive pairing between girls and cakes. All scenarios satisfied the condition of Plausible Dissent by containing an alternative individual (e.g. in the above-mentioned scenario, three girls and one boy). The alternative character always considered performing the activity described in the story, but failed to do so.

After a training session, which was used to familiarize the children with the TVJ task and in which unambiguous quantified sentences were used (e.g. Every boy climbed the tree), each child was given four items of each type (12 test items in total) and fillers in a fixed random order. The testing was divided into two sessions. Each test item was pronounced with a focus-neutral intonation, without stressing either the subject or the object NP. The stories were acted out with small toys by the experimenter, before the test sentence was presented.

3.2.2. Results

Table 1 below shows the results for each child.[11] Table 2 summarizes the results across children.

Table 1 **Number of Accepted Sentences in Each Condition**

	Surface	Inverse	False	Fillers	
Mike	3	0	0	3	
Ivan	4	4	0	4	
Jake	3	4	0	4	
Tatiana	3	0	0	4	
Amy	4	4	1	1	different fillers
Ron	4	0	0	4	
Cathy	2	0	0	3	
Billy	4	3	1	3	
Valerie	3	2	0	3	
Lionel	1	4	1	4	
Jane	3	0	0	3	
Mathew	4	3	1	4	
Helen	3	4	0	4	
Eva	3	0	0	4	
Nell	4	0	0	3	
Steve	2	4	0	4	

Table 2
Distribution of Responses in Children **(N = 16)**

	Accepted ≥3	Rej ≥3	Split
Surface	13	1	2
Inverse	8	7	1
False	0	16	0
Fillers[12]	15	1[13]	0

[11] The names are pseudonyms.

[12] Since fillers varied between true and false, the table indicates correct responses in the acceptance column and incorrect in the rejection column.

As we can see, the children are nearly unanimous in their acceptance/rejection of certain sentence types, but they are split with others: while children were adult-like in almost uniformly rejecting false sentences and accepting the surface scope, they fall into two almost equal groups with respect to inverse scope.

The main goal of the study was to obtain more fine-tuned findings about the rate of "q-spreading" with respect to sentences like (32) by teasing apart the two scope readings available for such sentences. Our results show that indeed there is a sharp difference in the rate of incorrect rejections with respect to the two readings. As we predicted, the test sentences were much more likely to be rejected in 'distributive' contexts, despite the complete symmetry between the agent and theme sets of protagonists.

The surface scope contexts contained an asymmetry (i.e. they did not contain exhaustive paring between the members of the agent and theme sets). Recall that under the "non-adult grammar of universal quantification" view, such asymmetry is expected to cause children to reject the sentence. Our results indicate, however, that when the context was presented in a rich story form, instead of a schematic picture showing agent/theme pairs, the asymmetry did not cause children to reject the sentence. The children consistently accepted stimuli in 'surface scope' contexts, demonstrating that they allow wide-scope indefinites, and when the sentence is interpreted that way, asymmetry in the context does not result in errors.

In the 'inverse scope condition,' on the other hand, the contexts were symmetrical –there was an exhaustive pairing between the agent and theme sets. Despite this symmetry, this condition presented difficulty for some children. The children in our sample were almost evenly divided: 8 out of 16 children accepted the stimuli in the inverse scope contexts and 7 rejected them (1 remaining child gave an equal number of yes- and no-answers).

Those who accepted the inverse scope support our hypothesis that adult-like knowledge of scopal ambiguities is available to children from early on. This experiment does not allow us to rule out the possibility that the difference between the "inverse" and "no-inverse scope" groups amounts to a developmental difference between those who have matured into a stage at which children allow inverse scope vs. those who remain at the isomorphic stage. However, according to independent evidence, children often choose the isomorphic interpretation given certain pragmatic conditions of the test, and do not lack the inverse scope entirely (Gualmini 2003, Hulsey et al. 2004). In light of such findings, I will adopt the assumption that inverse scope is generally available to children, but is difficult to access and requires certain conditions to be met by the task in order to make the inverse scope reading more salient. We did not address this issue in this experiment, which is presumably why a number of children

[13] The child who made errors on the fillers was a pilot case. After running the test with her, we adjusted the fillers to eliminate unnecessary complications in the story, which had to do with the plot and not the structure. Since she was very consistent in rejecting the false sentences while accepting both surface and inverse scope ones, we decided not to exclude her from the result table. However, eliminating her from the results would not change the general pattern.

rejected the inverse scope reading. However, I believe that those who rejected the inverse scope present an interesting finding.

Firstly, as I noted earlier, these children rejected the sentence in the inverse-scope context despite the fact that this context exhibits symmetry, supporting my claim that children's quantificational errors are not fully contingent on the contextual asymmetry. Secondly, the explanations offered by the children for why they rejected the sentence in the inverse scope contexts were quite revealing. All of such children explained that the puppet was wrong when he said that *a girl* tasted every cake because in the story there were *three girls*, *not one*. This explanation for rejecting the sentence supports my hypothesis that typical 'q-spreading' errors involve interpreting indefinites as singleton.

If we look at the control group of adults, we will see that they were unanimous in their acceptance of the surface scope, but, interestingly, were also somewhat divided in their acceptance of the inverse scope: 3 out of 16 adults rejected three or more of the items in the inverse scope condition (see table 3 for the summary of the results).

Table 3
Adult Controls (N = 16)

	Accepted ≥3	Rej ≥3	Split
Surface	16	0	0
Inverse	13	3	0
False	0	16	0
Fillers	16	0	0

Since even some of the adult native English speakers rejected the target sentences in the contexts in which others accepted them, it seems reasonable to conclude that what we found was a failure of these subjects to access this interpretation rather than a lack of this reading in their grammar. Such a view is supported by the studies showing a general preference for surface scope over the inverse scope in monolingual adult English-speakers (Kurzman and MacDonald 1993).

In K&M's study, in a self-paced reading task, subjects had to judge whether a sentence with two quantifiers (*a* > *every*) was compatible with a disambiguating continuation. While over 80% of continuations compatible with the surface scope were accepted, only around 30% of those compatible with the inverse scope were accepted. K&M term this preference 'the single reference principle'. They explain this preference by saying that single reference is simpler to represent than multiple reference, it is always possible and often obligatory (as when *a* is an only quantifier), and to switch from single to potential multiple reference involves a complex alteration of semantic representation (Kurtzman and MacDonald, 1993). Thus, they view the 'single reference' bias in adults as a sort of a garden path and not a grammatical phenomenon.

A final observation from our results was that satisfying Plausible Dissent was not a

sufficient condition for some children's acceptance of the target sentences in the inverse scope context. The condition of Plausible Dissent was satisfied across all of the experimental conditions, which, however, did not result in a uniform acceptance of the inverse scope sentences.

3.3. Experiment 2

3.3.1. Goal, Participants and Procedure

Goal: to test the prediction that children know the asymmetric entailment relations between the surface and inverse scope and consequently would make fewer "q-spreading" errors in "collective asymmetric" contexts compared with the "distributive single asymmetric" contexts.

Participants: 15 preschool and kindergarten children attending University of Connecticut Child Labs, median age 4; 9.

Materials and Procedure: universally quantified sentences presented in one of the following contexts:

i. distributive with a single extra item
ii. collective with a single extra item

The contexts were presented as pictures, samples of which are given below:

(36) a. Distributive asymmetric:
Every baby is inside a flowerpot. (∀ < ∃: true; ∃ < ∀: false)

b. Collective asymmetric:
Every girl is pushing a car. (∀ < ∃: true; ∃ < ∀: true)

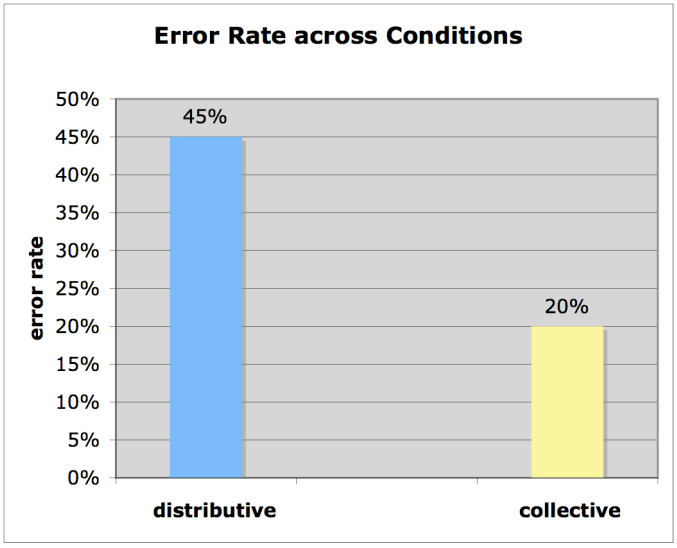
Each condition consisted of 4 items plus fillers, presented in a fixed random order. The child

was shown a picture, after which the puppet uttered a test sentences. The task of the child was to judge whether the puppet's statement was true of the picture.

3.3.2. Results

As predicted, we found a distinct rate of error across the two experimental conditions. The findings are summarized in figure 1. We can see that there is a highly significant contrast in the rate of errors in the distributive and the collective contexts: the former resulted in a rate of errors more than twice that in the latter condition despite the presence of a single extra item in both types of context.

Figure 1:



Paired t-test: t(13)=3.61, two-tailed p=.003

This observation is in concert with the hypothesis attributing 'classic spreading' to a pragmatic strategy used by children to resolve an ambiguity in contexts that have a single extra individual because its presence suggests to the child that a singleton reading for the indefinite should be considered and therefore resulting in a certain percent of rejections. According to this explanation, the extra individual triggers errors in conjunction with a number of agent/theme pairs because such context is maximally ambiguous: it contains two sets of individuals across which the event is distributed, which suggests the distributive reading, and the single individual of the sort denoted by the indefinite, which suggests the singleton indefinite reading. In this situation the child has to make a decision about which reading the speaker intends for the sentence. Consequently, the responses are not limited to either 'true' or 'false,' but are split between both. On the other hand, in the 'collective' context, the ambiguity is minimized because, as we discussed earlier, the indefinite wide scope reading entails the universal wide scope reading. The two readings are essentially indistinguishable since the only possible judgment for both of them is "true". Consequently, presence of an extra item does not matter to the same extent as in the 'distributive' contexts because it doesn't stand for a potentially different reading.

3.3.3. Independent Support

One major goal of the two experiments presented above was to refute the claim that for children sentences like (30) and (31) have identical LFs. In this section, I would like to review some independent evidence that children are sensitive to the syntactic position of the universal quantifier. Gualmini et al (2003) showed that children possess knowledge of the asymmetry between internal and external arguments of the universal quantifier with respect to the property of Downward Entailment (DE) (allowing inference of the truth of a proposition predicated of a set to its subset). In adult language, the two arguments of the universal quantifier *every* differ with respect to this property. The quantifier is downward entailing only in its internal but not in its external argument, i.e. an inference from a set to its subset is licensed only for the internal argument of the universal quantifier, as in (37), but not the external one as in (38):

(37) Every [boy who rode an elephant] [fell off] → Every boy who rode a wild elephant fell off.

(38) Every [boy who fell off] [rode an elephant] *→ Every boy who fell off rode a wild elephant.

One diagnostic of DE is that the disjunction operator *or* can receive a conjunctive interpretation in the internal, but only the exclusive disjunctive interpretation in the external argument of *every*.

(39) Every [boy who rode an elephant or a zebra] [fell off] ⇔ Every boy who rode an elephant fell off and every boy who rode a zebra fell off.

(40) Every [boy who fell off] [rode an elephant or a zebra] *⇔ every boy who fell off rode an elephant and every boy who fell off rode a zebra.

Gualmini et al. tested whether English-speaking children know the difference between the internal and external arguments of *every* with respect to the licensing of conjunctive *or*.[14] They report that children know that *or* can be used conjunctively in the internal argument of *every*, but only as exclusive *or* in the external argument.

Further support for the view that children are sensitive to the syntactic position of the quantifier, comes from the study that showed that the rate of children's errors is affected by whether the universal is in the subject ("right-spreading") or object ("left-spreading")

[14] Whether children allow conjunctive use of *or* in the internal argument of *every* was also tested by Gualmini and Crain (2001).

position.[15] Thus, H-K Kang (1999) reports a significant difference between the rate of the right-spreading (51%) and the left-spreading error (73%) in English-speaking children.

One other interesting piece of evidence that children are sensitive to the syntactic position of the universal quantifier comes from the study of quantification in child Catalan (Gavarro and Escobar 2002) and Spanish (Escobar 2002). In their study, G&E were testing the Event Quantification hypothesis with respect to sentences like (41) and (42). In both Spanish and Catalan, a grammatical property (precise nature of which is not crucial for the question at hand) would require sentences like (41) to have frozen scope, where the universal quantifier takes wide scope. When children were asked to judge the truth value of such unambiguous sentences in the contexts like those outlined in a and b, their responses closely mirrored those of adults, and they accepted sentences like (41) in the contexts analogous to (a) despite the 'extra' individuals, which typically elicit 'spreading' responses. At the same time, they correctly rejected the sentence in the context of (b).

(41) Is an elephant carrying all the balloons?

Contexts: a picture showing

a)	b)
elephant$_1$ carries ballon$_1$, balloon$_2$ and balloon$_3$	elephant$_1$ carries ballon$_1$
elephant$_2$	elephant$_2$ carries ballon$_2$
elephant$_3$	elephant$_3$ carries ballon$_3$
boy	boy

In G&E, 94% of the children accepted the surface scope reading (situation a) and 94% of 3- and 4-year olds (as well as 100% of older children) rejected the inverse scope reading (situation b). If in these children's grammar, the universal quantifier was an adverbial quantifier over events, we would expect to find the opposite: children should have rejected the sentence in (a) since it has elephants not carrying balloons, but accepted it in situation (b), since it exhaustively pairs elephants and balloons.

Interestingly, we find a different pattern of responses for G&E's children when the test sentences have a universally quantified subject and indefinite objects. When children were asked to judge the truth-value of (42), their responses across all of the experimental conditions had a higher error rate than what we saw with respect to (41).

(42) Are all the elephants carrying a balloon?

Thus, the younger group (3-4-year-olds) accepted (42) in the situation shown in (43b), a "classic spreading" context, at the rate of 72%. Even more striking was the fact that their responses were only 56% correct in the situation shown in (43a), the so-called 'under-

[15] The term left-spreading and right-spreading error comes from the direction in which the child is claimed to 'spread' the domain of the quantifier from its sister NP: if it is in the subject position, it spreads rightwards, and if it is in the object position, it is leftwards.

exhaustive' error.[16] Results in the Spanish study by Escobar were very similar to the Catalan results by G&E.

Context: picture showing

(43) a. elephant$_1$ carries ballon$_1$
elephant$_2$ carries ballon$_2$
elephant$_3$ carries ballon$_3$
elephant$_4$ carries umbrella$_1$

b. elephant$_1$ carries balloon$_1$
elephant$_2$ carries balloon$_2$
elephant$_3$ carries balloon$_3$
horse$_1$ extra balloon$_4$

I believe that these results can be easily accommodated under my approach, since in (42), but not in (41) there is an ambiguity in how the indefinite can be interpreted. In (41), the indefinite is obligatorily specific and children make very few errors judging the truth-value of this sentence regardless of the presence of extra individuals in the picture. In (42), on the other hand, one may interpret the indefinite object as either specific or non-specific depending on how its domain restriction is construed. The ambiguous stimuli trigger a higher rate of errors than the non-ambiguous ones.

This approach explains the errors not by appealing to children's lack of certain semantic knowledge, but by their full semantic competence, which leads them to recognize the potential ambiguity and, presumably for reasons independent from their linguistic competence, handle the ambiguity resolution differently from adults.

There is independent evidence that Spanish children have full knowledge of the semantic properties of indefinites, which comes from the study conducted by Miller and Schmitt (2003). The goal of their study was to see whether Spanish-speaking children are able to have both specific and non-specific interpretation of indefinites under negation. They studied Chilean Spanish-speaking children's responses to sentences containing indefinites, which are ambiguous, as in (44), and bare singulars, which are obligatorily non-specific, as in (45):

(44) El niño no se compró un perro. (neg > a; a > neg)
The boy neg rfl bought a dog

"The boy didn't buy a dog."

(45) El niño no se compró perro. (neg > a; *a > neg)
The boy neg rfl bought dog

"The boy didn't buy a dog."

When children were asked to judge the truth-value of sentences like (44) and (45) in the situation compatible only with the inverse scope (e.g. the protagonist bought a number of dogs except one), there was a significant difference in the rate of 'false' judgments between

[16] Their study included an addition type of context, analogous to the one that may give rise to perfectionist errors in English-speaking children. The rate of correct responses in this condition was 78%.

(44) and (45). While with respect to the unambiguous (45), the rate of 'false-judgments' was as high as 76%, it was a low 36% with respect to the ambiguous (44). In comparison, adults' 'false-responses' were 99% and 43% for the bare singular vs. indefinite respectively, the pattern the children essentially mirrored. It is plausible then that G&E's children's 'spreading' responses were due to specific indefinite readings intruding into how they interpret (42) and causing them to make the errors.

In short, the data reviewed in this section, as the results of the experiments presented in the previous sections shed some light on the mechanism that creates 'spreading' errors. On the one hand, they show that children have sophisticated semantic knowledge of quantification (including the knowledge of very subtle properties as shown by their sensitivity to a potential ambiguity due to scope interactions between the universal quantifier and indefinites and their differential treatment of the internal and external arguments in a universally quantified sentence with respect to the property of Downward Entailing). On the other hand, we can see that children's weakness (presumably lying outside of their grammatical competence and underlying their weak ability to compensate for insufficient context), makes them prone to errors when the context provided is insufficient for dealing with the complexity created by their sophisticated grammar.

3.4. Experiment 3

3.4.1. Goal, Participants, and Method

The experiments that report high rates of q-spreading typically present target sentences paired with a picture showing participants and their schematic relationships with each other in the event referred to in the target sentence (e.g. boys pulling wagons). Typically there is a distribution of participants across sub-events, but a lack of exhaustive pairing between the agent- and theme-sets. Why such contexts result in a high rate of q-spreading errors has been widely debated in the literature. I have proposed that "classic spreading" responses result from children's strategy of using asymmetry in the visual context as a pragmatic clue for selecting domain restrictions for the quantified phrases. If the picture contains a salient single individual with the property denoted by the indefinite (i.e. a salient single wagon in case of a sentence "no boy is pulling a wagon"), children are likely to see its salience as an indication of its relevance for the speaker and construct the domain restriction for the indefinite to include exactly one individual (the extra wagon). Consequently, the sentence 'no boy is pulling a wagon' would receive "wide scope" indefinite interpretation, true in the situation depicted in the scenario in which some boys are pulling wagons, but one salient wagon is not being pulled. This predicts that errors similar to classic q-spreading can be elicited with sentences that instead of the universal quantifier contain another quantifier given that they are presented under the typical "spreading" inducing conditions, e.g. visual context with a salient single "extra" individual. Thus, in such contexts children should be able to judge sentences with the negative determiner true.

Hypothesis:

- Children will accept as true sentences with the negative determiner and an indefinite in contexts that contain a salient single individual they can use as a value for a singleton domain restriction.

- The error rate can be manipulated by controlling the degree of visual salience of the extra individual.

Participants: Our sample consisted of 19 preschool age children (3- and 4-year old) attending UConn Child Labs. After the training session, 3 of them were excluded after they failed the training, bringing the sample to the total of 16. Five adult control subjects have also been interviewed.

Method: We used a version of the standard Truth Value Judgment Task. Children were shown pictures and were asked to judge the truth-value of target sentences like those in (46)-(47). The variable property across two of the experimental conditions I will present first was the degree of visual salience of the extra individual in the object set - single extra object and non-salient multiple extra objects. Each experimental condition consisted of 4 sentence/picture pairs presented in a fixed random order plus fillers. No linguistic context was given (no background story) to replicate the contextual paucity that typically gives rise to q-quantifier-spreading errors. Prior to presenting the target sentence, children were asked to point out who was in the picture to ensure its full comprehension. After that, the puppet uttered the test sentence, and the child was asked to judge whether the puppet's description of the picture was correct.

Materials: target sentences with a negative determiner presented in one of the following contexts:

(46) salient extra object: No boy is hugging a dog.

(47) non-salient (multiple) extra objects: No girl is holding a cat.

(48) controls: No boy is hugging a dog/ No boy is hugging a cat.

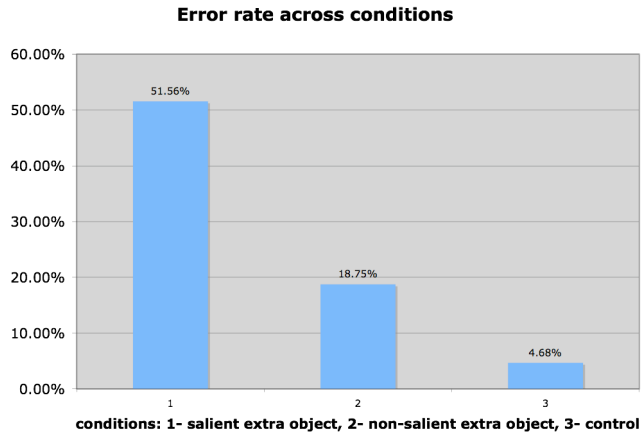
3.4.2. Results

The children were divided into the following two groups:

- The adult-like group, who correctly rejected all but the control sentences - 6 children (and all of the adult controls).

- The 'spreading' group - 10 children, who judged as true at least three out of 4 items of at least one type. For convenience, I will refer to these non-adult-like responses 'spreading' responses

The results in the three conditions across all children are summarized in figure 2. As we can see, the 'salient extra object' condition produced the highest rate of errors. Similar to 'classic spreading' children, the children who gave "yes" responses often explained their judgment by pointing to the extra individual in the picture and saying "not this one" or "he means this one". The 'yes' responses were given even though the children had successfully pointed out the multiple dog-hugging boys before the test sentence was presented.



3.4.3. Discussion

We can ask whether an adverbial theory of universal quantification, such the Event Quantification (Philip 1995), can be extended to account for these errors. The answer seems to be that we cannot, at least not without drastically modifying the lexical semantics of "no". If we simply adopt the event quantification semantics for sentences with the negative determiner, we would get the semantic form like that in (49):

(49) ∀e [a boy or a dog participate in e] [it's not the case that boy hugs dog in e]
"For every event in which a boy or dog (or both) is a participant, it is not the case that a boy hugs a dog."

The sentence construed this way would be falsified by any dog-hugging boy, which leaves the 'yes' responses we elicited unexplained. The correct truth conditions can, however, be captured by means of a contextually narrowed quantifier domain without altering the regular adult semantics of the negative determiner. For those children who accepted the target

sentence, it is interpreted as containing an implicit domain restriction, something like the one given in (50) with its meaning shown in (51):

(50) No boy is hugging a *fluffy white* dog *over here*.

(51) ∀x [boy(x) → ¬∃y[dog(y) and y is in C and x is hugging y]]
C={x: x is a fluffy white dog}

A conclusion that we can make is that the visual asymmetry is responsible for the negative determiner errors, particularly when the asymmetric individual is highly salient. The visual context serves as a pragmatic clue, particularly when the experimental design offers no linguistic context to supply that information. This asymmetry is interpreted as an indication of the relative relevance of the individuals in the picture: the salient extra dog is perceived as the most relevant and included into the singleton domain restriction for the indefinite. This allows for a yes-response, since there clearly is a dog such that no boy is hugging it.

3.5. Finding Values for the Domain Restriction Variables in Adults and Children

If children's semantics of the negative determiners is adult-like, we can ask why adults don't make the same type of errors. The answer has to do with the observation that for adults, the sentence "no boy is hugging a dog" uttered in the context of the picture with boys and dogs is most readily understood as talking about all of the individuals in the picture. As was observed by Kratzer (2004) in her discussion on covert domain restrictions in adult grammar, the utterance in (52) is most readily understood as talking about everybody in the room where the sentence is uttered. It would be judged false if only a subset of the people present in the room is smiling, even if there is a highly salient feature distinguishing the group of smilers (e.g. everyone who is smiling is wearing a red hat). Likewise, (53) would be judged false if there are any smilers in the room, even if the non-smilers share a highly salient feature.

(52) Everybody$_C$ is smiling.

(53) Nobody$_C$ is smiling.

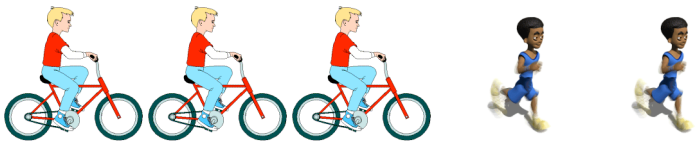
These examples show that for adults, properties of individuals, even very salient ones, are not readily picked up as values for domain restriction variables. This is, however, exactly what I claimed occurred with children in experiment 3. The contrast between adults and children becomes less drastic if we consider the following observation: the difficulty of picking up sub-properties as values for covert domain restrictions holds true only in an out-of the-blue context. Thus, if one utters 'every boy is smiling', and points at a picture, the listener would obligatorily interpret 'every' as ranging over all of the boys in the picture, and not any subset thereof, regardless of any visually distinctive features some of them may share. However, such narrowing is possible in natural discourse. Let's imagine the example given in (54) uttered in the following situation:

(54) *Situation*: department meeting where both students and faculty are present. The head of the department announces that according to the new regulations, the students who miss generals' deadlines will no longer receive department funding.

(55) *A person present in the room*: Now everybody is worried.

There is the intuition that the sentence may be judged true even if only the students present at the meeting are worried. From this, we see that in a natural discourse, there are contextual clues when domain restrictions are narrowed. Without overt clues, adults assume that the maximal set of individuals present in the situation has to fill the value for the domain restrictions. Children, on the other hand, do not always obey this strategy and may adjust domain restrictions without overt linguistic context. This may be, as I stipulated earlier, due to their over-interpreting the visual information as pragmatic clues that can be read by the interlocutors. One additional piece of evidence that this unexpected domain narrowing occurs comes from the so-called under-exhaustive errors, another type of errors usually included under the umbrella term of quantifier spreading. The error is illustrated in (56):

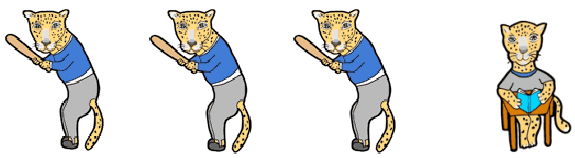
(56) Experimenter: Is every boy riding a bike?
Child: Yes.



While it is difficult to explain this type of response under the Event Quantification theory, it can be straightforwardly analyzed as the child's having narrowed the domain for 'every' to include only the boys deemed relevant, something an adult would do only if the context contained explicit clues for such narrowing.

I have found additional evidence of under-exhaustive errors in children that clearly suggest that children's domain restrictions are more flexible than those of adults. In an experiment reported in Rakhlin 2007, when children were shown pictures like those in (57) and asked to judge the truth of the sentence below, most accepted it as true:

(57) Puppet: One jaguar is reading a book, but every jaguar is playing baseball.
Child: True (78% in the 15 preschool and kindergarten aged children tested).



In contrast, their responses to the following controls were nearly 100% corect. The difference is that for 'both', the size of the quantifier domain restriction is fixed by lexical semantics, and "both" requires it to consist of exactly two individuals:

(58) Puppet: One cat is eating, but both cats are sleeping.
Child: No, only one is sleeping.


In contrast, adults responded to (57) with 'squeamishness' equal to that with which they responded to (58), judging both as contradictions. This suggests that a major difference between adults and children likely responsible for "q-spreading", is not in the formal semantics of quantification, but in the freedom children have when making assumptions about narrowing domain restrictions in situations of contextual paucity.

3.5.1. Experiment 3, Part II: the Extra Subject Condition

In addition to the general 'flexibility' of quantifier domains, there was another non-adult-like property I have uncovered in experiment 3, namely in the 'extra subject' condition.

In this condition, the target sentences had the same structure as in the two conditions discussed above, but the pictures contained an extra individual of the same sort as the agent, illustrated in (59)-(60):

(59) Puppet: No boy is hugging a dog.
Child: Yes (points to the extra boy)

(60)




In our sample, this type of response was given at the rate of 26.56 %, lower than in the 'extra dog' (salient extra object) condition, but higher than in the non-salient extra object condition (a picture with multiple extra dogs). Here again, the non-adult-like children seem to narrow the domain, but in this case it is the domain of the negative determiner that is narrowed to include a single boy, an option normally rejected by adults. This suggests another difference between adults and children: children allow singleton domain restrictions for those quantifiers that disallow them in adult gramamar. Thus, for adults, sentences with the negative determiner denote empty intersections, in our example between a set of boys and a set of dog-huggers, and require the set of boys to be non-singleton. The sentence is odd in a situation in which there is only one boy as a denial that the one contextually present boy hugged a dog (it is acceptable if understood as 'non-specific', denying that any boy huged a dog). Children do not seem to have this 'anti-uniqueness' requirement.

There is independent evidence that children do not obey the 'anti-uniqueness' for another quantifier that requires it for adults, namely the universal quantifier 'every'. In the study by Yatsushiro and Sauerland (2004), children were shown to allow singleton domain restrictions for "every", an option disallowed by adults. In their study, Y&S investigated children's knowledge of the presuppositions of 'every' – the existence and the anti-uniquness presuppositions. The former requires the context for a universally-quantified sentence to contain a non-null set of individuals of the sort denoted by the common noun of the universally quantified NP. The latter requires this set not to have the cardinality of one. These properties of the universal quantifier are illustrated in the following example. Both (62) and (63) are true in the context of (61), but each violates one of its presuppositions:

(61) Context: a boy named Johnny, his parents, his one red-headed sister, two brothers, no grandparents.

(62) Johnny: Every grandma of mine is wearing red pants. (*existence presupposition is violated*).

(63) Johnny: Every sister of mine has red hair. (*anti-uniqueness presupposition is violated*).

Y&S found that while children had a high rate of correct responses with (62) - 72% correct, with (63) there was only a low 32% of correct responses. The explanation offered by Y&S was based on Heim's theory of presuppositions. It holds that some presuppositions are inherent in the lexical semantics of the expressions, while others are implicated. The two types of presuppositions follow separate acquisition paths, with the implicated presuppositions acquired later than the semantic presupposition. Thus, the existence presupposition, which children know, is lexically encoded for "every", while the anti-uniqueness is derived as an implicature via Heim's principle "Maximize Presupposition" (Heim 1991). It states that if there are logically equivalent expressions that differ only with respect to their presuppositions, the one with the strongest presuppositions that are satisfied must be used. Consequently, using the expression with a weaker presupposition entails that the stronger presuppositions are not satisfied. According to this, the anti-uniqueness of "every" (and "no") arises as an implicature because a potentially more informative alternative ("the") is not used. Children do not reliably calculate implicatures and hence lack the anti-uniqueness requirement for "every" and "no."

4. Conclusion

The 'big question' behind the experiments reported here was the question of how the generative theory should deal with the well-documented inconsistencies between child language and the properties of the adult grammar. One approach to this question attributes the pre-adult characteristics of child language to the neurological maturation in certain grammatical mechanisms. A competing approach seeks to handle linguistic development within the Strong Continuity assumption (Pinker 1984) by accommodating any inconsistencies between the hypothesized grammar and the target grammar as incorrect (or

incomplete) parameter setting without positing any ad hoc stages or arbitrary changes in the linguistic development. Within this approach, any remaining discontinuity is handled by attributing it to performance factors, such as children's pragmatic or processing inflexibility, which may obscure the full extent of their adult-like grammatical competence.

The phenomenon of child language that I have focused on here, the so-called "q-spreading," has been seen as evidence of discontinuity – representing a stage at which children possess certain grammatical mechanisms that are not found in the adult grammar, and which the child eventually 'grows out of'. The responses elicited from children seemed to indicate that children imposed on the universally quantified sentences the truth conditions that require their semantic structure to include non-UG elements, such as restrictors formed by a conjunction of NPs in which only one forms a syntactic constituent with the quantifier (or even by the elements that are not mentioned in the sentence at all in case of the so-called perfectionist children).

However, there is strong evidence that the seemingly odd truth conditions arise under predictable conditions and can be manipulated by the experimental technique. A sharp decrease of errors can be produced by various types of manipulations. Yet, one generalization seems to hold across all experiments: children's performance with respect to q-spreading is facilitated by providing a richer context (either linguistic or visual). As I have argued, the role of the enriched context is that it supplies clues about the intended value for domain restrictions of quantifiers, or, in other words, provides information as to what contextual elements are relevant. According to my proposal, the source of children's difficulty and the cognitive module in which development takes place is not their semantic competence, but the area in which meaning and context intersect. As I discussed in section 2, the meaning of quantified sentences is partially determined by context, and the child, who has full semantic knowledge of universal quantification and scope ambiguities, gets into trouble when asked to interpret such sentences without sufficient context.

To summarize my main conclusions, I have argued that children are adult-like in:

i. formal semantics of quantification;

ii. allowing all and only those quantifier scope relations that are permitted in adult grammar;

iii. knowing that quantifier domain restrictions are contextually determined;

I have also argued that children are different from adults in:

a) judging what is relevant to others under sub-optimal pragmatic conditions;

b) allowing the covert domain restriction variables to pick up their values from a salient feature of a subset of the given individuals, even if the context is too poor for such domain narrowing for adults;

c) not recognizing 'implicated presuppositions', such as the anti-uniqueness of 'every' and 'no';

I would like to put forward the hypothesis that children show the behaviors enumerated in the second list due to their developing 'mind-reading' abilities, i.e. their weak ability to represent the content of other minds in a given situation. More specifically, the relevant property is children's insufficient ability to negotiate the relationship between the information discernable by other interlocutors in a given context and each speaker's (including self's) contribution to the discourse.

That there may be a connection between pragmatic tasks in general and ToM is not surprising. Understood broadly, pragmatics deals with those areas of interpreting an utterance that involve aspects of meaning beyond the truth conditions, namely various ways of using context for reconstructing the speaker's meaning (i.e. the proposition that the speaker intended to convey with both explicit and implicit information). Consider the following examples of this (from Wilson 2005):

(64) Peter left *the party.* (political group or festive gathering)

(65) The teachers told the students *they* (the teachers or the students) needed more time to finish the task.

(66) I saw no one in town. (no one I knew or no one interesting)

(67) *Some* of the talks were interesting (not all of them)

In order to decide what proposition the speaker intended to convey, the listener may have to lexically disambiguate (as in 64), establish co-reference (as in 65), fix quantifier domains (as in 66), or understand intended implications (as in 67) to list just a few examples of pragmatic tasks involved in sentence interpretation. Other examples of this involve recognizing context- based conditions on the felicitous use of an expression (presupposition accommodation) and discerning the speaker's communicative intentions for recognizing flouting implicatures. All these tasks require the hearer to have a sophisticated ability to reason about the content of other minds. This connection between pragmatics and 'mind-reading' goes back to Grice (Grice 1957, 1967, 1969, 1989). Thus, his 'working out schema' for deriving conversational implicatures involves making a series of conjectures about the speaker's desire/belief psychology. Following this schema, in order for speaker A to infer the implicated meaning of B's utterance, A has to go through a very complex reasoning process involving a sophisticated ability to "read" other minds given in (68):

(68) A: Is Sally coming to the meeting?

B: Her car broke down. ⇒ Sally is not coming at the meeting.

(69) He said that P; he could not have done it unless he thought that P; he knows (and knows that I know that he knows) that I will realize that it is necessary to suppose that Q; he has done nothing to stop me from thinking that Q; so he intends me to think, or is at least willing for me to think, that Q. (Grice 1989: 30-31)

There is a wealth of independent evidence that children undergo development with respect to their 'mind reading' abilities. It is fair to say that some questions within the field of the Theory of Mind development have not been settled, including precisely what set of abilities constitutes this cognitive module or whether it is a module in the Fodorian sense or rather something that Fodor considered a "central inferential cognitive system" (Fodor 1992). However, it is widely accepted that there is a developmental schedule according to which various pieces of ToM come on line, including evidence that children's ability to make accurate inferences about epistemic effects of particular situations on others does not become adult-like until at least the age of 8. Thus, Taylor (1988) demonstrated that children until this age exaggerate how much information can be inferred about a mostly obscured picture by a naive observer. In her experiment, children readily assumed that the puppet looking at a mostly covered up picture of an animal would know what animal was in the picture, even when only a small unrecognizable detail of the animal was left uncovered for the puppet to see.

In another experiment, Ruffman's (1996) 'two colors' task, the child and a puppet are both shown two dishes each filled with a different color candy – one with red and one with green. The puppet is told that one candy (without specifying which color) will be taken and placed in the box. The puppet then leaves, and the child observes the experimenter take one of the red candies and put in a box. The puppet returns and the child has to answer a series of questions, including "what color does the puppet think is in the box". Ruffman reports that a large majority of children between the ages of 5 and 8 incorrectly answered 'green', i.e. instead of realizing that the puppet was merely agnostic, they ascribed it false belief. This line of research shows that when asked to judge how much a third person knows from observing certain evidence, children often over-attribute as well under-attribute knowledge (cf. also Wimmer, Hogrefe, and Perner 1988, Wimmer, Hogrefe and Sodian 1988, etc.). If this weakness generalizes from visual information to communicative situations in general, this would predict that children are not be able to cope well with the types of tasks illustrated in (64) through (67).

For instance, working out conversational implicatures relies not just on the speaker's ability to know that the listener will be able to compute the implicated meaning in a given situation, but on the listener's ability to infer that the speaker knows that the listener would know that he knows that the implicated meaning can be computed. Certain aspects of meaning of sentences in context are derived by the listener from considering a set of alternative options the speakers had for expressing his intentions. For instance, scalar implicatures rely on the hearer considering possible alternatives, and assessing which alternative entails another and is thus more informative. Then, given the assumption that speakers would be maximally informative (or that the context is such that being maximally

informative is required), the hearer would infer that the speaker has avoided the more informative option because his intention is to express an implicated meaning – negating the alternative that wasn't used.

It is not surprising then that children have been shown to fail in computing scalar implicatures (e.g. Noveck 2001, Gedalyovich 2002). These results coexist with the findings that show that with improved experimental design, e.g. making the speaker's communicative intention to be maximally informative explicit, children are able to compute scalar implicatures (Papafragou and Tantalou 2005).

Children were also shown to use presuppostional expressions (e.g. definite determiners) in contexts in which their presupposition was not satisfied and couldn't be accommodated by the listener (Maratsos 1976, Karmiloff-Smith 1979). However, there is also evidence from comprehension tasks that children's semantics of definites is presuppositional (Maratsos 1976, Syrett, Kennedy, and Lidz 2007) and that the problem in production tasks is in their misjudging how much the listener can infer in a given situation in order to accommodate the presupposition rather than in failing to recognize that definites require a certain context in order to be interpreted. Thus, young children may use a definite NP in a context in which there is more than one object of the sort denoted by the NP. This is because they fail to realize that what they perceive as unique (e.g. a red car in an array containing black, brown and white cars), would not be perceived as unique by the listener unless the domain restriction is made explicit.

Now let's return to the cases of classic q-spreading and see whether we can draw a connection between these responses and reasoning about the content of other minds. I have proposed that verifying sentences like (70) involves making judgments about how the domain of the indefinite should be restricted since the meaning of the sentence relies on whether the "plural" or the "singleton" indefinite is chosen. If the singleton option is chosen, then (70) receives the 'wide scope' indefinite interpretation and would be false in the context of (71).

(70) Speaker**:** Every boy is pulling a wagon.

(71) 

(72) Listener: Does he mean all of these?  or just this one 

Presumably, both adults and children go through this type of reasoning, but adults quickly abandon the singleton option for object indefinites unless there is overt context

requiring them to choose it.[17] Many children, on the other hand, are almost equally likely to go with either option, particularly when the single extra item in the picture is highly perceptually salient, and hence they produce both adult-like 'yes'- and "q-spreading" 'no'-responses (at the rate of 44% and 56% respectively in Philip 1995).

I suggest that what causes the difference between adults and children is having to use a 'working out schema' that requires one to consider the content of other minds, something along the following lines:

(73) The speaker could mean the multiple X's or the single X for the domain restriction of the indefinite. Since the singleton X is more marked, if she means the single X, she has to assume that I know that she means the single X. However, she has no reason to assume that I would know that she means the single X since there have not been any overt clues given to me to inform me that she means the single X. Therefore, she must mean the multiple X's.

If we are correct in claiming that such type of reasoning is involved in making this decision, it is entirely plausible to suppose that q-spreading would disappear as children fully develop their ToM. Until that happens, they are unable to complete the inference in (73) and resort to guessing (or perhaps some other pragmatic strategy, such as using visual prominence of the objects in the picture as their guide).

Further research is necessary in order to demonstrate more directly the ToM/ Q-spreading connection. Perhaps, the Taylor-task (judging whether a partially obscured picture can be reconstructed by another observer) can be a good non-verbal predictor of a child's success with universal quantifiers.

If this conclusion about the ToM and children's pragmatic competence is correct, this means that we do not only have strong empirical reasons to adopt a pragmatic account of q-spreading that I have developed here, but we have a good theoretical justification for favoring such an account. It allows us to maintain the Strong Continuity Assumption, which provides a strong explanatory force to the acquisition theory. It also provides an explanation for 'why pragmatics should be different'.

References

Bucci, W. (1978) "The Interpretation of Universal Affirmative Propositions," *Cognition* 6, 55-57.

Chierchia, G. (2001) "A Puzzle about Indefinites." In C. Cecchetto, G. Chierchia, and M. T. Guasti, eds., *Semantic Interfaces: Reference, Anaphora and Aspect*, Stanford CA: Center for the Study of Language and Information, 51–89.

[17] Psycholinguistic evidence that adults consider both interpretations, but prefer the non-singleton option for object indefinites comes from Kurtzman and McDonald (1993). The preference is reversed for subject indefinites.

Conroy, A. and J. Lidz (2007) "A Return to Isomorphism: the Processing Demands Associated with Resolving Ambiguity," paper presented at CUNY Sentence Processing Conference, UC San Diego, CA.

Crain, S., L. Meroni and A. Gualmini (2000) "The Universal Quantifier is Strong in Children," paper presented at the 24th Annual Penn Linguistics Colloquium, University of Pennsylvania, Philadelphia, PA.

Crain, S., R. Thornton, C. Boster, L. Conway, D. Lillo-Martin, and E. Woodams (1996) "Quantification without Qualification," *Language Acquisition* 5(2), 83-153.

Crain, S. and R. Thornton (1998) *Investigations in Universal Grammar*, MIT Press, Cambridge Mass.

Davidson, D. (1984) *Inquiries into Truth and Interpretation*, Oxford University Press, New York, NY.

Drozd, K., and E. van Loosbroek (1998) "Weak Quantification, Plausible Dissent, and the Development of Children's Pragmatic Competence," *Proceedings of the 23rd Boston University Conference on Language Development,* Cascadilla Press, Somerville, 184-195.

von Fintel, K. (1994) *Restrictions on Quantifier Domains*, Ph.D. dissertation, Graduate Student Linguistics Association (GLSA), University of Massachusetts, Amherst.

Fodor, J. (1992) "A theory of the Child's Theory of Mind," *Cognition* 44, 283-296.

Fodor, J. D. and I. Sag (1982) "Referential and Quantificational Indefinites," *Linguistics and Philosophy,* 5: 355-398.

Gavarró, A. and L. Escobar (2002) "A Pilot Study of Quantification in Child Catalan," Report de Recerca GGT-02-3, UAB.

Geurts, B. (2000) "Indefinites and Choice Functions," *Linguistic Inquiry* 31. 731- 738.

Geurts, B. (2003) "Quantifying kids," *Language Acquisition*, 11(4), 197-218.

Gedalyovich, L. (2002) "Children's Knowledge of Non-Truth-Conditional Conventional Meaning: Evidence form the Contrastive Element of *Aval ("But")*," *IATL 17 Proceedings*.

Gordon, P. (1996) "The Truth Value Judgment Task." In McDaniel, D., C. McKee and H. Smith Cairns, eds., *Methods for Assessing Children's Syntax,* MIT Press, Cambridge, Mass., 211-231.

Grice, H. P. (1957) "Meaning," *Philosophical Review* 66:377-88.

Grice, H. P. (1967) "Logic and Conversation," William James Lectures, Harvard. Reprented in Grice (1989).

Grice, H. P. (1969) "Utterer's Meaning and Intentions," *Philosophical Review* 78, 147-177. Reprinted in Grice (1989).

Grice, H. P. (1975) "Logic and Conversation." In Peter Cole and James Morgan, eds., *Syntax and Semantics 3: Speech Acts*, Academic Press, New York, 41-58.

Grice, H. P. (1989) *Studies in the Way of Words*, Harvard University Press, Cambridge, Mass.

Gualmini, A. (2003) *The Ups and Downs of Child Language*, Ph.D. dissertation, University of Maryland.

Gualmini, A. and S. Crain (2001) "Downward Entailment in Child Language." In *University of Maryland Working Papers in Linguistics 11*, University of Maryland at College Park, 112-133.

Gualmini, A. and S. Crain (2002) "Why No Child or Adult Must Learn De Morgan's Laws," *Proceedings of the 26th Boston University Conference on Language Development*, 342-254.

Gualmini, A., S. Crain, L. Meroni, G. Chierchia and M. T. Guasti (2001) "At the Semantics/Pragmatics Interface in Child Language," *Proceedings of Semantics and Linguistic Theory* 11, Cornell University, Ithaca, NY: 231-247.

Gualmini A., L. Meroni and S. Crain (2003) "An Asymmetric Universal in Child Language." In M. Weisgerber, ed., *Proceedings of the conference "Sub7– Sinn und Bedeutung"*, *Arbeitspapier* 114, University of Konstanz, Germany.

Heim, I. (1982) *The Semantics of Definite and Indefinite Noun Phrases*, Ph.D. dissertation, University of Massachusetts, Amherst.

Heim. I. (1991) "Artikel und Definitheit." In A. von Stechow and D. Wunderlich, eds., *Semantik: Ein internationales Handbuch des zeitgenossischen Forschung*, de Gruyter, Berlin, 487– 535.

Heim, I. and A. Kratzer (1998) *Semantics in Generative Grammar*, Blackwell, Malden and Oxford.

Hornstein, N. (1984) *Logic as Grammar*, MIT Press, Cambridge, Mass.

Hulsey, S., V. Hacquard, D. Fox, and A. Gualmini (2004) "The Question-Answer Requirement and Scope Assignment," *MIT Working Papers in Linguistics* 48*, Plato's Problems: Papers on Language Acquisition,* MIT, 71-90.

Inhelder, B. and J. Piaget (1964) *The Early Growth of logic in the child*, London: Routledge, Kegan and Paul.

Kamp, H. (1981) "A Theory of Truth and Semantic Representation." In J. A. G. Groenendijk et al., eds., *Formal Methods in the Study of Language; Mathematical Centre Tracts 135*, Mathematical Centre, Amsterdam, 277-322. Reprinted in Portner and Partee (2002) eds., *Formal Semantics: the Essential Readings,* 189-222.

Kang, H-K. (1999) "Quantifier Spreading by English and Korean Children," *UCLWPL* 11, Iten, C. and A. Neeleman, eds., University College London.

Karmiloff-Smith, A. (1979) *A Functional Approach to Child Language: A Study of Determiners and Reference*, Cambridge University Press, New York.

King, J. (1988) "Are Indefinite Descriptions Ambiguous?," *Philosophical Studies* 53: 417-440.

Kratzer, A. (1998) "Scope or Pseudo-Scope? Are There Wide-Scope Indefinites?" In S. Rothstein, ed., *Events in Grammar*, Kluwer, Dordrecht, 163-196.

Kratzer, A. (2004) "Covert Quantifier Domain Restrictions," a talk at Milan Meeting, Palazzo Feltrinelli, Gargnano.

Kurtzman, H. and M. C. MacDonald (1993) "Resolution of Quantifier Scope Ambiguities," *Cognition*, 48, 243-279.

Lewis, D. (1975) "Adverbs of Quantification." In E. L. Keenan, ed., *Formal Semantics of Natural Language*, Cambridge University Press, Cambridge, 3-15. Reprinted in Portner and Partee, (2002), 178-188.

Maratsos, M. (1976) *The Uses of Definite and Indefinite Reference in Young Children: An Experimental Study of Semantic Acquisition*, Cambridge University Press, Cambridge.

Marti, L. (2003) *Contextual Variables*, Ph.D. dissertation, University of Connecticut.

May, R. (1977) *The Grammar of Quantification*, Ph.D. dissertation, MIT.

May, R. (1985) *Logical Form*, MIT Press, Cambridge, Mass.

Meroni, L., S. Crain and A. Gualmini (2001) "Felicity Conditions and On-line Interpretation of Sentence with Quantified NPs," paper presented at the *14th Annual CUNY Conference on Human Sentence Processing*, March 15th-17th, 2001, University of Pennsylvania. Philadelphia.

Meroni, L., A. Gualmini and S. Crain (2000) "A Conservative Approach to Quantification in Child Language," *Proceedings of the 24th Annual Penn Linguistics Colloquium*, 171-182.

Miller, K. and C. Schmitt (2003) "The interpretation of Indefinites and Bare Singulars in Spanish Child Language," Paper presented at the 6th Conference on the Acquisition of Spanish and Portuguese as First and Second Languages, University of New Mexico, Albuquerque.

Noveck, I. (2001) "When Children are More Logical than Adults: Experimental Investigations of Scalar Implicatures," *Cognition* 78, 165-188.

Papafragou, A., and J. Musolino. (2003) "Scalar Implicatures: Experiments at the Semantics-Pragmatics Interface," *Cognition* 86, 253-282.

Papafragou, A. and N. Tantalou (2004) "Children's Computation of Implicatures," *Language Acquisition* 12(1), 71-82.

Philip, W. (1995) *Event quantification in the acquisition of universal quantification*, Ph.D. dissertation, University of Massachusetts, Amherst.

Philip, W. and S. Aurelio (1991) "Quantifier Spreading: Pilot Study of Preschoolers' *Every*." In T. Maxfield and B. Plunkett, eds., *University of Massachusetts Occasional Papers: Papers in the Acquisition of WH*, GLSA, Amherst, Mass., 267-282.

Philip, W. and E. Lynch (2000) "Felicity, Relevance, and Acquisition of the Grammar of *Every* and *Only*," *Proceedings of the 24th Boston University Conference on Language Development*, Cascadilla Press, Somerville, MA., 583-596.

Philip, W. and M. Takahashi (1991) "Quantifier Spreading in the Acquisition of *Every*," In T. Maxfield and B. Plunkett, eds., *University of Massachusetts Occasional Papers: Papers in the Acquisition of WH*, GLSA, Amherst, Mass., 283-301.

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

Rakhlin, Natalia (2007) *Semantic Manifestations of the Developing Theory of Mind*, Ph.D. dissertation, University of Connecticut.

Reinhart, T. (1997) "Quantifier Scope: How Labor is Divided between QR and Choice Functions," *Linguistics and Philosophy* 20, 335-397.

Roeper, T. and E. Matthei (1975) "On the Acquisition of *All* and *Some*," *Papers and Reports on Child Language Development* 9, Stanford University Press, Stanford.

Roeper, T. and J. de Villiers (1993) "The Emergence of Bound Variable Structures." In Reuland E. and W. Abraham, eds., *Knowledge and Language*, Kluwer Academic Press, Boston, 105-139.

Roeper, T., U. Strauss and B. Zurer Pearson (2004) "The Acquisition Path of Quantifiers: Two Kinds of Spreading," In Heizmann, T., ed., *Current Issues in Language Acquisition*, UMOP 34, University of Massachusetts, Amherst.

Ruffman T. (1996) "Do Children Understand the Mind by Means of Simulation or a Theory: Evidence from their Understanding of Inference," *Mind and Language* 11, 388-414.

Russell, B. (1919) "Descriptions." in Moor (1993) *Meaning and* Reference. Oxford: Oxford University Press.

Schwarz, B. (2001) "Two Kinds of Long-Distance Indefinites." In van Rooy and Stokhof (2001), eds., *Proceedings of the 13th Amsterdam Colloquium*, Institute for Logic, Language and Computation, University of Amsterdam, 192–197.

Schwarzschild, R. (2002) "Singleton Indefinites," *Journal of Semantics,* 19, 289-314.

Sugisaki, K. and M. Isobe (2001) "Quantification without Qualification without Plausible Dissent," SULA, University of Massachusetts, Amherst.

Syrett, K., C. Kennedy and J. Lidz (2007) "Meaning and Context in Children's Understanding of Gradable Adjctives," ms. University of Maryland, College Park.

Taylor, M. (1988) "The Development of Children's Understanding of the Seeing Knowing Distinction." In J. W. Astington, P. L. Harris, D. R. Olson, eds., *Developing Theories of Mind*. Cambridge University Press, Cambridge, England, 207-225.

Viau, J., J. Lidz and J. Musolino (2007) "Priming Abstract Logical Representations in 4-Year-Olds," ms., Northwestern University, University of Maryland, and Indiana University.

Westerstahl. D. (1984) "Determiners and Context Sets." In J. van Benthem and A. ter Meulen, eds., *Generalized Quantifiers in Natural Languages,* Foris, Dordrecht, 45-71.

Wilson, D. (2005) "New Directions for Research on Pragmatics and Modularity," *Lingua* 115: 1129-1146.

Wimmer, H., J. Hogrefe and J. Perner (1988) "Children's Understanding of Information Access as Source of Knowledge," *Child Development* 59, 386-396.

Wimmer, H., J. Hogrefe and B. Sodian (1988) "A Second Stage in Children's Conception of Mental Life: Understanding Informational Accesses as Origins of Knowledge and Belief." In J. W. Astington, P. L. Harris and D. R. Olson, eds., *Developing Theories of Mind*. Cambridge University Press, Cambridge, England, 173-192.

Winter, Y. (1997) "Choice Functions and the Scopal Semantics of Indefinites," *Linguistics and Philosophy* 20: 399-467.

Yatsushiro, K. and U. Sauerland (2005) "The Acquisition of Presuppositions: The Presuppositions of *Every*," paper presented at Experimental Pragmatics: Exploring the Cognitive Basis of Conversation", Center for Research in the Art, Social Sciences and Humanities, University of Cambridge.