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# Universal Grammar and the Acquisition of Semantic Knowledge: An Experimental Investigation into the Acquisition of Quantifier-Negation Interaction in English

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University of Pennsylvania Institute for Research in Cognitive Science Technical Report No. IRCS-99-01.

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**Abstract**
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Regarding the first question, it appears that children's non-adult interpretations are nevertheless systematic, i.e. governed by principle. Specifically, children (unlike adults) are found to map overt syntactic relations between QNPs and negation and their relative semantic interpretation isomorphically. This, however, is just a descriptive generalization. The observation of isomorphism is treated as an epiphenomenon, derived from the interplay between a universally encoded dichotomy splitting the class of QNPs and learnability considerations. Regarding the second question, I show that children can move from their system of interpretation to the adult system solely on the basis of positive evidence and thus, that the observed difference does not create a learnability problem. In summary, this dissertation uncovers a new area where the linguistic behavior of children and adults diverge: the comprehension of sentences containing negation and quantified noun phrases. The rest of the dissertation is a methodological statement, namely that it is not only desirable but also possible to account for the observed difference between children and adults without invoking any differences between the two groups beyond minimal conceptual necessity. To the extent that this goal is achieved, the present investigation emphasizes the role played by the theory of Universal Grammar and language learnability in helping us understand language development and its biological basis.

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by

Julien Musolino

Dissertation submitted to the faculty of the Graduate School of the
University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
1998

Advisory Committee:

Professor Stephen Crain, Chair
Professor Bonnie Dorr
Professor Norbert Hornstein
Professor David Lightfoot
Professor Rosalind Thornton

# ABSTRACT

Title of Dissertation: UNIVERSAL GRAMMAR AND THE ACQUISITION OF SEMANTIC KNOWLEDGE: AN EXPERIMENTAL INVESTIGATION INTO THE ACQUISITION OF QUANTIFIER-NEGATION INTERACTION IN ENGLISH.

Julien Musolino, Doctor of Philosophy, 1998

Dissertation directed by: Professor Stephen Crain
Department of Linguistics

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# DEDICATION

To the memory of José and Valéry Musolino.

# ACKNOWLEDGMENTS

Much like a bodybuilder feels after lifting a 300-pound bar, I would like to believe that writing a dissertation is an individual achievement. Those who have spent any time at the gym however, know that bodybuilders have spotters. As the bodybuilder begins to lose his face-off with steel and gravity, the spotter - who has been patiently waiting for that very moment, steps forward and, in a nonchalant act of utter altruism, graciously counterbalances the effect of Newton's law. When the bar triumphantly regains it ascending course of motion, you can often hear the spotter yell to the bodybuilder "Come on ! It's all you !" But the bodybuilder knows damn well that it's not all him and that if it wasn't for the spotter landing a helping hand, he would most likely have been crushed by the weight of his own ambition. Graduate students too - as heroic as they may feel upon completion of the Everest of academic degrees, have spotters. I would like to take this opportunity to express my gratitude to those who have lent a helping hand - my 'spotters'.

My first words will go to my advisor, Stephen Crain, to whom I owe my interest in language acquisition and experimental studies and much more. At a time when I was working on inversion phenomena in French, and had manufactured more functional projections to fit my purposes than Chomsky had published papers, Stephen started as the new chairman, I am sorry, the new chairperson of linguistics at Maryland, and it didn't take him long to convince me - if the job market hadn't already done so - to switch from straight theoretical syntax to experimental psycholinguistics. And what a better person to

work with that the best experimentalist in the world ! Through his amazing knowledge of the field, his unparalleled experience and ingenuity, his intellectual rigor, his patience and his generosity Stephen has taught me a lot as a mentor, and for that I am grateful to him. To me, he is more than a spotter and my intellectual debt to him is immense. He is the guy who got me into the game, provided the equipment, showed me the way, watched my every step, listened to my complaints, and more than anybody else, turned my four years at Maryland into an extraordinary intellectual journey.

Then, there is Norbert Hornstein. I can picture him at his desk, with a squash racket in one hand, a dumbbell and the Minimalist Program in the other, and on the desk, a draft of his latest book, that he wrote over his lunch break. Yes, I do admire the man and I confess with candor that I envy the depth and sharpness of his intellect, his verve, his eloquence and his sense of humor. Juan Uriagereka says that it is my homosexual side. Maybe he's got a point (for the record, I am straight, happily married and when I need to convince myself of the existence of God, my eyes turn to the unparalleled beauty of the ultimate creation: the woman. As a famous Frenchman once said, the reason God created the man before the woman is because it always takes a first draft to produce a masterpiece). Coming back to Norbert, and to my intellectual debt to him, I would like to thank him for writing his 1984 book (part of my analysis rests on his original insight), for recognizing that my struggle with quantification was a worthy cause and for sharing some of his thoughts with me.

Next comes David Lightfoot. On a rainy Welsh day of March 1994, I went to one of the deserted libraries at UNWB (University of North Wales Bangor) to check my e-mail. 'You have 1 new mail message'. That message was from David Lightfoot who was

informing me that I had just been selected as the recipient of a Graduate School Fellowship at the University of Maryland at College Park, followed by a two year commitment from the Linguistics Department. What David was telling me is that I had just earned - or won; whichever way you want to look at things - my piece of the American Dream. A few years later, I delivered the first part of a co-authored talk entirely based on my co-author's work and sat through the entire question session without saying a word. People in the audience certainly and rightly wondered what I was doing there. David Lightfoot was in the audience. Back at Maryland, he came to me and told me I had made a mistake by getting involved in this talk. Of course, I didn't recognize it right away, and especially not in front of him, but he was absolutely right. A short while before the end of my degree I met with David to tell him about the ideas I was about to defend. At the end of the discussion, he looked up at me and said: "Good job kid". As I left his office, I felt happy and somehow relieved: I had just been blessed by a giant. I haven't had as much professional interaction with David as I have had with say, Stephen or Norbert but as I remember the occasions on which I had, I still feel the weight of his words. So thanks to him too, for his advice and encouragement during these four years.

Then there are the other members of my committee, Bonnie Dorr, Rosalind Thornton that I would like to thank for their encouragement and their useful comments and suggestions regarding my dissertation. Special thanks are due to Rozz (Rosalind) with whom I have worked pretty closely at some points throughout the years. She too is a wonderfully gifted experimentalist from whom I learned a lot. She is also a very sweet and pleasant person. My only wish is that she remembered that she lost her bet with me that I would stress out like crazy before the defense and have a really hard time producing

a draft of the thesis. Although I did stress out, I think that the timing was pretty good and that the draft didn't suffer. So Rozz, you still owe me lunch.

The name Juan Uriagereka appeared above. He is also someone I would like to thank. A few days after I had arrived in the US, and had absolutely no place to stay - I was feeling quite desperate actually - Juan offered me to stay at his place for a few days, until I found a place to live. I also worked with Juan on my generals paper. I remember giving him a 70 page paper to read on a Tuesday afternoon, I believe, and when I saw him again on Wednesday morning, he handed the paper back to me with comments all over the margins. He is also someone whose words marked me in a very positive way. After meeting with him to let him know about my ideas regarding my generals paper, he told me: "don't waste your time here, go back home and start writing". No ifs, buts, whys, hows etc. and that felt damn good. Words like those are sometimes all it takes to make you go on. As the French say "Quelques grammes de finesse dans un monde de brutes" (a few grammes of finesse in a world of brutes). Generous, handsome, modest and efficient, I often think of Juan Uriagereka as the Zorro of Linguistics. Now I bet Norbert Hornstein would blame that on my homosexual side !

Let me now get back 5 or 6 years, at a time when I didn't know what bagels and chips and salsa were; and thank three people who played a key role in my later discovery of such fine things as bagels and chips and salsa: Liliane Haegeman, Luigi Rizzi and Ian Roberts. You guessed right, this was my Geneva time. These three fellows introduced me to the fascinating world of generative linguistics and frankly, if they hadn't done a wonderful job back then, I wouldn't be sitting here writing the acknowledgment section of my Ph.D. thesis in Linguistics. Liliane did her best to try to get me a Ph.D. position at

Geneva but alas, lacking appropriate departmental funds and with tears in her eyes, she lost me to UMD. Meanwhile, Ian Roberts was already in place, i.e. a visiting Professor at Maryland (replacing Norbert Hornstein !). The next step in this Machiavelian plan was for Ian to try to convince David Lightfoot (who was the Chairperson at that time) that I would be a good graduate student. And boy, did Ian do a good job ! So Ian, as I once told you in an e-mail message, “Je te dois une fière chandelle” In case the reader is puzzled but this nebulous French idiom, this is the translation that Ian Roberts offered, and I am not joking: ”I owe you a pint of Guinness”. Finally, thanks to the third protagonist, Luigi Rizzi for that letter of recommendation to David Lightfoot.

Then, there are all the others, still on the faculty side, who directly or indirectly contributed to making these four years four wonderful ones. Thanks to Amy Weinberg whom I have relentlessly bugged about administrative issues and who always answered my questions with a smile. And finally, thanks to Linda Lombardi for reinforcing my conviction that although phonology is an extremely noble and worthy area of linguistics, it would not be one that I would pursue beyond strict conceptual necessity, i.e. not beyond the first year of the graduate program.

I would now like to express my gratitude to my fellow graduate students. My first words will go to my research buddy, Fred Savarese. It is no exaggeration to say that without Fred, I would have no dissertation and no generals paper. For over two years, Fred and I have spent time together almost a on daily basis, collecting data and interacting with the children at the Center for Young Children at the University of Maryland. What grew out of this time spent together is a strong friendship, and an enormous amount of respect and gratitude on my part. More than a research partner, Fred

has become a friend, a confident and one of the most reliable and courteous person that I have met. For all your time, your help, your advice (personal and professional), your friendship, your care and your generosity, your sensitivity; Fred: thank you. Next I would like to thank Becky Beausoleil who has also spent an amazing amount of her time helping me with my experiments. Then there are all the others that I would like to thank for their friendship and their encouragement throughout the years: Juan Carlos Castillo, John Drury, Kleanthes Grohmann, Pat Hironymous, Jeff and Emily Lilly, Akemi Matsuya, Viola Miglio, Frida Morelli, Bruce Moren, Tuomo Neuvonen, Caro Struijke, Acriso Pires.

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Special thanks are also due to all the children, the parents and the staff at the Center for Young Children at the University of Maryland without whose help none of the research reported in this dissertation would have been possible.

Finally, thanks to my family back in Europe for their love and support throughout these years. My last words will go to the most important person in my life, my wife Christine, to whom I would like to express my deepest gratitude for her love, support, and patience throughout my years in graduate school.

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# INTRODUCTION

"The only two people I know who have magic powers are God, up there, and the Power Rangers on the cartoon channel" Ulysses, 4;5.

With or without magic powers, every English-speaking child like Ulysses eventually comes to know that in his language, the sentence in (1) is ambiguous with respect to the interpretation of negation and the object DP but the sentences in (2) and (3) are not.

(1) Cookie Monster didn't eat two slices of pizza
(2) Cookie Monster didn't eat every slice of pizza
(3) Cookie Monster didn't eat a certain slice of pizza

(1) can either mean that there are two slices of pizza that Cookie Monster didn't eat, in which case *two slices of pizza* receives a wide scope reading with respect to negation or, it can mean that the number of slices of pizza that Cookie Monster ate is not two, but say, three. Here, *two slices of pizza* receives a narrow scope reading with respect to negation. In (2), *every slice of pizza* can only receive a narrow scope reading and in (3), *a certain slice of pizza* can only receive a wide scope reading.

Knowing the meaning of (2) and (3), therefore, involves knowing that (2) cannot receive a wide scope reading and (3) cannot receive a narrow scope reading. This, in turn, amounts to knowing that certain sentences cannot have certain meanings. Magic powers aside, where could such knowledge come from ? It would be hard to convince anyone

that every single English-speaking parent explicitly informed their child that sentences like (2) cannot receive a wide scope reading and sentences like (3) cannot receive a narrow scope reading. Clearly, the answer lies somewhere else. In the domain of the acquisition of syntactic knowledge, it is commonly assumed that children need not be explicitly informed about which sentences are impossible. Rather, it is believed that nature, through biological evolution, has preempted the 'no-negative-evidence problem' by endowing human infants with a genetic blueprint for language, called Universal Grammar (UG), which specifies the possible format for natural languages (Chomsky 1980, 1981, 1986 etc.)

The purpose of this dissertation is to extend the logic of this argument to the acquisition of semantic knowledge and show that in this domain too, UG determines the hypothesis space that children are allowed to explore. In order to achieve this goal, I systematically investigate children's interpretations of sentences like the ones in (1-3), through a series of psycholinguistic experiments. My central thesis, based on the results from these experiments, is that English-speaking children around the age of 5 do not interpret sentences containing negation and quantified NPs (QNPs) the way adult speakers do. This, in itself, need not be surprising. After all there are many other things that 5-year-olds don't do like adults. What is remarkable however, is that children's interpretations differ from those of adults in a systematic way, suggesting that their non-adult behavior is nonetheless governed by principle. Specifically, children's interpretations of sentences containing negation and QNPs, unlike those of adults, appear to be strictly determined by the surface syntactic form of these sentences, and in

particular, by the overt scope relations between negation and QNPs. If notions such as syntactic scope - which are drawn from a universal linguistic vocabulary - play a role in determining children's initial interpretive hypotheses, we then have evidence that the acquisition of semantic knowledge is contrained by UG.

Such a result however, i.e. the fact that children's semantic knowledge appears to differ from that of adults, has recently led to the conclusion that children lack certain semantic principles which characterize adult linguistic systems (e.g., Philip 1995). The conclusion I draw is different. On the basis of my findings, I contend that children and adults have access to the same universal linguistic principles and that children's interpretations are not only compatible with UG but also with the adult system they are acquiring. The only difference between children and adults is that children, as learners, are sensitive to the demands of learnability and therefore cannot hypothesize the full adult system at once. Rather, they need to make a more restricted set of initial hypotheses and await positive evidence to expend their knowledge. Only in this way are they guaranteed to successfully converge onto their target language. Specifically, I argue that children's non-adult interpretations of sentences containing negation and QNPs necessarily arise from the interplay between a universally encoded dichotomy splitting the class of QNPs and the demands of learnability. In the same spirit, I show that children can move from their system of interpretation to the adult system solely on the basis of positive evidence. Therefore, the observation that children differ from adults does not create any learnability problems. In sum, I view children's initial knowledge as *incomplete* rather than *inaccurate*. This approach can be construed as a methodological

statement, namely that it is not only desirable but also possible to account for the observed difference between children and adults without invoking any differences between the two groups beyond minimal conceptual necessity. To the extent that this goal is achieved, the present investigation emphasizes the role played by the theory of Universal Grammar and language learnability in helping us understand language development and its biological basis.

Apart from shedding light on the role and *modus operandi* of UG in the process of acquisition, I believe that observing a linguistic difference between children and adults also offers an interesting basis for reinterpreting the formal properties of the final state, i.e. the theory of adult grammatical competence. Until the initial state is fixed regarding a particular area of linguistic knowledge, a large number of competing characterizations of the final state are possible, provided that they adequately describe the facts. Once the initial state is fixed however, the number of competing hypotheses usually drops; often down to one. In certain cases therefore, data from child language can be brought to bear on the formulation of grammatical theory in an interesting way: they can help us distinguish between competing and otherwise equivalent views of the final state of UG regarding a particular linguistic phenomenon. I believe that some of the findings presented here have this property and I use this to emphasize the claim that data from child language can help us achieve an important goal of linguistic theory: reaching explanatory adequacy.

This is how the discussion is organized on a general level: In chapter I, I introduce the phenomenon under investigation - quantifier-negation interaction - and the theoretical and methodological tools I use to conduct my investigation. In chapter II, I present a series of psycholinguistic experiments designed to assess children's interpretations of sentences containing negation and QNPs. I conclude that children around the age of 5 interpret these sentences differently from adults. This finding raises two questions (a) how and why do children's interpretations of sentences containing negation and QNPs differ from those of adults ? (b) How can we ensure that children manage to move from their system of interpretation to the adult system relying on positive evidence only ? Chapter III and IV are devoted to addressing these two questions respectively. A detailed outline is provided at the beginning of each chapter.

# CHAPTER I

## Preliminaries

Writing a dissertation is much like cooking: one tries to choose good ingredients, follow a good recipe and hope that the combination will give rise to something worthy of a fine palate. In this chapter, my purpose is to introduce the ingredients and the recipe that I chose for this dissertation. I will, however, leave to the reader the task of determining whether the result is worth salivating over. Beginning with the ingredients, I start by introducing the phenomenon whose knowledge represents the object of my study: quantifier-negation interaction. First, in section 1, I describe the phenomenon. In section 2, I present an array of formal mechanisms, put forth by various investigators, and discuss their ability to capture the facts described in section 1. Next, in section 3, I explain why I think that the acquisition of quantifier-negation interaction is interesting by considering the issue in light of general problems of language acquisition. In section 4, I turn to the recipe. There, I lay out the theoretical assumptions underpinning this study, namely the Principles and Parameters theory of Universal Grammar (Chomsky 1981, 1986, 1995). Also, I discuss a particular model of the relation between grammar and other potential elements involved in language acquisition and language processing, known as the Modularity Matching Model (Crain and Thornton (in press). Next, I turn to a detailed description of the methodology used in the experiments reported in this study: the Truth Value Judgment Task (Crain and McKee (1985); Crain and Thornton (in press)). Finally,

in section 5, I present a survey of the literature on the acquisition of quantificational competence. First I review the major findings on the acquisition of Quantifier-Quantifier interaction. Next, I turn to the few studies focusing on the acquisition of Quantifier-Negation interaction. The upshot is that Quantifier-Quantifier interaction and Quantifier-negation interaction are separate phenomena and they should therefore not be conflated. The present study is an investigation of Quantifier-Negation interaction and represents, to the best of my knowledge, the first systematic investigation of the acquisition of this phenomenon.

## 1. Quantifier-Negation interaction

It has often been observed that in English, negation can interact semantically with quantified NPs (QNPs) (Jackendoff 1972, Lasnik 1979, Horn 1989). The examples below illustrate this fact.

(1) a. Every student didn't solve the problem.
b. Some students didn't solve the problem.
c. The students didn't solve two problems.
d. The students didn't solve every problem.
e. The students didn't solve some problems.

The example in (1a) is ambiguous. On one reading it can be paraphrased as *Every student is such that he didn't solve the problem*; i.e., none of the students solved the problem. On this reading, *every student* takes scope over negation (every > neg). On its other reading, (1a) can be paraphrased as *Not every student solved the problem*. Here, negation takes scope over *every student* (neg > every) giving rise to the *not every* reading. In the

example in (1b) on the other hand, *some students* must be interpreted outside the scope of negation. That is, (1b) must mean that some students are such that they didn't solve the problem. The interpretation where negation takes scope over the subject is not available in this case: (1b) cannot mean that none of the students solved the problem. The example in (1c) is ambiguous. On one reading it can be paraphrased as *the number of problems that the students solved is not two*. In this case, negation takes scope over *two problems* (not > two). On its other reading, (1c) can be paraphrased as *There exits two problems that the students didn't solve*. Here, *two problems* takes wide scope over negation (two > neg). In (1d), *every problem* must be interpreted where it occurs, that is in the scope of negation. (1d) must mean that *not every* problem was solved (not > every). The interpretation where *every* takes scope over negation as in *every problem is such that it didn't get solved* i.e., none of the problems were solved (every > neg) is not available[1]. Finally, in (1e), *some problems* must take scope over negation. (1e) can be paraphrased as *there exists some problems that the students didn't solve* (Some > neg). Here, *some problems* cannot be interpreted in the scope of negation[2]. In other words, (1e) cannot be interpreted as *the students didn't solved any problem* (neg > some).

From our pretheoretical inspection of the examples in (1) above, it seems that at least two factors are relevant in determining the way in which negation and QNPs interact

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[1] This is so if the set of problems in question is not the empty set. At any rate, strong determiners like *every* are usually treated as being presuppositional (e.g., Diesing, 1992), i.e. using the phrase *every problem* presupposes the existence of problems.

[2] In cases of metalinguistic negation (Horn 1989) this ban can be suspended. For example, as a reply to *John had some beans* one could say *John didn't have some beans, he had some rice*. In this case however, what is being denied if the first speaker's utterance: *it is not so that John had some beans, he had some rice.*

semantically. The first one is the overt syntactic position in which the quantified expression occurs. For example when a phrase headed by *every* occurs in subject position of a negated clause, two readings are possible: negation can take scope over the subject position or vice-versa[3]. On the other hand, when a phrase headed by *every* occurs in object position of a negated clause, only one reading is available: negation must take wide scope. The second factor is the nature of the quantified expression. We saw that when a universally quantified NP occurs in object position of a negated clause, negation must take wide scope. On the other hand, a phrase headed by the determiner *some* behaves differently in this case: it must take wide scope over negation. Finally, when the phrase in object position is headed by a numeral determiner such as *two* for example, two readings are possible: either negation or the quantified NP may take wide scope.

Let us summarize these observations formally. We are considering the various ways in which negation and quantified NPs can interact semantically. By doing so, we are considering the effects of two variables. The first one is the overt syntactic position in which the QNPs occur; the subject and the object position. The second variable is the nature of the QNPs. Finally, there is one constant, negation, which is sentential and unmoved[4]. These specifications define the configurations in (2).

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[3] The availability of two readings in this case actually depends on the status of negation, i.e. uncontracted *not* vs. contracted *n't*. We come back to this point later in the discussion.

[4] Sentential negation in English is standardly assumed to reside in I, or in a split IP framework, in the IP complex (e.g., Pollock 1989, Chomsky 1991). By unmoved, I mean that negation has not been raised to Comp (by I to C movement, for example).

(2) a. QNP . . . neg (Subject case)

b. neg . . . QNP (Object case)

We now define more precisely the notions of syntactic scope and semantic scope. Syntactic scope is defined by c-command relations in overt syntax. In a GB type framework for example (Chomsky 1981, 1986), syntactic scope would be defined by the c-command relations holding at S-structure. Semantic scope on the other hand refers to the relative interpretation of the elements. I want to avoid equating semantic scope with logical scope (i.e. scope determined by c-command relations at LF) since it is not clear that LF relations always fully determine semantic interpretation (e.g., the case of indefinites in Heim's (1982) sense). To take an example, in *The students didn't solve two problems*, although *two problems* occurs in the syntactic scope of negation, it may be semantically interpreted as taking wide scope over negation. On this particular reading then,i.e. *There exists two problems such that the students didn't solve them*, syntactic scope and semantic scope do not coincide.

With these definitions in mind, let us come back to the configurations in (2). (2a) represents the subject case. Syntactically, negation occurs in the scope of QNP. (2b) represents the object case. Syntactically, QNP occurs in the scope of negation. We can now determine the set of possible interpretive options corresponding to each of the configurations in (2), by allowing QNP to range over the set of such possible expressions in English. Consider (3a) first, the subject case. The first interpretative option available is

one where QNP takes scope over negation, in accordance with syntactic scope. Phrases headed by the determiner *some* are interpreted in this way when they occur in subject position. The second interpretative option, illustrated in (3b) in one where QNP can be interpreted in the scope of negation or outside the scope of negation. This is typically what happens with phrases headed by *every* in subject position. Interestingly, one logical option is missing from the subject paradigm, i.e. (3c). Indeed, no quantified expression is such that when it occurs in subject position of a negated clause the only interpretive option is the one where negation must take scope over the subject position.

(3) QNP . . . Neg

| | | |
|---|---|---|
| a. | QNP > Neg | (some) |
| b. | QNP > Neg and Neg > QNP | (every) |
| c. | * Neg > QNP | |

Let us turn to the object case. The first interpretive option is given in (4a). Here, QNP must be interpreted in the scope of negation. This is the case of universally quantified expressions, for example. The second option, illustrated in (4b) can be thought of as the mirror image of the option in (4a). Here, the scope relation established syntactically must be reversed semantically. This is the case of QNPs like *some N*, for example. Finally, (4c) illustrates the third option which can be thought of as a combination of the first two. Here both interpretations are available. This is the case of quantifier like *two N* which can either be interpreted inside or outside the scope of negation.

(4) Neg . . . QNP

| | | |
|---|---|---|
| a. | Neg > QNP | (every) |
| b. | QNP > Neg | (some) |
| c. | Neg > QNP and QNP > Neg | (two) |

## 2. Formal approaches to QNP-Neg interaction

As we observed in section 1, sentences of English containing negation and QNPs often display a lack of isomorphism between the overt syntactic position that these elements occupy and their relative interpretation. Three of our examples illustrate this point.

(5) a. Every horse didn't jump over the fence
b. The detective didn't find some guys
c. Cookie Monster didn't eat two slices of pizza

The fact that QNPs can be interpreted in positions different from those where they occur is not surprising however.

### 2.1 Quantifier scope and QR

It has long been noticed that sentences of English containing multiple QNPs, can display scope ambiguity. Take for example the classic pair in (6). In (6a), the object *somebody* can optionally take wide scope over the subject *everybody*; giving rise to an interpretation where there is somebody that everybody loves. Similarly, in (6b), *everybody* can optionally take wide scope over *somebody* to yield an interpretation on which everybody is loved by a different person.

(6) a. Everybody loves somebody
b. Somebody loves everybody

The logical form of quantified sentences like (6) has standardly been derived through a rule of quantifier raising (QR) (Chomsky 1976, May 1977, 1985) which creates operator variable structures by covertly moving and adjoining the operators to the immediate left of clausal boundaries, i.e. IP, thus deriving structures like (7b) from (7a). The variable left by movement - QR is typically a movement rule - is then bound by the operator from its raised position.

(7) a. $[_{IP} \ldots Qx \ldots ]]$
b. $[_{IP} Qx [_{IP} \ldots x \ldots ]]$

The free and unordered application of QR gives rise to two logical representations for each of the sentences in (6): the wide scope reading of *somebody* corresponds to (8a) and the wide scope reading of *everybody* to (8b).

(8) a. $[_{IP}$ somebody$_x$ $[_{IP}$ everybody$_y$ $[_{IP}$ x loves y ]]]
b. $[_{IP}$ everybody$_y$ $[_{IP}$ somebody$_x$ $[_{IP}$ x loves y ]]]

That QR is a movement rule can be illustrated by the fact that it is sensitive to the ECP[5], a prototypical constraint on movement-based dependencies . The standard analysis of the French sentence in (9) for example (Kayne 1984, Hornstein 1984) derives its unacceptability from the fact that the QNP *personne* (*anybody*) cannot be QRed out of the subject position of the lower tensed clause without leaving behind an improperly bound

[5] The Empty Category Principle (ECP) (Chomsky 1981, 1896; Rizzi 1990 among others) is a condition which states that traces left by movement must be properly governed. In GB-style frameworks, the ECP typically interacts with the rule move $\propto$ so as to constrain its application and account for the local behavior of a certain grammatical dependencies.

variable, hence yielding an ECP violation. The structure in (10) corresponds to what (9) would look like if QR had applied to it.

(9) * Jean n'exige que personne boive le vin.
'John doesn't demand that anybody drink the wine.'

(10) $[_{IP}$ personne $[_{IP}$ Jean n'exige $[_{CP}$ que $[_{IP}$ x boive le vin ]]]]

Similar effects have also been reported in English. In particular, Hornstein (1995) observes that while *every Republican* can enjoy wide scope over *someone* in an ECM construction such as (11a), this option becomes impossible if *every Republican* occurs in subject position of an embedded tensed clause as in (11b). According to Hornstein, these facts are also amenable to the ECP. In (11a), QR can raise *every Republican* out of the subject position of the non-finite lower clause, but as before, QR out of the subject position of a tensed clause is impossible, hence the absence of a wide scope reading for *every Republican* in (11b).

(11) a. Someone expect every Republican to win re-election
b. Someone expects every Republican will win re-election

### 2.2 QNP-Neg interaction: a QR-type phenomenon ?

Let us come back to the examples in (12), discussed above. We just saw how we could use the rule of QR to derive the relative scope of quantifiers in examples like (6). It would

therefore seem natural to try to extend this account to what, at first sight, may appear to be another type of scope phenomenon.

(12) a. Every horse didn't jump over the fence
b. The detective didn't find some guys
c. Cookie Monster didn't eat two slices of pizza

Leaving (12a) aside for the moment, suppose that the wide scope readings of (12b) and (12c) were to be derived via the application of QR. In (12b), QR would target *some guys* and adjoin it to the left of IP where it could take scope over negation. Similarly, *two slices of pizza* in (12c) would be QRed across negation to a position where it could enjoy wide scope. This is illustrated in (13) below.

(13) a. $[_{IP}$ some guys$_x$ $[_{IP}$ The detective didn't find x ]]
b. $[_{IP}$ two slices of pizza$_x$ $[_{IP}$ Cookie Monster didn't eat x ]]

This account, however, as originally observed by Hornstein (1984), faces a series of serious problems. First, note that the rule of QR as standardly described in (7) would need to be amended to account for the fact that it must obligatorily apply to (13a) but not to (13c). That is, unlike *two slices of pizza* in (12c), *some guys* in (12b) must obligatorily take wide scope over negation. This, in effect, amounts to having two rules of QR: one which applies optionally, as in (12c) and (6) and one which applies obligatorily, as in (12b). Second, the rule of QR would need to be complicated further in light of the fact that the wide scope reading of *every book* in (14) is impossible. *John didn't read every book* must mean that *Not every book was read by John* (not > every) and it cannot mean that *Every book was such that John didn't read it* (every > not). The question here is why

QR couldn't apply to derive the wide scope reading of *every* in (14) whereas this is precisely what it does in (15).

(14) John didn't read every book.
a. * [$_{IP}$ every book$_x$ [$_{IP}$ John didn't read x ]]

(15) Somebody loves everybody
a. [$_{IP}$ somebody$_x$ [$_{IP}$ everybody$_y$ [$_{IP}$ x loves y ]]]
b. [$_{IP}$ everybody$_y$ [$_{IP}$ somebody$_x$ [$_{IP}$ x loves y ]]]

At this point then, we would need to complicate the system further and have three rules of QR: one which optionally applies in cases like (12c) and (15), one which obligatorily applies in cases like (12b) and finally one which doesn't apply in cases like (14).

The third problem faced by a QR approach to quantifier-negation interaction - and arguably the worst - is that the wide scope reading of phrases headed by determiners like *two* and *some* does not appear to be induced by movement. Needless to say, this fact stands in direct contradiction to the fact that QR *is* a movement rule. First, the wide scope reading of *some problems* and *two problems* easily obtains in the examples in (16). If QR was responsible for these readings, we would have to assume that it can move material across strong islands, as shown in (17). We know however, that movement across strong islands is prohibited, as the overt examples in (18) indicate.

(16) a. I don't think that the fact that John didn't solve two problems bothered Mary.
b. I don't think that the fact that John didn't solve some problems bothered Mary.

(17) a. [$_{IP}$ two problems$_x$ [$_{IP}$ I don't think that [$_{IP}$ the fact that John didn't solve x bothered Mary ]]].
b. [$_{IP}$ some problems$_x$ [$_{IP}$ I don't think that [$_{IP}$ the fact that John didn't solve x bothered Mary ]]]

(18) a. * What don't you think that the fact that John didn't solve bother Mary ?
b. * Which problems don't you think that the fact that John didn't solve bother Mary ?
c. * [$_{CP}$ What$_x$ don't [$_{IP}$ you think that [$_{IP}$ the fact that John didn't solve x bother Mary ]]]
d. * [$_{CP}$ Which problems$_x$ don't [$_{IP}$ you think that [$_{IP}$ the fact that John didn't solve x bother Mary ]]]

Also, Hornstein (1984) offers a whole battery of arguments showing that the wide scope reading of expressions such as *some N, a certain N* etc. are not due to movement. First, he observes that in an example like (19), the indexed pronoun, *it*, cannot be bound by the indexed quantifier, *every dog*.

(19) a. * John likes every dog$_i$ and it$_i$ likes him
b. [$_{IP}$ every dog$_i$ [$_{IP}$ John likes x$_i$ ] and [$_{IP}$ it$_i$ likes him]

Hornstein points that this result is expected if QR applies to *every dog* and adjoins it to the left of the first clause, as shown in (19b). For the pronoun to be bound by *every dog*, it must be c-commanded by the quantifier at LF (see Chomsky 1976; Higginbotham 1980 for discussion). Since QR has moved *every dog* to a position where it does not c-command the pronoun, binding of *it* by the quantifier is correctly expected to be ruled out. On the assumption that expressions like *some N* or *a certain N* are also subject to the rule of QR, one would expect examples parallel to (19) but containing these expressions to also not allow pronoun binding. However, this is not the case as the examples in (20)

illustrate. (20a) is Hornstein's and (20b-c), which are mine, are intended to show that *some N* and *two N* behave in the same way as *a certain N*. The conclusion then is that expressions such as *some N* , *a certain N* and *two N* are not subject to QR - or any movement rule for that matter.

(20) a. John likes a certain $dog_i$ but $it_i$ only likes Sam
b. John like some $dog_i$ but $it_i$ only likes Sam.
c. John likes two $dogs_i$ but $they_i$ only like Sam.

Finally, Hornstein points out that the behavior of expressions like *some N* or a *certain N* parallels that of names, which unlike quantifiers are not subject to QR, i.e. they do not form operator variable structures. This point is illustrated in (21) by the fact that the name *Fido* can bind and therefore be coreferent with the pronoun *it*.

(21) John likes $Fido_i$ but $he_i$ only likes Sam

A second argument presented by Hornstein concerns the behavior of quantifiers and pronouns with respect to the Leftness Condition (Chomsky 1976; Higginbotham 1980), now subsumed under Principle B of the Binding Theory (Chomsky 1981; 1986).

(22) * That $he_i$ might be sent to the front doesn't bother every good $soldier_i$
a. * [$_{IP}$ every good $soldier_i$ [IP [CP That $he_i$ might be sent to the front doesn't bother $x_i$ ]]]

Here, QR raises *every good soldier* to a position where it c-commands the pronoun *he* and hence binding is ruled out as a violation of the leftness Condition, as shown in (22a).

Here again, binding is possible with expressions such as *a certain good soldier* or *some good soldier*, or *two good soldiers* suggesting that such expressions cannot be subject to QR. (23a) is Horsntein's example and (23b-c) which extend the argument to expressions such as *some N* and *two N* are mine.

(23) a. That $he_i$ might be sent to fight doesn't bother a certain $soldier_i$
b. That $he_i$ might be sent to fight doesn't bother some good $soldier_i$
c. That $they_i$ might be sent to fight doesn't bother two good $soldiers_i$

Hornstein's conclusion is that there are different types of quantifiers[6]: those whose interpretation is derived via movement - he calls them type II quantifiers - and others whose interpretative scope domain is not derived by movement and is always wide - type I quantifiers. Hornstein remarks that an unified approach to quantifiers such as *every N, a certain N, any N, some N,* is not impossible. Although it would not be 'elegant' to use Hornstein's term, QR could always be fixed in various ways to correctly capture the data. However, "if the goal is to explain how a child could acquire these rules, such approaches [i.e. complicating QR] would lead to insurmountable problems" (p.39) Hornstein continues "An account that bifurcates the class of natural language quantifiers does not face these difficulties.

[6] To be specific, Hornstein distinguishes between three types of QNPs:
I. a set of NP expressions whose interpretive scope domain is always wide;
II. a set whose interpretive scope domain is restricted to the clause in which the quantified NP is situated;

The quantifiers behave differently because they are different kinds of quantifiers in Universal Grammar ... The child need only decide whether a given quantifier is type I or type II ... Everything else follows from the child's innate grammatical endowment " (p.40, 41). Explaining how children acquire semantic knowledge of the type discussed by Hornstein is precisely my goal in this dissertation. I will therefore assume, following Horsntein that the wide scope interpretation of quantifiers like *some N* and *two N* with respect to negation is not derived by movement. These quantifiers can therefore be regarded as Type I Hornsteinian quantifiers.

### 2.3 Deriving existential wide scope

In the preceding section, we arrived at the conclusion that the wide scope interpretation of quantifiers such as *some N* and *two N* with respect to negation should not be derived via a movement rule. How then should we derive it ? In order to address this issue, we will consider a few proposals regarding the interpretation of QNPs.

#### 2.3.1 Progovac (1994)

Progovac (1994) offers a binding theoretic approach to the problem of polarity sensitivity. On her account English NPIs (negative polarity items such as *any*) and PPIs (positive polarity items such as *some* ) are treated as anaphors and pronominals respectively and

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III. a set whose scope domain is unbounded if originating in some syntactic

they are subject to principle A and B of a generalized version of the Binding Theory. The principles assumed by Progovac are given below:

**Principle A:** An anaphor must be X-bound in its governing category.

**Principle B:** A pronominal must be X-free in its governing category.

**Governing Category:** Y is a governing category for X if and only if Y is the minimal maximal category containing X, a governor of X, and a SUBJECT accessible to X.

**Accessible Subject:** X is accessible to Y if and only if Y is in the c-command domain of X and coindexing of (X,Y) would not violate any grammatical principles.

Potential binders for NPIs are negation and a special polarity operator which is semantically licensed in non-upward entailing contexts (for a definition of upward and downward entailment, see section 5). On Progovac's account, English PPIs like *some* are typically 'antilicensed' by clausemate negation. According to her: "All one needs to say about PPIs in English is that they are subject to Principle B, and therefore have to be free from negation in their governing category."(p.54) Interpreting *some problems* in the scope of clausemate negation in (24) would therefore amount to a Principle B violation. Consequently, *Some problems* must be interpreted outside the scope of clausemate negation.

(24) John didn't solve some problems

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positions but sententially bound when originating from other.

Note that Progovac's account of quantifiers like *some problems* does not straightforwardly extend to the behavior of the other QNP of interest to us here, namely *two problems*. If the wide scope reading of *two problems* in (25) was to be interpreted as a grammatical reflex barring a Principle B violation, we would have no account of the fact that (25) also has a reading where *two problems* is interpreted in the scope of negation. One possibility would be to assume that quantifiers like *two N* are ambiguous between a PPI and a non-PPI reading. On its PPI reading, *two problems* would have to take wide scope to avoid a principle B violation while on its non-PPI reading, it could receive a narrow scope reading.

(25) Cookie Monster didn't eat two slices of pizza

### 2.3.2 The Kamp-Heim theory of indefinites

Kamp (1981) and Heim (1982) advance a theory where indefinite NPs such as *a man*, *two slices pizza*, *some problems* are regarded as lacking inherent quantificational force. According to this view, indefinites merely introduce variables into the logical representations in which they appear. Crucially, unlike quantifiers like *every*, indefinites do not form restrictive clauses. Instead, they receive quantificational force by virtue of being bound by an existential operator inserted into the logical representation. This, in essence is the rule of Existential Closure. To illustrate how this works, consider (26b) which is the logical representation of (26a).

(26) a. A man owns a dog.
b. $(\exists_{x,y})$ [ man(x) & dog(y) & x owns y ]

In (26b), ∃, the existential operator inserted by existential closure unselectively binds *x* and *y*, the variables introduced by indefinite NPs *a man* and *a dog*. In this case then, no restrictive clause is formed; only a nuclear scope is formed, i.e. the piece of structure between square brackets in (26b), and the only quantificational operation (i.e. variable binding operation) which takes place is existential closure whose domain is the nuclear scope. To see how the formation of a restrictive clause takes place, we must consider the case of a quantified NP such as the one shown in the example in (27):

(27) a. Every man owns a dog
b. $\text{Every}_x$ [man(x)] $(\exists_y)$ dog(y) & x owns y

quantifier restrictive clause nuclear scope

In the kamp-Heim framework, quantified sentences like (27a) are represented as tripartite structures composed of a quantifier, a restrictive clause and a nuclear scope, as shown in (27b). Here, the quantifier *every* quantifies over a restricted set, the set determined by the restrictive clause [ x is a man ]. In other words, *every* quantifies over everything that is a man. In this case, (27a) is true just in case the value of the variable *x* makes the restrictive clause true and the value of the variable *y* makes the nuclear scope true. In (27b) the different variables are bound as follows: *every* binds the variable introduced in the restrictive clause and the existential operator introduced in the nuclear scope by existential closure binds the variable introduced by the indefinite NP *a dog*.

In this framework, the tripartite structure in (27b) can also be used to represent sentences where indefinite NPs appear to acquire quantificational force from certain adverbs. Take for example the sentence in (28a) and the corresponding tripartite structure in (28b):

(28) a. If a man owns a dog, he usually pets it
b. $\text{Usually}_{x,y}$ $\text{man}_x$ & $\text{dog}_y$ & x owns y x pets y

quantifier restrictive clause nuclear scope

Having introduced some of the assumptions underlying the Kamp-Heim theory, we can now come back to our original concern, namely trying to derive the wide scope interpretation of *some guys* and *two slices of pizza* in (29).

(29) a. John didn't solve some problems
b. Cookie Monster didn't eat two slices of pizza

What is interesting for our purposes is that the rule of Existential Closure in the Kamp-Heim theory is not a movement rule but rather a rule that inserts or rather "Adjoin[s] a quantifier ∃ to the nuclear scope of every quantifier" in Heim's (1982, p.138) words. Note also that in the examples in (29), the indefinites have an existential interpretation on their wide scope reading: (29a) could be paraphrased as *There exists some problems that John didn't solve* and (29b) could be paraphrased as *There exists two slices of pizza that Cookie Monster didn't eat*. The examples in (29) could therefore be logically represented in (30) in a Kamp-Heim framework. Here, the existential operator inserted by Existential closure binds the variables introduced by the indefinite NPs *some problems* and *two slices of pizza* respectively. Note also that in each case, ∃ takes scope over negation. There is a

problem however. Since indefinites typically do not form operator-variable structures on this account, the N restriction of *some problem* or *two problems* must stay in the nuclear close and therefore in the scope of negation.

(30) a. $(\exists_x) \neg$[ problems(x) & John solved x ]
b. $(\exists_x) \neg$ [two slices of pizza(x) & Cookie Monster eat x ]

### 2.3.3 Reinhart's choice functions

Reinhart (1995) points out that deriving existential wide scope in the way that we just did, i.e. via existential closure and unselective binding, is problematic for the reason we just mentioned. Consider (31) and the logical representation in (31b) obtained via existential closure and unselective binding of the variable introduced by the NP *some problems*.

(31) a. John didn't solve some problems
b. $(\exists_x) \neg$[ problems(x) & John solved x ]

The problem, according to Reinhart is that the representation in (31b) fails to correctly capture the truth conditions of the sentence in (31a) and can therefore not be regarded as a valid logical representation for that sentence. Here's how her argument unfolds: one state of affairs which would make (31a) false would be if John solved all the problems. That is, if it is true that John solved every problem then it cannot be true that he didn't solve some of the problems, i.e. (31a) cannot be true. However, Reinhart argues, in this state of affairs, it is nonetheless possible to find a value for x which would satisfy (31b) an therefore make it true just in case x is not a problem. For example, x could be a puzzle

and (31b) would then state that there exists a thing x, namely a puzzle, and this thing is not a problem and John did not solve it. Put another way, even in a situation where John solved all the problems and (31a) therefore can't be true, there is still a way to make (31b) true, just in case the entity in question in a non-problem. It is therefore obvious that (31b) cannot be the correct logical representation for (31a) since it fails to properly capture its truth conditions.

The problem, according to Reinhart is that the restriction of the determiner *some*, i.e. the N *problems* occurs in the nuclear scope in (31b) and therefore in the scope of negation. This guarantees that a value of x which happens not to be a problem and which is also solved by John, will always satisfy the logical formula in (31b). So basically, x can have any value (apart from being a problem). Interestingly, Reinhart points out that if the logical representation of (31a) was derived via the rule of QR, this problem wouldn't arise. The reason being that QR would pull both *some* and its restriction (the N *problem*) out of the nuclear scope, in order to form a restrictive clause. This is illustrated in (32) below.

(32) $(\exists_x)$ problems(x) & ¬[ John solved x ]

The crucial difference between (31b) and (32) is that in (32), the N-restriction no longer occurs in the scope of negation. It is therefore not possible to choose a value where *x* is a non-problem to satisfy the logical formula. In this case, *x* must be a problem. Although a logical derivation obtained via QR would correctly capture the truth conditions of the

sentence in the case of (31a), Reinhart observes, as we did before, that an approach in terms of QR also faces problems and in certain cases also fails to capture the correct truth conditions. For a complete discussion of the problems faced by a QR approach, I refer the reader to Reinhart's own work. I will just mention one of these problems here since it refers to our discussion in section 2.2. Reinhart gives the example in (33) and observes that the wide scope reading of *some politician* obtains in this case. Note however that *some politician* would need to be extracted out of an island (the subject position of a embedded tensed clause) which once again raises problems for a movement account such as QR (recall our discussion in section 2.2).

(33) Max did not consider the possibility that some politician is corrupt.

Reinhart summarizes the interpretive problem in the following way: "How to assign wide scope to existential NPs, which, otherwise, show properties of remaining in situ. Specifically, how can the N-restriction remain in situ, while still being interpreted as a restriction on a remote operator."(p.29). The solution that Reinhart proposes is to allow existential quantification over choice functions, that is functions applying to a set and yielding a member of the set. Let's consider the example used by Reinhart first and then see if we can extend her approach to the examples of concern to us. Suppose we want to represent the wide scope reading of *some book* in (34):

(34) Every lady read some book
a. $(\exists f)\ (\forall z)\ [\text{lady}(z) \rightarrow z \text{ read } f(\text{book})]$
b. $(\exists x)\ \text{book}(x)\ (\forall z)\ [\text{lady}(z) \rightarrow z \text{ read } x]$

In (34a), the choice function, *f*, applies to the set of books and existential closure of the function variable can happen arbitrarily far away. As before, existential closure is a purely interpretive procedure. (34a) says that there exists a function, *f*, such that for every *z*, if *z* is a lady, then *z* reads the book selected by *f*. Reinhart points that this is equivalent to (34b) that is, it is equivalent to saying that there exists a book such that every lady read it. Also, she observes that in this case, *f(book)* is an argument of *read* and that this corresponds to the fact that the NP has remained in situ, as desired. *f(book),* in turn, denotes the value of the function, that is a given book, i.e. *some book*.

As Reinhart shows, this analysis easily extends to existential wide scope with respect to negation. We will use our own example here, instead of hers.

(35) a. John didn't solve some problem
b. (∃ f) ¬ [John solved f(problem)]
c. (∃ x) problem(x) ¬ [John solved x ]

In this case, what (35b) means is that there exists a function such that it is not the case that John solved that problem that it selects. Again, this is equivalent to saying that there exits a problem such the John didn't solve it, (35c). Finally, we can see how the wide scope interpretation of *two slices of pizza* would be derived in (36).

(36) a. Cookie Monster didn't eat two slices of pizza
b. (∃ f) ¬ [Cookie Monster ate f(two slices of pizza)]
c. (∃ two x) slice of pizza (x) ¬ [Cookie Monster ate x]

Here, (36b) means that there exists a function such that it is not the case that Cookie Monster ate the two slices of pizza that it selects. This is also equivalent to saying that there exists two slices of pizza that Cookie Monster didn't eat, as shown in (36c). To sum up, we now seem to have an interpretative mechanism to derive the wide scope existential reading of NPs such as *some N* and *two N* which correctly captures the truth conditions of the sentences containing these NPs and does not involve any movement operation.

Let us now make sure, as Reinhart does, that this solution can receive a natural syntactic implementation. To do this, consider the structure of an existential DP such as *some problem*, given in (37)

(37) DP

| | Det | N |
|---|---|---|
| | some | problem (i) |
| a. | (∃ x) | (problem (x)) |
| b. | f | {x \| woman (x)} |

Following Higginbotham (1983), Reinhart assumes that N is generated with an index-argument which must be bound. On way to bind the index variable is to treat D *some* as an existential operator, as in (37a). Reinhart remarks however that indefinite determiners are not always viewed as operators (see our discussion of the Kamp-Heim theory and also Diesing 1992). As an alternative, she proposed to view the determiner as a choice

function variable, applying to the N-set. On her account, binding of the function variable is done by existential closure.

## 2.4 A look at Chinese

A classic difference between English and Chinese, at least since Huang (1982), is that English exhibits quantifier scope ambiguity in sentences like (38), but Chinese doesn't.

(38) Someone loves everyone

(39) Turan, yige jingsha zhuazou le meige xuesheng (from Lee 1991)
Suddenly, a cop arrested every student

In (38), as we already observed, the universally quantified object can take wide scope over the existential subject. In the Chinese example in (39), however, the universally quantified object must be interpreted in the scope of the existentially quantified subject. In Chinese then, the interpretation of QNPs appear to be fixed by the surface position (for details on the idea of isomorphism between S-structure and LF regarding quantifier scope phenomena, see Huang 1982).

There are cases however where English seems to behave like Chinese and Chinese like English. In English double object constructions for example, the scope properties of QNPs appear to be fixed by their surface position. In (40) for example, *every book* must be interpreted in the scope of *someone*. In other words, (40) must mean that someone got all the books. As observed by Aoun and Li, Chinese passive constructions appear to

display scope ambiguity. In (41), *everyone* can take scope over *two clues* resulting in a reading where everyone got two different clues (for an account of these facts, see Aoun and Li 1989, 1991 and Hornstein 1995 for a minimalist approach to quantifier scope phenomena)

(40) John gave someone every book

(41) Yaoshi liang-ge xiansuo bei meigeren zhaodao
*If two clues by everyone found*

Given the differences between English and Chinese described above, it would be interesting to see how quantified NPs interact with negation in Chinese. Surprisingly, the examples below, which parallel the English paradigm discussed in section 1, show that Chinese and English behave virtually identically with respect to quantifier-negation interaction. The Chinese judgments are from Huang (personal communication)

(42) Mei-pi ma dou mei tiao-guo langan (every > neg)
*Every horse didn't jump over the fence*

(43) You yi-pi ma mei tiao-guo langan (A/some > neg)
*A/some horse didn't jump over the fence*

(44) Laoshi mei kandao jiaoshi-li de yi-ge xueisheng (some > Neg)
*The teacher didn't see some student in the classroom*

(45) Laoshi mei kandao mei-ge xueisheng (neg > every)
*The teacher didn't see every student*

(46) Laoshi mei kandao liang-ge xueisheng (neg > two / two > neg)
*The teacher didn't see two students*

Apart from (42) where, unlike English, Chinese does not allow negation to take scope over a universally quantified subject, the rest of the examples are identical in Chinese and English. That is, in both languages, expressions like *some N* must always take wide scope over negation and expressions like *two N* are ambiguous in object position between a narrow scope and a wide scope reading. Finally, strong quantifiers like *every* must be interpreted in the scope of negation when they occur in object position.

These Chinese facts are discussed in Huang (1982, chapter 3). Huang's generalization is that Chinese does not display QNP-neg scope ambiguities and that the readings are those determined by c-command a S-structure. Given this characterization, (44) and (46) are apparent problems for Huang. Here's how he deals with these cases: in (44), the object *yi-ge xuesheng* means *one student* and is not being used in the existential sense, rather in the specific sense (according to Huang (personal communication) a pure existential sense of the QNP would require the use of *renhe xuesheng* (*any student*) in the c-command domain of negation). Huang points that elements like *some* (stressed), *one, several, a certain* etc. are positive polarity items that cannot be interpreted in the scope of clausemate negation. If these are considered to be specific determiners, then their wide scope property comes from their inherent nature and NPs headed by these determiners are not inherent QNPs. As for (46), Huang argued that on the *not 2* interpretation, *2 students* denotes a quantity that is being negated. On the *2 not* reading, *2* may be considered specific like *one, several* etc. Huang concludes that if we consider that certain indefinites and numerally quantified NPs are like definites in that they do not have scopal properties, i.e. they always have wide scope, then it is possible to preserve the generalization that in

Chinese the interpretation of QNPs and other logical elements (such as negation) can be predicted from their c-command relation at S-structure.

## 2.5 Quantifier-negation interaction: a separate phenomenon

Based on our previous discussion, we can now distinguish two broad classes of QNPs. First, there are QNPs whose interpretation is determined grammatically, i.e. via movement-based operations which are typically sensitive to locality conditions such as Islands (Ross 1977) or the ECP (Chomsky 1981, 1986). For our purposes we may equate these operations with QR-type rules as in May (1977, 1985) or, alternatively, in more recent minimalist terms, we may follow Hornstein (1995) who seeks to do away with the rule of QR and subsume its effects under properties of A-chains (for other recent approaches, see Reinhart 1995, Ruys 1992, Beghelli 1993, Ben-Shalom 1993, Szabolcsi 1995 among others). Second, there are QNPs whose interpretation is determined by extragrammatical, i.e. non movement-based interpretive mechanisms such as, for example, Heim's (1982) rule of Existential Closure of Reinhart's (1995) Choice Functions. These interpretive mechanisms, in turn, are typically not sensitive to the locality conditions mentioned above. This distinction between two types of QNPs essentially parallels that of Hornstein (1984) and we therefore borrow his terminology and call the first class of quantifiers type II QNPs and the second class Type I QNPs. In order to avoid confusion, type I QNPs are those whose interpretation relies on non-grammatical mechanisms while the interpretation of type II QNPs is determined

grammatically. Typical type II QNPs are strong[7] quantifiers such as *every N* or *most N*. Type I quantifiers are typically indefinites in Heim (1982) and Diesing's (1992)[8] sense, i.e. quantifiers such as *a N* or *two N*.

In light of the distinction between type I and type II QNPs, it is important to emphasize that the two types of interaction we have been discussing, namely QNP-Neg and QNP-QNP, should be regarded as distinct phenomena - albeit sometimes overlapping - and should therefore not be conflated. This follows from the fact that QNP-Neg and QNP-QNP interaction rely on different operating principles. QNP-Neg interaction is essentially a property of type I QNPs. That is, by virtue of their non-grammatical (i.e. non movement based) wide existential interpretation, type I QNPs give the illusion of displaying scope interaction with negation. Type II QNPs, on the other hand, do not generally create scope ambiguity with negation. Their interpretation with respect to it is typically fixed by their overt syntactic position. This distinction between two types of QNPs and two types of phenomena (QNP-Neg and QNP-QNP interaction) is an important one to which we come back in chapter III. First, my account of children's interpretation of sentences containing negation and QNPs is partly based on the distinction between two types of QNPs. Second, it is crucial to understand the difference

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[7] For a discussion of strong vs. weak determiners, see Milsark (1977) and Diesing (1992).

[8] As a matter of fact, Diesing (1992) proposes a dichotomy reminiscent of the one discussed here. Drawing on Milsark (1974), she proposes that weak quantifiers, unlike strong ones, are ambiguous between a strong (i.e.presupositional) reading and a weak (i.e. cardinal, adjective like) reading. On her account, strong quantifiers only have a strong (presuppositional) reading.

between QNP-Neg and QNP-QNP interaction in order to avoid making incorrect inferences regarding the predictions of the account I give in chapter III.

Before leaving the topic, I wish to discuss the exceptional behavior of *every* , a typical type II quantifier, when it occurs in subject position of a negated clause. When it occurs in object position *every* does not create scope ambiguity with negation. In subject position however, its interpretation with respect to negation is ambiguous. Recall the contrast between (47a) and (47b). Basically, in (47b), *every* must take narrow scope with respect to negation (neg > every). In (47a) however, both wide scope and narrow scope interpretations are available (every > neg and neg > every).

(47) a. Every horse didn't jump over the fence
b. John didn't solved every problem

This fact has already been observed by Horn (1989), Jackendoff (1972) and Lasnik (1979). Jackendoff (1972) links the behavior of *every* in (47a) to the effect of focus. On this approach however, it remains mysterious why other quantifiers and in particular other strong quantifiers cannot be interpreted in the scope of negation in examples like (47a). This property seems to be restricted to universal quantifiers such as *every* and *both* (which can be regarded as a universal on a set of two). In the examples below, negation cannot take scope over the QNP in subject position.

(48) a. Some students didn't solve the problems
b. Most students didn't solve the problems

An other interesting fact, that Norbert Hornstein pointed out to me (personal communication), is that the narrow scope interpretation of *every* seems to correlate with the status of negation i.e. *n't* instead of *not*. In (49), where negation is not contracted, only the wide scope reading of *every student* is available. In other words, (49) cannot mean that I would prefer that not all the students came to the party. It is unclear to me why a narrow scope reading of *every* is possible in (47a). Apart from Jackendoff's approach, I know of no good explanation for this fact. What is clear however, is that the behavior of *every* in this case is exceptional as the contrast between (47a) and (48) indicates.

(49) I would prefer for every student not to come to the party

## 3. The acquisition of QNP-Neg interaction:

### 3.1 The logical problem of induction

A familiar issue in the theory of language acquisition and language learnability is the *overgeneralization problem* (Baker, 1979; Bowerman, 1987; Lasnik 1981; Pinker 1986, 1989; Wexler and Cullicover 1980 among others). Essentially, this problem would arise if the learner were to make a conjecture about her target grammar which was too broad and happened to include the correct hypothesis. If so, every piece of data encountered by the learner would be compatible with both the more inclusive and the less inclusive hypothesis. The learner may therefore get stuck with the wrong guess since

disconfirmation of the incorrect hypothesis on the basis of data from the input sample alone would not be possible.

So why generalize at all if there is a risk of overgeneralizing ? The need to generalize comes from the inductive nature of the learning process. In the acquisition of syntactic knowledge for example, children are exposed to a finite set of sentences in the course of their experience. However, given the unbounded generative capacity of natural languages, the child must generalize to an infinite set which not only includes the input sample but goes well beyond it. The problem of course, as in all cases of induction, is that there is an infinite number of hypotheses which are compatible with the input data, and to make things worse, there is no way of distinguishing these hypotheses from one another on the basis of that input sample alone. Pinker (1989) illustrates this problem by means of intersecting circles representing the different hypotheses compatible with the input sample represented by the X's. The arrow points to the circle representing the correct hypothesis.

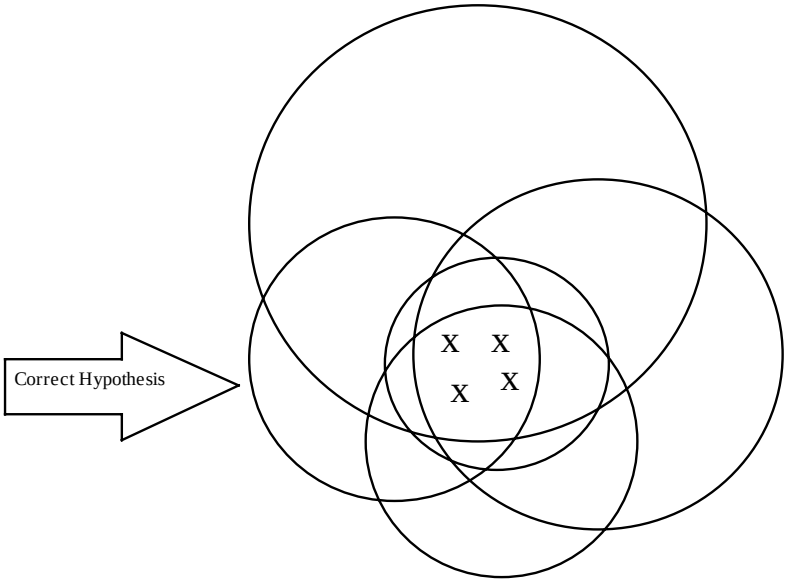



**Figure 1: The generalization problem (adapted from Pinker 1989)**

Pinker (1989) distinguishes four ways in which a given hypothesis regarding the target language can turn out to be incorrect. First, the circles representing the child's hypothesized grammar and the actual target grammar can be disjoint, as in (a) in Figure 2 below. In this case, positive evidence is sufficient to indicate to the child that her hypothesis is incorrect. This type of evidence is represented by "+" signs in Pinker's diagram. Next, the circles representing the child's hypothesized grammar and the target grammar may intersect, as in (b) or the child's hypothesis language may represent a subset of the target language, as in (c). In both these cases again, positive evidence is sufficient to indicate to the child that her hypotheses are incorrect. Finally, the child's hypothesis may be a superset of the target hypothesis, as in (d). In this case, the child would need negative evidence; that is, for example, information about which sentences or which sentence-meaning pairs are not available in the target language. Such evidence is represented by "-" signs in Pinker's diagram. The problem with this situation is that it is

generally assumed that learners do not have access to negative evidence. If so, it is hard to see how they could ever recover from their errors in such cases.

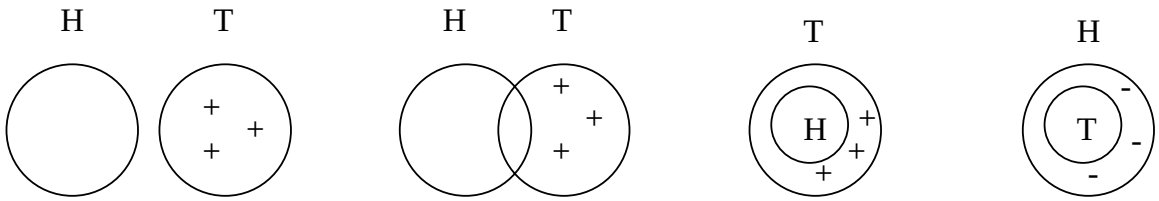



**Figure 2: Learning cases (adapted from Pinker 1989)**

Thus, children are torn between the need to generalize on the one hand - to go beyond their limited experience - and, on the other hand, the need to be conservative in order to avoid making generalizations which could not later on be discomfirmed on the basis of positive evidence alone. At the heart of this dilemma lies the fact that, as Crain and Fodor (1987) put it, "the generalizations that natural languages exhibit are partial generalizations only" (p. 36). To take a classic example from Baker (1979), a child may incorrectly conclude, on the basis of alternations such as the ones in (50), that the alternations in (51) are also possible in her language.

(50) a. John gave a book to Mary / John gave Mary a book.
b. John passed the salt to Mary / John passed Mary the salt
c. John told a joke to Mary / John told Mary a joke

(51) a. John donated money to charity / * John donated charity money
b. John reported the crime to the police / *John reported the police the crime

### 3.2 The acquisition of QNP-Neg interaction

The issues raised regarding the acquisition of syntactic knowledge also apply to the acquisition of semantic knowledge. In this case, children need to generalize from the pairs of sentence-meaning provided in the input to all such possible pairs in their language. Assuming that children are not implicitly informed about the incorrect sentence-meaning pairs of their language, the acquisition of syntactic and semantic knowledge become fully parallel. Moreover, the presence of partial generalizations can also be observed in the domain of semantics in general and in particular in the interpretation of QNPs with respect to sentential negation. When a QNP occurs in object position of a negated clause for example, it is sometimes interpreted where it occurs syntactically, i.e. in the scope of negation, as in (52d); sometimes this order is reversed and it must be interpreted outside the scope of negation, as in (52e) and sometimes a combination of these two options is available, as in (52c). When a QNP occurs in subject position of a negated clause, it must sometimes be interpreted outside the scope of negation, as in (52b) or sometimes, two interpretations are possible as in (52a).

(52)
a. Every student didn't solve the problem.
b. Some students didn't solve the problem.
c. The students didn't solve two problems.
d. The students didn't solve every problem.
e. The students didn't solve some problems.

Consequently, a child generalizing for the object case on the basis of (52d) where only one interpretation is available, namely Neg > QNP, would undergeneralize with respect to

(52c), where two interpretations are available, i.e. Neg > QNP and QNP > Neg and misgeneralize with respect to (52e) where QNP > Neg is the only possible interpretive option. If, on the other hand, the child was generalizing on the basis of (52c), where two interpretations are available, namely QNP > Neg and Neg > QNP, she would overgeneralize with respect to both (52d) and (52e) where only one interpretation is available. Finally, if the child were to generalize on the basis of (52e) where only one interpretation is available, i.e. QNP > Neg, she would misgeneralize with respect to (52d) where Neg > QNP is the only possible option and she would undergeneralize with respect to (52c) where both Neg > QNP and QNP >Neg are possible. In the subject case, if the child was to generalize on the basis of (52a) where two interpretations are available, i.e. QNP > Neg and Neg > QNP, she would overgeneralize with respect to (52b) where only QNP > Neg is possible. Conversely, if the child were to generalize on the basis of (52b) where only one scope option is available, i.e. QNP > Neg, she would undergeneralize with respect to (52a) where both QNP > Neg and Neg > QNP are possible.

In short, the evidence available to the child regarding the interpretation of QNPs with respect to negation is misleading and provides a dangerous basis for generalization. In spite of these potential obstacles, all language learners eventually arrive at similar conclusions regarding the interpretation of the examples in (52) above. We know that whatever path language learners embark on, it will invariably leads them to the right conclusions. What we don't know however is what particular path they take and if there is only one. So what routes do children follow and what kinds of generalizations do they make regarding the interpretation of negation and QNPs ? How do they navigate through

the maze of interpretive options, what guides them in the choices they make and what could this tell us about the acquisition of semantic knowledge ? We will find out in the chapters to come.

## 4. Theoretical and methodological premises

### 4.1 Theoretical premises

This work presupposes the validity of what is often referred to as the innateness hypothesis (Chomsky 1965); along with a particular version of the theory of Universal Grammar (UG) known as the Principles and Parameters framework (P&P) (Chomsky 1981, 1986, 1995). The innateness hypothesis specifies that a substantial part of a person's linguistic knowledge is genetically determined . In the P & P framework, this knowledge - UG - comes in the form of a finite set of universal linguistic principles along with an array of option points, i.e. parameters. On this model, the task faced by the child acquiring language amounts to a proper fixation of the parameters of UG upon exposure to linguistic input. Given the widespread character of these ideas among generative linguists, I will not elaborate on them any further.

Next, we consider a particular model of the interrelations between grammar and the other factors that may be involved in language acquisition and language processing. This model is known as the Modularity Matching Model (MMM) of Crain and Wexler (1995) and Crain and Thornton (in press). The MMM rests on two fundamental assumptions; one

about the nature of the language faculty and the other about the relation between language learners (i.e. children) and mature speakers (i.e. adults). The first assumption is that the language faculty is a separate cognitive module whose architecture is itself modular in nature. The language faculty is taken to be a discrete cognitive module in the sense that it is assumed to operate according to principles that are specific to it and not shared by other cognitive modules. The assumption of internal modularity specifies that the different components of the language apparatus obey different operating principles.

The second fundamental assumption of the MMM is that the language processing system of a child learner is essentially the same as that of an adult. Specifically, children and adults are assumed to use the same strategies when processing natural language sentences. Besides, in the absence of evidence to the contrary, children and adults are also assumed to have the same processing capacities and memory limitations. What is meant by modularity matching then, is that the modules of the language faculty and their operating principles are shared both by children and adults. Reducing cognitive differences between children and adults essentially follows from the need to explain language learnability - how it is at all possible, under normal conditions, for children to invariably and effortlessly succeed in converging onto their target language despite the impoverished nature of their linguistic experience.

Another important feature of the MMM is that its formulation is tightly woven into the fabric of the theory of Universal Grammar. According to the MMM innately specified linguistic knowledge charts the hypothesis space available to language learners and

linguistic experience only plays a role in allowing learners to fix the correct parametric options for their target grammar. Within the MMM, it is perfectly conceivable that learners temporarily entertain hypotheses about their target language that differ from those of adult speakers. However, flexibility in this domain is constrained by adopting the continuity hypothesis according to which children's intermediate grammars are only allowed to differ form their target grammars in ways in which different grammars can differ from each other within the theory of Universal Grammar.

So far, the strategy of the MMM has been to maximize similarities between children and adults. One difference between them is worth emphasizing though. This difference arises when adults and children are faced with certain cases of ambiguity. A salient property of natural language is that sentences can often receive more than one interpretation. In certain cases, the different interpretations made available by UG form subset-superset relations (i.e. one interpretation is true in a subset of the set of circumstances in which an alternative interpretation is true). For language learners, this poses a semantic subset problem just in case the target language contains the subset interpretation but not the superset one. To avoid semantic subset problems, there must exist a principle instructing children to initially choose the interpretation which is true in the narrowest set of circumstances, i.e. the more specific interpretation. This, in essence, is the Semantic Subset Principle (Crain, Ni and Conway 1994). Adults processing language must also deal with ambiguity. On the MMM, the sentence-parsing mechanism, responsible for language processing, is assumed to be guided by a Principle of Parsimony. In essence this principle specifies that when confronted with ambiguity, the

parser selects the interpretation that makes the fewest commitments, so as to limit the number of revisions that may have to be made in light of subsequent information. The interpretation that makes the fewest commitments is the one which is true in the broadest set of circumstances.

Before leaving the topic, it is worth pointing out that the logic of the Semantic Subset Principle rests on the assumption that children do not have access to a particular type of negative evidence, i.e. information regarding what meanings sentences cannot have. In other words, children are assumed not to have access to negative semantic evidence of the following type: < sentence, *meaning >. For a discussion of the arguments underlying the claim that children do not have access to negative evidence - syntactic or semantic - and for a review of recent literature on this topic, see Pinker (1989). For purposes of our discussion, we will assume, following Pinker and many others, that children do not have access to negative evidence in the course of language development. The upshot of this comparison between learners and adults is that in cases of ambiguity where the alternative representations of a sentence are arranged in a subset-superset relation, the interpretation that is preferred by the sentence-parsing mechanism, i.e. the one that is true in the broadest set of circumstances is precisely the one which would create learnability problems if it was initially adopted by learners. For these reasons, learners need to initially favor the interpretation which is true in the narrowest set of circumstances. In this Model, therefore, children and adults are expected to have opposite preferences in such cases; a prediction to which we come back later.

## 4.2 Methodological premises: the Truth Value Judgment Task

The Truth Value Judgment Task (TVJT) is an experimental technique whose purpose is to assess children's understanding of the meaning of sentences. Principles of UG often specify that certain sentences cannot have certain meanings or that other sentences have more that one meaning. These situations are represented in (53) and (54) respectively.

(53) < sentence, {meaning1, *meaning2} >
(54) < sentence, {meaning1, meaning 2} >

The strategy of the TVJT is to place subjects in an experimental situation where both potential meanings of a given sentence are available; one being true in the experimental context and the other is false. At the end, subjects are presented with the target sentence and they are asked to indicate if, in their opinion, that sentence represents a correct description of the experimental context. Concretely, in the TVJT, one experimenter presents short stories to the child subjects, acting them out using toys and props. A second experimenter manipulates a puppet who watches the stories alongside the child. At the end of the story, the puppet tells the child what he think happened, using the target sentence as a description of the story. The child's task is to indicate whether the puppet's description is correct.

To illustrate how the TVJT can be used and discuss its basic design and main features, let us take a concrete example where a linguistic principle specifies that sentences containing Referential Expressions cannot have certain meanings, as

schematized in (53). This, in essence, is Principle C of the Binding Theory (Chomsky 1981, 1986). Consider the sentence in (55) adapted from Crain and Thornton (in press).

(55) He thinks that the Troll is the best jumper
a. * $He_i$ thinks that the $Troll_i$ is the best jumper (Meaning 1)
b. $He_i$ thinks that the $Troll_j$ is the best jumper (Meaning 2)

Principle C prohibits the reading of (55) where the pronoun he and the NP the Troll refer to the same individual, i.e. (55a). In the adult grammar, the only possible reading of (55) is one where he and the Troll refer to different individuals, as in (55b). In other words, he, a male individual different from the Troll, thinks that the Troll is the best jumper. Let us call the reading in (55a) Meaning1 and the reading in (55b) Meaning2. We get the situation represented in (56).

(56) < sentence (3), {*Meaning1, Meaning2} >

Suppose now that the research question is to determine whether children adhere to Principle C. The experimental hypothesis is that children have knowledge of Principle C and therefore are expected to adhere to it. The prediction of the experimental hypothesis is that children should not allow Meaning1 for the sentence in (55) but that they should allow Meaning2, like adults. On the other hand, the null hypothesis is that children lack knowledge of Principle C. In this case, children are expected to allow Meaning1 for sentence (55), as well as Meaning2.

The general strategy of the TVJT is driven by methodological desiderata such as avoiding Type 1 errors; that is, an improper acceptance of the experimental hypothesis. In order to achieve this goal, these authors stress that it is important for the researchers to be conservative by stacking the cards against the experimental hypothesis and in favor of the null hypothesis. In our example, this means that the part of the story which corresponds to Meaning1 should elicit a 'YES' answer. In other words, Meaning1 should be true in the context of the story. This is so since the null hypothesis states that children will have access to Meaning1 since they lack knowledge of Principle C. In Crain and Thornton's view, there is a bias for child subjects to answer 'YES' in response to a sentence they don't understand or simply when they're confused. Associating the null hypothesis with the 'YES' therefore establishes the desired bias towards it and against the experimental hypothesis. In our example therefore, Meaning1, under which he and the Troll refer to the same person will be true.

The part of the story corresponding to Meaning2 is designed to evoke a 'NO' answer. Recall that this meaning corresponds to the experimental hypothesis. If children have knowledge of Principle C, then Meaning2 is the only meaning they should access. In order for Meaning2 to evoke a 'NO' answer, it should be false in the context of the story. In other words, the interpretation on which he and the Troll refer to different characters should be false in the context of the story.

| | |
|---|---|
| *Meaning1, True: | The Troll thinks he (the Troll) is the best jumper. |
| Meaning2, False: | He (not the Troll) thinks that the Troll is the best jumper. |

With these elements in mind, let us turn to the basic plot around which the stories are organized. There are three characters, A, B and C, involved in a contest of some kind. In this case, the purpose of the contest is to determine who is the best jumper. A fourth character, J, is the judge of the contest and decides who he thinks is the best jumper. After each character perform their jumps, the judge, J, considers them in turn. He begin by telling A that his performance was too poor and that he won't win the contest. The judge then moves to B and tell him that he was quire impressed with his jump and that he stands a good chance of winning. However, before he makes his decision, the judge must consider contestant C. The judge then turns to C and declares him the winner of the jumping contest. The judge therefore awards C the prize. At that point, contestant B protests, says he his the best jumper and grabs a prize for himself.

Let us now consider how the plot makes Meaning1 true while falsifying Meaning2. On Meaning1, which is ruled out by Principle C, the pronoun he and the NP the Troll refer to the same individual. Suppose that character B in the story is the Troll. In the plot outlined above, character B protest the decision of the Judge, J, and says that he, B, is the best jumper. Meaning1, i.e. where he (the Troll) thinks that the Troll is the best jumper is therefore true in the context of the story. On Meaning2, he and the Troll in he thinks that the Troll is the best jumper must refer to different individuals. In other words, for Meaning2 to be true, there must exist a male individual who thinks that the Troll is the best jumper. In the context of the story however, this male individual, the Judge, J, does not think that the Troll, B, is the best jumper. Rather, J thinks that B is the best jumper. In the context of the story then, Meaning2 is false.

At the end of the story, the puppet says what he thinks happened using the target sentence *He thinks that the Troll is the best jumper* as a description of the story. The child's task is to indicate whether she thinks that the puppet's description is correct. If the child knows principle C and therefore only has access to Meaning1, which is false in the story, she is expected to reject the puppet's statement and say 'NO'. If, on the other hand, the child fails to adhere to principle C and interprets the target sentence under Meaning1, which is true in the story, she is expected to accept the target sentence as an accurate description and say 'YES' to the puppet.

Two important features of the TVJT, that C & T call the Condition of Falsification and the Condition of plausible Dissent, deserve special attention. The Condition of Falsification states that the experimenter should make the test sentence false on the meaning which is consistent with the experimental hypothesis. In our example, the meaning of *He thinks that the Troll is the best jumper* which is consistent with the experimental hypothesis (in this case the adult interpretation) is Meaning2, according to which the pronoun he and the NP the Troll must refer to different individuals. To make the test sentence false under Meaning2, then, the Judge must not think that the Troll is the best jumper. In other words, the condition of falsification is met when the context of the story makes the negation of the test sentence under Meaning2 true. In order to implement the Condition of falsification, the context of the story must provide a male figure different from the Troll, as the referent of the pronoun *he*. In the present case, this male figure is the judge, J. Besides, he, the judge, must not think that the Troll, B, is the best jumper. The way this feature is implemented in the plot that we considered is to have the Judge, J,

consider the Troll, B, but eventually decide that another character C, is the winner of the contest, i.e. is the best jumper.

According to C & T, the purpose of the Condition of Plausible Dissent is to avoid errors of Type 2, i.e. rejections of valid experimental hypotheses. Essentially, the condition of Plausible Dissent is a condition of felicity on the TVJT. Russell (1948) observed that "perception only gives rise to a negative judgment when the correlative positive judgment has already been made or considered". Following this observation, C & T comment that in the TVJT, it is appropriate to ask children for potentially negative judgments only if the corresponding positive judgment has been under consideration. What this means in the present context is that Meaning2 should be under consideration in the context of our story. The way in which this feature is implemented is by having the judge, J, consider the Troll as a potential winner at some point in the story. After considering the final contestant however, the judge decides that the Troll will not be the winner of the contest. It should therefore be clear to the child subjects that Meaning2 why, after being under consideration, Meaning2 turns out to be false.

Two last features of the TVJT are worth considering. The first one is what C & T call 'a record of events'. The idea is that by the end of the stories, the toys and props should be arrange in such a way as to provide the child subjects with a visual reminder of the events that took place in the story. For example, in the Principle C, story, at the end, the judge stands by charter C along with the prize, to remind the child that it is character C that the judge declared to be the winner of the contest. Also, the Troll, character B, is seen

standing with the portion of the prize that he grabbed for himself. This is to remind the child that the Troll protested and declared himself the winner. The particular order of the events is also worth mentioning, in particular the fact that the event where the Troll declares himself to be the winner and grabs a prize happens last. Recall that this event corresponds to Meaning1, ruled out by Principle C, under which the pronoun he and the NP the Troll refer to the same person. Under the null hypothesis, Meaning1 should be available to children. The fact that the event corresponding to Meaning1 happens last, and is therefore made more salient is also used to stack the cards against the experimental hypothesis in order to avoid Type 1 errors.

Finally, at the end of the story, if the child rejected the puppet's statement, she is encouraged to say "what really happened in the story". This provides the experimenter with valuable information regarding the child's understanding of the story. For example when asked "what really happened" in the Principle C story, the child might explain that the puppet was wrong because the Judge didn't think that the Troll was the best jumper and that only the Troll himself did. This technique allows the experimenter to verify that the child rejected the puppet's statements for the right reason.

To summarize our discussion of the TVJT, let us consider how the story designed to test children's knowledge of Principle C fulfills the main criteria of the TVJT.

**Experimental hypothesis:** Children have knowledge of Principle C
**Null Hypothesis:** Children lack knowledge of Principle C

**Test sentence:** He thinks that the Troll is the best jumper.

***Meaning1, True:** The Troll thinks that he (the Troll) is the best jumper
**Meaning2, False:** He (not the Troll) thinks that the Troll is the best jumper

**Background**

Context, Part 1: There is a jumping contest. The Judge decides who is the best jumper.

**Condition of Plausible dissent** (Meaning2 is under consideration)

Context, Part 2: The judge could end up thinking that the Troll is the best jumper (possible outcome).

**Condition of falsification** (Meaning2 = False)

Context, Part 3: The Judge doesn't think that the Troll was the best jumper. The Judge thinks that character C is the best jumper (actual outcome)

**Final event** (Meaning1 = True)

Context, Part 4: The troll protests. He says that he is the best jumper.

## 5. Previous research

Previous work on the acquisition of relative quantifier scope has mainly focused on QNP-QNP interaction and in particular on children's interpretation of sentences containing a universally quantified and an existentially quantified NP, as in *A boy kissed every girl* or *Every girl was kissed by a boy* (see for example Lee 1991, Chien and Wexler 1989, Chien 1994, Philip 1991, 1992, 1995, Roeper and de Villiers 1991, Takahashi 1991, Crain et al 1996). Three main observations emerge from these studies. First, based on an apparent tendency for children to interpret sentences containing the universal quantifier *every* as requiring a one-to-one correspondence between different sets of objects, Philip (1995) has proposed the existence of a stage where, unlike adults, children have a preference for quantification over events. Second, for languages like Chinese where relative scope ambiguity is more restricted than it is in English, it has been observed that unlike adults, children do not seem to map scope relations isomorphically with the surface positions of QNPs (e.g. Lee 1991, Chien and Wexler 1989). Third, it has been observed that children acquiring Chinese are sensitive to distinctions between QNPs and bare NPs, and their respective scope properties. The same children also have a tendency to assign scope properties to numerally quantified NPs such as *two umbrellas*, different from those assigned by Chinese adults. In comparison, fewer studies have considered the way in which children interpret sentences containing quantified NPs and negation and to my knowledge, no study so far has systematically investigated this phenomenon. In this section, I present the main findings observed in QNP-QNP studies by reviewing three representative studies, namely Philip (1995), Lee (1991) and Lee (1996). I then turn to

QNP-Neg studies and review the findings of three more studies: O'Leary (1994), Park (1995) and Thornton (1995).

## 5.1 QNP-QNP studies

### 5.1.1 Philip 1995

It has been observed in the literature on language acquisition that children who are shown a picture like figure 1 and asked the question *Is every farmer feeding a donkey ?* often respond 'NO' and justify their answers by pointing to the unfed donkey ( e.g., see Philip 1991, 1992, 1995; Roeper and de Villiers 1991; Takahashi 1991).


**Figure 1: extra object condition**

In a similar vein, children who are shown the picture in figure 2 and asked the question *Is a farmer feeding every donkey* have a tendency to respond 'NO' and to justify their answers by pointing to the farmer who is standing by himself.


**Figure 2: the extra agent condition**

Other children who also respond negatively to the questions above seem to do so for a different reason. When shown the picture in figure 3 and asked "Is every farmer feeding a donkey ?", these children answer 'No' and justify their answers by pointing to the fox (Philip 1995). The first type of negative responses (to pictures in figure 1 and 2) are called symmetrical responses because it seems that children require a one-to-one correspondence between the set of farmers feeding and the set of donkeys being fed. Philip (1995) calls the second type of negative response (to picture 3) the exhaustive response.

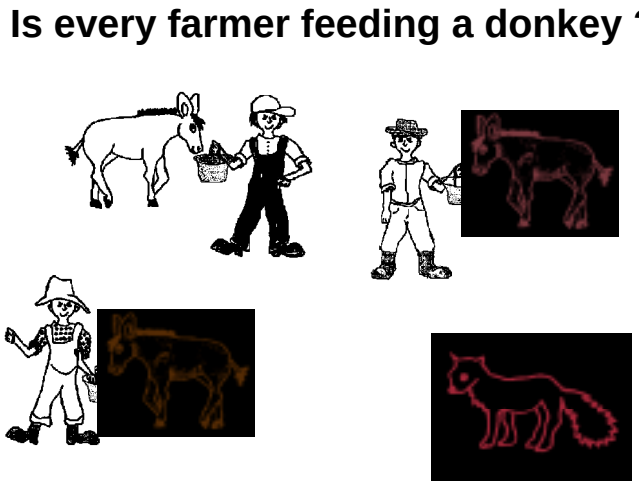



**Figure 3: Control condition**

Although different accounts have been proposed to explain the nature of children's non-adult responses to questions like "Is a farmer feeding every donkey ?" and "Is every farmer feeding a donkey ?" - some of which are non-linguistic like Inhelder and Piaget (1964) - we will focus on more recent linguistic accounts and in particular on Philip's (1995). According to him, the symmetrical and the exhaustive responses are determined by UG and they also correspond to separate sub-stages in the acquisition of universal quantification. At the symmetrical stage, although children are capable of accessing the correct adult interpretation, they show a preference for the symmetrical response. Likewise, children at the exhaustive stage have a preference for the exhaustive response even though they can assign the correct adult interpretation.

Philip (1995) argues that children and adults' interpretations of sentences containing the universal quantifier such as *Every farmer is feeding a donkey* differ in two ways. The first difference concerns the domain of quantification of the determiner *every* and the second difference is the type of variable that *every* binds. Philip proposes that children, unlike adults, allow *every* in main clauses to take more than one nominal in its domain of quantification. The second difference is that children allow *every* to bind an event variable where for adults, it must bind an individual variable. The different representations assigned by children and adults for a sentence like *Every farmer is feeding a donkey* are given in (57) and (58) respectively. Here, we focus on the symmetrical interpretation.

| (57) | Quantifier | Restrictive clause | Nuclear scope |
|---|---|---|---|
| | Every(e) | [PART(farmer(e)) or [PART (donkey(e) ] | Farmer-is-feeding-a donkey(e) |

| (58) | Quantifier | Restrictive clause | Nuclear scope |
|---|---|---|---|
| | Every(x) | farmer(x) | (∃ y) [donkey(y) & z is feeding y] |

In (57), the child's representation, *every* binds event variables, represented by *e*. Two types of events occur in the restriction of *every*: events in which a farmer participates or events where a donkey participates. Finally, the nuclear scope states that the farmers must be feeding the donkeys. Note that on this account, (57) will be false just in case, their is an unfed donkey or an extra farmer. The adult representation in (58) states that for every farmer, there must be a donkey that the farmer is feeding.

Philip proposes two reasons why symmetrical children appear to have a preference for the representation in (57), even though they can sometimes access the adult representation in (58). The first one is that quantification over events, for some reason is simpler than quantification over individuals. The other reason is that children may have difficulty applying the adult mechanism to derive the representation in (58). When children do give adults responses to questions like "Is every farmer feeding a donkey", Philip assumes that children may have access to the adult analysis but for the reasons just mentioned, they prefer the symmetrical response. Another possibility is that children's event quantificational analysis happens to have the same truth conditions as the adult's representation. This could happen in case the questions children are asked contain intransitive verbs and therefore only one nominal. For example, *Every cat is waving* would receive the analysis in (59) which turns out to be truth-conditionally equivalent to correct adult representation in (60).

(59)

| Quantifier | Restrictive clause | Nuclear scope |
|---|---|---|
| Every(e) | [PART (cat(e)) ] | A-cat-is-waving(e) |

(60)

| Quantifier | Restrictive clause | Nuclear scope |
|---|---|---|
| Every(x) | cat(x) | x is waving |

A prediction of Philip's account then is that children should respond differently to sentences containing the universal quantifier and a transitive verb and those containing the universal quantifier and an intransitive verb. Philip's experimental findings suggest that this prediction is born out. Since the symmetrical response is contingent on the presence of the universal quantifier, another prediction of Philip's account is that question

like *Are farmers feeding donkeys* which do contain the universal quantifier, should evoke more adult like responses by children. Again, this prediction was confirmed experimentally.

### 5.1.2 Lee (1991)

Lee's (1991) study investigates the acquisition of the principles which determine relative quantifier scope in Chinese. In an earlier study designed to investigate how 3 to 8 year-old Mandarin speaking children assign relative scope to quantified NPs in subject and object position, Lee (1986) observed that children "probably interpreted QNPs are inherently referential" (p.190). That is, in a sentence like (61a), whose adult interpretation is given in (61b), children before the age of 5 interpreted *yige dangao*, 'a cake' to refer to a specific entity.

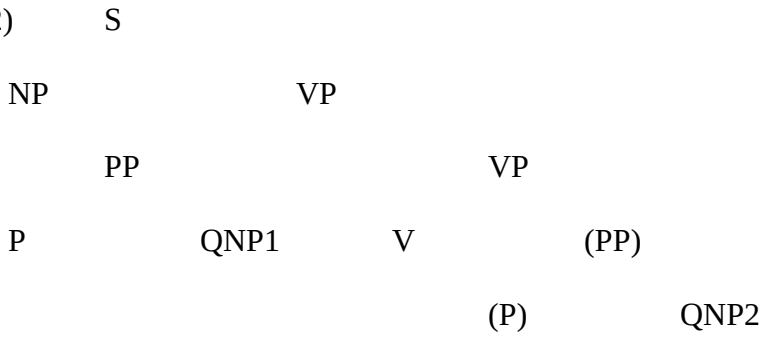
(61) a. Meige xiaohai dou zai chi yige dangao
every-CL child all ASP eat one-CL cake
'Every child is eating a cake'

b. For all x=child, there is a y=cake such that x is eating a cake

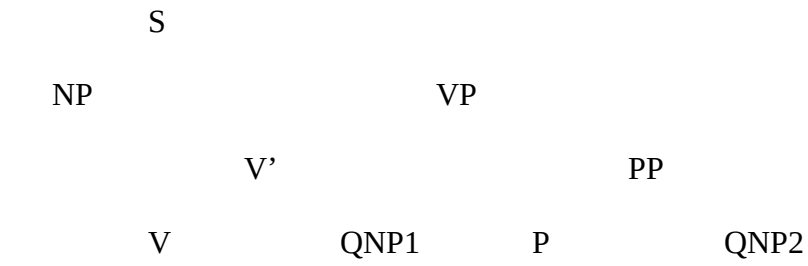
Lee observes however, that this study failed to establish the scope principles used by children once the proper interpretation of (61a) is arrived at. This is so since in this sentence, the subject QNP both precedes and (asymmetrically) c-commands the object QNP. For the older children, who correctly interpreted the subject QNP to take scope over the object QNP, it was therefore unclear whether they were following c-command or linear precedence.

In order to overcome this difficulty, Lee (1991) tested children's interpretations of sentences where there is no c-command relation between the QNPs. The structures below illustrate this situation. In both cases, there is no c-command relation between the QNPs.

(62)




(63)




As a working hypothesis, Lee assumes the following scope principles for Chinese:

(64) Suppose A and B are QNPs, then:

a. If A asymmetrically c-commands B at S-structure, A has scope over B at Logical Form (LF). (A *commands* B if neither dominates the other and the first S node dominating A also dominates B)

b. If A and B command each other and A precedes B at S-structure, A has scope over B at LF.

Given the scope principle in (64), QNP1 is predicted to take scope over QNP2 in the structures in (63) since in both cases, QNP1 and QNP2 do not asymmetrically c-command each other and QNP1 always precedes QNP2 a S-structure. The test sentences in Lee's study were of two types, illustrating the structures in (63) above. In the first type, QNP1 occurs in a preverbal locative phrase headed by *zai* 'at' and QNP2 is a preverbal object. Lee observes that sentences of type 1 are unambiguous with QNP1 obligatorily taking scope over QNP2. In the second type, QNP1 occurs as a direct object and QNP2 as the postverbal object of a locative phrase also headed by *zai*. Sentences of type 2 are ambiguous with respect to the interpretation of QNP1 and QNP2, i.e. both scope options are possible and the linearity principle only predicts one of the two readings, i.e. the one where QNP1 takes scope over QNP2. Sentences of Type 1 and Type 2 are illustrated below.

(65) Type 1 sentences

a. X zai yige dengzi shang fang meigen shengzi
   *'X puts every string on a stool'*
b. X zai meige dengzi shang dou fang yigen shengzi
   *'X puts a string on every stool'*

(66) Type 2 sentences

a. X fang yigen shengzi zai meige dengzishang
   *'X puts a string on every stool'*
b. X fang meigne shengzi zai yige dengzishang
   *'X puts every string on a stool'*

In the sentences above, X stands for the name of the child subjects who were asked to act the meaning of the sentences out. The subjects were 117 Mandarin speaking children between the ages of 3 and 8. Adults were also tested on the basis of the sentences above but the procedure was slightly different. First, they were not tested individually but in groups of 5 or 6 and X was replaced by *please*. Also, the adults were asked to draw their interpretations on a piece of paper.

Here are Lee's main findings. The percentage of an age group who consistently selected the wide scope interpretation of QNP1 across sentences types started at around 10% at age 3, raised to approximately 40% at age five and reached 70 to 80% by age 7. Lee observes that the gradual strengthening of linearity correlates with the decline in the wide scope reading of QNP2 between the age of 4 and 7. Lee also observes differences between the interpretation of Type 1 and Type 2 sentences which he attributes to the fact that type 2 sentences unlike type 1 sentences allow scope ambiguity. One difference between type 1 and type 2 sentences with respect to the ∃∀ order (existential quantifier - universal quantifier) is that the wide scope interpretation of QNP1, the existential quantifier, showed a visible decline after the age of 7 in sentences of type 2 but not in sentences of type 1. This observation is also reflected in the rise in the wide scope reading of QNP2 (the universal quantifier) after 7 in sentences of type 2 but not in sentences of type 1. Lee concludes that:" quantifier order is distinguished by Chinese children by age 6 and that the linearity principle for scope interpretation is firmly established by age 7." (p.204)

### 5.1.3 Lee (1996)

Lee (1996) presents a study of Chinese speaking children's interpretation of the relative scope of numeral phrases such as *two umbrellas*. Lee points out that such phrases have the well-known property of displaying both scope-dependent and scope independent or branching readings (e.g., Barwise 1979, Liu 1990, Beghelli, Ben-Shalom and Szabolcsi 1993). We illustrate this point below with examples from Lee.

(67) Three boys are holding two umbrellas

(68) a. [Three boys$_1$ [two umbrellas$_2$ [$t_1$ be holding $t_2$ ]]]
b. [Two umbrellas$_2$ [three boys$_1$ [ $t_1$ be holding $t_2$ ]]]

(69) a. There are 3x=boy, such that for each x, there are two y=umbrella, x is holding y (subject wide scope)
b. There are 2 y=umbrella, such that for each y, there are 3 x=boy, x is holding y (object wide scope)
c. There is a set of three boys and there is a set of two umbrellas such that each member of the boy set is holding at least an umbrella, and each member of the umbrella set is held by at least a boy(scope independent)

The scope-dependent readings of (67) are given in (68a-b). (68a) represents the subject wide scope reading where three boys are such that they are holding two umbrellas, as in (69a). (68b) represents the object wide scope reading where two umbrellas are such that they are being held by three boys, as in (69b). In addition to the scope-dependent readings in (69a-b), (67) also has a scope independent reading where the two QNPs are taken independently and a variety of connections are established between the members of each set. Lee distinguishes two scope-independent readings: what he calls the *each-all* reading where each member of one set is connected to all the members of the other set and the

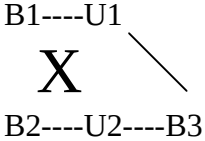
*cumulative* reading where each member of either set is connected to at least one member of the other set. Lee provides the following graphic in order to illustrate the various readings of (67).

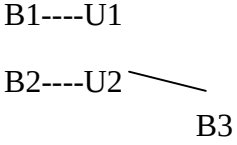
(70) Scope dependent and scope-independent readings of "Three boys are holding two umbrellas" (B=boy; U=umbrella)



Scope-dependent (subject wide scope)

Scope dependent (object wide scope)




Scope-independent (each-all)

Scope independent (cumulative)

Lee's research question, given the availability of both scope-dependent and scope independent interpretations is to try to determine which interpretation is the more basic. According to Lee, two positions have been taken regarding the relative markedness of scope-dependent and scope-independent readings. On the one hand, it has been suggested

by Gil (1992), on the basis of typological evidence, that scope-independent readings are unmarked. On the other hand, Hornstein (1984) suggested that children should initially treat QNPs to have operator status and hence assign scope dependent readings (i.e. children should initially assume that QNPs are of type II in Hornstein terms). Investigating children's interpretations of the relative scope of numeral phrases may therefore shed some light on this issue.

Lee's study investigates Chinese speaking children's interpretations of QNPs in the five types of sentences. We will focus on the three given below.

**1. Universal quantifier subject; numeral phrase object**

Souyoude shushu dou tiaozhe liang tong shui
all uncle each carry-on-shoulder two bucket water
'All the men are carrying (on their shoulder) two buckets of water'

**2. Universal quantifier subject; bare NP object**

Souyoude shushu dou tiaozhe shuitong
all uncle each carry-on-shoulder water-bucket
'All the men are carrying (on their shoulder) water-buckets'

**3. Numeral phrase subject; numeral phrase object**

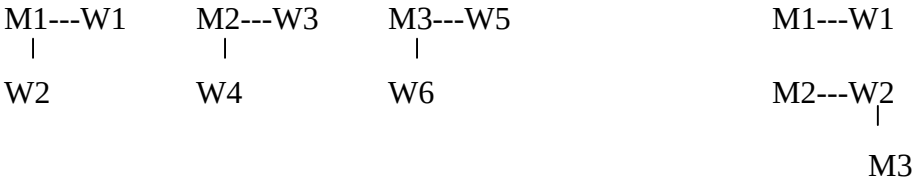
You sange shushu tiaozhe liang tong shui
Exist three uncle carry-on-shoulder two bucket water
'Three men are carrying (on their shoulder) two buckets of water'

Lee's experiments used truth-judgment tasks and the subjects were 13 four-year-old children, 14 five-year-olds and 14 adults. Each of the sentence types in (1-3) were associated with 6 interpretations depicted by pictures: *distributive, each-all, cumulative,*

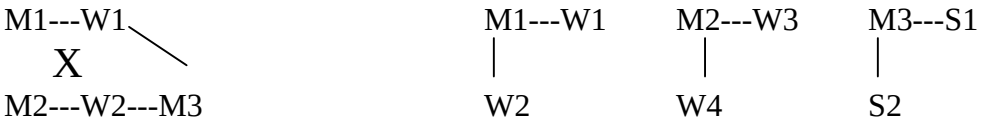
*extra theme object*, *unrelated theme*, *non-exhausted agent*. The *distributive* reading corresponds to the subject wide scope reading, the *cumulative* reading represents a scope-independent reading, the each-all reading can either be a scope-dependent or a scope-independent reading. The unrelated theme and the non-exhausted agent represent reading on which the sentences are falsified. Finally, Lee incorporated the extra theme condition, which differs from the distributive reading, in order to test Philip's (1995) proposal. Recall that according to Philip, a symmetry child would not accept the extra-theme picture but would accept the distributive reading. Lee illustrates the various interpretations by means of the following diagram:

(71) Interpretations for type1-3 sentences

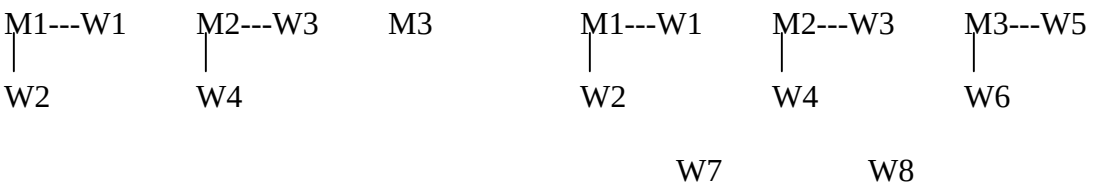
(M=person, W=water bucket, S=stone)




**Distributive** **Cumulative**




**Each-all** **Unrelated theme**




**Non-exhausted agent** **Extra theme**

Here are Lee's main findings. Both groups of children (the 4 and the 5-year-olds) behaved like adults in accepting the *distributive* and *each-all* reading of sentences like (1) and (2) about 70% (or more) of the time. Children also correctly rejected the non-exhausted and unrelated theme interpretations of these sentences. Also, both groups of children differentiated numeral NPs and bare NPs in relation to a universally quantified NP. According to Lee, about half of the 4-year-olds and 80% of the 5-year-olds rejected the cumulative readings for sentences with object numerals like (1) but accepted this reading for sentences with bare object NPs like (2). Regarding children's interpretation of sentences like (3) with a numeral subject and a numeral object, Lee remarks that "a surprising finding of our study is that unlike adults [who assigned a cumulative reading], 4 and 5-year-olds overwhelmingly favored the distributive interpretation. The preponderance of distributive readings cannot be attributed to a task bias, since the children did not reject all sentences paired with non-distributive contexts. For example, they correctly rejected the unrelated-agent and the non-exhausted agent pictures, and showed different levels of acceptance for the cumulative reading in Type I and Type II sentences."(p.178)

Lee concludes that children are sensitive to the distinction between QNPs and bare NPs regarding a universally quantified subject since they allow cumulative interpretations only for the bare NPs but not for QNPs. Also, and importantly, children have a strong preference for a distributive reading with sentences with a numeral subject and a numeral object. Lee interprets this finding to lend support to Hornstein's proposal that scope dependency is unmarked and run counter to Gil's (1992) prediction that scope-independent reading are unmarked. Finally, Lee observes that the children in his study did not give symmetrical interpretations even when they were presented with extra theme objects, contrary to Philip's (1995) predictions.

## 5.2 QNP-Neg studies

### 5.2.1 Thornton 1995

Thornton's work on quantification and negation stems from the observation that, unlike adults, children appear to be unable to raise negation to Comp in their production of negative questions. In an experiment designed to elicit a large variety of questions, Guasti, Thornton and Wexler (1993) observed that children consistently produced forms which are no attested in the adult grammar. The question forms that were problematic for children involved movement of the reduced form of negation, *n't* , to Comp, along with the auxiliary verb, as illustrated in (72). In the questions they produced, children failed to raise *n't* to Comp. Instead, they consistently retained *n't* (or not) in the IP. The variety of

structures produced by children are given in (73).

(72) What don't you like ? (Preferred adult structure)

(73) a. What you don't like ? (No I to C)
b. What do you don't like ? (Aux doubling)
c. What don't you don't like ? (Neg/Aux Doubling)

In (73a), I to C movement fails to apply, and negation is retained in the IP. In (73b), children still fail to raise negation to Comp but in this case, C is filled by an extra occurrence of *do*. Finally, in (73c), negation and *do* occur both in Comp and in the IP.

Based on these observations, Thornton undertakes to investigate the effect that children's inability to raise negation to Comp may have on their comprehension of sentences whose interpretation relies on the presence of negation in Comp. In order to address this issue, Thornton tested children's comprehension of the sentences in (74) where the different positions of negation give rise to subtle differences in meaning.

(74) a. Did any of the turtles not buy an apple ?
b. Didn't any of the turtles buy an apple ?

In (74a), existential *any* takes wide scope over negation and the question asks if there exists a turtle such that it did not buy an apple, (75a). In (74b) on the other hand, negation take scope over existential any and the question asks if there does not exit any turtles that bought an apple, (75b).

(75) a. $\exists$ (x), (x, turtle) $\wedge \neg$ [(x) bought an apple]
b. $\neg \exists$ (x), (x, turtle) $\wedge$ [(x) bought an apple]

To better appreciate the difference in meaning between (74a) and (74b), consider these questions in the context illustrated in Figure 1. In response to (74a) *Did any of the turtles not by an apple ?*, the correct answer is 'YES' and the appropriate justification is to point to the turtle the furthest to right and say *Yes, This one didn't*. The correct answer to question (74b) *Didn't any of the turtles* buy an apple is also 'YES'. However, in this case, the appropriate justification involves pointing to the first two turtles from the left and say *Yes, these two did*. In summary, the answer to both questions is 'YES' but the reason for answering 'YES' is different in each case.

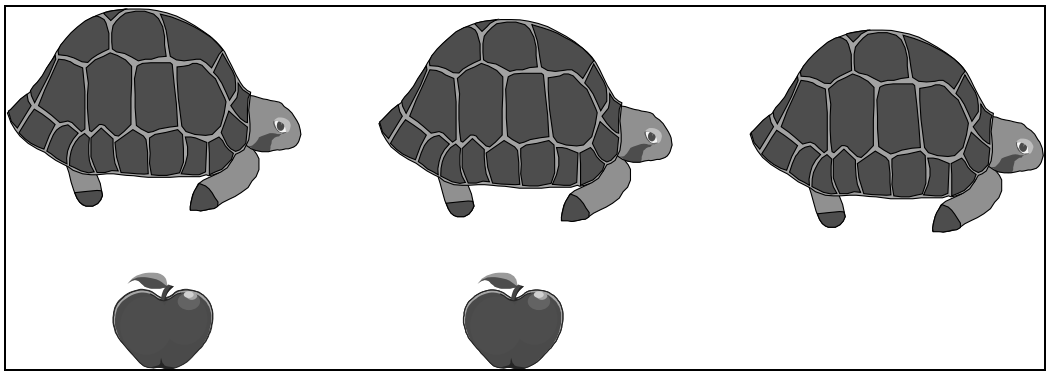


**Figure 1: Turtles and Apples**

In order to find out whether children can interpret negation in Comp, Thornton tested them on the basis of the examples in (74). The crucial construction here is (74b). The logic of the argument is that if children correctly interpret (74b) as (75b), where takes scope over existential *any*, then there is evidence that children can interpret negation in Comp. The experiment used a modified form of the Truth Value Judgment Task (Crain

and McKee 1985). On a typical trial, a story was acted out by one experimenter, and watched by the child and the second experimenter, who was playing the role of a puppet, in this case, 'Snail'. At the end of each story, the experimenter asked Snail a targeted question. Snail had difficulty with the question ("*That's a hard one* ..."), and requested help from the child subject. If the child was cooperative, she answered the question for the snail.

The participants were 10 children between the ages of 3;6 and 4;11. The scenarios used to test children's comprehension of questions like (74a) and (74b) were designed to be felicitous for either interpretation of the question. The stories all followed the same basic plot; two characters acted one way, and a third character acted differently. This step was taken to ensure that there was always a plausible answer available for children. For example, the story accompanying the questions in (74) might be about three turtles who are hungry and go to the store to buy something to eat. The store only sells fruit. Two of the turtles like fruit, and buy an apple. The other turtle says he hates fruit, and decides to go without. Below is a sample protocol used by Thornton.

**Protocol** Characters: Turtles; Turtle 1 (=T1), Turtle 2 (=T2) and Turtle 3 (=R3) ('Exp' stands for the experimenter)

Exp: In this story, there are three turtles. They just went for a short walk and now they are really hungry. Turtles can't walk very fast, and when they do go for a walk, they always want to eat something afterwards.
T1: My legs are so tired! Let's go in this store and get something to eat. I can't walk any more!
T2: Good idea! My legs are tired too.
T3:` I'm hungry too, but what do they sell in this store? Let's go in and find out.
T1: I can see fruit over there. Oh look at those big apples. I'll have one of those.

T2: I love apples too. Especially big red apples like these ones. I'll have this apple <chooses one>

T2: Well, I don't like fruit. I want a different kind of snack, but this store only has fruit. Well,I'm too tired to walk to any more stores, so I'll just take a rest right here. That will give me more energy.

Exp: Well, let's see if the snail understood this story. Snail, did any of the turtles not buy an apple ?

OR

Didn't any of the turtles buy an apple ?

Snail: That was a hard one. <To child> Could you help me ? Did any of the turtles not buy an apple ? (or Didn't any of the turtles buy an apple ?)

The main finding of this comprehension experiment is that children do not have difficulty interpreting *any* with respect to negation. Questions like (74a), *Did any of the turtles not buy an apple ?* were answered correctly on 93 % of the trials (37/40). When justifying their answers in the context of the situation depicted in Figure 1, children correctly pointed to the turtle the furthest to the right and said *Yes, this one didn't*. Questions like (74b), *Didn't any of the turtles buy an apple ?* evoked 85% correct responses (34/40). When justifying their answers, children correctly pointed to the first two turtles and said *Yes these two did*.

Thornton observes that there is a possible objection to the validity her results. This objection rests on the view that children may ignore items that are not part of their current grammar. Suppose, then, that children ignore negation when it occurs in Comp. In this case, children would interpret (74b) as (76).

(74b) Didn't any of the turtles buy an apple ?

(76) Did any of the turtles buy an apple ?

The obvious problem here is that the answer to (76), where negation has been omitted is the same answer to (74b) where negation is present. In each case, the appropriate answer would be to say “Yes, these two did”, and point to turtles A and B. According to this view, children’s appropriate answers to questions like (74b) do not necessarily indicate that they can interpret negation in Comp.

In order to address this issue, Thornton conducted another experiment where she tested children’s interpretation of examples like (77) and (78). In this case also, the position of negation gives rise to different sets of interpretations for the questions in (77) and (78) but in this case, the set of interpretations available for (78), where negation occurs in Comp, is different from the set of interpretations available to the same question if negation was omitted.

(77) What did every rabbit not buy ?
(78) What didn’t every rabbit buy ?

Let us first consider the interpretations available for (77). There are (at least) two. On one interpretation, the question asks ‘what item is such that every rabbit didn’t buy it?’. In this case, *every* has scope over negation. The second interpretation is one that distributes over the set of rabbits, asking for a list of the item(s) that each individual rabbit didn’t buy. This interpretation is termed the *pair list* reading. Like (77), (78) can also receive a paired list reading and a reading where *every* takes scope over negation. However, the question in (78) also offers interpretive options not available for (77). First, (78) has an interpretation in which negation has scope over *every*. On this interpretation, the question

asks ‘what item is such that not every rabbit bought it ?’. Finally, the question in (78) can be given a cumulative interpretation that asks for all of the items not bought by the group of rabbits.

Let us consider how the interpretations of (77) and (78) were made available in the context of a situation like the one depicted in Figure 2. The paired list reading and the cumulative reading are not the focus of this experiment. The interpretation of (77) which is of interest to us is the one where *every* takes scope over negation. This interpretation inquires about an item which every rabbit did not buy. A child who interprets (77) in this way will answer “Ears” in this context. This interpretation is also available for (78). A child who only has access to the interpretation in which *every* has scope over negation should respond to (78) with “Ears” also. However, as we saw, (78) also has an interpretation in which negation takes scope over *every*. This interpretation of the question asks what *not every* rabbit bought. Children who have a preference for this interpretation should answer “Tails”. Finally, if children were to omit negation in (78), and understood the question to mean “What did every rabbit buy ?”, they should answer “Hearts”. In short, if children answer “Tails” to a question like (78), this would constitute evidence that they are capable of interpreting negation in Comp. Moreover, if children never answer ‘Hearts’ to the same question, Thornton would have evidence that they do not omit negation.

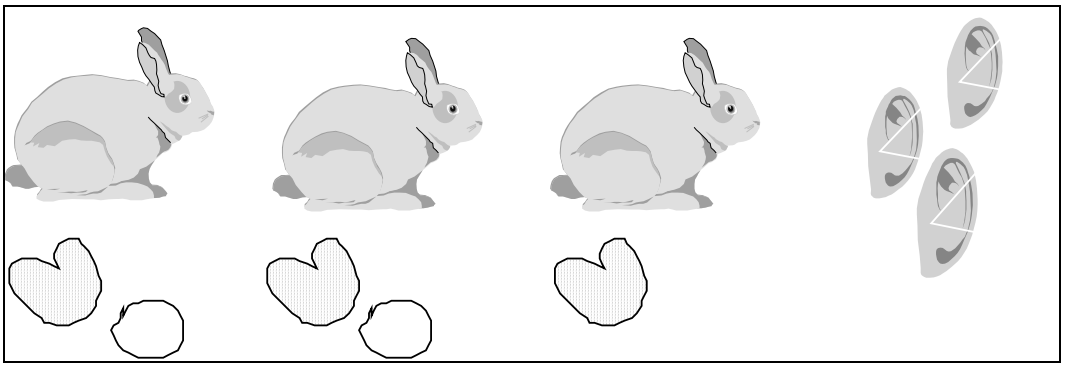


**Figure 2: Rabbits at the Store**

The subjects in this experiment were 10 children ranging in age between 3;10 and 5;4. Nine of these children had participated in the previous experiment. On additional child was added to their number. The experiment incorporated two targets like (77). These were included as part of an unrelated experiment. Four targets like (78) were tested in a different session. This was so that children's preferential interpretation for (78) could be assessed without it being biased by the interpretation given to (77). The same modified version of the Truth Value Judgment Task, as described in the previous experiment was used to test children's comprehension of questions like (77) and (78). As before, the child and the snail puppet watched stories. Unable to answer the experimenter's question about the story, the snail turned to the child for help. The stories were felicitous for all the interpretations described above. The child's response to the question, therefore, was informative about her preferred interpretation. At the end of the story, two of the rabbits are in possession of a spare heart and a spare tail, and the third rabbit just has a heart, as illustrated in figure 2. Below is a sample protocol used by Thornton.

**Protocol** Characters: Rabbits; Rabbit 1 (=R1), Rabbit 2 (=R2) and Rabbit 3 (=R3) ('Exp' stands for the experimenter)

Exp: In this story, there are three rabbits who go to a store that sells spare parts. That's where you can go if you want to buy spare body parts like ears, legs, tails and things like that. The three rabbits went into the store to see what was for sale.
R1: Oh look, spare hearts ! They are beautiful ! Let's all get one of these.
R2: Good idea.
R3: These hearts are very soft. We can use them for a pillow.
R1: Is there anything else we can buy ? What about these ears over here ?
R2: I don't like those ears. They wouldn't look good on a rabbit.
R3: He's right. Those ears are too big for us.
R1: You're right. OK, let's not buy the ears. But there must be something else we would like ..
R2: I see some tails. A spare tail would be useful. I could wear a spare one while my usual tail is in the wash. I'll have a white one.
R1: That's true. It would be useful to have a spare. I'll take an orange one to wear at birthday parties.
R3: I don't need a spare tail. I like the one I have. It never gets dirty.

Exp: Well, let's see if the snail understood that story. Snail, what didn't every rabbit buy ?

OR

What did every rabbit not buy ?

Snail: That was a hard one. <To child> Could you help me ? What didn't every rabbit buy ? (or What did every rabbit not buy ?)

Child: A tail
OR
Child: Ears

Here are Thornton's main findings. For questions like (77), *What did every rabbit not buy ?*, children gave responses associated with the adult interpretation in which *every* has wider scope than negation (i.e. Ears) 78 % of the time (14/18). On child (aged 3;10), however, gave a different response, namely the item that not every rabbit bought. The remaining responses for (77) were attributable to the cumulative reading, in which

children listed all of the items the rabbits had considered, but had chosen not to buy. For questions like (78), children did not have any difficulty finding the interpretation that asks what *not every* rabbit bought. That is, children responded "Tail" 89 % of the time (32/36). The remaining responses for (78) were attributable to the cumulative reading and the reading where *every* has scope over negation. Children never answered *Hearts* to question like (78).

Thornton takes these results to show that children can interpret negation in Comp, since they have no problem accessing the 'not every' interpretation of (78), but also, importantly for her, they validate the results of experiment 2. Recall that the questions 'Didn't any of the turtles buy an apple ?' and 'Did any of the turtles buy an apple ?' can be answered in the same way. If children ignore negation then, they may still give the answer we would expect them to give if they were interpreting negation correctly. In this case, however, *What didn't every rabbit buy* ? and *What did every rabbit buy ?* cannot be answered in the same way. The former may be answered by 'Ears' or 'Tails' while the latter must be answered by 'Hearts'. The fact that children never answer 'Hearts' to 'What didn't every rabbit buy' shows that they take negation into account. If children are aware of the presence of negation in questions like *what didn't every rabbit buy* there is no reason to think that they would ignore negation in questions like *Didn't any turtle buy an apple*. Therefore, Thornton argues, their answers to questions like *Didn't any turtle buy an apple* are based on their correct interpretation of negation in Comp. Thornton's general conclusion then, is that their exists a comprehension/production asymmetry in the grammar of children since they fail to raise negation to Comp in negative questions while

being perfectly capable of interpreting it in that position.

### 5.2.2 Park 1995

Park's (1995) study is an investigation of the acquisition of negation in Korean. Her main concern is the acquisition of two different types of negation, that she calls pre-verbal and post-verbal negation, which manifest different scope properties. Basically, pre-verbal negation must always be interpreted in the scope of a quantified subject while post-verbal negation allows for two options. It can be interpreted in the scope of the quantified subject but it may also take scope over it, thus yielding ambiguity. These facts are illustrated in the examples below from Park (1995):

(79) a. Manun haksaeng-i Chomsky-lul ani manna-ess-ta
Many students-Nom Chomsky-Acc not meet-Past-Dec
'Many students did not meet Chomsky.'
(For many students, it is not the case that they met Chomsky.)

b. Manun haksaeng-i Chomsky-lulmanna-ciani ha-ess-ta
Many student-Nom Chomsky-Acc meet-ci not do-Past-Dec
'Many students did not meet Chomsky'
(For many students, it is not the case that they met Chomsky.)
(Few students met Chomsky)

In (79a), preverbal negation must be interpreted in the scope of the quantified subject. In other words, (79a) must be paraphrased as *Many students are such that they did not meet Chomsky*. (79b) on the other hand is ambiguous with respect to the interpretation of the quantified subject and negation. The subject can take scope over negation as in (79a) but it is also possible for negation to take scope over the subject. In this case, (79b) could

be paraphrased as ‘Not many students met Chomsky’. Based on these observations, Park’s research question was to determine whether children are aware of the existence of these two forms of negation and the extent to which they know their different scope properties. In a first experiment, Park investigates the stages of acquisition of the two types of negation focusing on the question of whether only pre-verbal negation is available to children at the earlier stage of development. The idea was to place children in an experimental situation where the use of post-verbal negation is obligatory in order to properly capture the truth conditions of the context presented to them. Park reasoned that in this case, if children fail to use post-verbal negation it could be inferred that their grammar does not make that option available. The experiment involves two experimenters. One experimenter act out stories with toys and props and the second experimenter plays a puppet, in this case a fox, who describes the situation correctly using a quantifier and post-verbal negation. The child subjects are requested to repeat what the puppet said. What follows is a protocol for one of the stories used by Park:

| | |
|---|---|
| Experimenter: | Three aborigines go hunting. |
| Aborigine 1: | Look, there is a crocodile. Let’s hunt it. |
| Aborigine 2: | That’s a good idea. |
| Aborigine 3: | Oh, no ... I’m too scared. I want to go home. (he runs away.) |
| Aborigine 1: | He is a coward. Hey, you (indicating aborigine 2), let’s hunt it. |
| Aborigine 2: | OK. |
| Aborigine 1: | Hurry up. (The two aborigines try to kill the crocodile.) |
| Fox: | Aha, I see. All the aborigines did not hunt the crocodile (using postverbal negation). |

Toin Ta ake-lul sanyangha-ci ani ha-ess-ta
Aborigine all crocodile-Acc hunt-ci not do-Past-Dec

Experimenter: What did the Fox say ? All the aborigines . . .

Child:

A group of 16 Korean children ranging in age between 2;8 and 6;5 participated in the experiment. Children were separated into two groups according to the responses they gave to the story described above: Group A (average age 3;3) and Group B (average age 5;5). Children in group A produced sentences with pre-verbal negation 75 % of the time. The rest of the time they used responses which did not contain negation. In group B, children produced sentences with postverbal negation 90 % of the time. Adults in the control group used post-verbal negation 100 % of the time.

On the basis of these results, Park observes that younger children at an earlier stage, Group A, produce sentences with only pre-verbal negation despite the situation of the story where it was obligatory to use post-verbal negation, and that postverbal negation appears in the older age group, B. The fact that younger children do not use post-verbal negation in their production, even in contexts where it is obligatory leads Park to wonder whether this also extends to their comprehension. In other words, is it necessary for children to be able to produce post-verbal negation in order to correctly interpret it ? In order to address this issue, Park designed another experiment where she tested children's comprehension of sentences with post-verbal negation. The idea was to place children in an experimental situation where both the wide scope and the narrow scope reading of post-verbal negation were available, the former being true and the latter false in the context of the story. The puppet would then described what happened in the story using a statement containing post-verbal negation. If children accept the puppet's statement as a

correct description of the story, then one might infer, Park argues, that they have access to the wide scope reading of post-verbal negation. On the other hand, if children reject the puppet's statement, this is indication that they do not have access to that interpretation. Here's a protocol for one of the stories used by Park.

**Protocol:** (Three smurfs find some grape and some strawberries on the table)

Smurf 1: Wow, here's some grapes. I like grapes and I am hungry.
Smurf 2, 3: We like grapes and we are hungry too.
Smurf 1: Let's eat them.
Smurf 2, 3: Yes, Yes . . . Nyam, Nyam. (All of them eat grapes)
Smurf 1: Look. There are strawberries too. They look so fresh. I am going to eat them. (He eats a strawberry.)
Smurf 2: I like strawberries very much. (He also eats a strawberry.)
Smurf 3: Well, I am full now. I will go out and play. (He goes out without eating any strawberries)

Fox: I see. All the smurfs ate grapes.

Child:

Experimenter: How about strawberries ?

Fox: All the smurfs didn't eat strawberries (using post-verbal negation)
Smurf Ta t'algi-lul mek-ci ani ha-ess-ta
All strawberry-Acc eat-ci not do-Past-Dec

Child:

What Park found is that while adults and older children accepted the puppet's statement, that is the wide scope reading of negation 100% of the time, younger children in group A rejected the puppet's statement 83% of the time.

In summary, two main facts emerge from Park's investigation of the acquisition of negation in Korean. First, children seem to acquire or produce pre-verbal negation before post-verbal negation. In other words, there is a stage where children only use pre-verbal negation even when post-verbal negation is obligatory. Not surprisingly this extends to children's comprehension. That is, younger children, who cannot produce post-verbal negation yet, fail to understand its wide scope interpretation. On the other hand, older children, who correctly use post-verbal negation in their production, are also aware of its wide scope interpretation. In order to account for these facts and in particular for the order of acquisition between pre-verbal and post-verbal negation, Park builds an argument based on the notion of semantic entailment. First she observes that in an example like (80), the narrow scope reading of negation with respect to the quantified subject, (80a), entails the wide scope reading (80b). In other words, (80) under a narrow scope reading is true in a subset of the circumstances in which it is true under the wide scope reading.

(80) Everybody didn't come

a. $\forall(x) \neg$ [person (x) $\rightarrow$ came (x)] (Nobody came)

b. $\neg\forall(x)$ [person (x) $\rightarrow$ came (x)] (Not everybody came)

Nobody came $\Rightarrow$ Not everybody came

What this means for Korean is that the reading available for pre-verbal negation, the narrow scope reading, entails the wide scope reading available for post-verbal negation only. Having established this relation between the interpretations of pre-verbal and post-verbal negation, Park then invokes the Semantic Subset Principle of Crain and Philip (1993). The point of this principle, as she puts it is to guarantee that children's hypotheses

are falsifiable on the basis of positive evidence. Falsifiability is achieved by limiting children's initial hypotheses in certain cases where alternative interpretations are available to adults. Thus, according to this principle, only one of the alternative meanings is initially available to the child.

**Semantic subset principle:**

If a sentence S with LF representation Φ is true in a subset of circumstances that make S true with LF representation φ, then Φ is the child's initial representation of S.

Park goes on to argue that "for the sentence 'Everyone didn't come', young children are predicted to learn interpretation [7a] before [7b] by virtue of the Semantic Subset Principle. This principle leads us to expect that pre-verbal negation is acquired before post-verbal negation in Korean." Park reasons that since pre-verbal negation allows for a subset of the interpretations available for post-verbal negation; by virtue of the SSP, children should acquire pre-verbal negation before post-verbal negation. And this is indeed what she found Korean children to do.

Although I have nothing to say about Park's findings, I believe that her account is problematic. In my eyes, the problem lies in Park's use of the SSP. The SSP, as formulated above states that if a sentence has two interpretations which are arranged in a subset-superset relation, learners are expected to initially choose the subset interpretation. In other words, the SSP evaluates alternative interpretations of the same sentence, it does not - and this is crucial - evaluate alternative interpretations of different sentences. Consequently, Korean sentences with pre-verbal negation and those with postverbal

negation cannot be in the same comparison set for purposes of the SSP, even if their interpretations are correctly arranged in a subset-superset relation. Therefore, one cannot infer that the SSP is responsible for the fact that children acquire one type of sentences (sentences with pre-verbal negation) before the other (sentences with postverbal negation).

### 4.3 O'Leary 1994

The study reported in O'Leary (1994) presents an investigation of children's knowledge of the semantics of so-called polarity sensitive items (Baker 1970, Ladusaw 1979, Linebarger 1980 and Progovac 1994 among others). The research question was to determine whether children adhere to the constraints prohibiting the appearance of *some* and *any* in certain types of environment. Specifically, *some* cannot occur in the scope of negation or a downward entailing determiner, under a narrow scope reading. Polarity sensitive *any*, on the other hand, is restricted to such environments. In other words, it cannot occur in upward entailing contexts.

Before we move on, let us briefly explain the notion of Upward and Downward entailment. Basically, an element is Upward entailing if it licenses inferences from subset to supersets. Conversely, an element is Downward entailing if it licenses entailment relations from supersets to subsets. For example, the determiner *every* is downward entailing on its first argument (the N it combines with). To see this, consider the following inference pattern:

Every woman is beautiful ⇒ Every French woman is beautiful
Where French women ⊇ women

Every is also upward entailing on its second argument (the VP which the sequence [Det N] combines with. To see this, consider the following inference pattern:

Every woman wears nice clothes ⇒ Every woman wears clothes
Where nice clothes ⊇ clothes

Having clarified the notion of Upward and Downward entailment, we can now return to O'Leary and Crain's study. The experimental procedure was a Truth Value Judgment Task (see section 4.2), with an elicitation component. The subjects were 11 children between the ages of 4;4 and 5;4. Each child was presented with test sentence of four kinds. These sentences contained the negative polarity items *any* and *anything* and the positive polarity items *some* and *something*. However, these sentences produced by the puppet were inaccurate descriptions of the stories they followed. Children were therefore expected to reject the puppet's statements. O'Leary proceeded with the elicitation component of the task whenever children correctly rejected the puppet's statements. That is, they asked the children "what really happened". The descriptions provided by children were used in evaluating their knowledge of the constraints on polarity sensitive items.

The first target sentences, Type 1, contained the NPI *anything*. By hypothesis, children should have corrected the puppet by producing an affirmative sentence. If so, their productions should not contain an NPI, but could contain a PPI.

Type 1
Puppet: None of the Ninja Turtles got anything from Santa.
Child: *No, this one found something from Santa.*

Sentences of Type 2 contained the NPI, *anything* , and the focus operator *only*. In the stories that preceded these sentences, every character performed the action mentioned in the sentence. By hypothesis, therefore, children's responses to the puppet's incorrect description of the story should have contained *all* or *every*, which are Upward Entailing on their second argument. If so, the NPI *anything* that appeared in the puppet's sentences should not be repeated by children. Rather, children were expected to replace the NPI *anything* with the PPI *something*, whenever their response included a Upward Entailing determiner.

Type 2
Puppet: Only one of the reindeer found anything to eat.
Child: *No, every reindeer found something to eat.*

Sentences of type 3, contained the PPI *something*. In the stories that preceded these sentences, not all the characters performed the action mentioned by the puppet. By hypothesis, children should correct the puppet by producing a sentence containing negation or a downward entailing determiner, such as *none*, for example. If so, their productions may contain an NPI, but not a PPI, as illustrated below.

Type 3
Puppet: Every dinosaur found something to write with.
Child: *No, this one didn't find anything to write with.*

Sentences of type 4, contained the PPI *some* and the focus operator *only*. In the stories that preceded these sentences, none of the characters performed the action mentioned by the puppet. By hypothesis, therefore, children's responses to the puppet's incorrect description of the story should contain a downward entailing determiner like *none* or *no-one*. If so, children were expected to replace the PPI *some* by its NPI equivalent, *any*, whenever their response included a downward entailing determiner.

Type 4
Puppet: Only one of the friends had some presents for Gonzo.
Child: *No, none of the friends had anything for Gonzo.*

Here are the main findings of O'Leary study. In response to sentences of Type 1, children produced 44 affirmative sentences, none of which contained an NPI. Twenty-two of the children's sentences contained a PPI and 22 were 'other' responses. In response to Type 2 sentences, children produced 44 sentences. Thirty-two of them had an Upward Entailing determiner, usually *all*. As predicted, the vast majority of these sentences, 31/32, contained a PPI, e.g., *something*. Only one sentence by one child contained an NPI. The 12 remaining sentences were 'other' responses. For sentences of type 3, children produced 29 negative sentences and containing an NPI, 7 negative sentences and a PPI and 11 other responses. For sentences of type 4, children produced 18 sentences with a downward entailing determiner and an NPI, 10 sentences with a downward entailing determiner and a PPI and 16 other responses. Below are a some examples in which children produced PPI *some* in contexts where it is not expected to occur:

(81) a. He didn't get something to eat. (C.E-K. 4;6)
b. Well, they didn't get some food. (E.E. 4;7)
c. None people had some presents. (E.P. 4;9)
d. So he didn't get some money. (E.G. 4;10)

Summarizing the results, O'Leary concludes that children are aware of the distributional constraints on NPIs but that they may not be aware of the distributional restrictions on PPIs.

## 6. Summary

In this chapter, we observed that negation and QNPs can interact semantically and display what appears to be scope ambiguity. This is true in English but also in Chinese, a language where scope ambiguity is otherwise more restricted. Specifically, we considered how subject and object QNPs interact with sentential negation. We determined three interpretative options for object QNPs and two for subject QNPs. Object QNPs may either be obligatorily interpreted in the scope of negation (*every N*) or outside the scope of negation (*some N*) or they may display ambiguity and allow both options (*two N*). Quantified subjects may either be interpreted outside the scope of sentential negation (*some N*) or display ambiguity and, in addition to the first option, allow a narrow scope interpretation (*every N*).

We examined the properties of QNP-Neg interaction and came to the conclusion that this phenomenon cannot be reduced to quantifier scope ambiguity, i.e. QNP-QNP interaction. The essential observation is that there exists two classes of QNPs: those whose scope properties are determined grammatically, i.e. via movement operations, type

II QNPs; and those whose scope properties are not determined grammatically, that is not via movement operations but rather via separate interpretive mechanisms. These are type I QNPs. The generalization is that the interpretation of type II QNPs with respect to negation is fixed by their overt syntactic position[9]. Type I QNPs on the other have the characteristic property of always exhibiting existential wide scope irrespective of their logical environment. The phenomenon of QNP-Neg interaction is therefore essentially a consequence of the special status of type I QNPs. The acquisition of quantifier-negation interaction represents an interesting problem of generalization for the learner, one which is likely to shed some light on the design and properties of UG. My goal in the next chapter is to investigate how children acquire knowledge of quantifier-negation interaction through a series of experiments designed to systematically assess their comprehension of sentences containing sentential negation and QNPs.

[9] With the exception of *every* in subject position of a negated clause.

# CHAPTER II

## Experimental Investigations

This chapter presents a series of experiments designed to assess children's interpretation of sentences containing negation and QNPs. We focus on how children interpret QNPs in argument position of negated clauses. In chapter I, we distinguished two interpretive options available for quantified subjects and three for quantified objects. These options are repeated in (1) and (2).

(1) QNP Neg VP (Subject case)
a. QNP > Neg
b. QNP > Neg / Neg > QNP

(2) DP Neg V QNP (Object case)
a. Neg > QNP
b. QNP > Neg
c. Neg > QNP / QNP > Neg

In the subject case, the first option, (1a), fixes the interpretation of the QNP outside the scope of negation. The second option, (1b), grants the QNP more interpretive freedom by additionally allowing negation to take scope over it, hence giving rise to ambiguity. In the object case, a QNP may either be interpreted in the scope of negation as in (2a), or outside the scope of negation as in (2b) or finally, both scope options may be available, as in (2c). The purpose of the experiments that follow is to systematically investigate children's knowledge of each of the interpretative options in (1) and (2) on the basis of

their comprehension of sentences representing each option. These sentences are given in (3) and they represent each of the options in (1) and (2), respectively.

(3) a. Some girls won't ride on the merry-go-round.
b. Every horse didn't jump over the fence.
c. The Smurf didn't buy every orange.
d. The detective didn't find someone/some guys.
e. Cookie Monster didn't eat two slices of pizza.

This chapter is organized as follows: section 1 provides some background information and discusses general features of the experiments. In section 2, we move to a detailed description of the experiments, including the results obtained. In section 3, we take a closer look at the design of the experiments and show step by step how the various methodological criteria discussed in chapter I are satisfied. Finally, in section 4, we present a summary of the main findings and spell out the questions they raise.

## 1. General facts

The experiments presented in this chapter are based on the Truth Value Judgment Task methodology of Crain and McKee (1985) and Crain and Thornton (in press), as discussed in chapter I. The subjects were 3 to 7 year-old English-speaking children at the Center for Young Children (CYC), a day care center at the University of Maryland at College Park. In each experiment, the child subjects were presented with 4 test trials and 3 control trials which were used between two test trials. These were used to control for the subjects' ability to respond 'YES' or 'NO' when appropriate. Whenever a child accepted the puppet's statement and therefore answered 'YES' on a test trial, the

following control trial was designed to evoke a 'NO' on their part. Conversely, whenever the child rejected the puppet's statement and answered 'NO' on the test trial, the control trial was deigned to evoke a 'YES'. This feature was incorporated to ensure that the children wouldn't get under the impression that the puppet always got things right or that he always got things wrong. The stories used in the control trials were of equal complexity as those used in the test trials. That is, the number and the nature of the events as well as the number of characters used in each type of stories were held constant in as much as possible. This precaution was taken so that children's 'YES' and 'NO' responses on test trials and on control trials could be legitimately compared.

At the end of each story, the puppet told the child what he thought happened, using a test sentence as a description of the story. When a subject rejected the test sentence, she was always encouraged to tell the puppet "what really happened in the story". This provides the experimenter with valuable information regarding the child's understanding of the stories. A child was considered to have the 'adult' interpretation of the sentence under investigation when she correctly accepted or rejected the puppet's statements on at least three of the four test trials. Conversely, she was considered to differ from adults when she incorrectly accepted or rejected the puppet's statement on at least three of the four test trials. Whenever we found that children's responses appeared to differ from the one adults would give, we tested a group of adult speakers of English on the basis of a videotaped version of the stories we used with the children. The statistical procedure that we used to compare the proportions of a certain type of responses given by adults and children is the *arcsin transformation*, which is written as *arcsin(sqrt(p))* where *p* is the

proportion observed and *arcsin* is the inverse sine (in radians). This transformation stabilizes variances of data collected as proportions, where on the original scale, the variances are much smaller near the extremes of 0 and 1. This transformation also normalizes the data, so that one can compare it to the standard normal distribution.

Prior to testing, the children were familiarized with the TVJT both in groups and individually. Usually, this was done by becoming part of their daily activities. That is, in addition to being able to do other activities, children could also come to our 'puppet games' where they were introduced to Kermit the Frog and to our stories. We also ask them to tell us if they thought Kermit was saying the right thing or the wrong thing at the end of the stories. In a nutshell, children were getting accustomed to the TVJT. Next, the experimenters visited the different classrooms to show children more 'puppet games'. This step was taken to make sure that the children who may have missed our 'puppet games' earlier, had a chance to find out what they were about. After all the children had been familiarized with the TVJT in groups, we familiarized them individually. Finally, after piloting each batch of stories with a few children, to make sure that they were running smoothly, we started to collect the data for our experiments. For the sake of exposition, the experiments are not presented in chronological order. Chronologically, experiment 3 was done first, then experiment 2, experiment 1, experiment 5 and experiment 4. Besides, the same subjects were used in experiment 1, 4 and 5.

## 2. The experiments

In this section, we turn to a description of the experiments and the results that were obtained. Each experiment is described on the basis of one representative test story. All the test stories have the same format. The protocols of the other test stories as well as individual data are presented in appendix 1 through 5. We begin our investigation by testing children's interpretation of *every*, first in object position (section 2.1) then in subject position (section 2.2). Next we turn to *some* in object position (section 2.3) and in subject position (section 2.4). Finally, we consider children's interpretation of *two* in object position (section 2.5); thus arriving at a complete coverage of the paradigm in (3). In each case, we consider our specific research questions in light of the generalization problem discussed in chapter I and we spell out what learnability considerations lead us to expect. In certain cases, findings from previous research also lead us to specific expectations. Finally, section 2.6 summarizes the main findings and raises the questions that will be addressed in Chapter III and IV.

### 2.1 Experiment 1: *Every* in object position

In chapter I we observed that a universally quantified NP in object position only gives rise to one interpretation with respect to sentential negation whereas in subject position, it gives rise to two interpretations. This asymmetry is illustrated in (4) and (5).

(4) The Smurf didn't buy every orange
a. $\neg\forall(x)$ [orange(x) $\rightarrow$ The Smurf bought(x)]
b. * $\forall(x)$ [orange(x) $\rightarrow$ $\neg$ The Smurf bought(x)]

(5) Every horse didn't jump over the fence.
a. $\forall(x)$ [horse(x) $\rightarrow$ $\neg$ Jump over the fence(x)]
b. $\neg\forall(x)$ [horse(x) $\rightarrow$ Jump over the fence(x)]

This provides a good illustration of the overgeneralization problem for language acquisition. Suppose that children were to generalize the behavior of *every* on the basis of the subject case, (5) where two interpretive options are available. If so, they would overgeneralize with respect to the object case where only one interpretation is available. In other words, they would hypothesize an interpretation which is not attested in the adult grammar of their target language. This, in turn, would create a learnability problem. It is reasonable to expect then, on learnability grounds, that children should be conservative and not generalize on the basis of the subject case. This leads us to expect that in the object case, children should not hypothesize an interpretation which is not available in the adult grammar.

In order to test this prediction, we turn to an experiment whose purpose was to assess children interpretation of sentences like (4). The research question was to determine whether children would correctly interpret *every* in the scope of negation, as in (4a) or whether they would incorrectly allow for an interpretation where *every* takes scope over negation, as in (4b). The research strategy was to place children in an experimental situation where both the narrow scope and the wide scope reading of (4) were available, the former being true in the context of the story while the latter was false. If children have

access to the narrow scope reading of (4), they should answer 'YES' to a statement of the form in (4) in this situation. On the other hand, if children interpret *every* outside the scope of negation, they should reject a statement of the form in (4). The subjects were 20 children ranging in age between 3;11 and 6;0 (mean 4;10). The protocols for the stories typically involved a main character and two sets of three objects with respect to which the main character was supposed to perform an action such as eating, buying, cleaning etc. In a first round of activity, the character considers performing the action with respect to one set of objects but upon further reflection, decides not to do so. He then performs the action with respect to one of the objects of the second set but not the two others. In the end, therefore, a sentence of the form "the character didn't V every Y " is true.

In one story for example, a Smurf decides to go to the grocery store to buy some apples. He examines the three apples in the store to see if he can buy them. The first two have big bruises and the third one has a worm inside. The Smurf therefore decides that he is not going to buy any apples. Instead, he considers buying some oranges. There are three oranges in the store and the Smurf starts examining them. The first one is big and firm and he decides to buy it. The second one is not firm enough and the third one is too small so the Smurf decides not to buy them. Kermit's description of the story is *The Smurf didn't buy every orange*. In this situation, it is felicitous to say 'YES', because the negation of the sentence was under consideration. That is, if the outcome had been different, it would not have been true that the Smurf didn't buy every orange, he could also not have bought the first orange and in this case, not buy any orange. The context of the story also falsified the wide scope reading of *every* with respect to negation; i.e. the

interpretation where it is taken to mean that none of the oranges were bought. Indeed, it is not true that the Smurf didn't buy any oranges as he actually bought one. Therefore, a child who could only assign the wide scope interpretation should have responded 'NO' to Kermit's statement that the Smurf didn't buy every orange.

**Protocol** Characters and props: A Smurf, three apples and three oranges
('Exp' stands for the experimenter)

Exp: In this story, a Smurf decides to go to the grocery store to buy some fruit.
< The Smurf is in the store and he I trying to decide which fruit he is going to buy>

Smurf: How about some apples ? These apples look nice. Let me see.
< There are three apples and the Smurf starts examining them >
Smurf:Oh, no ! This one has a big bruise ! I can't buy an apple with a bruise. How about this one here. < The Smurf examines the second apple >. This one looks fine but, wait a minute, this is a rotten spot ! I can't buy an apple with a rotten spot ! < Finally the Smurf examines the third apple > There is no bruise on this one, no rotten spot ... but, what is this ? A worm !! This apple has a worm inside ! Well I guess I/m not going to buy any apples today.
< The Smurf thinks that he may have more luck with oranges. Besides, oranges are healthy and he can make orange juice with them. There are three oranges in the store and the Smurf starts examining them >

Smurf: This orange looks great ! It is big, round and firm. I'll get it. <The Smurf then examine the second orange > This one is not as nice as the first one. Besides it's not very firm. I'm not going to buy it. <The Smurf then looks at the third orange >That one is way too small. I need big oranges if I want to make orange juice. I'm not going to buy it either. < In the end, the Smurf goes to the register and buys one orange>

Puppet: That was a story about a Smurf at the grocery store and I know what happened: "The Smurf didn't buy every orange"

Child: Yes, you're right. He bought this one but he didn't buy the others.
OR
Child: No, you're wrong. He did buy one orange.

Here are the main findings. Children accepted the puppet statement, i.e. the *not every* reading 85 % of the time (68/80). Specifically, out of 20 children, 18 accepted the puppet's statements, that is the correct *not every* interpretation 94 % of the time (68/72). Two children rejected this interpretation on all the trials. We conclude that children correctly interpret *every* with respect to negation when it occurs in object position. For individual data and the protocols of the three other test stories used in this experiment, see appendix 1.

## 2.2 Experiment 2: *Every* in subject position

Summarizing our discussion so far, we observed that the interpretation of a universally quantified NP varies according to its syntactic position. In the subject case, two interpretations are available while only one is available in the object case. Furthermore we discovered that in the object case, children correctly interpret *every* in the scope of negation. We now turn to the other side of the problem and investigate whether children are aware that in the subject case, an extra interpretation is available whereby negation can take scope over *every*. In this experiment, the research question was to determine whether children are aware of the fact that the sentence in (6) allows for the interpretation in (6b) where negation takes scope over the phrase *every horse*.

(6) Every horse didn't jump over the fence.
a. $\forall(x)$ [horse(x) $\rightarrow$ $\neg$ Jump over the fence(x)]
b. $\neg\forall(x)$ [horse(x) $\rightarrow$ Jump over the fence(x)]

The research strategy was to place children in an experimental situation where both the narrow scope reading, (6b) and the wide scope reading of *every horse* (6a), were available; the former being true in the context of the story while the latter was false. If children can correctly interpret (6) as meaning (6a); that is, if they can correctly interpret the quantified subject in the scope of negation, they should accept a statement like (6) in this situation. On the other hand, if children can only interpret (6) as (6a); that is, if they can only interpret the quantified subject outside the scope of negation, they should reject a statement like (6). The participants were 20 children ranging in age between 4;0 and 7;3 (mean 5;11). The protocol for the stories typically involved three characters and an action to be performed with respect to different objects. In a first round of activity, all three characters would fail to perform the action with respect to the first object. In a second round of activity, two of the characters, but not the third one would perform the action with respect to the second object. In the end, therefore, a sentence of the type *Every character didn't do X* is true of the action performed with respect to the second object.

In one story, for example, three horses decide to jump over various obstacles to test their skills. First they consider jumping over a barn. They start running towards it but as they get closer, they realize that the barn is to tall for them to jump over. The horses then decide to jump over a fence which would be easier than jumping over the barn. The first and the second horse jump over the fence. The third horse considers jumping but remembers that he hurt his leg the day before and decides that it should rest. The third horse, therefore, decides not to jump over the fence. Kermit's description of the story is *Every horse didn't jump over the fence*. In this situation, it is felicitous to say 'YES',

since, although it was their initial intention, not all of the horses end up jumping over the fence. Therefore, a child who could assign the narrow scope interpretation should respond 'YES' to Kermit's statement that every horse didn't jump over the fence. The context of the story also falsified the wide scope reading of *every* with respect to negation since it is not true that none of the horses jumped over the fence; two of them actually did. Therefore, a child who could only assign the wide scope interpretation should respond 'NO' to Kermit's statement.

| | |
|---|---|
| **Protocol** | Characters and props :3 horses; Horse 1 (H1), Horse 2 (H2), Horse 3 (H3); a fence and a barn ('Exp' stands for the experimenter) |
| Exp: | In this story, three horses are talking about how good they are at jumping and they decide to practice by jumper over a barn and a fence. |
| H1: | Let's start practicing by jumping over the barn there ! |
| H2: | Great, I'm sure we can do it ! |
| H3: | Me too ! <The horses start galloping towards the barn but as they get closer they realize that it is much too high for them> |
| H1: | Wait a minute. This barn is much taller than I thought ! |
| H2: | You're right, it much to high ! |
| H3: | I think we'd better not jump, we could end up hurting ourselves. |
| H1: | How about we jump over that fence instead, it looks less tall. |
| H2: | You're right, let's do it. |
| H3: | That's a good idea !<The horses line up in front of the fence. H1 goes first and does a great jump over the fence. H2 follows and also does a nice jump over the fence> |
| H3: | Well, I guess it's my turn now. I don't know though. I hurt my leg the other day and I am not sure it's feeling strong enough to jump over that fence. Maybe I'd better not do it. <H3 ends up not jumping over the fence> |
| Puppet: | That was a great story about three horses trying to jump over things and I know what happened: *Every horse didn't jump over the fence.* |
| Child: | You're wrong these two did ! |
| OR | |
| Child: | You're right. Two did but not the third one. |

Here are the main findings. Children rejected the puppet's statements, that is the narrow scope interpretation of *Every N* 92.5 % of the time (74/80). Specifically, 18 children rejected the puppet's statement, that is the interpretation where negation takes scope over *every*, 100 % of the time and two children aged 6;11 and 7;3 accepted the puppet's statement 75 % of the time. When asked to explain "what really happened in the story" all the children who rejected the puppet's statement invoked the wide scope interpretation. That is, in the case of the horse story for example, they said that the puppet was wrong because two horses did jump over the fence. A group of 20 native speakers of English (University of Maryland undergraduates) was tested on the basis of a videotaped version of the stories used with the children. All of them accepted the puppet's statements, that is the interpretation where negation takes scope over *every*, 100 % of the time. We compared the proportions of YES responses given by children (6.5 %) and adults (100%) and found that the difference was significant ($z = 8.34$, $p < .05$). Our conclusion is that until the age of about 7, the children tested do not know that negation can take scope over a universally quantified expression in subject position. For individual data and the protocols of the three other test stories, see appendix 2.

### 2.3 Experiment 3: S*ome* in object position

On the basis of the Brown corpus, Bellugi (1967) originally observed that children had a tendency to use *some* in the scope of negation. Van der Wal (1996) found that this phenomenon was recurrent in the speech of other children in different corpora (Bloom, Clark, Kuczaj, MacWhinney, Sachs, Snow and Suppes, available in the CHILDES

database, MacWhinney 1995). O'Leary (1994) also observed that children had a tendency to produce *some* in the scope of negation, in contexts where *any* would have been expected (see chapter I for discussion). In this experiment, we investigate whether this phenomenon extends to children's comprehension as well. Specifically, our research question is to determine whether children would correctly interpret the phrase *some guys/someone* outside the scope of negation in the example in (7). The other possibility is that children may incorrectly interpret *some guys / someone* in the scope of negation. Milsark (1974) distinguished two versions of *some*: a stressed version, rendering 'some' where *some* is used quantificationally and an unstressed version, rendering 'sm' where *some* is used as a cardinality expression. This view is discussed more at length in chapter IV. For the purposes of this experiment, we used the stressed form of *some*, 'some'.

(7) The detective didn't find some guys/someone
a. $\exists(x)$ Guy(x) & $\neg$ The detective found(x)
b. * $\neg \exists(x)$ Guy(x) & The detective found(x)

The research strategy, based on the methodology of the Truth Value Judgment Task, was to place children in an experimental situation where both the wide scope and the narrow scope readings of the example in (7) were available, the former being true in the context of the story while the latter was false. In this situation, a child who can correctly assign wide scope to the phrase *some guys / someone* should accept the statement in (7) as a description of the story. On the other hand, if children can only interpret the phrase *some guy / someone* in the scope of negation, they should reject the statement in (7). The subjects were 30 children ranging in age between 3;10 and 6;6 (mean 5;1). Two versions of the stories were constructed. In one version, the puppet's statement contained the

words *someone / something*. In the other version, the statements contained the sequence *some N*. The 30 children were divided into two groups: the first group, G1, composed of 18 children was tested on the basis of the *someone/something* stories. The second group, G2, composed of 12 children was tested on the basis of the *some N* stories.

The protocols for the stories involved a set of characters and a specific action to be performed by a main character and accomplished with respect to some object(s) or other character(s). In a first round of activity, the main character would fail to accomplish the action altogether. In a second round of activity, he would accomplish the action with respect to some object(s) or character(s) but crucially fail to accomplish it for a specific object(s) or character(s). In the end, therefore, a sentence of the form *The character didn't V someone/something/some N* is true. In one story, for example, a detective and his two friends decide to play 'hide and seek'. While the detective is not watching, one of the characters hides behind a tree and the other one hides under the seat of a covered wagon. After inspecting the tree and the covered wagon without success, the detective reflects that his friends are really well hidden. He nonetheless refuses to give up and inspects the hiding places again, this time more carefully. The detective successfully spots the character hidden behind the tree but misses the one hidden inside the covered wagon again. Kermit's description of the story is 'The detective didn't find someone'. In this situation, it is felicitous to say 'YES', i.e. to assign wide scope to *someone*, because the negation of the sentence was under consideration. That is, if the outcome had been different, it would not have been true that the detective didn't find someone; the detective could also have missed the character hidden behind the tree and in this case, not find

anyone. The context of the story also falsified the narrow scope reading of *someone*; i.e. the interpretation where it is taken to mean *anyone*. Indeed, it is not true that the detective didn't find anyone as he found the character hiding behind the tree. Therefore, a child who could assign only the narrow scope interpretation should have responded 'NO' to Kermit's statement that the detective didn't find someone. Notice also that the last event mentioned in the experiment is the detective failing to find the character hiding under the seat of the covered wagon. The wide scope interpretation should, therefore, be readily available. Here's the protocol use for this story.

| | |
|---|---|
| **Protocol** | Characters and props: a detective, two friends, a tree, and a covered wagon ('Exp' stands for the experimenter) |
| Exp: | This story is about a detective and two of his friends who decide to play hide and seek. |
| Friends: | Hey detective, we heard about your reputation. They say you're the best detective in town. So how about playing hide and go seek with us to test your skills ? |
| Detective: | Well, that not really the kind of work that I usually do but yes, let's give it a try. <The detective covers his eyes and starts counting to a hundred while his friends go hide. One guy hides behind the tree and the other one hides under the seat of the covered wagon where he thinks the detective will never find him > |
| Detective: | 98, 99, 100 ! Ready or not, here I come ! <The detective starts walking around, and inspects the tree and the covered wagon > |
| Detective: | Where did everybody go ? There must have found great hiding places. I'm going to have to use my special detective skills to find them ! < The detective starts over again, inspecting the various places more carefully. He begins with the tree and this time decides to look behind it.> |
| Detective: | I found you, you were hiding behind the tree !! |
| Friend: | Good job detective ! < The detective then proceeds to examine the covered wagon; looks behind it, under it, on top of it but fails to find the character hiding under the seat > |
| Detective: | I can't find the other guy, he must be really well hidden ... |

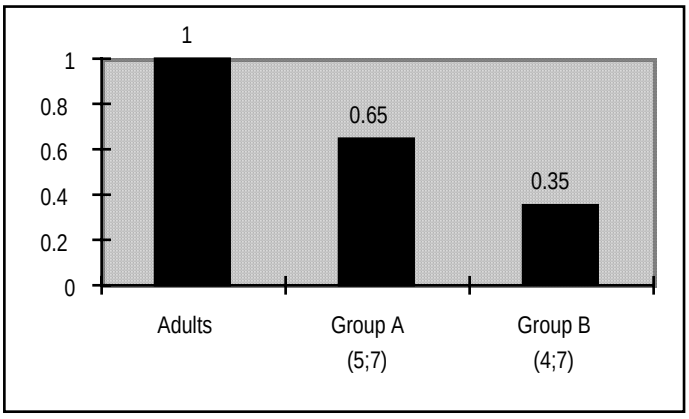
Puppet: That was a great story about a detective and his friends who were playing hide and seek and I know what happened: The detective didn't find someone.

Child: Yes, you're right. He didn't find the guy hiding in the covered wagon.
OR
Child: No, you're wrong. He found the guys who was hiding behind the tree.

Here are the main findings. Children rejected the puppet statement 50 % of the time (60/120). Specifically, out of 30 children, 14 rejected the puppet's statements, 87.5 % of the time (49/56). When asked 'what really happened in the story', all these children explained their rejection of Kermit's statement by invoking the narrow scope interpretation. In other words, in the case of the detective story, they said that the puppet was wrong because the detective found someone: the character hidden behind the tree. 13 children accepted the puppet's statements 90 % of the time (47/52) and 3 children accepted the puppet's statement on 2 trials and rejected it on the 2 others. The split observed among the 30 children was also observed within the two subgroups, G1 and G2. Specifically, out of 18 children in G1 (mean 5;2), 9 rejected the puppet's statements 86 % of the time (31/36). 7 children accepted the puppet's statements 89 % of the time (25/28) and 2 children accepted the puppet's statement on 2 trials and rejected it on the two others. Out of 12 children in G2 (mean 5;0), 5 rejected the puppet's statements 90 % of the time (18/20). 6 children accepted the puppet's statements 91 % of the time (22/24) and 1 child accepted the puppet's statements on 2 trials and rejected them on the 2 others. A group of 20 native speakers of English (University of Maryland undergraduates) was tested on the basis of a videotaped version of the stories the children watched. All of them accepted the puppet's statements 100 % of the time.

We compared the proportions of YES responses given by adults (100%) and children (50%) and found that the difference was significant ($z = 5.46$, $p < .05$). In order to determine whether age could be a factor causing the split among children (i.e. those who consistently rejected the puppet's statements and those who consistently accepted them), we divided the 30 children into two groups of 15, according to age: in the first group, GA the ages ranged between 6;6 and 5;2 (mean 5;7), and in GB, the ages ranged between 5;2 and 3;10 (mean 4;7). Children in GA accepted the puppet's statements 65 % of the time (39/60) and children in GB only 35 % of the time (21/60). We compared the proportions of YES responses among these two groups of children and found that the difference was significant ($z = 1.64$ ; $p < .05$). This result suggests that the split among children could be due to age. For individual data and the protocols of the three other test stories used in this experiment, see appendix 3.

**Chart 1: Proportions of YES responses by age group**



## 2.4 Experiment 4: *Some* in subject position

In this experiment, we turn to children's interpretation of *some* in subject position of a negated clause. We observed in experiment 3 that younger children have a tendency to misinterpret *some* with respect to negation when it occurs in object position of a negated clause. The purpose of this experiment was to determine whether this phenomenon extends to the subject position. Specifically, the research question was to determine whether children would correctly interpret *Some girls* in (8) outside the scope of negation or whether they would incorrectly assign an interpretation where negation takes scope over *Some girls*. Note that since children were unable to assign a narrow scope interpretation when this option is available in the adult grammar, i.e. in the case of universally quantified subjects, we do not expect them to be able to do so in this case either. Here too, we used the stressed form of *some*.

(8) Some girls won't ride on the merry-go-round
a. $\exists(x)$ [Girls (x) $\wedge$ $\neg$ will ride on the merry-go-round (x)]
b. * $\neg$ $\exists(x)$ [Girls (x) $\wedge$ will ride on the merry-go-round (x)]

The research strategy was to place children in an experimental situation where both the narrow scope reading and the wide scope reading were available, the former being false in the context of the story while the latter was true. If children were to correctly interpret *Some girls* outside the scope of negation (wide scope) they should therefore accept a statement of the form in (8) in this situation. On the other hand, if children were to incorrectly interpret *Some girls* in the scope of negation (narrow scope) they should reject a statement of the form in (8).

In our experiments so far, we have been using the TVJT in the *descriptive* mode. What this means is that the puppet's statement at the end of each of the stories was used as a description of what happened in the stories. In this experiment, for reasons that we explain now, we used the TVJT in the *predictive* mode. The TVJT is used in the predictive mode when instead of waiting until the end of the story to describe it, the puppet makes a prediction about what he thinks will happen in the story, before the story is told. Apart from this, the rest of the task remains the same. At the end of the story we simply ask the child to indicate whether the puppet's prediction, or 'guess' was correct. In this case, our reason for using the TVJT in the predictive mode is driven by methodological considerations, namely the need to maximally satisfy the condition of Plausible Dissent (see chapter I) as well as stack the cards against the experimental hypothesis.

In this case, we expect children to correctly interpret *some girls* outside the scope of negation as in (8a). However, the TVJT demands that the other interpretation, (8b) also be felicitous. Suppose now that we were to use the TVJT in the descriptive mode. At the end of the story then, the puppet would say to the child: "I know what happened: some girls didn't ride on the merry-go-round". However, saying that *some girls didn't ride* carries an implicature, namely that the other girls did ride. This has the effect of rendering the interpretation where no girls rode infelicitous and therefore biasing the child's interpretation in favor of the experimental hypothesis. To see this, imagine that in the story, none of the girl rode on the merry-go-round. In this case, although it is strictly speaking true that some girls didn't ride (since none of them did) it is nonetheless

infelicitous to describe the story by saying that some of the girls didn't ride since this carries the implicature that some did. The reason we used the TVJT in the predictive mode in this case should now be evident. Our purpose was to use a context which would suspend the implicature that we mentioned. In the context of a prediction or a bet, if the puppet says: " I think that some girls won't ride on the merry-go-round", both outcomes, i.e. the wide scope and the narrow scope interpretations are felicitous. In other words, the puppet would win his bet if none of the girls end up riding or if some end up riding but not the others. Using the predictive mode renders both interpretations felicitous and therefore suspends the bias towards the experimental hypothesis which arises in the descriptive mode. For a more detailed discussion of the predictive mode use of the TVJT, see Chierchia et al (1998).

The participants in this experiment were the same subjects we used in experiment 1. They were 20 English speaking children ranging in age between 4;0 and 6;2 (mean 4;11). The protocol for the stories typically involved three characters and a specific action to be performed. In a first round of activity, all the characters fail to perform the action with respect to a specific object or character. In a second round of activity, only one of the three characters performs the action with respect to a different object or character. In one story for example, three girls decide to go out to the playground. They first consider playing in the sandbox but since it rained and it is muddy, they look for something else to do. Next they consider riding on the merry-go-round. One of the girls gets on it and starts spinning but the two others decide that they won't. One says that she just had lunch and spinning around could upset her stomach and the other says that she could get a headache

if she goes too fast. Kermit's prediction was 'Some girls won't ride on the merry-go-round'. In this situation, it is felicitous to say 'YES', because the negation of the sentence was under consideration. That is, if the outcome had been different, it would not have been true that some girls didn't ride on the merry-go-round; they could have all decided that they wanted to ride. Therefore, a child who could assign the wide scope interpretation should have answered 'YES' to Kermit's prediction. The context of the story also falsified the narrow scope reading; i.e. the interpretation where *Some girls won't ride on the merry-go-round* is taken to mean that none of the girls will ride on the merry-go-round. Indeed, it is not true that none of the girls rode on the merry-go-round since one of them actually did. Therefore, a child who could only assign the narrow scope interpretation should say 'NO' to Kermit's prediction.

| | |
|---|---|
| **Protocol** | Characters and props: three girls, a sand box, a merry-go-round and a seesaw ('Exp' stands for the experimenter) |
| Exp: | This is a story about three girls who have inside all morning and decide to go play in the playground. There's a sand box, a merry-go-round and a seesaw. |
| Puppet: | I know what will happen: Some girls won't ride on the merry-go-round |
| G1: | Look, a sand box ! Let's go play in the sand box ! |
| G2: | Great ! |
| G3: | Good idea ! |
| G2: | But wait. Look, it was raining this morning and the sand is all wet and it turned to mud. We'll get really dirty if we play in the sandbox. |
| G1: | You're right, we don't want to get our nice clothes full of mud. |
| G3: | Fine. Let's look for something else to play with. |
| G2: | How about the merry-go-round, I love merry-go-rounds ! |
| | < The three girls approach the merry-go-round. G2 get on it and start spinning around > |
| G1: | You know, I like merry-go-rounds but I just had lunch and I'm afraid that riding it will give me an upset stomach. |

G3: I like merry-go-rounds too, but whenever I start spinning around, I get very dizzy. So, I don't think I'm going to ride it either.

Puppet: Was I right or wrong ?

Child: You were right, these two girls didn't ride on the merry-go-round.
OR
Child: You were wrong, this girl did ride on the merry-go-round.

Here are the main findings. All the 20 children accepted the puppet's statements 100 % of the time. We conclude that children correctly interpret phrases like *Some N* in (8) outside the scope of negation. For individual data and the protocols of the three other test stories used in this experiment, see appendix 4.

## 2.5 Experiment 5: *Two* in object position

Finally, we turn to children's interpretation of *two N* in object position, where two interpretations are available in the adult grammar. Here we have reasons to believe that children will not initially hypothesize that a QNP headed by *two* in objet position of a negated clause gives rise to two interpretations. These reasons are based on the observation that in a similar case, i.e. where two interpretations are available in the adult grammar, children appear to be initially restricted to one of the two options (see experiment 2). This again can be seen to follow from learnability considerations. Initially hypothesizing ambiguity comports an inherent learnability risk just in case one of the interpretations hypothesized turns out not to be available in the target grammar.

In this experiment, the research question was to determine whether children are aware of the fact that in addition to the interpretation of (9) where negation takes scope over the phrase *two slices of pizza,* (9a) (narrow scope), there exists another interpretation where *two slices of pizza* can take scope over negation, (9b) (wide scope).

(9) Cookie monster didn't eat two slices of pizza
a. $\neg \exists$(two(x)) Slice of pizza(x) & Cookie Monster ate(x)
b. $\exists$(two(x)) Slice of pizza(x) & $\neg$ Cookie Monster ate(x)

The research strategy was to place children in an experimental situation where both the narrow scope and the wide scope reading of the sentence in (9) were available, the former being false in the context of the story while the latter was true. If children have access to the wide scope reading of (9) they should therefore accept a statement of the form in (9) in this situation. On the other hand if children only have access to the narrow scope interpretation, they should reject a statement like (9). The participants in this experiment were the same subjects we used in experiment 1 and 4. They were 20 English speaking children ranging in age between 3;11 and 6;1 (mean 4;10).The protocols for the stories typically involved one main character and an action to be performed with respect to four objects or other characters. The main character would successfully perform the action with respect to two of the objects or characters but crucially, he would fail to perform the action with respect to the two other objects or characters. In the end, therefore, a sentence of the form *The character didn't V two N* is true. Finally, we made sure that the children tested knew how to count at least up to two. In order to do this, we had each child count the number of props used in the story.

In one story, for example, Cookie Monster's friend the troll, who heard of Cookie Monster's reputation as a great eater, brings him four big slices of pizza and challenges him to eat them all. Cookie Monster takes up the challenge and starts eating the pizza. He eats the first two slices only to realize that he is too full to even touch the two others. Kermit's description of the story is *Cookie Monster didn't eat two slices of pizza*. In this situation, it is felicitous to say 'YES', because the negation of the sentence was under consideration. That is, if the outcome had been different, it would not have been true that Cookie Monster didn't eat two slices of pizza, he could also have eaten all the slices. The context of the story also falsified the narrow scope reading of *two slices of pizza* with respect to negation; i.e. the interpretation where it is taken to mean that two is not the number of slices of pizza that Cookie Monster ate. Indeed, it is not true that the number of slices of pizza that Cookie Monster ate is different from two: Cookie Monster actually ate exactly two slices. Therefore, a child who could only assign the narrow scope interpretation should have responded 'NO' to Kermit's statement that Cookie Monster didn't eat two slices of pizza.

| | |
|---|---|
| **Protocol** | Characters and props: Troll, Cookie Monster (CM), four slices of pizza ('Exp' stands for the experimenter) |
| Troll: | Hey Cookie Monster, I heard about your reputation. They say you're the best eater in town. Well, I was curious to know whether you could eat all the pizza I brought you. <The troll puts four huge slices of pizza on the table> |
| CM: | No problem, I'm the best ! Let me finish my cookie and I'll start the pizza. I'm sure I can eat everything ! |
| | < Cookie Monster finishes his cookies and eats a first slice of pizza> |
| CM: | These slices are bigger than I thought ! |
| | <Cookie Monster starts on the second slice of pizza and he barely manages to finish it> |
| CM: | I'm full ! I can't eat anymore. These slices are too big ! |

<Cookie Monster looks at the two remaining slices of pizza>

CM: I thought I could eat this slice and this one too ... But I'm full, I couldn't swallow another bite !

Puppet: That was a story about Cookie monster and some pizza and I know what happened: 'Cookie Monster didn't eat two slices of pizza'

Child: Yes, you're right ! He didn't eat these two.

OR

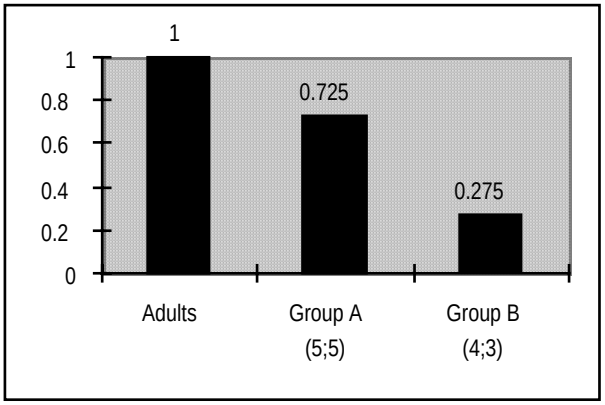
Child: No, you're wrong. He did eat two.

Here are the main findings. Children rejected the puppet's statements, that is the wide scope interpretation of phrases headed by *two* 50 % of the time (40/80). Specifically, out of 20 children 9 rejected the puppet's statements 94 % of the time. When asked "what really happened in the story", these children said that the puppet was wrong because Cookie Monster ate two slices of pizza. 10 children accepted the puppet's statements 90 % of the time. One child rejected the puppet's statements on the first two trials and accepted them on the two following trials[10]. We tested a group of 20 adult native speakers of English (University of Maryland Undergraduates) on the basis of a videotaped version of the stories that we used with the children. All the adults accepted the puppet's statements, that is the wide scope reading of phrases headed by *two* 100 % of the time.

[10] It is interesting to note here that after the child had rejected the puppet's statement on the second test story, one of the experimenters pointed to the two slices of pizza that Cookie Monster had not eaten and told the child: "You see, Cookie Monster didn't eat two slices of pizza. He didn't eat these two right here". On the next two trials, the child accepted the puppet's statement, that is the wide scope reading. It is quite possible, in my view, that the experimenter's

We compared the proportions of YES responses given by adults (100%) and children (50%) and found that the difference was significant ($z = 5$, $p < .05$). In order to determine whether age could be a factor causing the split among children (i.e. those who consistently rejected the puppet's statements and those who consistently accepted them), we divided the 20 children into two groups of 10, according to age: in the first group, GA the ages ranged between 6;1 and 4;8 (mean 5;5) and in GB, the ages ranged between 4;5 and 3;11 (mean 4;3). Children in GA accepted the puppet's statements 72.5 % of the time (29/40) and children in GB only 27.5 % of the time (11/40). We compared the proportions of YES responses in these two groups of children and found that the difference is significant ($z = 2.05$; $p < .05$). This result suggests that the split among children may be caused by age. For individual data and the protocols of the three other test stories used in this experiment, see appendix 5.

**Chart 2: Proportions of YES responses by age group**




explicit remark provided the child with positive evidence that the wide scope reading was indeed possible.

## 2.6 Determining the initial state

The general conclusion from this series of experiments is that English-speaking children around the age of 5 do not interpret sentences containing negation and QNPs the way adult speakers do. Specifically, children showed non-adult interpretations for sentences like (a) *Every horse didn't jump over the fence*, (b) *The detective didn't find someone* and (c) *Cookie Monster didn't eat two slices of pizza*. Basically, they failed to access the narrow scope interpretation of sentences like the one in (a) (i.e. not > every), they failed to access the wide scope interpretation of sentences like (c) and finally, they incorrectly assigned a narrow scope reading to sentences like (b). In fact, for sentences like (b) and (c) we observed a split among the children tested: the older ones (mean = 5;7 and 5;5 respectively) correctly accessed the relevant adult interpretations a higher percentage of the time than the younger ones (mean = 4;7 and 4;11 respectively). These results suggest that we may be dealing with a developmental phenomenon where children initially lack the relevant adult interpretations. These interpretations are acquired as the children grow older. I will therefore assume that the initial state is determined by the non-adult behavior of the younger children.

In the case of sentences like (a) *Every horse didn't jump over the fence*, we observed that 18 of the 20 children tested (age range = 4;0 to 7;3; mean = 5;11) rejected the narrow scope reading 100 % of the time and that two children aged 6;11 and 7;3 accepted the narrow scope reading 75 % of the time. Here, I take the initial state to be characterized by a failure to access the narrow scope interpretation of sentences like (a).

The cutting point in this case seems to happen at around 7 years of age which is later than in the two previous cases. Similarly, for sentences like (b) and (c), I take the initial state to be characterized by a failure to access the wide scope reading of phrases like *some N / someone* and *two N*. The fact that we observed a split among the same children (used in experiment 1, 3 and 5) regarding the interpretation of sentences like (c) *Cookie Monster didn't eat two slices of pizza* but not regarding the interpretation of sentences like (d) *The smurf didn't buy every orange* and (e) *Some girls won't ride on the merry-go-round* where they accessed the relevant adult interpretation indicates that the initial state in the case of (d) and (e), corresponds to the relevant adult knowledge. The initial state regarding the interpretation of sentences containing negation and QNPs is summarized below:

(a) Every horse didn't jump over the fence
initial = (every > not); lack (not >every)

(b) The detective didn't find someone
initial = (not > some); lack (some > not)

(c) Cookie Monster didn't eat two slices of pizza
initial = (not > two); lack (two > not)

(d) The smurf didn't buy every orange
initial = (not > every) = adult

(e) Some girls won't ride on the merry-go-round
initial = (some > not) = adult

## 3. A closer look at the experiments

In this section, we replay the experiments in slow motion, to reveal their logical structure and show how the main methodological features have been implemented. In a first phase, we focus on the events that make up the plots, through a series of frames depicting scenes from the various stories. In the next phase, we go through a checklist of the main methodological criteria and show how they are met in the context of each story.

### 3.1 Experiment 1: The Smurf didn't buy every orange

This is a story about a Smurf who goes to the fruit store to buy some fruit. The store has apples (left) and oranges (right) and the Smurf would like to buy some apples, Picture 1.

**Picture 1: The Smurf at the fruit store**

Before buying any of the apples, the Smurf wants to make sure that they're not damaged and he starts examining them. Unfortunately, two have big bruises and the third one has a worm inside. The Smurf decides that he won't buy any apples, Picture 2.

**Picture 2: The Smurf examining the apples**

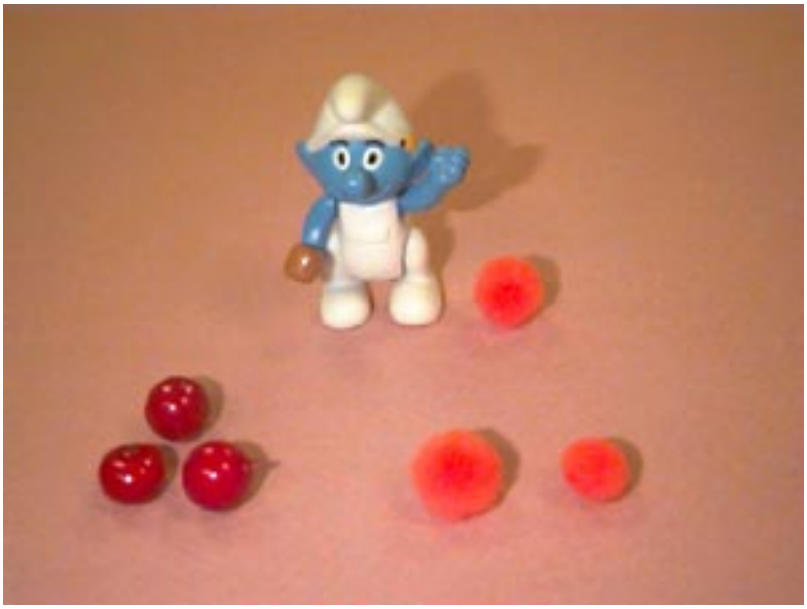
Since he couldn't buy any apples, the Smurf considers buying oranges instead, Picture 3.

**Picture 3: The Smurf considers buying oranges**

Next, the Smurf starts examining the oranges. The first one looks big and firm and the Smurf decides that he is going to buy it. The second one is too small and the third one is not firm enough, Picture 4.

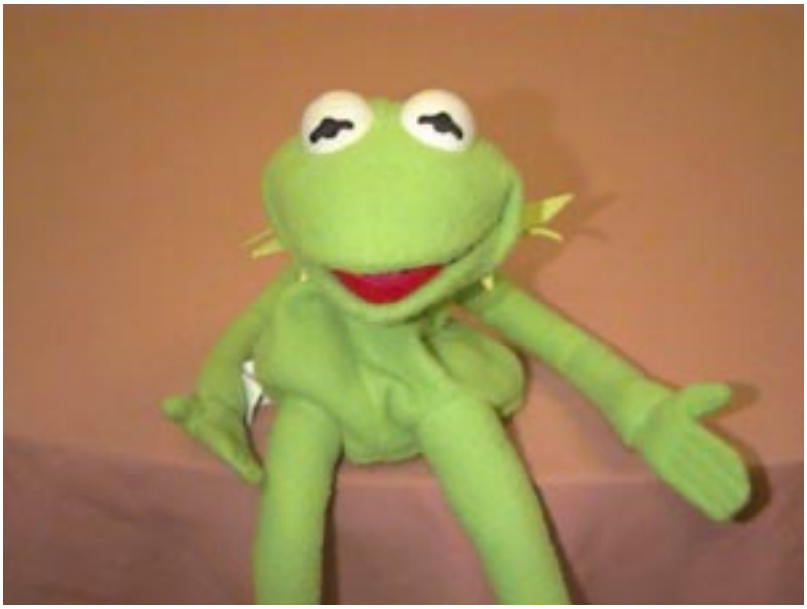
**Picture 4: The Smurf examining the oranges**

This is the end of the story. The toys are arranged in such a way as to provide a visual reminder of what happened in the story. The Smurf is standing by the orange he bought and he his facing the apples and the two oranges that he didn't buy, Picture 5.



**Picture 5: The end of the story**

Next, Kermit tells the child what he thinks happened in the story: "That was a great story about a Smurf who went to the store to buy some fruit and I know what happened: The Smurf didn't buy every orange", Picture 6.



**Picture 6: Kermit: I know what happened ...**

## The logical structure of the story

We begin with a reminder of the two hypotheses, the test sentence, the meanings under consideration and their truth values.

**Experimental hypothesis:** Children have correct narrow scope interpretation (not > every)

**Null Hypothesis:** Children have incorrect wide scope interpretation (every > not)

**Test sentence:** The Smurf didn't buy every orange.

**Meaning1 =** Not every orange was bought buy the Smurf (not > every) (True)

**Meaning2 =** None of the oranges were bought by the Smurf (Every > not (False)

Note here that the truth values had to be assigned in this particular way. Because of the entailment relation between the wide scope reading and the narrow scope reading (see chapter III for a detailed discussion) it would not have been possible to falsify the wide scope reading while making the narrow scope reading true. This is so since the wide scope reading entails the narrow scope reading.

Next, we turn to an outline of the plot of the story.

- **Background**

The story is about a Smurf going to the grocery store to buy some fruit.

Context, part 1: The Smurf is at the store to buy some fruit (Picture 1)

- **Condition of Plausible dissent** (Meaning2 is under consideration)

The Condition of plausible dissent dictates that Meaning2 should be under consideration. The Smurf must consider buying some oranges and it should be possible that he ends up not buying any. This is achieved when the Smurf considers buying some oranges. Since he considered buying some apples and ended not buying any, it is quite plausible that the same may happen with the oranges.

Context, part 2: The Smurf is considering buying some oranges. However, it is possible that the oranges are damaged and consequently, the Smurf may end up not buying any (possible outcome) (Picture 3)

- **Condition of falsification** (Meaning2 = False)

Next, Meaning2 must be falsified in the context of the story. In other words, it must not be true that the Smurf ends up buying none of the oranges. This is achieved by having the Smurf buy one of the oranges (Picture 4)

Context, part 3: It is **not** true that the Smurf bought none of the oranges. He actually ended up buying one (actual outcome) (Picture 4)

- **Final event** (meaning1 = True)

Finally, Meaning1 must be true in the context of the story. In other words, it must be true that the Smurf ends up not buying every orange. This is achieved by having him buy one orange but not the two others.

Context, part 4: The Smurf only buys the first orange; the two others are damaged. It is therefore true that the Smurf didn't buy every orange (meaning 1)
(Picture 5)

### 3.2 Experiment 2: Every horse didn't jump over the fence

This story is about three horses who have decided to practice jumping. There is a barn and a fence over which the horses will try to jump, Picture 1.

**Picture 1: The horses and the obstacles**

The horses first consider jumping over the barn. They start running toward it but as they get closer, realize that the barn is too tall for them to jump over. Since they do not want to hurt themselves, they decide not to jump, Picture 2.

**Picture 2: The barn is too tall for the horses**

Next, the horses consider jumping over the fence which doesn't look as tall as the barn, and they line up in front of it, Picture 3.

**Picture 3: The horses are considering jumping over the fence**

The first horse clears the fence. Great jump ! Picture 4.

**Picture 4: The first horse clearing the fence**

The second horse also clears the fence. Nice jump ! Picture 5.

**Picture 5: The second horse clears the fence**

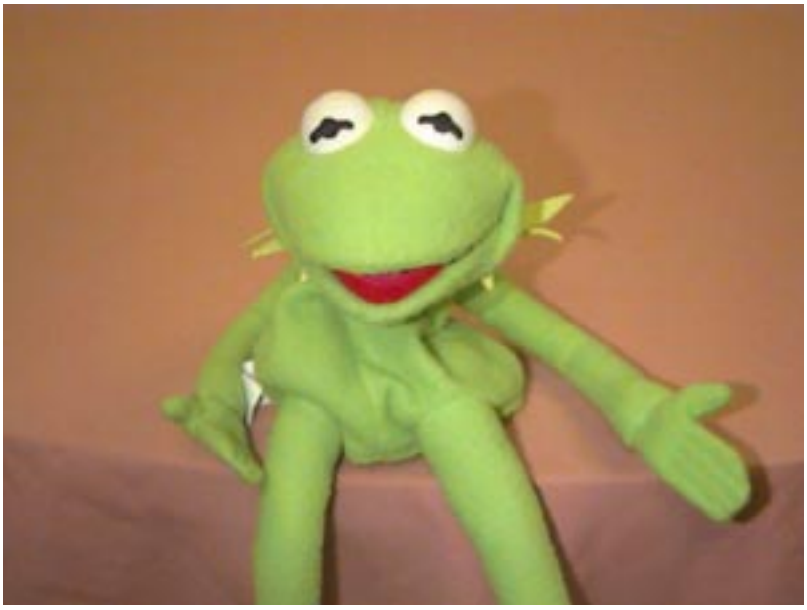
The third horse gets ready to go but remembers that he hurt his leg the day before and judges it wise not to take any risks: his leg needs to rest. He therefore decides not to jump, Picture 6.

**Picture 6: The third horse hurt its leg and won't jump**

This is the end of the story. The toys are arranged in such a way as to provide a visual reminder of what happened. Two horses are on the other side of the fence, to remind the child that they jumped while the third one is behind the fence, to remind them that he didn't jump, Picture 7.

**Picture 7: A reminder of what happened**

Kermit tells the child what he thinks happened in the story: "That was a great story about three horses trying to jump over a barn and a fence and I know what happened: Every horse didn't jump over the fence" Picture 8.



**Picture 8: Kermit: I know what happened ...**

**The logical components of the story**

The following summarizes the main features of the experiment. First, we establish the experimental and the null hypothesis, remind ourselves of the test sentence and the meanings under consideration as well as the truth value assigned to them.

**Experimental hypothesis:** Children lack narrow scope interpretation (not > every)

**Null Hypothesis:** Children have narrow scope interpretation (every > not)

**Test sentence:** Every horse didn't jump over the fence

**Meaning1 =** Not every horse jumped over the fence (not > every) (True)

**Meaning2 =** None of the horses jumped over the fence (every > not) (False)

Next, we consider an outline of the structure of the story, focusing on the key methodological features, as discussed in chapter I.

- **Background**

The first part of the context provides the background: there are three horses and some obstacles to jump over (Picture 1).

Context 1, part 1: There are three horses and some obstacles (Picture 1)

- **Condition of Plausible dissent** (Meaning2 under consideration)

The condition of Plausible Dissent dictates that Meaning2 ought to be under consideration. In other words, a plausible outcome ought to be that none of the horses end up jumping over the fence. After realizing that they couldn't jump over the barn, the horses consider jumping over the fence, picture 3. At this point, Meaning2 is under consideration: a possible outcome may be that after considering jumping over the fence none of the horses actually do. After all this is what happened with the barn.

Context, part 2: The horses could end up not jumping over the fence (possible outcome) (Picture 3)

- **Condition of falsification** (Meaning2 = False)

According to the Condition of Falsification, Meaning2 should be falsified in the context of the story. In other words, it should not be true that none of the horses jumped over the fence. This is achieved by having two horses jump over the fence (Picture 4 and 5).

Context, part 3: It is **not** true that none of the horses jumped over the fence
Two of the horses end up jumping over the fence (actual outcome) (Picture 7)

- **Final event** (meaning1 = True)

Finally, Meaning1 has to be true in the context of the story. In other words, it must be true that not every horse jumped over the fence. This is achieved by having the third horse decide not to jump over the fence (Picture 6).

Context, part 4: The third horse doesn't jump over the fence. It is therefore true that not every horse jumped over the fence (meaning 1) (Picture 6)

### 3.3 Experiment 3: The detective didn't find someone:

This story is about a detective and two of his friends playing 'hide and seek', Picture 1.

**Picture 1: The detective and his friends**

It is time to go hide and the first friend finds a great hiding place behind the tree, Picture 2.

**Picture 2: The first friend hiding behind the tree**

The second friend finds a better spot: he hides under the front seat of the wagon, Picture 3.

**Picture 3: The second friend hiding under the front seat of the wagon**

Everybody has found a hiding place. The detective starts looking and he examines possible hiding places. No success this time though, the friends are really well hidden ..., Picture 4.

**Picture 4: Where did they all go ?**

The detective may have to use his special skills. He inspects the various hiding places more carefully and he spots the person hiding behind the tree, Picture 5.

**Picture 5: You were hiding behind the tree !**

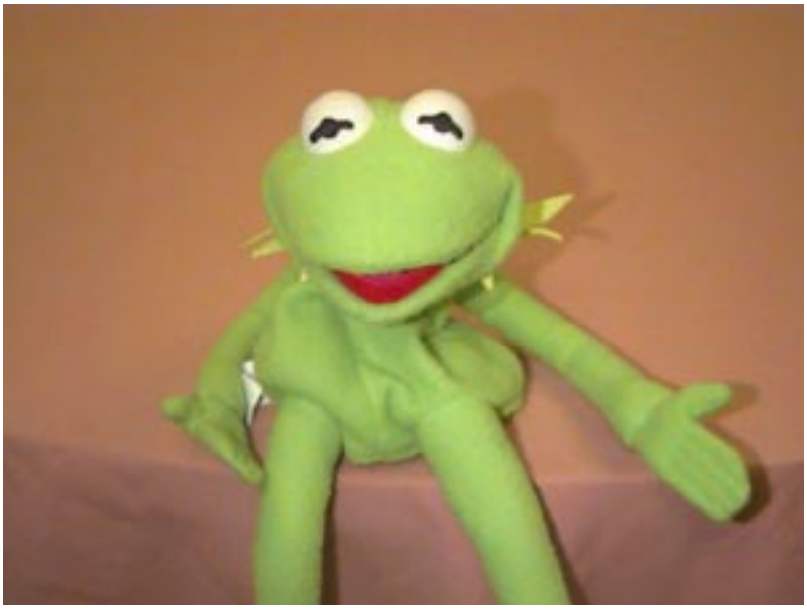
It is now time to look for the second friend. The detective inspects the hiding places again and in particular the wagon but he never checks under the front seat. Eventually, he gives up. The second friend is too well hidden, Picture 6.

**Picture 6: Where did this guy go ?**

This is the end of the story. The toys are arranged in such a way as to provide a visual reminder of what happened. The detective is standing by the friend he did find while the other one is still hiding under the front seat of the wagon, Picture 7.

**Picture 7: The end of the story**

Next, Kermit tells the child what he thinks happened: “That was a great story about a detective and his friends and I know what happened: The detective didn’t find someone”, Picture 8.



**Picture 8: Kermit: I know what happened ...**

**The logical structure of the story**

As before, we begin our summary with a reminder of the experimental hypothesis and the null hypothesis, the test sentence, the meanings under consideration and their truth values.

**Experimental hypothesis:** Children have incorrect narrow scope interpretation (not >some)

**Null Hypothesis:** Children have correct wide scope interpretation (some > not)

**Test sentence:** The detective didn't find someone

**Meaning1 =** There is someone that the detective didn't find (some > not) (True)

**Meaning2 =** The detective didn't find anyone (not > some) (False)

Note here that the truth conditions had to be assigned in this way because of the entailement relation between the two readings. Since the narrow scope reading entails the wide scope reading, it would have been impossible to make the narrow scope reading true and the wide scope reading false.

- **Background**

This story is about a detective and his friends playing hide and seek.

Context, part 1: The detective and his friends are playing hide and seek (Picture 1)

- **Condition of Plausible dissent** (Meaning2 is under consideration)

According to the condition of plausible dissent, Meaning2 must be under consideration. The detective must therefore be looking for his friend and it should be plausible that he ends up not finding any of them. This is achieved in the first part of the story when, after a first round of searching, the detective doesn't find any of the friends.

Context, part 2: The detective is looking for his friends. He may not find any of them (possible outcome) (Picture 4)

- **Condition of falsification** (Meaning2 = False)

Next, Meaning2, which was under consideration, must be falsified in the context of the story. This means that it must not be true that the detective ends up not finding anyone. This is achieved when he successfully spots the character hidden behind the tree (Picture 5).

Context, part 3: It is **not** true that the detective didn't find any of his friends. The detective did find one of them (actual outcome) (Picture 5)

- **Final event** (meaning1 = True)

Finally, Meaning1 must be true in the context of the story. There must therefore be someone that the detective ends up not finding. This is achieved when the detective fails to find the character hidden under the seat of the covered wagon.

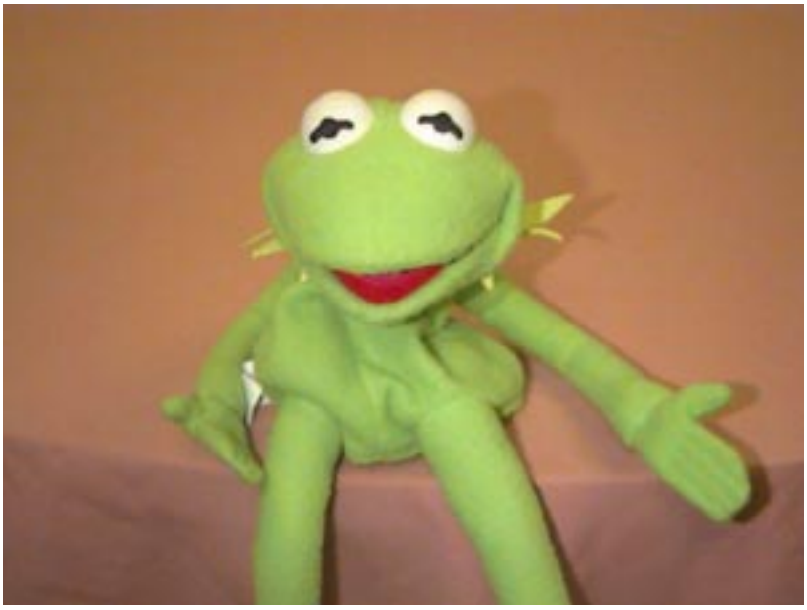
Context, part 4: The detective fails to find the friend who was hidden under the front seat of the covered wagon. It is therefore true that there is someone that the detective didn’t find (Picture 6)

### 3.4 Experiment 4: Some girls won't ride on the merry-go-round

This is a story about three school girls who decide to go out to the playground. There is a sand box, a merry-go-round, a rocking horse and a seesaw, Picture 1.

**Picture 1: The girls in the playground**

The toys and the characters have been introduced. It is time for the Wizzard to make his prediction:"I know what will happen: some girls won't ride on the merry-go-round".



**Picture 2: Kermit the wizzard makes his prediction**

Kermit the Wizzard made his prediction and the story can begin. First, the girls consider playing in the sand box but since it rained that morning, the sand turned into mud. The girls don't want any mud on their dresses so they decide to do something else Picture 3.

**Picture 3: The girls can't play in the muddy sand box**

Next, the girls consider riding on the merry-go-round which is a lot of fun, Picture 4.

**Picture 4: The merry-go-round looks like fun !**

The first girl gets on the merry-go-round and starts riding, Picture 5.

**Picture 5: The first girl riding on the merry-go-round**

Next, the second girl considers riding on the merry-go-round but remembers that she just had lunch and is afraid riding will upset her stomach. She therefore decides not to ride, Picture 6.

**Picture 6: Riding could upset my stomach**

The third girl would love to ride but she's afraid this would give her a bad headache. She therefore decides not to ride either, Picture 7.

**Picture 7: Riding could give me a headache**

This is the end of the story. The toys are arranged in such a way as to provide a visual reminder of what happened. The girl who rode on the merry-go-round is still on it while the two girls who didn't ride are standing on the side, Picture 8.

**Picture 8: The end of the story**

## The logical structure of the story

Let us begin our summary of this experiment by considering the experimental and the null hypothesis, the test sentence, the meanings under consideration and their truth conditions. These elements are given below.

**Experimental hypothesis:** Children have correct wide scope interpretation (some > not)

**Null Hypothesis:** Children lack correct wide scope interpretation, instead they have incorrect narrow scope interpretation (not > some)

**Test sentence:** Some girls won't ride on the merry-go-round

**Meaning1 =** Some girls won't ride on the merry-go-round (some > not) (True)

**Meaning2 =** None of the girls will ride on the merry-go-round (not > some) (False)

Next, consider the logic of the plot and the way in which the main methodological features are implemented.

- **Background**

The story is about three girls who are in the playground to try out some new toys.

Context, part 1: The girls are in the playgound to try the new toys (Picture 1)

- **Condition of Plausible dissent** (Meaning2 is under consideration)

The condition of Plausible Dissent dictates that Meaning2 should be under consideration. In other words, the girls have to consider riding on the merry-go-round, as shown in Picture 3. At this point, it is plausible that none of them end up riding on the merry-go-

round. This is reinforced by the fact that after considering playing in the sand box, none of the girls actually ended up doing so.

Context, part 2: The girls consider riding on the merry-go-round. It is possible that none of them end up riding (possible outcome) (Picture 3)

- **Condition of falsification** (Meaning2 = False)

According to the Condition of Falsification, Meaning2 must be falsified in the context of the story. In other words, it must not be true that none of the girls rode on the merry-go-round. This is achieved by having one of them decide to ride on the merry-go-round (Picture 4).

Context, part 3: It is **not** true that none of the girls rode on the merry-go-round
One girl actually did ride on the merry-go-round (actual outcome) (Picture 4)

- **Final event** (meaning1 = True)

Finally, Meaning1 has to be true in the context of the story. In other words, it must be true that some of the girls don't ride on the merry-go-round. This is achieved by having two of them decide not to ride (Picture 5 and 6).

Context, part 4:  Two of the girls decide not to ride on the merry-go-round. It is therefore true that some girls don’t ride on the merry-go-round (meaning 1) (Picture 7)

### 3.5 Experiment 5: Cookie Monster didn't eat two slices of pizza

This is a story about Cookie Monster who was challenged by his friend the Troll to eat four huge slices of pizza. Cookie Monster replied that as soon as he finished his cookie, he would start eating the pizza, Picture 1.

**Picture 1: Cookie Monster and the four slices of pizza**

Cookie Monster finishes his cookie and starts eating the first slice of pizza. Although the pizza tastes great, the slices are a little bigger than he expected, Picture 2.

**Picture 2: This pizza tastes great !**

Cookie Monster finishes the first slice of pizza and gets started on the second one. This time he has to make a real effort to finish the slice, Picture 3.

**Picture 3: Cookie Monster barely finishes the second slice**

After these two huge slices of pizza, Cookie Monster is really full. He couldn't swallow another bite. There are two slices left though. Cookie Monster takes a look at the third slice and realizes that he's too full to eat it, Picture 4.

**Picture 4: Cookie Monster cannot eat the third slice**

Next, Cookie Monster considers the fourth slice but once again, he realizes that he is too full to eat it, Picture 5.

**Picture 5: Cookie Monster cannot eat the fourth slice either**

This is the end of the story. The toys are arranged in such a way as to provide a visual reminder of what happened in the story. Cookie Monster is standing by the two slices that he ate and faces the two that he didn't eat, Picture 6.

**Picture 6: The end of the story**

Next, Kermit tells the child what he thinks happened in the story: "That was a great story about Cookie Monster and pizza and I know what happened: Cookie Monster didn't eat two slices of pizza", Picture 7.

**Picture 7: Kermit: I know what happened ...**

## The logical structure of the story

As usual, we begin with the experimental hypothesis and the null hypothesis, the test sentence, the meanings under consideration and their truth values.

**Experimental hypothesis:** Children lack wide scope interpretation (two > not)

**Null Hypothesis:** Children have wide scope interpretation (two > not)

**Test sentence:** Cookie Monster didn't eat two slices of pizza

**Meaning1 =** There are two slices of pizza that Cookie Monster didn't eat (two > not) (True)

**Meaning2 =** The number of slices that Cookie Monster ate is different from two (not >two) (False)

Next, we turn to the plot.

- **Background**

Cookie Monster must try to eat four big slices of pizza.

Context, part 1:Cookie Monster has been challenged to eat four huge slices of pizza (Picture 1)

- **Condition of Plausible dissent** (Meaning2 is under consideration)

According to the condition of plausible dissent, Meaning2 must be under consideration. This is achieved when Cookie Monster considers eating the pizza. A plausible outcome is that Cookie Monster ends up eating a number of slices different from two (Meaning2).

Context, part 2: Cookie Monster took up the challenge and is therefore considering eating the pizza. He may end up eating a number of slices different from two, say one, three or all four slices (possible outcome) (Picture 1)

- **Condition of falsification** (Meaning2 = False)

Next, Meaning2 must be falsified which means that Cookie Monster must not eat a number of slices different from two. This is achieved by having Cookie Monster eat exactly two slices.

Context, part 3: It is **not** true that Cookie Monster ate a number of slices different from two. In fact, he ate exactly two slices of pizza (actual outcome)

(Picture 6)

- **Final event** (meaning1 = True)

Finally, Meaning1 must be true. In other words, it must be true that there are two slices of pizza that Cookie Monster didn't eat. This is achieved by having Cookie Monster not eat the last two slices of pizza.

Context, part 4: After eating two slices of pizza, Cookie Monster is full. He can't eat the third and the fourth slice. It is therefore true that there are two slices of pizza that Cookie Monster didn't eat (meaning 1)

(Picture 6)

## 4. Summary

The main experimental findings are summarized in the table below. The left column indicates the sentences tested, the column in the middle shows the initial state (i.e. the interpretations assigned by younger children) and the right column indicates the interpretations assigned by adults. The shaded areas highlight sentences for which children's interpretations differ from those of adults. When the sentences are potentially ambiguous for adults, as in 1 and 3, we indicated both interpretations in the right column.

The ones in parentheses are the ones that children accessed. The others are the ones that children, unlike adults, failed to access. In cases where we observed in split among children as in (2) and (5), we are interested in the group of children who failed to access the relevant adult interpretations.

| **Sentences** | **Children (Initial state)** | **Adults** |
|---|---|---|
| 1. Every horse didn't jump over the fence | Every > Neg | Neg > Every (Every >Neg) |
| 2. Some horses won't jump over the fence | Some > Neg | Some > Neg |
| 3. Cookie Monster didn't eat two slices of pizza | Neg > Two | Two >Neg (Neg > Two) |
| 4. The Smurf didn't buy every orange | Neg > Every | Neg > Every |
| 5. The detective didn't find some guys | Neg > Some | Some > Neg |

Children's interpretations fall into three categories: (a) they correspond to the relevant adult interpretation as in 2 and 4 (b) they represent one of the possible adult interpretations as in 1 and 3 (c) they are different from any possible adult interpretation in the relevant situation, as in 5. These findings raise the following questions:

(a) How and why do children's interpretations of sentences containing negation and QNPs differ from those of adults ?

(b) How do children move from their system of interpretation to the adult system of interpretation ?

Chapter III and Chapter IV are devoted to addressing these questions.

# CHAPTER III

## How and why are children different from adults ?

The purpose of this chapter is to address the following question: how and why are children's interpretations of sentences containing negation and QNPs different from those of adults ? In section 1, I begin by observing that children, unlike adults, map overt syntactic relations between QNPs and negation and their relative semantic interpretation isomorphically. This however, is just a descriptive generalization which I attempt to derive from more fundamental properties of the grammar. This is the purpose of section 2. In section 2.1, I begin by considering whether children's non-adult interpretations may be caused by parsing preferences, or a lack of sensitivity to intonation or limited processing capacities. I conclude that these accounts face a certain number of problems and, therefore, that none of them offers a satisfactory derivation of the observation of isomorphism. Next, in section 2.2, I consider children's and adults' interpretations of sentences containing negation and QNPs in light of the assumptions of the Modularity Matching Model (MMM) discussed in chapter I. In particular I consider the role played by the Semantic Subset Principle (Crain, Ni and Conway 1994) and the Continuity Hypothesis. My conclusion is that although promising, an account in terms of the SSP only provides a partial account of our experimental findings. In section 2.3, I present a way to derive the observation of isomorphism similar in spirit to a derivation in terms of the SSP, but different in implementation. In section 2.4, I reconsider the findings of previous studies on the acquisition of quantification (discussed in chapter I) in light the

account offered in section 2.3. Section 3 summarizes the discussion presented in this chapter and introduces the topic of chapter IV.

## 1. Observing Isomorphism:

We observed in Chapter I that in English, semantic scope relations between negation and QNPs are not always fixed by the position that these elements occupy in overt syntax. In other words, semantic scope cannot always be read off overt syntactic scope. Coming back to the examples we have been discussing, this remark applies specifically to (1a-c).

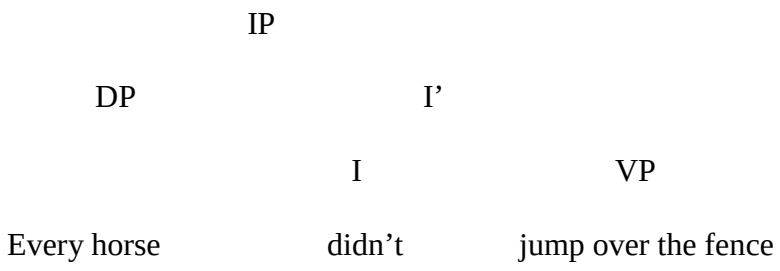
(1) a. Every horse didn't jump over the fence.
b. The detective didn't find some guys.
c. Cookie Monster didn't eat two slices of pizza.
d. Some girls won't ride on the merry-go-round.
e. The smurf didn't buy every orange.

What is striking about children, is that their interpretations of the sentences in (1) differ from those of adults precisely in those cases where syntactic scope and semantic scope do not coincide, i.e. (1a,b,c). On the other hand, when syntactic scope and semantic scope do coincide, so do children's and adults' interpretations. Moreover, when syntactic scope and semantic scope do not coincide, children's interpretations correlate with the interpretations determined by syntactic scope. To see this, let us compare children's interpretations of each of the examples in (1) with the structural representations of these examples.

Consider (1a) and its structural representation in (2a).

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

(2a)

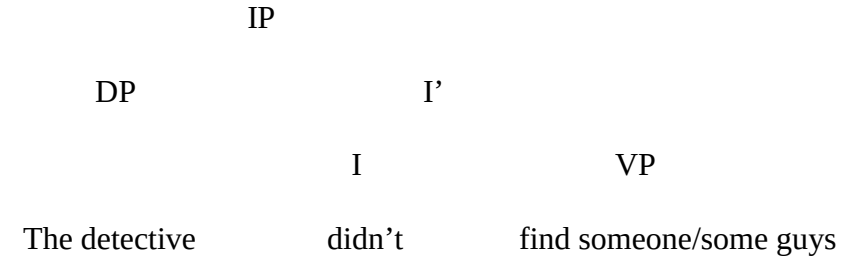



Here, *Every horse* occurs outside of the c-command domain of negation and to the left of it. This corresponds to children's initial wide scope interpretation (see experiment 2, chapter II)

Next consider (1b) and its structural representation, (2b).

(1b) The detective didn't find some guys.

(5)

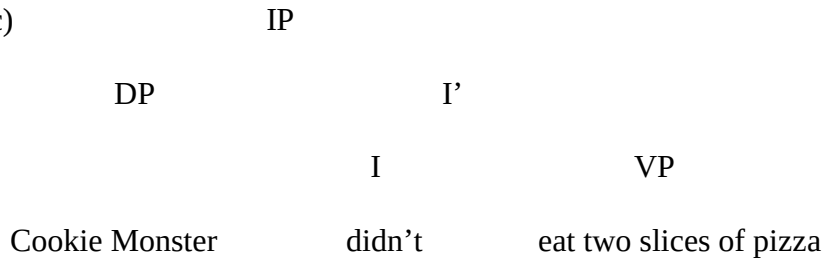



Here, *someone/some guys* occurs in the c-command domain of negation and to the right of it. This corresponds to children's initial (incorrect) narrow scope interpretation (see experiment 3, chapter II).

Now, consider (1c) and its structural representation, (2c).

(1c) Cookie Monster didn't eat two slices of pizza

(2c)

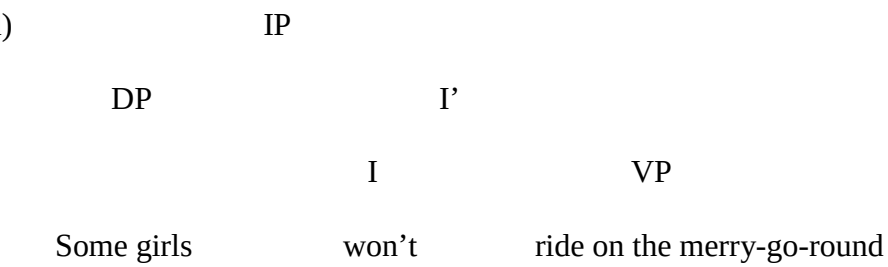



Here, *two slices of pizza* occurs in the c-command domain of negation and to the right of it. This corresponds to children's initial narrow scope interpretation (see experiment 5, chapter II).

Next, consider (1d) and the structural representation, (2d)

(1d) Some horses won't jump over the fence.

(2d)

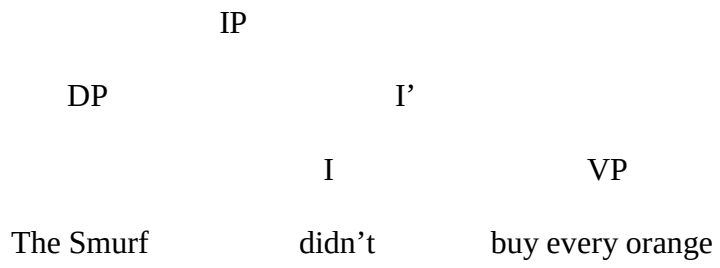


Here, *Some girls* occurs outside the c-command domain of negation and to the left of it. This corresponds to children's initial wide scope interpretation (see experiment 4, chapter II)

Finally, consider (1e) and the structural representation, (2e).

(1e) The Smurf didn't buy every orange

(2e)




Here, *every orange* occurs in the c-command domain of negation and to the right of it. This corresponds to children's initial narrow scope interpretation (see experiment 1, chapter II).

In sum, we observe that in the domain of QNP-Neg interaction, children map overt syntactic scope (defined here in terms of asymmetric c-command or linear precedence[11]) and semantic scope isomorphically which suggests that their non-adult system of interpretation is governed by principle. The fact that an abstract notion such as syntactic

[11] Note here that we cannot decide whether children compute scope on the basis of (asymmetric) c-command relations between Neg and QNP or on the basis of linear precedence (Neg to the left or right of QNP) since the two happen to coincide in each of the cases under consideration.

scope, which is drawn from a universal linguistic vocabulary, constrains children's initial semantic hypotheses supports the view that the acquisition of semantic knowledge is constrained by UG. Note in this case that children's initial interpretations are not only compatible with UG; they are also compatible with the adult grammar of the target language, since mapping syntactic and semantic scope isomorphically is a possible option in the adult grammar of English (e.g., 1d-e above). It happens not to be the only option however. In other words, Children's initial hypotheses are more restricted that those of adults in the sense that they only represent one of the possible options available in the adult grammar. Children's non-adult semantic knowledge should therefore be regarded as *incomplete* rather than *inaccurate*.

## 2. Deriving Isomorphism

There would be a simple way to capture the observation of isomorphism: take isomorphism at face value and invoke it as a primitive learning principle. Call it 'the Principle of Isomorphism'. The principle would state that in the acquisition of QNP-Neg interaction syntactic scope and semantic scope are mapped isomorphically. My purpose in this section is to argue that this is *not* the right way to proceed however. Instead, the observation of isomorphism should be derived from more fundamental properties of the grammar. My contention, therefore, is that isomorphism in the acquisition of QNP-Neg interaction is epiphenomenal. It should only be regarded as an emergent property arising from the interplay between properties of QNPs and learnability considerations. Before I

present my own account, however, I discuss alternative approaches and show that they fail to properly derive the observation of isomorphism.

## 2.1 Parsing preferences, contrastive stress and processing capacity

It is well-known, from the literature on language processing, that ambiguous sentences are often associated with parsing preferences. In the absence of explicit context, one of the two (or more) interpretations is favored. Two of the sentences used in our experiments are ambiguous in the adult grammar of English, namely *Every horse didn't jump over the fence* and *Cookie Monster didn't eat two slices of pizza*. We observed, moreover, that children, unlike adults, appeared unable to access the narrow scope reading of the first sentence (not > every horse) and the wide scope reading of the second sentence (two slices of pizza > not). Instead, the accessed the wide scope reading (Every horse > not) and the narrow scope reading (not > two slices of pizza) respectively.

Since these sentences are ambiguous, adults may have a preference for a particular interpretation. Suppose, for the sake of the argument, that adults have a preference for the wide scope reading of *Every horse* (Every horse > not) and for the narrow scope reading of *two slices of pizza* (not > two slices of pizza). If so, one could argue that children have no difficulty accessing these interpretations because they are the ones preferred by adults. One could push this line one step further and argue that the reason children access these interpretations exclusively is because they have stronger preferences than adults. If so, the fact that children rejected the narrow scope reading of *Every horse* (not > every) and

the wide scope reading of *two slices of pizza* (two > not) would be reduced to parsing preferences: children do not lack knowledge of the narrow scope reading of *Every horse* and the wide scope reading of *two slices of pizza*: they have a strong preference for the alternative interpretations.

As we specified at the outset, this argument relies on the assumption that adults have a preference for the wide scope reading of *Every horse* (Every > not) and the narrow scope reading of *two slices of pizza* (not > two). However, just the opposite is true: all the adult subjects that I interviewed easily recognized the ambiguity in sentences like *Every horse didn't jump over the fence* and *Cookie Monster didn't eat two slices of pizza* but in the absence of explicit context they indicated a clear preference for the narrow scope reading (not > every) and the wide scope reading (two > not), respectively. Besides, when these sentences were placed in context, the adults tested on the basis of the stories used with children all interpreted *Every horse didn't jump over the fence* on narrow scope reading (Every > not) and *Cookie Monster didn't eat two slices of pizza* on a wide scope reading (not > two), without a single exception. In sum, children rejected the interpretations that are preferred by adults in contexts where these interpretations were made salient. I cannot think of a stronger way to show that children lack the interpretations in question.

Another avenue would be to relate children's non-adult interpretations of sentences containing negation and QNPs to an other well-known phenomenon where children have been found to access non-adult interpretations. This is the case of children's difficulty

with Principle B of the Binding Theory (Chien and Wexler 1990, Grimshaw and Rosen 1990, McDaniels, Cairns, and Hsu 1990, McKee 1992, among others). The typical manifestation of this difficulty is that children seem to allow coreference between a pronoun and a local c-commanding antecedent in sentences like *Mama Bear washed her*. Adults in the same situation typically do not allow the pronoun and the full NP to refer to the same individual. Another important finding is that children have been shown to obey Principle B when the pronoun acts as a bound variable. Children who otherwise allow coreference between the pronoun and the NP in cases like *Mama Bear washed her*, reject the interpretation where *him* refers to *every bear* in *Every bear washed him* (Chien and Wexler 1990, McDaniel et al. 1990). Finally, it has been observed that the Principle B lag doesn't occur in all languages. In languages like Spanish and Italian, where pronouns are clitics, children have been found to perform well on Principle B (McKee 1988, 1992, Solan 1987).

One type of account discussed by Chien and Wexler (1990), Grimshaw and Rosen (1990) and McDaniel et al. (1990) is that although children do have knowledge of Principle B, they do not know the conditions under which coreference is possible between contraindexed NPs. To use McDaniel and Maxfield's examples, shown in (3), there are cases where coreference is possible between contraindexed NPs.

(3) a. You'll never guess who I chose. I chose *me*.
b. You need to think about *you*.
c. When John looks in the mirror, he doesn't see *me*, he sees *him*.

To quote these authors: ”Sentences like these [3] are not considered to be Principle B violations, because coindexing, not coreference, is the crucial notion of the Binding Theory. The two NPs are contraindexed, as required by Principle B, but they actually *refer* to the same person. This is what creates the surprise effect in these sentences. Because these apparent Principle B violations are used only in special pragmatic contexts, Chien and Wexler (1990) proposed that the children are missing this pragmatic knowledge.” (p.340) Moreover, Grimshaw and Rosen (1990) and McDaniel et al. (1990) pointed out that in examples like (3) the pronouns receive emphatic stress. McDaniel et al. (1990) suggest that children who have difficulty with Principle B have not yet mastered contrastive stress. McDaniel and Maxfield (1992) provide experimental evidence for this claim by showing that there exits a correlation between performance on Principle B and mastery of contrastive stress (for details on the experiments, I refer the reader to McDaniel and Maxfield’s work).

The claim is that not all children have mastered contrastive stress when they encounter sentences like the ones in (3). According to McDaniel and Maxfield: “children who have categorized NPs into reflexives, pronouns, and R-expressions will know, from Principle B, that the NPs in these sentences [3] are contraindexed. They will therefore correctly take them to be cases of coreferential contraindexed NPs. However, they do not know that this special usage requires contrastive stress on the pronoun and they therefore allow apparent Principle B violations in which the pronouns is not stressed.” (p.352). This is how McDaniel and Maxfield summarize their account:” ... show a correlation between performance on Principle B and mastery of contrastive stress. The account we

propose is consistent with the Lexical Learning Hypothesis, in that once children have categorized the NPs, all three Binding Principles, being innate, will be operative in their grammars. However, the children will appear to lack Principle B (and possibly also Principle C in some cases) if they have not mastered contrastive stress when they notice sentences like *I chose <u>me</u>*. Because such cases are impossible with bound variables or clitics, the account also explains why English-speaking children perform well on bound-variable cases and why children learning language with clitics perform well on all cases of Principle B." (p.355)

One could imagine an account of the observation of isomorphism along similar lines. Contrastive stress and pragmatics also play a role in determining the relative interpretation of negation and QNPs. For example, although *some* cannot generally receive a narrow scope reading with respect to clausemate negation, there are special pragmatic circumstances such as the use of Metalinguistic Negation (Horn 1989) under which this reading appears to be possible. For example, a reply to *John wants some beans* could be *John doesn't want some beans, he wants some rice.* In this case, what is being denied is the previous utterance, namely the assertion that John wants some beans. In a similar vein, if negation is stressed as in *The boy was NOT holding two flowers* (maybe in response to *The boy was holding two flowers*) the sentences becomes unambiguous with respect to the relative interpretation of negation and the object QNP. In this case, the isomorphic reading would be the only possible reading. The general point is that to the extent that there exists special conditions (due to contrastive stress and special pragmatic circumstances) under which negation and QNPs are interpreted exclusively

isomorphically, one could extend the argument from Principle B and claim that children's non-adult interpretations are due to their lack of mastery of contrastive stress. Such an account has a certain number of virtues. First, it ties the results on the acquisition of quantifier-negation interaction to other findings in the literature such as children's non-adult interpretation of pronouns. Also, since there is evidence that children are experiencing difficulty with contrastive stress, i.e. McDaniel and Maxfield's results, this type of account receives independent motivation. Finally, this account makes certain predictions that are directly testable and therefore falsifiable. In particular, it predicts that the children who are apparent Principle B violators should also be the one who fail to access the relevant adult interpretations of sentences containing negation and QNPs.

Although attractive, this account faces certain problems. First, although this is not necessarily a problem, I find such an account counterintuitive. In light of the numerous learnability problems that plague language acquisition, it strikes me as odd that children would generalize the behavior of pronouns or negation on the basis of their exceptional behavior. Pronouns, for example, cannot in general be interpreted as being coreferent with a local c-commanding antecedent. In certain exceptional cases however (use of stress and special pragmatic circumstances) this option becomes possible. The same is true regarding the interpretation of *some* with respect to clausal negation. Again, *some* cannot generally be interpreted in the scope of clausemate negation although there are exceptional circumstances, such as the use of Metalinguistic Negation, where this options is possible. Therefore, an account which relies on the fact that children do not initially know what sets of interpretations to assign in what circumstances begs the following

question: why don't children simply assume that pronouns and local c-commanding antecedents cannot be coreferent until they come across positive evidence that under special circumstances coreference is a possible option ? Similarly, wouldn't it be simpler for children to initially assume that *some* cannot be interpreted in the scope of clausemate negation until they encountered positive evidence that under special pragmatic circumstances, i.e. Metalinguistic Negation, this option is possible ? But of course, what we need to explain is precisely why children appear to overgeneralize on the basis of the exceptional behavior of pronouns or negation. In the case of QNP-Neg interaction however, I will propose a different way to view the problem. Although it appears that children generalize on the basis of the exceptional behavior of *some* with respect to clausemate negation, I will suggest that this observation is epiphenomenal in that it reflects the consequence of a more global and more conservative type of generalization.

Finally, the account discussed above faces the following empirical problem: its main prediction fails to be borne out in any significant way. Recall that under this approach, children's non-adult interpretation of pronouns and their non-adult interpretations of sentence containing negation and QNPs are treated on a par: both are due to a lack of mastery of contrastive stress. The prediction, therefore, is that children who access non-adult interpretations of pronouns (i.e. those who appear to violate Principle B) should also be the ones failing to access the relevant adult interpretations in the case of negation and QNPs. In order to test this prediction, I compared the performance of 12 of the 20 children that were tested in experiment 5 (*Cookie Monster didn't eat two slices of pizza*) and were independently tested for their adherence to principle B on the basis of

constructions of the type *Mama Bear washed her* by Fred Savarese[12] (in progress). Out of 12 children, only 4 showed the correlation predicted by the approach discussed above. That is, these 4 children interpreted *Mama Bear* and the pronoun *her* to be coreferent in the Principle B experiment and they also failed to assign the wide scope interpretation of *Cookie Monster didn't eat two slices of pizza* in the Neg-QNP experiment. The 8 remaining children either incorrectly accepted coreference in the Principle B experiment but assigned the relevant wide scope interpretation in the Neg-QNP experiment or vice-versa. In sum, treating children's non-adult interpretations of pronouns and their non-adult interpretations of negation and QNPs as being caused by the same factor, i.e. lack of mastery of contrastive stress, fails to account for the fact that two thirds of the children tested (8/12) fail to manifest the expected correlation.

Finally, one could imagine an explanation of the fact that children appear to be guided by isomorphism based on the claim that children have limited processing capacities compared to adults. It would reasonable to think, I believe, that accessing the nonisomorphic reading of sentences like *Every horse didn't jump over the fence* or Cookie *Monster didn't eat two slices of pizza* involves more computational resources than accessing the isomorphic reading. The intuition would be that the isomorphic readings come for free as a result of parsing the sentences and assigning structure to them, while some extra work would be needed in order to compute the nonisomorphic readings. One could therefore argue that if children's processing capacities are limited with respect to

[12] Note that the same experimental technique was used in my experiments and in Savarese's, namely the Truth Value Judgment Task of Crain and Thornton (in press).

those of adults, these limitations are precisely what prevents them from accessing the nonisomorphic readings of sentences like *Every horse didn't jump over the fence* or *Cookie Monster didn't jump over the fence*. However, there are no a priory reasons to assume that children and adults do not have the same processing capacities. On the contrary, if we want to maintain learnability, the null hypothesis should always be that children and adults do not differ. In other words the burden of proof should lie on those who claim that such differences exist between children and adults. In the absence of decisive evidence on this matter and in compliance with the assumptions of the Modularity Matching Model discussed in chapter I, I will assume that children and adults have the same processing capacities.

## 2.2 The Modularity Matching Model (MMM)

The accounts discussed above have one important feature in common. They all rely on a putative difference between children and adults: children are either claimed to have limited processing resources or to fail to correctly pair prosodic information with the relevant sets of interpretations etc. From a methodological point of view, however, such putative differences - in the absence of independent evidence - are undesirable. In order to maintain learnability, the null hypothesis should always be that children and adults are maximally similar. Departure from such methodological desiderata should occur only as a last resort option; not as an initial hypothesis. The purpose of this section is to show that it is indeed possible to account for children's non-adult interpretations of sentences containing negation and QNPs without invoking the type of putative differences between

children and adults discussed above. In other words, I will show that it is possible to explain children's non-adult behavior while maintaining that children and adults are maximally similar in the sense of the Modularity Matching Model discussed in chapter 1.

One of the two fundamental assumptions of the MMM is that the modules of the language faculty and their operating principles are shared both by adults and children. However, children and adults differ in one important respect which stems from the fact that children, unlike adults, are language learners. On the MMM this difference manifests itself when children and adults are confronted with ambiguous sentences, i.e. sentences for which more than one interpretation is made available by UG. When the alternative interpretations of an ambiguous sentence are arranged in a subset-superset relation, learners face a potential subset problem since there would be no way for them to retrieve from an incorrect superset choice in the absence of negative information. On the MMM such a problem can be avoided on the assumption that learners are equipped with a Semantic Subset Principle (SSP) which instructs them to initially choose among the competing interpretations of ambiguous sentences the one which makes these sentences true in the narrower set of circumstances. Adults processing language must also deal with ambiguous sentences. On the MMM the sentence parsing mechanism, responsible for language processing, is assumed to be guided by a Principle of Parsimony whereby the interpretation which is true in the broadest set of circumstances is preferred in the absence of decisive context. This difference between children and adults gives rise to an interesting prediction, namely that the interpretations of ambiguous sentences initially

hypothesized by children for learnability reasons are the ones which are disprefered by adults for processing reasons.

As Crain and Thornton observe, “It is important ... not to confuse the state of affairs we are describing, where the child selects among competing grammatical options, with the state of affairs that confronts adults in processing structurally ambiguous sentences.” (p. 324, footnote 2). In other words, selecting competing grammatical options is an intentional (i.e. I-language) process while adults deal with sentences extensionally, i.e. as pieces of E-language when resolving ambiguity. The upshot of this distinction is that sentences which are ambiguous to adults are not necessarily ambiguous to children. To quote Crain and Thornton again, “Even if UG makes alternative interpretive options available for a sentences, the sentence is not necessarily ambiguous for the child.”(p. 324, footnote 4). Another prediction of the MMM, which follows from its adherence to the Continuity Hypothesis is that if a sentence is not ambiguous for adults, it should not be ambiguous for children either. If children were to initially hypothesize ambiguity, they would face learnability problems just in case one of the two interpretations hypothesized is not available in the adult grammar. Thus, the MMM offers an interesting platform against which our experimental findings can be discussed. In particular, I will consider the extent to which the observation of isomorphism can be derived from the SSP coupled with the continuity hypothesis. First, I introduce the SSP and show how it has been applied to other cases in the literature on language acquisition.

### 2.2.1 The Semantic Subset Principle

To preface my discussion of the SSP, I provide a brief introduction to Truth Conditional Semantics. Much of the discussion that follows is based on Stephen Crain's work. Truth conditional Semantics originated in the writing of the German Logician Frege and in particular in his paper 'On sense and reference', Frege (1893). In this framework, the meaning of a linguistic expression is the expression's *intention*. In addition to their intention, certain linguistic expressions have a reference, or what is called its *extension*. We now turn to an illustration of these concepts.

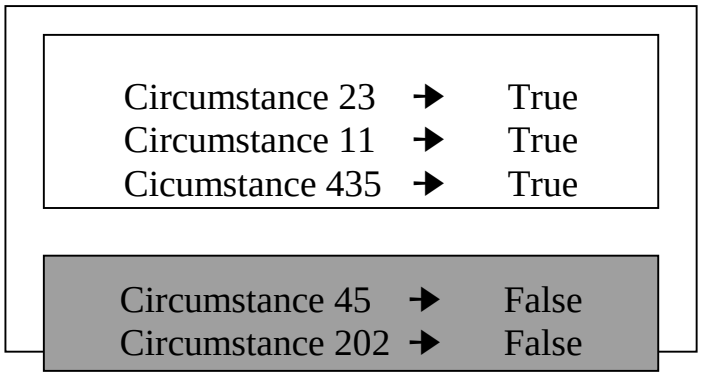
To take an example, the extension of an NP such as *John*, is an individual, namely John. The extension of a VP such as *sneezed* is a property of individuals, namely the property of sneezing. A VP like *sneeze* therefore picks out a set of individuals who have the property of sneezing. If an individual denoted by an NP, say John for example, happens to be in the set of individuals that the VP *sneezed* picks out; that is, if John has the property of sneezing, then the sentence composed of the NP *John* and the VP *sneezed*, i.e. *John sneezed* is true. It follows then that the extension of a sentence is its truth value, True or False. Summarizing what we have so far, the extension of an NP is an individual or a set of individuals, the extension of a VP is a property of individuals and finally, the extension of a sentence is its truth value; True or False.

In this framework, the intention of a linguistic expression can be expressed as a function whose value is its extension. In this case, the argument of the function is a set of circumstances. A circumstance is a possible state of affairs at a certain time. It follows then that the intention of a linguistic expression is a function from a set of circumstances (its argument) to its extension (its value). For example, the intention of the VP sneezed, is a function from circumstances to properties of individuals. In other words, it is a function that picks out the properties of sneezing at different states of affairs and at different times; that is in different circumstances. To summarize, the intention of an NP a is function from circumstances to individuals. The intention of a VP is a function from circumstances to properties of individuals and finally, the intention of a sentence is a function from circumstances to truth values. The extension and intention of NPs, VPs and Ss are summarized below.

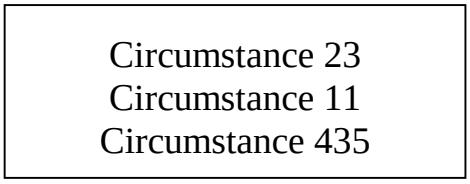
| **Expression** | **Extension** | **Intention** |
|---|---|---|
| NP | Individual | Circumstances → Individuals |
| VP | Properties of individuals | Circumstances → Properties of individuals |
| S | Truth Value | Circumstances → Truth Values |

We need to take one more step before turning to a definition of the Semantic Subset Principle. So far, we have been thinking about sentences or the propositions that they express as functions, i.e. the characteristic functions of sets, mapping from circumstances to truth values. Using the logical equivalence between sets and their characteristic functions, a proposition can be viewed simply as a set circumstances; the set of circumstances which make the proposition true. The graphic below illustrates this equivalence by showing that the informational content of these two ways of viewing propositions is the same.

**Proposition = Characteristic Function of a Set**




**Proposition = Set of Circumstances**



With these notions in mind, we can now define the relationship between entailment and sets. The notion of entailment can be defined as follows:

**Entailment**

A proposition P entails a proposition Q iff every circumstance in which P is true is also one in which Q is true.

We can now define the following relation between propositions:

**Subsets**

If reading P entails reading Q, but not vice-versa, then P is the subset reading and Q is the superset reading.

To illustrate these definitions, suppose for example that a sentence S expresses two propositions, i.e. S is ambiguous. Suppose further that one of the propositions expressed by S, say P entails the other propositions expressed by S, say Q. In this case, we can say that S is true on reading P in a subset of the circumstances that make it true on reading Q.

On the basis of these observations, Crain proposed that whenever a learner faces a situation where more than one interpretive option is available for a given sentence, there must exist a principle instructing the learner to initially hypothesize the interpretation which is true in the smallest set of circumstances, i.e. in the subset interpretation. This is what Crain calls the Semantic Subset Principle (SSP). If there were no SSP, and the learner was facing an ambiguous sentence whose alternative interpretations are arranged in a subset-superset relation, nothing would prevent her from initially hypothesizing the superset reading. However, if the learner's target language only makes the subset reading

available, positive evidence would not suffice to force her to abandon the superset reading. In other words, assuming that the learner doesn't have access to negative (semantic) evidence, all the data she would encounter would be compatible with the superset interpretation that she incorrectly hypothesized and consequently, she could never converge on her target. Crain defines the SSP as follows:

> **Semantic Subset Principle** (Crain, Ni and Conway 1994)
>
> If the interpretive component of UG makes two interpretations, A and B, available for a sentence, S and if interpretation A makes S is true in a narrower range of circumstances than interpretation B does, then interpretation A will be hypothesized before B in the course of language development.

Let us consider an example of how the SSP has been used in the literature on language acquisition. Crain, Ni and Conway (1994) consider children's interpretation of sentences containing the focus operator *only* such as the one in (3). They observe that (3) is ambiguous between two readings: one where *only* focuses on the entire VP as in (3a) and one where it focuses only on part of the VP, namely the object NP, as in (3b).

(3) The dinosaur is only painting a house.
a. The only thing the dinosaur is doing is painting a house.
b. The only thing the dinosaur is painting is a house.

Crain et al also observe that: "the alternative readings of [3] are in a subset-superset relation."(p.456) Specifically, the (a) reading entails the (b) reading, i.e. the (a) reading makes (3) true in a narrower set of circumstances than the (b) reading. According to them, therefore, the semantic subset principle should compel children to initially hypothesize the (a) reading of (3). In order to test this prediction, Crain et al designed an

experiment to test children's interpretation of sentences like (3). According to Crain et al, a result from a previous experiment (Crain, Philip, Drozd, Roeper and Matsuoka 1992) on children's understanding of sentences with *only* played an important role in this experiment. In this previous experiment, children were asked to judge the validity of the sentences in (4) when presented with a picture depicting a cat holding a flag, a frog holding a balloon and a goose holding both a flag and a balloon.

(4) a. Only the cat is holding a flag.
b. The cat is only holding a flag.

The main finding is this experiment is that an important number of children consistently interpreted *only* as though it was construed as focusing on the VP, irrespective of its syntactic position. That is, these children interpreted both (4a) and (4b) as adults would interpret (4b). For this reason, these children VP-oriented children. In their experiment testing children's understanding of sentences like (3) Crain et al used 6 VP-oriented children. Crain et al comment that: " Use of these children made it possible to avoid a potential problem in presenting sentences like [3], namely, the possibility that the prosodic contour of sentences could favor one reading or another. This problem was avoided because VP-oriented children would assign focus on the VP even when *only* preceded the subject NP. This allowed us to present sentences like [5] auditorily, with *only* in presubject position, to test children's assignment of focus within VPs."(p.461)

(5) Only the dinosaur is painting a house.

This sentences was used to describe a picture where a dinosaur was painting a house, a chair and holding a kite. There was also an elephant painting a car and holding a balloon. Here's Crain et al commenting on the findings of their experiment: "The main finding was that three of the six children always associated only with the entire VP of the test sentences, such as [5] not with the direct object NP. The response of these children clearly conform to the semantic subset principle. The circumstances corresponding to the alternative readings of [5] are in a subset-superset relationship. Therefore, the semantic subset principle compels children to initially hypothesize the reading that makes the maximal commitments. In the present example, this is the reading in which the only activity being performed by the dinosaur is that of painting a house. Three children's responses were exactly of this form. For example, they rejected [5] on the grounds that the dinosaur was flying a kite and painting a chair, as well as painting a house."(p.461)

### 2.2.2 QNP-Neg interaction and the SSP

According to Crain et al, children's non-adult interpretations of sentences containing *only* can be explained in terms of the SSP because such sentences create a Semantic Subset Problem. A natural question to ask is whether sentences containing negation and QNPs also create a Semantic Subset Problem and if so, whether we can explain children's non-adult interpretation of such sentences using the SSP. That is, if children did follow the SSP in formulating their initial interpretive hypotheses, would their interpretations be the ones that we observed in Chapter II ? Put another way, can we derive isomorphism from the SSP ? In order to address these questions, we need to consider each of the three cases

where children's interpretations differ from those of adults. In other words, we will consider whether sentences like *Every horse didn't jump over the fence, The detective didn't find some guys* and *Cookie Monster didn't eat two slices of pizza* pose a semantic subset problem. We saw that a semantic subset problem arises just in case a choice needs to be made between alternative interpretations which are arranged in an entailment (i.e. subset-superset) relation. For the sake of the argument, we assume that UG makes available alternative interpretations for each of the three sentences above. We come back to this assumption later. What we need to determine then is whether the alternative interpretations of these sentences arranged in a subset-superset relation if so, whether the observed non-adult interpretations accessed by children correspond to the subset case.

First consider children's interpretation of sentences like (6). Recall from experiment 2 that children failed to access the adult interpretation where negation takes scope over *every horse* (not > every). Rather, they interpreted *every horse* outside the scope of negation (every > not). Let us call these interpretations the narrow scope reading and the wide scope reading respectively. Recall that the narrow scope reading can be paraphrased as *Not every horse jumped over the fence* (not > every) and the wide scope reading as *None of the horses jumped over the fence* (every > not).

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

Now, we need to determine whether there is an entailment relation between the narrow scope and the wide scope reading. In this case, the wide scope reading entails the narrow

scope reading. That is, the wide scope reading is true in a subset of the circumstances that make the narrow scope reading true. Let us see how. Suppose that the wide scope reading is true, i.e. it is true that none of the horses jumped over the fence. If so, it follows that not every horse jumped over the fence. To take a concrete example, think about three horses: horse 1, horse 2 and horse 3 and suppose that none of them jumped over a fence. That is, horse 1 didn't jump over the fence, horse 2 didn't jump over the fence and horse 3 didn't jump over the fence. If so, it follows that say, horse 1 and horse 2, didn't jump over the fence, i.e. it follows that not every horse jumped over the fence. In sum, the wide scope reading (none) entails the narrow scope reading (not every). This is shown in figure 1 below.

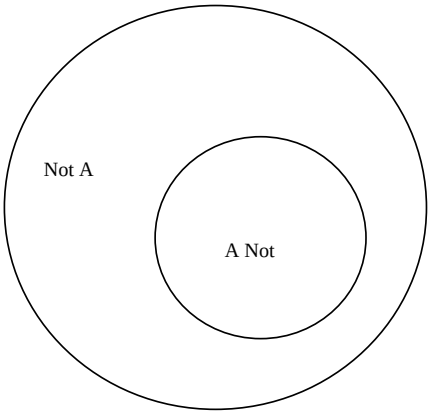



**Figure 1: [∀ not] entails [not ∀]**

To summarize, sentences like (6) create a semantic subset problem since by assumption both the wide scope and the narrow scope reading are made available by UG and the wide scope reading entails the narrow scope reading. The SSP therefore predicts that

learners should initially interpret (6) on the wide scope reading, since this represents the subset case. As the results from experiment 2 indicate, this prediction is borne out.

Next consider children's interpretation of sentences like (7). Recall from experiment 3 that some children interpreted (7) as though it meant *The detective didn't find any guys*. In other words, these children interpreted *some* in the scope of negation whereas for adults, it must be interpreted outside the scope of negation. Let us call this interpretation the narrow scope reading (not > some) and the correct adult interpretation the wide scope reading (some > not). As before, we will assume that both interpretations are made available to learners by UG.

(7) The detective didn't find someone/some guys.

Let us consider the relation between these two interpretations. The question of interest here is whether there is an entailment relation between the wide scope reading and the narrow scope reading. In this case, the narrow scope reading entails the wide scope reading. Let us see how. Suppose that the detective didn't find any guys (narrow scope reading); it then follows that the detective didn't find some of them (wide scope reading). Let us take a concrete example. Imagine a situation where a detective is looking for three guys: guy 1, guy 2 and guy 3 and he didn't find any of them: he didn't find guy 1 and he didn't find guy 2 and he didn't find guy 3. If so, it follows that the detective didn't find say, guy 1 and guy 2 or guy 1 and guy 3; that is, some of the guys. Put another way, if it is true of every guy that they weren't found by the detective then it is true of the some

them. The narrow scope reading therefore entails the wide scope reading. This entailment relation is represented in figure 2.

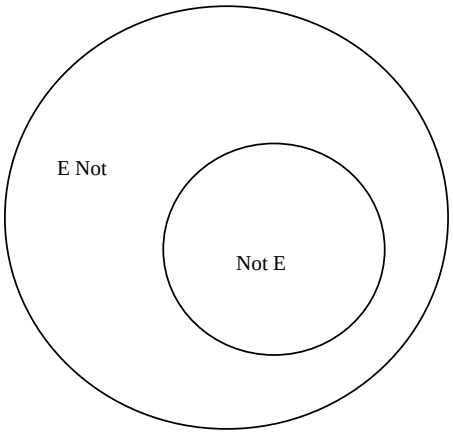



**Figure 2: [not ∃ ] entails [ ∃ not]**

As in the previous case, sentences like (7) create a semantic subset problem since by assumption both the wide scope and the narrow scope reading are made available by UG and in this case, the narrow scope reading entails the wide scope reading. The SSP therefore predicts that learners should initially (incorrectly) assign sentences like (7) a narrow scope reading, since this represents the subset case. Here again, this prediction is confirmed by the results of experiment 3.

In sentences like (8), we found that some children did not allow phrases like *two slices of pizza* to take wide scope over negation. Instead, they interpreted *two slices of pizza* in the scope of negation. In other words, they understood (8) to mean that the number of slices of pizza that Cookie Monster ate was not two.

(8) Cookie Monster didn’t eat two slices of pizza.

Let us call the wide scope reading, the reading of (8) on which it can be paraphrased as *There are two slices of pizza that Cookie Monster didn’t eat* (two > not) and the narrow scope reading, the one on which (8) can be paraphrased as *The number of slices of pizza that Cookie Monster ate is not two (not > two).*

We now need to determine whether there exists an entailment relation between the two readings available for (8). Let us first consider whether the narrow scope reading entails the wide scope reading. Imagine a situation where the narrow scope reading of (8) is true; that is, Cookie Monster ate a number of slices of pizza different from two, say three. Does it then follow that there are two slices of pizza that Cookie monster didn’t eat ? It could, but it doesn’t have to. If we could find a situation where the narrow scope reading is true but the wide scope reading isn’t then we would have proven that the narrow scope reading does not entail the wide scope reading. Imagine a situation where there are three slices of pizza and Cookie Monster eats all of them. In the case, the narrow scope reading is true, since Cookie Monster ate a number of slices of pizza different from two, i.e. three. However, in this particular situation, it is not true that there are two slices of pizza that cookie monster didn’t eat, i.e. the wide scope reading isn’t true since Cookie Monster ate all the pizza. We thus have a situation where the narrow scope reading is true but the wide scope reading isn’t. We can therefore conclude that the narrow scope reading does not entail the wide scope reading.

Next, we need to determine if the wide scope reading entails the narrow scope reading. Let us proceed as we did previously and look for a situation where the wide scope reading is true but the narrow scope reading isn't. If such a situation exists, we can conclude that the wide scope reading does not entail the narrow scope reading. Imagine a situation where there are four slices of pizza. Cookie Monster eats two of them but doesn't eat the two others. In this case, the wide scope reading is true: there are two slices of pizza that cookie monster didn't eat. However, the narrow scope reading is false in this case: the number of slices of pizza that Cookie Monster ate is not different from two since he ate exactly two slices of pizza. We thus have a situation where the wide scope reading is true but the narrow scope reading is not. We can therefore conclude that the wide scope reading does not entail the narrow scope reading.

In summary, there is no entailment relation between the wide scope and the narrow scope reading of sentences like (8), *Cookie Monster didn't eat two slices of pizza*. The narrow scope reading does not entail the wide scope reading nor does the wide scope reading entail the narrow scope reading; as shown in figure 3. Therefore sentences like (8) do not pose a semantic subset problem. The SSP, therefore, does not apply.

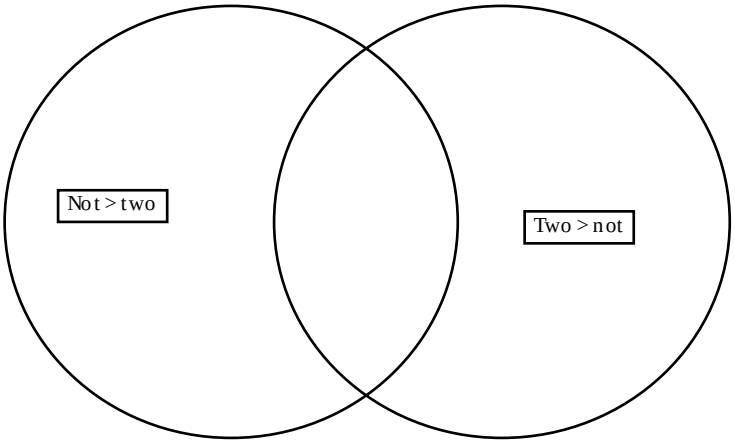



**Figure 3: No entailment relation between *not two* and *two not***

Summarizing our discussion so far, we have been considering whether children's non-adult interpretations of sentences containing negation and QNPs could be reduced to a semantic subset problem and, hence, derived from the SSP. We saw that for sentences like *Every horse didn't jump over the fence* and *The detective didn't find some guys*, children's initial isomorphic interpretations can be successfully derived from the SSP. In the first case, the wide scope reading (every > not) entails the narrow scope reading (not > every) and children, as learners, initially opt for the subset case, i.e. the wide scope reading. In the second case, the narrow scope reading (not > some) entails the wide scope reading (some > not). It therefore comes as no surprise that children initially hypothesize the narrow scope reading, i.e. the subset reading. For sentences like *Cookie Monster didn't eat two slices of pizza*, however, no entailment relation holds among the alternative interpretations, i.e. the wide scope reading (two > not ) and the narrow scope reading (not > two). In this case then, the SSP has no reason to apply. The upshot of this discussion is that the interpretation of sentences containing negation and QNPs only partially reduces

to a semantic subset problem. Where it does, the observation of isomorphism can be derived from the SSP but, where it doesn't, we need to seek a different explanation.

Before we do so, let us turn to children's adult-like interpretations of sentences like *The smurf didn't buy every orange* and *Some girls won't play on the merry-go-round*. Recall that one of the fundamental properties of the MMM is its adherence to the Continuity Hypothesis. This hypothesis guarantees learnability. Its specific import here is that sentences that are not ambiguous for adults should also not be ambiguous for children. One can easily see that if they were, children would need to unlearn one of the alternative interpretations at some point in the course of language development. Suppose now that sentences like *The smurf didn't buy every orange* and *Some girls won't play on the merry-go-round* are not ambiguous to the learner. That is, UG only provides one interpretive option in each case. If so, the continuity hypothesis predicts that this unique interpretive option should be the same for children and adults; the desired result.

Another virtue of the Modularity Matching Model is that it makes some predictions regarding which of the interpretations for the sentences we discussed above should be preferred by adults. Among the sentences that we have discussed, only two are ambiguous in the adult grammar of English namely *Every horse didn't jump over the fence* and *Cookie Monster didn't eat two slices of pizza*. Besides, only the alternative interpretations of *Every horse didn't jump over the fence* are arranged in a subset-superset relation. The Principle of Parsimony (see Chapter I) predicts that the interpretation which is true in the broader set of circumstances - the superset interpretation - namely the

interpretation where negation takes scope over *Every horse*, should be preferred by adults in the absence of decisive context. This prediction is borne out since the preferred interpretation of *Every horse didn't jump over the fence* is *Not every horse jumped over the fence*, the superset interpretation.

Summarizing our discussion so far, we have been trying to assess the extent to which children's interpretations of the sentences in (12) can be explained within the Modularity Matching Model.

(12) a. Every horse didn't jump over the fence.
b. Some horses won't jump over the fence.
c. The detective didn't find some guys.
d. The Smurf didn't buy every orange.
e. Cookie Monster didn't eat two slices of pizza.

In particular, we have considered the role of the Semantic Subset Principle and the continuity hypothesis. On the assumption that more than one interpretive option is made available by UG for sentences like (12a, c, e), we saw that the SSP offers an account of children's non-adult interpretations of sentences like (12a) and (12c). On the assumption that only one interpretive option is made available by UG for sentences like (12b, d), the Continuity Hypothesis correctly predicts that children and adults should interpret these sentences in the same way. With the MMM, we therefore come close to a derivation of the observation of isomorphism. The only case that falls outside the domain of prediction of the MMM is children's non-adult interpretations of sentences like (12e). What prevents us from giving an account in terms of the SSP here is the fact that one of the

conditions of application of the principle does not hold: the alternative readings of (12e) are not arranged in a subset-superset relation, hence, the SSP has no reason to apply.

We now come back to some of the assumptions we made in our discussion on how the SSP can be applied to account for children's interpretations of sentences containing negation and QNPs. In particular, we made the convenient and arbitrary assumption that sentences like *Every horse didn't jump over the fence*, *The detective didn't find some guys* and *Cookie Monster didn't eat two slices of pizza* are ambiguous to learners while sentences like *Some girls won't ride on the merry-go-round* and *The smurf didn't buy every orange* are not. First, these assumptions are convenient, because we assumed ambiguity precisely where children's and adults' interpretations diverge and we assumed a lack of ambiguity where children accessed the relevant adult interpretations. Imagine for example that sentences like *Some girls won't ride on the merry-go-round* and *The smurf didn't buy every orange* were ambiguous to learners. If so, the SSP would predict that children should initially assign these sentences a narrow scope reading (not > some) and a wide scope reading (every > not) respectively since these represent the subset options. In other words, the prediction is that children should initially interpret these sentences to mean that none of the girls will ride on the merry-go-round and that the smurf bought none of the oranges. Clearly, this wouldn't fit with our experimental findings.

Second, these assumptions are arbitrary, because there is no objective procedure or criterion to determine, independently of the results observed, which sentences are

ambiguous to learners and which ones are not. Obviously, we cannot rely on whether the sentences in question are ambiguous in the adult language to determine whether they are ambiguous to learners. This would lead to a paradox. That is, in the case of *Every horse didn't jump over the fence*, for example, learners would need to know that this sentence is ambiguous in the adult grammar of their target language in order to follow the SSP and hypothesize that the sentence is not ambiguous, i.e. that only the wide scope reading is initially available. Clearly, what we need here is an intentional (i.e., I-Language) notion of ambiguity, not an extensional (i.e., E-Language) one. However, as long as the problem is posed in terms of sentences, i.e. does sentence such and such create a semantic subset problem, it is an ill-posed problem. Sentences are pieces of E-language, not I-language.

### 2.3 The roots of isomorphism

So, why should isomorphism hold in children's grammars ? In particular, why are children's interpretation of sentences containing QNPs and negation fixed by the overt relations between these elements ? Recall from our discussion in chapter I that the class of QNPs can be partitioned in two groups: (a) type II QNPs whose interpretation is fixed grammatically, i.e. via movement operations. Recall that these are the quantifiers whose interpretation is fixed by their overt position with respect to negation and (b) type I QNPs which, in addition to functioning like type II quantifiers, are also subject to an extragrammatical (i.e. non-movement based) wide scope interpretive mechanism of the type described by Reinhart (1995). In this light, isomorphism can now be seen as a property of type II quantifiers. The question now is why children interpret all QNPs as

though they were of type II. By now, the answer should be obvious: type I QNPs have more interpretive options than type II QNPs: type I QNPs have the interpretive options of type II QNPs plus the availability of a distinct wide scope mechanism. It should therefore come as no surprise that children initially treat QNPs as being of type II; the more restrictive option. If, on the other hand, children were to initially assume that QNPs were of type I and hence had two possible interpretive options, they would be at risk of massively overgenerating. In other words, initially treating QNPs as being of type II can be seen as a more conservative strategy driven by learnability considerations. Thus, the general line of conduct is to assume that a QNP is of type II until there is positive evidence that it is of type I, i.e. that it can take wide scope with respect to negation in the object case. Note that if children assume that a QNP is of type II and it is in fact of type I, there will *always* be positive evidence for the possible wide scope interpretation. If on the other hand children assume that a QNP is of type I - and has the wide scope option - whereas the QNP is in fact of type II, they will need negative evidence to indicate to them that the wide scope reading is *not* available.

There is an interesting point of detail that we need to consider now. Until now, I have been implicitly assuming that type I quantifiers have a proper superset of the interpretive options available to type II QNPs. This is not quite true though. In fact type I QNPs come in two flavors: those for which the WSIM (Wide Scope Interpretive Mechanism) is one of two possible options and those for which the WSIM is the only interpretive option. Let me illustrate this point with two familiar examples.

(15) a. The detective didn't find some guys
b. Cookie Monster didn't eat two slices of pizza.

*Some guys* in (15a) must be interpreted via WSIM since the narrow scope reading is impossible in this case. In (15b) on the other hand, *two slices of pizza* can either receive a narrow scope reading, in which case it behaves like a type II quantifier (i.e. like *every*) or it can receive a wide scope reading via WSIM. Therefore only type I QNPs like *two N* have a true superset of the interpretive options available to type II QNPs. Type I QNPs like *some N* or *a certain N* only have one possible reading: they must take wide scope[13]. In view of this refinement, let us slightly complicate the terminology. We still have two types of QNPs: type I and type II. But we now have two subtypes of type I QNPs. Type Ia QNPs which must be interpreted via WSIM and thus always receive wide scope (i.e. *some N*, *a certain N*) and Type Ib QNPs which are ambiguous between a type II reading and a reading given by WSIM reading (i.e. *two N*).

As we noted, children initially treat QNPs as being of type II for learnability reasons. Type II QNPs only have a subset of the options available to type I QNPs. However, this is true only of Type Ib QNPs. Type Ia QNPs do not have a proper superset of the options available to type II QNPs since type Ia QNPs precisely lack the narrow scope option which is characteristic of type II QNPs. Therefore, children initially treating QNPs to be of type II are expected to face learnability problems in case they are actually dealing with a type Ia QNP. Concretely, children who initially hypothesize that *some N* must be interpreted in the scope of negation will later on have to unlearn this option since *some N*

can only be interpreted outside the scope of negation, i.e. it must take wide scope via WSIM. We began by arguing that initially treating QNPs as though they were of type I would create learnability problems in case

the QNPs in question are of type II. We just argued now that initially treating QNPs as though they were of type II also creates learnability problems just in case the QNPs in question happen to be of type Ia. The upshot is that either way, we face learnability problems. So why assume that QNPs are initially of type II since a priori, this doesn't seem to be a better option than initially taking them to be of type I ? The reason is that if children initially assume that QNPs are of type II, whereas in fact they are of type I, they will *always* have positive evidence of the possible wide scope reading. If, on the other hand, children initially assume that QNPs are of type I whereas in fact they are of type II, there is no positive evidence which guarantees that they will always unlearn the incorrect wide scope readings. So from a learnability perspective, initially assuming that QNPs are of type II is a better solution than initially assuming that QNPs are of type I since globally, type I QNPs have a superset of the interpretative options available to type II QNPs.

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[13] It should be emphasized here that QNPs like *some N* or a *certain N*, which

In sum, the approach taken here does view the acquisition of quantifier-negation interaction as creating a subset problem. It is therefore similar in spirit to an approach in terms of the SSP. However, on this approach, the subset problem is posed differently. Instead of focusing on individual sentences to determine whether they create a semantic subset problem (i.e. whether UG allows alternative interpretations for them and if so, whether there are any entailment relations among them) the focus is shifted to an intensional binary parametric choice. The parameter in question determines, in a global way, the number of interpretive options available to QNPs. The two choices are as follows: (a) QNPs have interpretative option A (i.e. they are of type II) or (b) QNPs have interpretive options A and B (i.e. they are of type I). Note now that (a) and (b) are arranged in a subset-superset relation. (a) is a subset of (b). Learners initially opt for option (a), i.e., the subset option, thereby initially treating all QNPs as being of type II, without ever having to worry about relations among the sentences that would be generated by a grammar with option (a) of the parameter vs. a grammar with option (b).

The case of *every* in subject position illustrates the approach taken here. We observed that the behavior of *every* in subject position appears to be parametrized. In languages like English, two readings are available with respect to sentential negation: a wide scope reading and a narrow scope reading. Note here that the wide scope reading is the isomorphic one since subject *every N* c-commands negation (or occurs to the left o negation) in the surface string. So on the wide scope reading, *every* is a well-behaved type II quantifier. In Chinese, on the other hand, only the isomorphic reading is possible.

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always take wide scope are the true type I QNPs in Hornstein's (1984) sense.

That is *every N* must be interpreted outside the scope of negation. The examples are repeated below.

(16) Every horse didn't jump over the fence
  a. Every > not
  b. Not > every

(17) Mei-pi ma dou mei tiao-guo langan
*Every horse didn't jump over the fence*
  a. Every > not

Thus, in this case, Chinese has a proper subset of the options available in English. It should therefore come as no surprise that children initially assume that *every* only has one interpretive option in the subject case and thus behaves like in Chinese. If it turns out that the language children are learning is in fact English, then there will be positive evidence for the non-isomorphic narrow scope reading. Suppose now that children were to initially assume that *every* has two possible options in the subject case, like in English, but that in fact their target language is Chinese which only allows the isomorphic reading. This situation would create a learnability problem since the non-isomorphic narrow scope option would need to be unlearned.

This is a typical subset-superset argument. We should ask, therefore, how it is different from the Semantic Subset Principle argument. Recall that the SSP argument is based on the entailment relation between alternative interpretive options. As it turns out the wide scope reading (every > not) is the subset reading and we found that it is indeed the interpretation children initially choose, in compliance with the SSP. As we just saw,

there is in fact a different way to get the same result. Suppose UG makes two options available: languages can be of the Chinese type or of the English type. If a given language is of the Chinese type then only the isomorphic reading is possible. If it is like English, two readings are possible: the isomorphic reading and the non-isomorphic one. Here, there is no need for the learner to compute what the different options mean or entail to decide which one to pick. The simple fact that one system (i.e. Chinese) is more restrictive is sufficient to force learners to initially adopt it. In sum, if learners have a choice between initially picking a system with option 1 or a system with option 1 and 2 they do not need to know the nature or relation between the options to decide which system to pick. As I suggested above, this approach can be generalized to the problem of quantifier-negation interaction on the assumption the difference between type I and type II QNPs is encoded in UG. Given the existence of two types of QNPs and the fact that type I QNPs allow for two interpretative options (isomorphic and non-isomorphic) whereas type II quantifiers only allow for one (isomorphic), we need not worry about the entailment relations between alternative readings of specific sentences on a case by case basis. Rather, the problem should be defined and solved on a more general level: the intentional (I-language) choice that learners face is to decide whether they will initially treat QNPs to be of type I or II, independently of the sentences in which they occur.

Thus, we have posed the acquisition of quantifier-negation interaction as an intensional (i.e. I-language) subset problem. That is to say, we suggested that learners need not perform any computations on sentences containing negation and QNPs, since sentences can only be defined extensionally (i.e. in terms of E-language). Rather, we

argued that learners made an intensional choice between two options encoded in UG: initially treating QNPs as being of type I or of type II. We claimed that learners were driven to make the initial assumption that QNPs were of type II for learnability reasons. Implicit in this claim is the assumption that learners are designed to avoid subset problems. Fodor (1989) discusses three ways in which this can be realized:

> "(i) The values of all parameters might simply be listed innately inside the learner's head in a fixed order which satisfies the Subset Principle, and he would take them in turn, not moving from one to the next until the facts forced him to.
> (ii) The possible values of each parameter might be innately specified but unordered, and when faced with a choice between them the learner would choose extensionally, i.e., he would work out which value would result in the least inclusive language.
> (iii)The values might be unordered but the learner would have an innate selection criterion by reference to which he would make intensional choices, i.e., choices involving comparison of the mental representations of the alternative parameter values." (p.136-137)

Let us consider these alternatives in turn. Fodor argues that alternative (i) is only feasible if the number of parameters is small and their values are limited. In particular, she argues that if core and peripheral properties of the grammar form a continuum (as she believes), then parameters would have to accommodate for all possible crosslinguistic variation. As Fodor puts it, if this were so "a enormous amount of brute innate listing of ordered

parameter values would apparently be required in the infant brain, and this seems implausible - or, to put it more mildly, it would seem implausible if we could think of some more projectible, less storage oriented alternative." (p.137). Fodor argues that if learners satisfy the subset principle along the lines suggested by alternative (ii) i.e. by means of extensional comparison among languages generated by different grammars then, "Alternative (ii), extensional selection, thus requires learners to be equipped with mental apparatus which they otherwise would not need. As long as there is some alternative, it therefore loses on general scientific grounds of parsimony." (p.138). Fodor comments that "This leaves us with alternative (iii), the intentional choice mechanism: children have grammars in their heads, and when they choose, they choose between grammars. That is, they have some sort of selection criterion which refers to the formal representations of grammars, and picks one on the basis of some property of its representation. This selection criterion must reliably choose subset languages ... Ideally it will be systematic and have broad coverage, unlike alternative (i). And unlike alternative (ii), it will not presuppose any psychological mechanism that brings no benefit besides selecting subset languages. What sort of criterion could possibly satisfy all these conditions ? A very traditional suggestion is that it is a simplicity metric. The idea is that the child just picks the simplest available grammar compatible with his data, i.e., the one that takes the fewest symbols to represent in whatever the canonical mental notation for grammar formulation is." (p.142). The solution that I proposed to derive the observation of isomorphism can be made to fit nicely with Fodor's views on the way learners obey the subset principle. First, I argued that the choice that learners have to make is intentional (learners choose between grammars, not languages), i.e., they have to

determine whether to initially assume that QNPs are of type I or type II. Second, this choice can be made on the following simplicity metric: one interpretive option (i.e. type II QNPs) is simple than two interpretive options (i.e. type I QNPs).

## 2.4 There is no 'isomorphism principle'

### 2.4.1 A second look at previous QNP-Neg findings

Chapter I reviewed two studies that bear on the acquisition of quantifier-negation interaction in English: O'Leary (1994) and Thornton (1995). Let us consider these findings again. O'leary observed that children had a tendency to produce *some* in the scope of clausemate negation in contexts where *any* would have been appropriate. In other words, these children were incorrectly using *some* in narrow scope contexts. This is shown in (19).

(19) So he didn't get some money (E.G. 4;10)

In her study, Thornton observed that children assigned questions like (20a) an interpretation where *every* takes wide scope with respect to negation (every > not) and that they assigned questions like (20b) an interpretation where negation takes scope over *every* (not > every).

(20) a. What did every rabbit not buy ?
b. What didn't every rabbit buy ?

What these results show once again is that children's interpretations are determined by the overt syntactic relations between negation and QNPs. In (19) children produce *some* in a narrow scope context since in the surface string *some money* occurs in the scope of negation. Thus, O'Leary's production results are fully parallel to the interpretation results that we obtained in chapter II. Thornton's results also parallel our findings. The reason children assigned (20a) an interpretation where *every* takes scope over negation (every > not) is due to the fact that in the surface string, *every* takes scope over negation. Similarly, children assigned (20b) an interpretation where negation takes scope over *every* since in this case, negation c-commands (or precedes) the subject position, i.e. *every rabbit*. Here again, isomorphism can be observed.

### 2.4.2 Isomorphism is just an observation - not a principle

My concern is the following: I can easily imagine someone reading my work and thinking: "I see, Musolino has this principle of isomorphism - not a new idea by the way - and he predicts that children will interpret QNPs where they occurs in the surface string". The trouble with this thinking is that it is exactly what I DO NOT claim or even think. First, there is no Isomorphism Principle, at least as far as I am concerned. Maybe James Huang would think differently for Chinese, but this is besides the point. What we are concerned with here is how children interpret QNPs with respect to negation in English, not how quantification in general works in adult Chinese. There is, however, an *observation* of isomorphism but as I tried to show, this observation can be derived from learnability considerations in conjunction with a typology of QNPs. I never invoked an

Isomorphism Principle to explain my findings. Rather, I believe that isomorphism in this case is epiphenomenal in the sense that it is an emergent phenomenon which results from the interplay of linguistic principles; namely principles of UG, coupled with the demand that languages be learnable. Thinking that I believe in a principle of isomorphism amounts to thinking that after 1981, Chomsky believes that there is a rule of passive or a rule of relative clause formation. In the P & P framework, both of these are taxonomic artifacts; and so would be a putative principle of isomorphism.

Second, the account I have given does not make any predictions in the domain of quantifier-quantifier interaction when the QNPs involved are of type II. That is, there is no reason to expect isomorphism in this domain (in children's grammars of course). Let us see why. The reason we observed isomorphism in the acquisition of QNP-Neg interaction is because children, I argued, initially treat QNPs as being of type II and the interpretation of type II QNPs with respect to negation happens to be fixed by their overt position. This does not mean however, that type II QNPs do not interact with each other and with other QNPs. Recall that in *Somebody loves everybody*, the object, a type II QNP can take scope over the subject. The upshot, then, is that children initially treat QNPs as though they were of type II and these QNPs display scope ambiguity, albeit not with negation. It therefore becomes an empirical matter to decide whether children map quantifier scope isomorphically when the QNPs are of type II and this bears no consequence on the account I developed. Once again, QNP-Neg interaction and QNP-QNP interaction (when the QNPs are of type II) are different phenomena. There is one general prediction of my account however: the basic difference between type I QNPs and

type II QNPs is that only the former can exhibit scope independence (as we discussed in chapter I). Consequently if children begin by assuming that QNPs are of type 2, they should not initially have access to scope independent readings in QNP-QNP interactions where the QNPs are of type I. We will see in our next section that this prediction is indeed borne out by Lee's (1996) findings.

### 2.4.3 Another look at QNP-QNP findings

In this section, I reconsider the findings from the studies on the acquisition of QNP-QNP interaction discussed in Chapter I in light of my findings and the account I have offered. Since QNP-QNP and QNP-Neg interaction are not one unique phenomenon, I point to areas where previous findings on QNP-QNP interaction are relevant to the approach developed here and other areas where they are not. I begin my discussion with Lee's (1996) study, then move to Lee (1991) and finally, I reconsider Philip's (1995) study.

Recall that Lee's (1996) study focused on Chinese children's interpretation of the types of sentences below, among others:

**21. Universal quantifier subject; numeral phrase object**

Souyoude shushu dou tiaozhe liang tong shui
all uncle each carry-on-shoulder two bucket water
'All the men are carrying (on their shoulder) two buckets of water'

**22. Numeral phrase subject; numeral phrase object**

You sange shushu tiaozhe liang tong shui
Exist three uncle carry-on-shoulder two bucket water
'Three men are carrying (on their shoulder) two buckets of water'

The two readings of concern to us here are what Lee called the *distributive* reading, a scope dependent reading, where the subject has a wide scope reading and the *cumulative* reading, a scope-independent reading. To recast these readings in terms of our own terminology, the distributive reading is a type II reading and the cumulative reading is the prototypical type I reading ( see chapter I). According to Lee, about half of the 4-year-olds and 80% of the 5-year-olds rejected the cumulative readings for sentences with object numerals like (21). Regarding children's interpretation of sentences like (22) with a numeral subject and a numeral object, Lee remarks that "a surprising finding of our study is that unlike adults [who assigned a cumulative reading], 4 and 5-year-olds overwhelmingly favored the distributive interpretation. The fact that children reject the cumulative reading in favor of the distributive reading indicates that they treat the QNPs as being of type II instead of being of type I, as predicted. Thus, Lee's findings provide crosslinguistic support for the approach developed here.

Consider now the findings of Lee's (1991) study. The test sentences are repeated in (23) and (24) below:

(23) Type 1 sentences

a. X zai yige dengzi shang fang meigen shengzi
   *'X puts every string on a stool'*
b. X zai meige dengzi shang dou fang yigen shengzi
   *'X puts a string on every stool'*

(24) Type 2 sentences

a. X fang yigen shengzi zai meige dengzishang
   *'X puts a string on every stool'*
b. X fang meigne shengzi zai yige dengzishang
   *'X puts every string on a stool'*

Recall that Lee's linearity principle predicts that in each case, the subject QNP (QNP1) should take wide scope over the object QNP (QNP2). Lee's main finding is that the linear interpretation of QNP1 and QNP2 seems to be acquired gradually. Specifically, the percentage of an age group who consistently selected the wide scope interpretation of QNP1 across sentence types starts at around 10% at age 3, raises to approximately 40% at age five and reaches 70 to 80% by age 7. Lee observes that the gradual strengthening of linearity correlates with the decline in the wide scope reading of QNP2 between the age of 4 and 7. In this case, Chinese speaking children do not seem to map semantic scope and syntactic scope isomorphically but again, as far as the approach I have taken, we had no particular reason to expect isomorphism to hold. Let me therefore speculate as to why Chinese speaking children, unlike adults, seem to initially treat the examples above as though they were ambiguous.

An interesting difference between English and Chinese, that we already observed in chapter I is that English allows scope ambiguity in sentences like (23) and (24) above

while Chinese doesn't. Chinese speaking children therefore appear to treat these sentences as though they were sentences of English, i.e. displaying scope ambiguity. Before offering any insight as to why Chinese speaking children behave in the way observed by Lee, let me spell out some recent ideas by Hornstein (1995) regarding quantifier scope in the two languages in question, English and Chinese. Hornstein's minimalist goal is to get rid of rules such as QR. Instead, he proposes an account of quantifier scope ambiguity based on properties of A-chains. Hornstein's account rests on the following assumptions:

(25) At the CI [Conceptual Intentional] interface, an A-chain has at most and at least one lexical element.
(26) A quantified argument Q1 takes scope over a quantified argument Q2 iff Q1 c-commands Q2 (and Q2 doesn't c-command Q1) [at LF]
(27) A definite argument must be outside the VP shell at the CI interface
(28) NPs in English begin in VP internal positions and move out of the VP shell to Spec Agr positions for case checking.
(29) Movement is copying and deletion.

With these assumptions in mind, consider the ambiguous sentence of English in (30).

(30) Someone attended every seminar (adapted from Hornstein 1995)

Hornstein proposes the phrase marker in (31) as an LF representation of (30), after case checking has applied.

(31) [$_{AgrS}$ someone [$_{TP}$ Tns [$_{AgrO}$ every seminar [$_{VP}$ someone [$_{VP}$ attended every seminar ]]]]]

Let us briefly consider the derivation of the phrase marker in (31). Both arguments of the verb, i.e. *someone* and *every seminar* initially occupy their VP internal positions. As the derivation proceeds both of these phrases need to raise out of the VP shell in order to check case. A copy of *every seminar* and a copy of *someone* are merged to AgrO and Tense respectively where checking of case features against the appropriate heads can take place. Next deletion must apply as the two A-chains in (31) each have two members; and Hornstein consider the following four possibilities.

(32) a. [$_{AgrS}$ someone [$_{TP}$ Tns [$_{AgrO}$ every seminar [$_{VP}$ ~~someone~~ [$_{VP}$ attended ~~every seminar~~ ]]]]]

b. [$_{AgrS}$ someone [$_{TP}$ Tns [$_{AgrO}$ ~~every seminar~~ [$_{VP}$ ~~someone~~ [$_{VP}$ attended every seminar ]]]]]

c. [$_{AgrS}$ ~~someone~~ [$_{TP}$ Tns [$_{AgrO}$ ~~every seminar~~ [$_{VP}$ someone [$_{VP}$ attended every seminar ]]]]]

d. [$_{AgrS}$ ~~someone~~ [$_{TP}$ Tns [$_{AgrO}$ every seminar [$_{VP}$ someone [$_{VP}$ attended ~~every seminar~~ ]]]]]

According to Hornstein, (32b) and (32c) will crash at the CI interface since *every seminar*, a strong quantifier (i.e. definite in Diesing's sense) occurs in the nuclear scope, i.e. the VP shell. The two remaining options, (32a) and (32d) represent the subject wide scope and the object wide scope reading respectively. Hornstein proposes to extend this approach to languages like Chinese where quantified objects cannot take scope over quantified subjects in sentences like (30). In order to do this, Hornstein assumes the approach outlined above and the assumption from Aoun and Li (1993) that Chinese subjects are base generated in AgrS, unlike in English where they are base-generated inside the VP and raise to AgrS. The LF representations of a sentence like (30) in the two languages and before deletion are given below.

(33)a. $[_{AgrS}$ Subject $[_{TP}$ Tns $[_{AgrO}$ object $[_{VP}$ subject V object ]]]] (English)
b. $[_{AgrS}$ Subject $[_{TP}$ Tns $[_{AgrO}$ object $[_{VP}$ V object ]]]] (Chinese)

As we saw above the object wide scope reading in English obtains after deletion of the subject copy in AgrS and the object copy in VP. Notice now that in the Chinese representation in (33b), whether the AgrO or the VP copy of the object deletes does not change the fact that the subject always has wide scope. Thus, the difference between English and Chinese vis-à-vis scope ambiguity in sentences like (30) reduces to where subjects are base generated. An interesting question raised by this account is which of the two options is unmarked: base generating subjects inside or outside the VP shell.

Suppose for the sake of the discussion that the unmarked option is to generate subjects inside the VP shell. In this case, English would become the unmarked case and we may therefore expect children to initially allow quantified objects to take wide scope over quantified subjects. This is indeed what Lee (1991) found Chinese speaking children to do until the age of about 7. I do not wish to offer this account as an explanation for Lee's data but simply to point to a possible direction. This discussion however, illustrates a point I have tried to emphasized before. What we observe in the acquisition QNP-Neg and QNP-QNP interaction need not be similar. For example, the expectation or the prediction that isomorphism should be observed in the acquisition of QNP-QNP interaction because it is observed with QNP-Neg interaction rests on the erroneous assumptions that both phenomena involve the same underlying mechanisms. If we adopt

Hornstein's approach, as sketched above, QNP-QNP interaction arises as a consequence of the syntax of A-chains. QNP-Neg interaction, on the other hand must involve a different mechanism. This becomes clear if we consider the LF representation of a sentence like (34) containing sentential negation which is standardly assumed to reside at least above AgroP (e.g, Pollock 1989, Chomsky 1991)

(34) a. $[_{AgrS}$ Subject $[_{TP}$ Tns NEG $[_{AgrO}$ object $[_{VP}$ subject V object ]]]]

Here, no matter which copies are deleted there is simply no way that the object can have scope over negation, since it c-commands both copies. This shows once again that QNP-QNP and QNP-Neg interactions should be not be conflated and that observations in one domain are not necessarily expected to hold in the other. Thus, we observed that isomorphism holds in the acquisition of QNP-Neg interaction in English but not in the acquisition of QNP-QNP interaction in Chinese and there is nothing odd or contradictory about this fact. After all, children have also been observed to adhere to principle C but not to principle B (e.g., Crain and Thornton (in press), Chien and Wexler 1990).

Let me now say a few words about Philip's (1995) account. We discussed two types of non-adult responses given by children to questions containing the universal quantifier such as *Is every farmer feeding a donkey* or *Is a farmer feeding every donkey* ? The symmetrical response where children seem to require a one-to-one mapping between farmers and donkeys and the exhaustive response where every object in the picture must enter in the feeding relation described by the sentence. To account for these findings,

Philip proposes that children treat *every* roughly as an adverb of quantifcation (i.e. as quantifying over more than one nominal in matrix clauses) and that at the relevant stages, children also have a preference for quantification over events. The first question that comes to mind is whether Philip's analysis could account for our own findings regarding children's interpretation of the universal quantifier in negated clauses. What would be hard for Philip to explain, I think, is the asymmetry that we observed between children's interpretation of (35a) and (35b).

(35) a. Every horse didn't jump over the fence.
b. The smurf didn't buy every orange.

Recall from chapter II that children do not seem to have access to one of the two possible adult interpretations of (35a), namely the one where negation takes scope over *Every horse* (not > every). Suppose for the sake of the discussion that children's non-adult behavior in this case was to be explaining by Philip's analysis in some way. Under this view however, it would be mysterious why children correctly interpret *every orange* with respect to negation in (35b), as we observed in chapter II. Both sentences contain a universally quantified NP and a definite NP and both contain sentential negation. The only difference is that the universally quantified NP occurs in subject position in (35a) and in object position in (35b). Unless I am mistaken, this difference should play no role in Philip's analysis and his account should predict that children either misinterpret both sentences or correctly interpret both. Clearly, this prediction is not borne out and I leave this asymmetry as an open problem for Philip's account.

Unlike Philip, I do not make claims about the way children interpret the word *every* itself. Rather, I am concerned with the way children interpret the universal quantifier when it interacts with sentential negation. Therefore, there is little to say about his findings. Let me simply point the reader to Crain et al. (1996) for an extensive review and critique of Philip's study. In a nutshell, this argues that Philip's analysis poses severe learnability problems. The paper concludes that Philip's findings are due to flaws in experimental design. Crain et al conclude from their own experiments that " ... children have full grammatical competence with universal quantification" (p.83). As a final note, let me add that Lee's (1996) findings on Chinese fail to support Philip's observations.

## 3. Summary

In this chapter, we observed that in the domain of quantifier-negation interaction, English-speaking children, unlike adults, map overt syntactic scope (the overt position occupied by negation and QNPs) and semantic scope (the relative interpretation of negation and QNPs) isomorphically. We began by considering whether children's non-adult behavior could be accounted for in terms of a difference in parsing preferences, a lack of sensitivity to contrastive stress or, finally, by assuming that children have a limited processing capacity. These accounts, in addition to the empirical problems they may raise, all have in common the fact that they rely on the existence of a putative difference between children and adults. From a methodological point of view, however, postulating the existence of differences between children and adults should be a last resort option. If an account could be found which did not rely on such putative differences, it would therefore be preferred on conceptual grounds. In light of these

methodological desiderata, we considered children's and adults' interpretations of sentences containing negation and QNPs in light of the Modularity Matching Model (Crain and Thornton, in press). Specifically, we explored the possibility that the observation of isomorphism can be derived from the application of the Semantic Subset Principle, coupled with the Continuity hypothesis. Our conclusion is that the SSP offers at best a partial derivation of isomorphism. The account that I have offered rests on the interplay between principles of UG and learnability considerations and is therefore similar in spirit - although not in implementation - to the logic underlying the SSP. Specifically, this account relies on a universally encoded distinction between two types of QNPs: those whose interpretation is determined grammatically, i.e. via movement operations, type II QNPs; and those whose interpretation, in addition to the former option, can also be determined via an extragrammatical, i.e. non-movement-based, interpretive mechanism. In light of this dichotomy, explaining the observation of isomorphism amounts to determining why children initially treat all QNPs as being of type II. Since type II QNPs have a subset of the interpretive options available to type I quantifiers, children's initial choice is motivated by learnability considerations and in particular, by the need to make a choice which would not require access to negative evidence if it turned out to be incorrect. Finally, I emphasized that this account makes no further predictions regarding how children determine relative quantifier scope between QNPs of type II. In our final chapter, we turn to another question, namely how children eventually manage to move from their non-adult system of interpretation to the correct adult one on the basis of positive evidence only.

# CHAPTER IV

## On the way to adulthood

Having established that children's interpretations of sentences containing negation and quantified NPs differ from those of adults, I now show how it is possible for children to move from their system of interpretation to the adult system, in the absence of negative evidence. We discussed three cases where the interpretation of children and adults diverge (a) sentences like *Every horse didn't jump over the fence* (b) sentences like *Cookie Monster didn't eat two slices of pizza* and (c) sentences like *The detective didn't find someone*. In (a) and (b), two readings are available for adults but only one of them is initially available for children, namely *every* > *not* and *not* > *two* respectively. Children are therefore restricted to one of the two possible interpretations available in the adult grammar. This, in itself, does not pose a learnability problem: children simply need to realize than an extra interpretation is available for sentences like (a) and (b), namely *not* > *every* and *two* > *not*, respectively. Thus, children simply need positive evidence of the availability of these interpretations. We will return to what this evidence might be. On the other hand, children's interpretation of sentences like (c) *The detective didn't find someone* poses a potential learnability problem since they interpret *someone* in the scope of clausemate negation; an option which is not available in the adult grammar. The question here is how do children manage to abandon this incorrect interpretation in the absence of negative evidence ? I will suggest that there exists a piece of linguistic knowledge which can be learned on the basis of positive evidence alone and whose

incorporation into children's grammars has the effect of compelling them to expunge their incorrect interpretation and thus converge on the adult grammar.

## 1. Adding an extra interpretation

The task that children face in order to arrive at the correct set of adult interpretations for sentences like (a) *Every horse didn't jump over the fence* and (b) *Cookie Monster didn't eat two slices of pizza* is to learn that an interpretation that they had not initially hypothesized is available in each case. Specifically, children need to learn that negation can take scope over *Every horse* (not > every) and that *two slices of pizza* can take wide scope over negation (two > not). There are two ways in which this can be achieved: via direct positive evidence or indirect positive evidence. Direct positive evidence that sentences like *Every horse didn't jump over the fence* allow a narrow scope interpretation (not > every) consists in hearing a sentence of this type used in situation which makes it true under a narrow scope interpretation. Imagine for example, a situation where soup and fries are served for dinner. Suppose that everybody at the table finishes his fries but only 3 out of 4 people finish their soup. In this situation, the child's mother may say: "I see that everybody finished his fries but everybody didn't finish his soup !". Since it is true in this particular situation that not everybody (not > every) finished his soup but false that nobody finished it (every > not), -since three people actually did finish it; the child would realize that *everybody didn't* can mean *not everybody did* and hence that sentential negation can take scope over a universally quantified subject.

In a similar vein, children can learn that sentences like *Cookie Monster didn't eat two slices of pizza* may receive a wide scope interpretation (two > not) by hearing them being used in a situation which makes them true on a wide scope reading. Imagine for example a situation where meat balls are served for dinner. Suppose that the child leaves two meatballs in her plate and told her mom: "I'm done. Can I go play now ?"; to which her mother would reply "No, you're not done. You didn't eat two meatballs". Since there are actually two meatballs that the child didn't eat, her mother's reply would indicate to her that *You didn't eat two meatballs* can be interpreted as *Two meatballs were not eaten*, the wide scope reading.

Indirect positive evidence that sentences like *Every horse didn't jump over the fence* and *Cookie Monster didn't eat two slices of pizza* would be positive evidence of a certain property of say, quantifiers like *every N* and *two N* on the basis of which children may infer their scope properties regarding negation. According to Milsark (1974) and Diesing (1992) weak determiners like *two* are ambiguous between a quantificational reading and an cardinal, adjective-like reading (see, discussion in Chapter I). The fact that object quantifiers like *two N* can receive both a wide scope and a narrow scope reading with respect to negation is certainly linked to the ambiguity described above. Suppose that object quantifiers like *two N* allow a wide scope reading with respect to negation only on their cardinal, adjective like interpretation (after all, we know that purely quantificational QNP such as *every N* only allow a narrow scope reading in this position). If the wide scope reading of quantifiers like *two N* is linked to their possible adjective-like reading, then children may simply need to learn that *two* can be used as an adjective to infer its

possible wide scope property. Such knowledge could come from hearing sentences like *Pass me the two books on the table* where the quantifier *two books* is used with another determiner, *the* on a par with a sentence like *Pass me the blue book on the table*. On the other hand, unambiguous quantifiers like *every N*, cannot be used in this way **Pass me the every book on the table*. Regarding sentences like *Every horse didn't jump over the fence*, it is unclear to me what kind of indirect positive evidence would be needed for children to conclude that sentences of this type can receive a narrow scope interpretation.

## 2. The learnability issue

As we observed, young children incorrectly interpret sentences like *The detective didn't find someone* to mean *The detective didn't find anyone*. This option however, is not available in the adult grammar where the correct interpretation is the wide scope reading of *someone* with respect to negation as in *There is someone that the detective didn't find*. Thus, children need to 'unlearn' their incorrect interpretation; that is, they have to learn that *The detective didn't find someone* cannot mean *The detective didn't find anyone.* However, such information, i.e. negative evidence, is assumed not to be available to learners. We are therefore facing a potential learnability problem. In section 2.1, I review O'Leary's (1994) discussion of this problem and her inability to resolve it. After considering several possible scenarios, O'Leary concludes that " ... The learnability problem still exists." (p.53). The rest of this section is devoted to presenting my own solution to the problem.

Solving this learnability problem amounts to showing that children can unlearn their incorrect interpretation - and learn the correct one - solely on the basis of positive evidence; and I argue that this is possible. Specifically, I argue that in order to accomplish this task children need to learn that *some* and *any* are different morphological realizations of the same lexical item (i.e. *some* and *any* are allomorphs). I show that once incorporated into children's grammars this piece of knowledge has the dual effect of blocking the incorrect narrow scope interpretation of *some* with respect to clausemate negation while enforcing the correct wide scope interpretation. Before I present my solution in full detail however, I need to motivate certain of the assumptions I make. First then, I show in section 2.2 that there are independent reasons to believe that *some* and *any* should be treated as allomorphs. In section 2.3, I discuss a special property of allomorphs called Mutual Exclusivity, which plays a crucial role in my analysis. Finally, in section 2.4, I put the pieces of the puzzle together by juxtaposing allomorphy and Mutual Exclusivity; thereby demonstrating that the learnability problem can be resolved.

### 2.1 The O'Leary-Progovac approach

In her production study, O'Leary (1994) observed that children have a tendency to use PPIs like *some* or *something* with clausemate negation in contexts where *any* would have been required. This is shown again in the examples below:

(1) He didn't get something to eat. (C.E-K. 4;6)
Well they didn't get some food. (E.E. 4;7)

Here's how O'Leary summarizes the situation: "Children used PPIs illicitly with clausemate negation without a wide scope reading ... In the NPI control sentence "None of the penguins found anything to keep their feet warm", 5 of the 11 children tested used "something" rather than "anything" in repeating the puppet's statement, even though they rewarded the puppet." (p.44)

O'Leary, who assumes Progovac's (1994) theory of polarity sensitivity, considers several possible solutions to the puzzle described above, i.e. children's non-adult use of PPIs. We will consider each of these solutions in turn and conclude, as does O'Leary, that none of them provides a solution to the learnability problem. Recall that Progovac treats NPIs as anaphors subject to Principle A of the extended Binding Theory and PPIs as pronominals, subject to Principle B. O'Leary therefore observes that children's non-adult use of PPIs with clausemate negation suggests that they are experiencing difficulties with Principle B. This observation, she argues, has an immediate similarity to other studies done on Principle B (e.g., Chien and Wexler 1990) where children show a virtually perfect command of Principle A (in O'Leary's case children use *any*, correctly) while at the same time showing non-adult command of Principle B. Chien and Wexler (1990) for example, argued that children did have knowledge of Principle B but that they had non-adult knowledge of a pragmatic Principle P which allows coreference between a pronoun and a local antecedent in certain pragmatic contexts. According to Chien and Wexler, knowledge of this principle requires experience. In spite of the similarity between her results and those of Chien and Wexler, O'Leary emphasizes a fundamental difference between the two. In Chien and Wexler's study, children did show adult-like knowledge

when pronouns were used as bound variables as in *Every bear washed her* instead of simply being coreferent with a bare NP as in *Mama bear washed her*. In Progovac's framework, binding of a pronominal PPI by negation is akin to A-bar operator binding not to A-binding. O'Leary therefore concludes:" Thus, unfortunately, the comparison of this study [i.e. her own] to the results of other studies on the binding principles does not extend far." (p.45)

Another possible solution discussed by O'Leary who continues to assume that PPIs should be regarded as pronominals is that children do know Principle B but that they lack an interpretive principle which states that free with respect to binding principles means wide scope. O'Leary suggests that the principle that free means wide scope could be learned from situations where sentences with a PPI and clausemate negation are used in wide scope contexts. However, she comments that: " ... this solution is not especially appealing. The interpretive principle "free = wide scope" is really just a stipulation by Progovac which seems more metaphorical than factual. In addition, there remains a *learnability* problem [my italics]. Children will never learn that free must mean wide scope given the positive evidence cited. To learn that it can only mean wide scope, they would need negative evidence, which is unavailable. Thus, this solution will not be pursued further."(p.46)

A third hypothesis discussed by O'Leary is that children do have knowledge of Principle B and of the interpretive principle that free mean wide scope, but that they do not have perfect knowledge of negation yet. In particular, they do not know that negation

is a potential binder for polarity sensitive items. O'Leary suggests that children may only recognize Progovac's non-overt polarity operator, Pol Op, as a potential binder for polarity sensitive items. In English, on Progovac's account, NPIs such as *any* raise at LF to be bound by Pol Op in spec-CP. O'Leary conjectures that if children do not recognize negation as a potential binder, PPIs would not need to raise since there is no binder in their governing category. This, in turn, would account for children's illicit narrow scope use. O'Leary argues that in order to maintain this hypothesis, Progovac's definition of a governing category needs to be modified. This definition is given below:

> The governing category for X is the first maximal projection Y which contains X and its first potential antecedent.

The problem with this definition is that if children do not know that negation is a potential binder, they will assume that the whole clause is the governing category since it contains the first potential binder, Pol Op. Thus, PPIs would have to raise out of the whole clause to be free which would result in a sentence where the PPI takes wide scope over negation. This is obviously not the interpretation that some children assign. O'Leary goes on to argue that the definition of governing category could be modified and that one could assume Chomsky's (1986) definition in terms of CFC (Complete Functional Complex). Although the benefits from such a move and O'Leary's discussion are unclear to me at that point, she nonetheless ends up rejecting this solution as well. Here's what she concludes: "While Chomsky's (1986) definition of governing category helps support the hypothesis that the reason why the children studied allowed PPIs to coexist with

clausemate negation, this hypothesis itself seems theoretically unappealing. This hypothesis assumes that both NPI and PPI licensing are governed by principle, namely the binding principles. Thus, children's non-adult preferences with respect to PPI licensing reflects their non-adult knowledge of a principle. This result is unattractive. If part of children's knowledge is fragile, it is theoretically more likely to be knowledge which is learned, rather than knowledge given by principle. Innate knowledge would be triggered all at once. Lexical knowledge is knowledge that may be acquired slowly and in pieces. If children have knowledge of a principle, they should know the whole principle, not just parts of it."(p.48,49)

Finally, O'Leary considers another potential solution based on an observation due to Milsark (1974) who claims that determiners like *some* are ambiguous. Consider the following example from Milsark cited by O'Leary:

(2) Some unicorns entered

According to Milsark, (2) can either mean that an indefinite number of unicorns entered the room or that there is a previously established set of unicorns, some of which entered the room while the others stayed outside. On the first reading, *some* is used as an adjective-like cardinality expression and on the second reading, it has a quantificational reading. In Milsark's notation cardinality *some* is unstressed, rendering 'sm' while quantificational *some* is stressed rendering 'some'. O'Leary conjectures that: " Some may be interpreted as taking wide or narrow scope in simple affirmative sentences, depending

on the context of the sentence and the stress placed on some. These influences on the interpretation of some, and thus, its acceptability in certain sentences, are largely pragmatic influences, in the sense that they play a role in making conversation more felicitous. As our experience of conversational norms grows, we learn which situations are appropriate to emphasize and stress some in order to make the meaning of the sentence clearer."(p.51) The idea here is that children's non-adult use of *some* may come from insufficient pragmatic knowledge and a lack of experience distinguishing between the two forms of *some,* 'some' and 'sm'. However, as O'Leary observes herself, this idea won't work either. First, she reports that: "Grammaticality judgments do not conclusively show that adults distinguish between "sm" and "some"."(p.51) Second, she observes that: " ... as we noted before, there is no evidence to lead children to the conclusion that PPIs must take wide scope with respect to clausemate negation. The learnability problem still exists." (p.53). O'Leary's discussion represents a thorough attempt to address the learnability problem raised by children's non-adult use of PPIs like *some*. One possibility that she does not consider, however, is that Progovac's theoretical approach may not be the adequate tool to understand the properties of PPIs. I argue below that this is where the key to solving the learnability problem lies.

## 2.2 Resolving the learnability problem

I now turn to my own solution to the learnability problem discussed above. First, in section 2.2.1, I review the properties of *some* and *any* and present a morphological analysis of the pair. On the basis of a certain empirical facts, I argue that *some* and *any*

are best understood as allomorphs. In section 2.2.2, I discuss the notion of Mutual Exclusivity - an important property of allomorphs - and its use in the literature on language acquisition. Finally, in section 2.2.3, I present what I call the morphological solution to the learnability problem described above.

### 2.2.1 On the status of *some* and *any*

Before turning to the morphological analysis of *some* and *any*, I review their basic properties, beginning with *any*. It is generally believed that *any* belongs to the class of negative polarity items[14] (NPIs), (Baker 1970, Ladusaw 1979, Linebarger 1980, Progovac 1994). The so-called 'negative' behavior of *any* comes from the obligatoriness of negation in an example like (3).

(3) a. John doesn't have any money
b. * John has any money

The paradigm in (3) suggests that NPI *any* needs to be licensed by some element such as negation, for example. It is well-known however that this licensing problem is more complex than (3) might suggest. That is, negation is not the only possible licenser for NPI *any*. For example, *any* can occur in questions as in (4a), in *too*-constructions as in (4b), as the complement of verbs like *refuse*, as in (4c), or in sentences containing the focus operator *only*, as in (4d), to just mention a few examples (for a more detailed list of possible licensing contexts, see Linebarger 1980).

(4) a. Does John have any money ?
b. John is too tired to do any work.
c. John refused to do any work.
d. Only John had any money left.

In the literature on polarity sensitivity, various proposals have been made to characterize the contexts in which NPIs such as *any* are allowed to occur. Some proposed a purely syntactic condition (Klima 1964) or a purely semantic one (Ladusaw 1979), others opted for a syntactico-semantic approach (Progovac 1994) or a syntactico-pragmatic one (Linebarger 1980). While opinions diverge regarding the exact nature of the licensing condition that NPIs are subject to, the fact that they need to be licensed is uncontrovertial. For purposes of the present discussion, we will therefore assume the existence of a condition, call it Condition X, which states that NPIs must be licensed and that they must be interpreted in the scope of their licenser (for a stricter version of this idea, see Linebarger 1980). The exact nature of this condition need not concern us.

**Condition X**

NPIs must be licensed and interpreted in the scope of their licensers.

In addition to its polarity reading, *any* also has what has been called a free choice (FC) reading (Carlson 1981, Horn 1972, Kamp 1973, Kadmon and Landman 1993), as illustrated in the examples below.

(5) a. I don't know any lawyers in the area (NPI)
b. Any lawyer could tell you that (FC)

[14] Free Choice (FC) *any* is discussed below.

The ambivalent behavior of *any*, (i.e. NPI vs. FC), has sometimes given the impression of lexical ambiguity (for discussion of this idea, see Carlson 1981, Horn 1972 and Kamp 1973). NPI *any* is usually regarded as an indefinite determiner with existential force. For example, Ladusaw (1979) offers a battery of arguments in favor of this idea (for similar ideas, see Horn 1972). On the other hand, FC *any* seems to have universal quantificational force. Carlson (1981) for example, observes that only universally quantified NPs can be modified by *almost*, as shown in (6) and that it should therefore not be surprising that it can also modify FC *any* but not NPI *any*, as shown in (7).

(6) a. Almost every man in the room is drunk
b. *Almost some men in the room are drunk

(7) a. * I don't know almost any lawyers in the area (NPI)
b. Almost any lawyer could tell you that (FC)

Finally, it should be noted that in spite of its ability to occur in declaratives (unlike NPI *any*), FC *any* also appears to be subject to a licensing requirement. The contrast illustrated in (8) suggests that the presence of the modal *could* in (8a) may play a role in the licensing of FC *any*.

(8) a. Any lawyer could tell you that
b. *Any lawyer told you that

In sum, *any* has been recognized to function in two ways: either as a negative polarity item (NPI) with existential properties or as a Free Choice (FC) item, in which case it

displays universal quantificational force. For purposes of our discussion, we will restrict our attention to NPI *any* .

It is generally assumed that NPI *any* has a positive counterpart, namely *some*, which is often classified as a positive (or affirmative) polarity item (PPI). The so-called 'positive' behavior of *some* comes from its inability to be interpreted in the scope of clausemate negation as shown in (9).

(9) John didn't solve some problems
  a. $\exists(x)$ [problems(x) & $\neg$ John solved(x)]
  b. *$\neg$ $\exists(x)$ [problems(x) & John solved(x)]

For example, Progovac (1994) offers an account of the behavior of PPI *some* - and its NPI counterpart *any* - in binding theoretic terms, as we discussed earlier. Her account relies on the intuition is that NPIs have anaphoric properties, and hence must be bound - a possible binder being negation - while PPIs are pronominal in nature and therefore cannot be bound by negation. Under this approach, the fact that the phrase *some problems* in (9) cannot be interpreted in the scope of negation comes from the pronominal nature of *some* with respect to negation. Interpreting *some* in the scope of negation is therefore barred as a Principle B violation.

Having reviewed the basic properties of *some* and *any*, I now turn to the particular treatment that I wish to adopt. This analysis, originally proposed by Klima (1964) challenges the common view that *some* and *any* are different lexical items (Baker 1970, Ladusaw 1979, Progovac 1994). According to Klima, structures containing a form of the

quantifier *some N* are subject to a transformational rule of *Indefinite Incorporation* which in certain contexts (such as negatives and questions) obligatorily turns *some* into *any* . In fact, Klima argued that the rule of indefinite incorporation is also responsible for alternations such as *yet* from *already*, *anymore* from *still* etc. I will depart from Klima in assuming that there is no general transformational rule of Indefinite incorporation, as argued in Jackendoff (1969), but preserve his insight that *some* and *any* are morphologically related. I will simply assume that *some* and *any* are allomorphs of the same abstract morpheme, say $\alpha$.

Let me now show that there are reasons to believe that *some* and *any* are morphologically related in the way that I suggest. The evidence comes from the behavior of the pair *some-any* in VP elliptical contexts. The examples below suggest that VP ellipsis can ignore certain features like the presence or absence of negation since *some* and *any*, in (10) and (11), can serve as antecedents for one another; indicating that some form of sloppy identity must be at work there.

(10) John didn't eat any soup but I did
John didn't eat any soup but I did *~~eat any soup~~ /~~eat some soup~~

(11) John ate some soup but I didn't
John ate some soup but I didn't *~~eat some soup~~ /~~eat any soup~~

If so, we should expect other negative polarity items, such as *until*, for example, to behave in the same fashion under VP-ellipsis. Surprisingly however, (13), which is parallel to (10), is unacceptable. The fact that *until* is an NPI is illustrated in (12).

(12) a. John didn't come home until 10.
b. * John came home until 10.

(13) * John didn't come home until 10 but Bill did ~~come home until ten~~.

Under the morphological approach advocated here, this puzzling set of facts receives a natural explanation. On this view the perceptible difference between *some* and *any* is a phonetic illusion and underlyingly (i.e. pre-Spell Out), *some* and *any* are the same morpheme, say α. Let us reconsider the derivation of (10) in this light.

Pre-Spell Out:
Step 1: John didn't eat α soup but I did eat α soup.
Step 2: John didn't eat α soup but I did ~~eat α soup.~~

Post-Spell out:
Step 3: John didn't eat any soup but I did ~~eat α soup.~~

At step 1, the underlying form of *some* and *any*, α, appears in both VPs. At step 2, VP ellipsis can take place[15] under identity: the upper VP [eat α soup] serves as the antecedent for the lower VP, [eat α soup]. At the point of Spell Out where the elements must be phonetically realized, step 3, the question arises as to how α will surface. There are two options: *some* or *any*. In this case, α occurs in the scope of negation where it can be licensed as *any*, as in step 3.

[15] I am assuming a PF deletion theory of ellipsis merely for simplicity of exposition. As far as I can tell, my proposal is neutral between a PF deletion and LF copying approach.

Let us briefly consider the derivation of (11) for the sake of completeness.

Pre-Spell Out:

Step 1: John ate α soup but I didn't eat α soup.

Step 2: John ate α soup but I didn't ~~eat α soup.~~

Post-Spell out:

Step 3: John ate some soup but I didn't ~~eat α soup.~~

At step 1, both VPs are identical and ellipsis can therefore take place, step 2. At the point of Spell Out, α needs to be phonetically realized and in this case only *some* can surface since there is no possible licenser for *any* . Thus, the behavior of the pair *some-any* in VP-elliptical constructions provides evidence for their special morphological status.

Lasnik's (1994) analysis of the English verbal system, developed essentially along similar lines, provides additional support for our approach. In order to explain certain differences between the French and the English verbal systems, Lasnik proposes that English auxiliaries *have* and *be* are fully inflected in the lexicon while all other English verbs are bare in the lexicon. Besides, he proposes that Infl is freely an affix or a set of abstract features. When Infl is featural, verbs must raise to it so that feature checking can take place (Chomsky 1995). On the other hand, when Infl is affixal, it must merge with a verb. This is essentially Chomsky's (1957) Affix Hopping which Lasnik takes to be a PF morphophonemic rule demanding adjacency between the affix and the verb.

Lasnik argues that this approach, in addition to explaining certain differences between the French and the English verbal system, also has the virtue to shed some light on an otherwise puzzling set of facts within the English verbal system itself, originally discussed by Warner (1986). As noticed by Quirk et al (1972) cited in Sag (1976), a finite form of a verb can serve as an antecedent for the deletion site of the bare form of that verb in VP-elliptical contexts. For example, in (14), *slept* can serve as the antecedent of *sleep*.

(14) John slept and Mary will too
a. * John slept and Mary will ~~slept~~ too
b. John slept and Mary will ~~sleep~~ too

This phenomenon can also be observed in (15) where *sleeps* can serve as an antecedent for *sleep*.

(15) John sleeps (every afternoon), and Mary should too
a. * John sleeps and Mary should ~~sleeps~~ too
b. John sleeps and Mary should ~~sleep~~ too

If some form of *sloppy identity* is at work in the examples above, one would naturally expect an example like (16), which is parallel to (14), to be acceptable. Surprisingly, however, it isn't. Here, it seems that an inflected form of the verb *be*, i.e. *was* cannot serve as an antecedent for the bare form. The same holds of *is* and *be* in the example in (17).

(16) * John was here and Mary will too
a. *John was here and Mary will ~~was~~ too
b. * John was here and Mary will ~~be~~ too

(17) *John is here and Mary will too
a. *John is here and Mary will ~~is~~ too
b. *John is here and Mary will ~~be~~ too

Interestingly however, ellipsis can happen when the elided form *be* and its antecedent are the same form, as shown in (18).

(18) John will be here and Mary will too
John will be here and Mary will ~~be here~~ too

In sum, while some form of sloppy identity is apparently possible with main verbs such as *sleep*, auxiliaries like *be* seem to demand strict identity in VP elliptical contexts.

Under Lasnik's approach, this set of facts receives a natural explanation. Recall that on his account lexical verbs are bare in the lexicon while auxiliaries are fully inflected. If VP ellipsis happens at a point in the derivation prior to Affix hopping, then what we believed to be a case of sloppy identity in the examples in (14) and (15) above is in fact ellipsis under strict identity of form. This is shown in below where (14) and (15) are repeated as (19) and (20).

(19) John slept and Mary will too
John past-affix sleep and Mary will ~~sleep~~ too

(20) John sleeps (every afternoon), and Mary should too
John -s sleep and Mary should ~~sleep~~ too

If ellipsis occurs under strict identity of form and auxiliaries, unlike main verbs, are fully inflected in the lexicon, the contrast between (14)-(15) and (16) becomes transparent: an inflected form of *be* cannot antecede the bare form of the verb as shown by the unacceptability of (16) and (17) whereas a non-inflected form of *be* can as shown in (18). Lasnik's analysis is therefore fully parallel to mine: in both cases, what could initially be regarded as sloppy identity between *some* and *any* on the one hand and inflected and bare forms of main verbs on the other, is in fact ellipsis under strict identity of form. Prior to Spell Out, main verbs are bare and *some* and *any* are the same lexical element.

Let us now reconsider the basic facts regarding the distribution and interpretation of *some* and *any* in light of our morphological treatment. Consider (21) and (22) below.

(21) a. John doesn't have any money.
b. *John has any money.

The fact that the realization of $\alpha$ as *any* is subject to a licensing requirement is captured by Condition X, as before. Condition X, however, must be stated as an 'only if' (i.e. one way entailment) condition in view of the fact that distributionally, *some* and *any* are not in strict complementary distribution, as the examples below illustrate.

(22) a. John didn't see anyone
b. John didn't see someone

The realization of α as *any* entails that Condition X is satisfied. However, the fact that condition X is satisfied does not guarantee that α will surface as *any*, as illustrated in (22b).

**Condition X defined as a one way entailment**

$\alpha \rightarrow$ any $\Rightarrow$ Condition X is satisfied; Condition X is satisfied $\not\Rightarrow$ $\alpha \rightarrow$ any

'For α to surface as *any*, condition X must be satisfied. If Condition X is satisfied, α need not surface as *any*'

The realization of α as *some* when condition X is satisfied results in an interpretive asymmetry. As we saw before, although both *some* and *any* can occur in (22), a noticeable difference in meaning arises. Basically, while *any* must be interpreted in the scope of clausemate negation, *some* must be interpreted outside the scope of clausemate negation, as shown in (23).

(23) a. John didn't see anyone
$\neg\exists$(x) [Person(x) & John saw(x)]

b. John didn't see someone
$\exists$(x) [Person(x) & $\neg$ John saw(x)]

Under the morphological approach, we can dispense with the assumption that *some* belongs to the special class of positive polarity items. Rather, its behavior with respect to clausemate negation can be understood as a byproduct of its special morphological relation to *any*. Allomorphs are subject to the condition of Mutual Exclusivity, i.e. they must contrast in meaning (a point that we discuss at length below) and *any* must be

interpreted in the scope of negation by Condition X. It therefore follows that *some* cannot be interpreted in the scope of negation (for a similar idea, see Krifka 1994).

A prediction of the morphological approach and in particular of the condition of Mutual Exclusivity is that there should not exist a context where *some* and *any* can both occur without contrasting in meaning. *Prima facie*, questions appear to offer an immediate counterexample to this prediction. Indeed, it is not immediately clear that (24a) and (24b) contrast in meaning.

(24) a. Who wants some beans ?
b. Who wants any beans ?

However, Lakoff (1969) argues that there is a noticeable difference in meaning between (24a) and (24b). Let me quote her here, to understand what she means by meaning:

"My use in this paper of the terms 'same in meaning' or 'synonymous', and their opposites, differs rather sharply from the use of these terms in traditional philosophical and linguistic literature. It is generally assumed in such writings that two utterances are synonymous if and only if they are identical in truth value: that is, if one is true in a given set of circumstances, the other must also be true in those circumstances. Conversely, two utterances are considered to be not synonymous if and only if an environment can be found in which one is true and the other not true. In dealing with the complexities of sentences such as the ones in this paper [i.e. sentences involving *some* and *any*], I have come to believe that this traditional definition is neither necessary nor sufficient as a condition of synonymy. There are cases where I doubt that an environment could ever be found so that one sentences is was true and the other false, but still we would want to consider the pair, in a very real and significant sense, different in meaning." (footnote 2, p.610)

According to Lakoff, the question containing *some*, (24a) is usually an invitation to have some beans. The speaker assumes that someone will want them. The question containing

*any* however, is often used as an expression of scorn, not spoken by the person offering the beans but by someone to whom they are offered. This difference can be brought out by providing a continuation to Lakoff's examples.

(25) a. Who wants some beans ? I know you're all hungry.
b. Who wants any beans ? They're impossible to digest !

To illustrate this point further, let us consider some more examples provided by Lakoff.

(26) a. Do you think that those men want to do some work ?
b. Do you think that those men want to do any work ?

(27) a. If you eat some spinach, I'll give you ten dollars.
b. If you eat any spinach, I'll give you ten dollars.

Consider the questions in (26a) first. According to Lakoff, the form of the question containing *some* can be used as a remark before going to the men to offer them work. In this case, the assumption is that the men do want to work. Lakoff points that this question can be followed by a sentence like *because my road needs to be repaired*. A speaker using the form of the question containing *any* would have a different set of assumptions in mind however. It could either be that he doesn't know whether the men want to work, and doesn't really care, or perhaps more likely that he doesn't think that the men want to work. Lakoff points out that in this case, a natural continuation of (26b) would be something like *Because they've been standing around all morning telling dirty jokes*.

Lakoff observes that similar differences hold of conditionals depending of whether *some* or *any* is used. For example, (27a) which contains *some*, assumes that the person addressed wants tens dollars, as most people would, and the sentence is used as a promise that if the person does something that the speaker wants him to do, i.e. eat spinach, he will be rewarded. On the other hand, someone would use the sentence in (27b) which contains *any*, as a threat; assuming that for some reason, the person addressed did not want the ten dollars. Lakoff points that the 'promise' and the 'threat' reading of the sentences in (27), associated with *some* and *any* respectively, correlate with the fact that in the examples below, only some can be used with *promise* while only *any* can be used with *warn*. The judgments below are Lakoff's.

(27) a. I promise you that, if you eat some/*any candy, I'll give you ten dollars.
b. I warn you that, if you eat any/*some candy, I'll whip you.

Lakoff further argues that in the examples in (28) and (29), the beliefs and expectations of the speaker are reflected in his choice of *some* or *any*, and the meaning of the sentences is correspondingly changed. According to her, (28b) containing *any* is much more natural that (28b) which contains *some*. The reason is that the speaker seems to be stating that he doesn't believe that there are unicorns outside, but at the same time, because of his use of *some*, he seems to be making the tacit presupposition that that there are, in fact, unicorns outside. Lakoff therefore finds (28a) very strange. Interestingly, she points out that just the opposite holds of the pair (29a-b). Here, if *some* is used, the presupposition matches the explicit statement: the speaker assumes the presence of

Goldfish in the tank. If *any* is used, on the other hand, the presupposition does not match and the sentence is odd.

(28) a. Unicorns are mythical beasts: if John sees some unicorns out there, I'll eat my hat.
b. Unicorns are mythical beasts: if John sees any unicorns out there, I'll eat my hat.

(29) a. If John sees some goldfish in the tank, it's not surprising: there are lots of them in there.
b. If John sees any goldfish in the tank, it's not surprising: there are lots of them in there.

Lakoff argues that additional support for this idea can be found by examining what she calls *only if* conditionals such as, *If only John were here, I'd feel happier* or *If Bill had only behaved decently, he wouldn't have been arrested*. According to her, these examples show that the speaker always hopes or wishes that the situation described in the second clause was true. In other words, the speaker's attitude towards it must be positive. This predicts that only *some*, but not *any*, can be found in the second conjunct of *only if* conditionals. According to Lakoff, this is precisely the case, as the examples in (30) illustrate.

(30) a. If only John had said something/*anything we'd know what was going on.
b. If someone/*anyone would only explain the theory of relativity to me, I could pass the test easily.

Summarizing her discussion, Lakoff remarks that "In questions of certain types, the use of *some* implies that the speaker hopes for, or at least anticipates, a positive answer; the use of *any* implies the expectation of a negative answer, or at least a neutral feeling on

the part of the speaker. In conditions, we must distinguish between cases like [27a] and [27b] on the one hand, and [28] and [29] on the other. The first two are not real conditionals: they are rather, threats or promises. In these again, the emotional bias of the speaker comes into play, in the choice between *some* and *any*. A threat goes with *any*, since usually someone threatens someone else to prevent an undesired action; a promise goes with *some*, for a similar reason. In [28] and [29], the hopes of the speaker are not relevant; what is relevant are the speaker's beliefs about the world - specifically, about whether or not the thing referred to exists, or whether the act he was describing was actually performed." (p. 612). My own conclusion is that Lakoff's fact supports a consequence of the morphological view defended here, namely that *some* and *any* always contrast.

In summary, we have argued that *some* and *any* are different morphological realizations of the same abstract entity, i.e. *some* and *any* are allomorphs. We found supporting evidence for this claim in the behavior of *some* and *any* in elliptical constructions. Under our approach the distribution of *some* and *any* is captured as follows: the realization of $\alpha$ as any is subject to an independent condition on the licensing of negative polarity items, that we called Condition X. This explains why *some* but not *any* can occur in declarative contexts, for example. The fact that *some* must take wide scope with respect to clausemate negation follows from its special morphological relation to *any*. Since Condition X demands that *any* be interpreted in the scope of negation, it follows from the condition of Mutual Exclusivity (to which I come back now) that *some*, its allomorph, cannot also be interpreted in the scope of clausemate negation and that it

must therefore take wide scope. Finally, this morphological approach predicts that contexts where *some* and *any* are allowed to occur under the same interpretation should not exist; again as a result of the condition of Mutual Exclusivity: the reason of being as well as the function of two allomorphs is to indicate a contrast (for a broader formulation of this idea, see Clark 1980, 1987). We saw from our discussion of Lakoff's facts that even in questions and conditionals where *some* and *any* are allowed to co-occur, a contrast could clearly be felt. The first piece of the puzzle is now in place: we motivated our morphological approach to the status of *some* and *any*. Before I turn to my account of the learnability problem, let me discuss the other piece of the puzzle: the condition of Mutual Exclusivity.

### 2.2.2 On Mutual Exclusivity in language acquisition

In this section, I discuss the notion of Mutual Exclusivity, often invoked in studies on language acquisition. I begin by defining this notion and giving an overview of the various places in the literature where it has been used, albeit under different names. Next, I illustrate the various effects that have been attributed to Mutual Exclusivity in the domain of word learning where it was originally proposed. I then turn to another application of ME in the domain of the acquisition of verbal morphology, namely Pinker' s (1986) account of children's overregularization of the English past tense rule. Finally, I show that an account in the spirit of Pinker's, coupled with the assumption that *some* and *any* are allomorphs is exactly what we need to solve the potential learnability problem we are facing.

There is a pervasive idea in the literature on language acquisition according to which children's word learning involves a tendency to construct mutually exclusive extensions for the words of their language. Lyons (1977) for example, defines a word's extension as the set of all the referents the word can have. Two extensions are said to be mutually exclusive if they do not have any members in common. In other words, the claim is that children are biased to keep the set of referents of one word from overlapping with those of others. Merriman and Bowman (1989) (M & B) provide the following example to illustrate mutual exclusivity (ME). The extension of 'cow' is mutually exclusive with that of nouns such as 'horse' and 'farm' but not with the extention of words such as 'animal' or 'bovine' (when they are used to refer to a cow). The extention of the word 'cow' is also mutually exclusive with the extensions of all words that are not nouns such as the adjective 'brown' for example. According to M & B, even though 'cow' and 'brown' can be said of the same thing, namely a brown cow, their extensions are nonetheless mutually exclusive since one refers to an object while the other refers to an attribute.

The notion of ME, in turn, has been used under various labels by a number of investigators. For example, Slobin (1973, 1985) defines a notion of *Unifunctionality* according to which children must obey a one-to-one mapping of forms and meanings until positive evidence forces them to revise their hypotheses. In the same spirit, Markman (1984) proposes that children initially obey *Mutual Exclusivity*, which states that "category terms will tend to be mutually exclusive" (1984, p.403). In the domain of syntax, Wexler and Cullicover (1980) proposed a *Uniqueness Principle* assumed necessary to maintain learnability. According to them, the Uniqueness Principle specifies

that children must take each surface form in the input to correspond to a single 'deep structure' representation which in turns corresponds to a single meaning -- at least until they have evidence that the same surface form can have more than one meaning. The Uniqueness Principle, originally used in the domain of syntax by Wexler and Cullicover has been extended to the domain of morphology by Grimshaw (1981), Pinker (1984, 1986) and Roeper (1981). Finally, Clark (1987) argues that Unifunctionality, Mutual Exclusivity and Uniqueness are all special cases of what she calls the *Principle of Contrast* according to which "different words mean different things. That is, wherever there is a difference in *form* in a language, there is a difference in *meaning*" (p.1).

Let us illustrate ME by considering its possible effects in the domain of word learning. In their seminal discussion of ME, Merriman and Bowman (M & B) (1989) distinguish four effects that the influence of an ME-bias could have on children's word learning. First is what they call the *disambiguation* effect whereby the child's decision about the reference of a new word is affected (Markman and Wachtel, 1988). Imagine, for example, that a child is told "Bring me the saw" in a situation where she sees both a hammer and a saw. Suppose that she knows the word *hammer* (and what a hammer is) but doesn't know the word *saw* yet. Even if the word *saw* is unfamiliar, the ME-biased child would respond correctly in this situation and pick the *saw* reasoning that the word *saw* could no be used to refer to the hammer since a different word that she already knew, namely *hammer*, was used to refer to the hammer. Second, the ME bias might compel a child to modify the extention of a familiar word (Barrett, 1978; Merriman 1986). The idea here is that if a child hears a new word used for what she believes to be the referent

of a familiar one, she might be compelled to correct her belief. To take M & B's example, if a child who thinks that a certain animal is a 'dog' hears people call it a 'wolf', she may remove 'wolves' from the extention of dogs. This is what M & B call the *correction* effect. The third effect that the ME-bias may have is what M & B call the *rejection* effect (Macnamara, 1982; Mervis, 1984). In the case that we considered above, where a child hears people use the word 'wolf' for what she thinks is a dog, she might simply respond 'No, this is a dog' and reject the word 'wolf'. M & B observe that although this effect might be appropriate if someone misnamed something; it would be inappropriate in most other circumstances. Finally, M & B observe that effects of the ME-bias could be felt in the domain of word generalization. If children know that something has a particular name, they should not generalize other names to it (Merriman, 1986). This is what M & B call the *restriction* effect. The example they use to illustrate this point comes from Labov (1973). In a situation where a child sees an object which is a cross between a cup and a glass and is told that it is a glass, she will infer that it is not a cup. On the other hand, if the child is told nothing she will conjecture that the object in question is either a glass or a cup but not both. M & B note that responses that are compatible with this effect may or may not be appropriate. Finally, three basic position have been taken regarding the ME-bias; some investigators have argued that children have it from the start (Barrett, 1978, 1986; Clark, 1987, Markman, 1987); other that children never have it (Gathercole, 1987; Nelson, 1988) and finally, Merriman (1986) and Mervis (1987) argued that the ME emerges in the course of language development.

Let us now consider how ME has been applied to concrete cases in the acquisition literature. Pinker (1986) considers the phenomenon of overapplication of the English past tense inflection rule to inappropriate stems, resulting in *bringed* instead of *brought* or *goed* instead of *went*, for example. The problem here is to determine how children manage to expunge the incorrect form *goed*, in the absence of negative evidence. Pinker proposes that this problem can be solved by invoking a version of the Uniqueness Principle (one of the effects of ME, see discussion above) of Wexler (1979) and Wexler and Cullicover (1980). "The child could use the Uniqueness Principle in the following way: if a certain form has been created through the application of some productive mechanism, and then the input contains an alternative realization of that form, then the earlier form is 'pre-empted" and hence expunged from the grammar. But if that earlier form is exemplified in the input (as opposed to owing its existence solely to the application of productive processes), it is immune from pre-emption by an alternative form, and both are retained." (p.71)

In this case[16], the forms created by children through the application of a productive mechanism - the English past tense rule - are *goed* or *bringed*. On the other hand, the input contains the forms *went* and *brought* which adults use in contexts where children would use the overregularized forms. Once children realize that both forms are used to express the past tense of *go* or *bring*, the Uniqueness Principle informs them that only one of the two forms can be retained; *goed* or *went*. Since children have positive evidence

[16] For other examples of how a version of the Uniqueness Principle has been used to explain how children unlearn their mistakes in the absence of negative evidence, see Pinker (1984, 1986) who applies this logic to errors in the syntactic categorization of verbs, in determining the control properties of verbs, the syntactic head of a phrase type, and in determining which verbs subcategorize for which complementizers.

that *went* is the form used by adults, *goed* must therefore be abandoned. In terms of M & B's discussion of ME, the version of Uniqueness invoked by Pinker in the case of verbal morphology, (i.e. *goed* vs. *went*) can be translated as a reflex of the *restriction* effect or, informally, what we may call the no-overlap effect. That is two different forms, *goed* and *went*, cannot both be used to express the past tense of *go*.

As Pinker observes, this account may be at odds with the well-known fact that children first use the irregular form of a verb, say *went*; and then the overregularized form, i.e. *goed* (e.g., Ervin 1964). If children have already mastered the irregular form of the verb, shouldn't the Uniqueness Principle prevent them from producing the overregularized form ? One reason presented by Pinker as to why the acquisition of an irregular form may not prevent overregularization in spite of the Uniqueness Principle is that children may not immediately recognize that *goed* and *went* belong to the same paradigm, i.e. they may think that these are two different verbs. This position has been taken by Kuczaj (1981) who cites the fact that children often inflect the irregular forms themselves, as though they were different stems (e.g., *wented*, *wenting*). Once children recognize that say, *goed* and *went* are expressions of the same stem, i.e. that they are allomorphs, Uniqueness would compel them to drop *goed*.

Pinker remarks that the use of Uniqueness Principles in the theories of language acquisition has a certain number of implications, one of which is to specify in what domains of the theory uniqueness holds. One way in which this can be done is to invoke a general principle stating that two forms cannot have the same meaning; in other words,

languages avoid synonimity (see for e.g., Clark, 1987; Bolinger 1975). This way, the child could discard a form if she witnessed in the input another form with the same meaning. However, adopting such a principle would require a precise definition of "meaning" so that Uniqueness would apply in all the necessary cases only. Alternatively, there may not be such a general principle but rather, one may need to specify different instantiations of uniqueness in the components of the theory where it appears to hold. Finally, uniqueness may not be defined semantically in which case one would need another way to determine what forms their may be a unique realization of. Whatever the correct alternative may be, Pinker insists that "the issue of which forms the child expects to have unique realizations is central to the problem of accounting for error recovery in the absence of negative evidence." (p.75). For my own purposes I will assume, following Pinker (1986) that Uniqueness or ME holds at least in the domain of morphological paradigms, i.e. in cases of allomorphy. Whether it holds in other domains of the grammar will not be of any concern to us here.

### 2.2.3 The morphological solution

With the discussion of Uniqueness (i.e. ME) and its applications to language acquisition in mind, let us return to the case which concerns us more directly. Here, what young children need to 'unlearn' is that *some* can be interpreted in the scope of clausemate negation. Interestingly, when *some* is incorrectly interpreted in the scope of clausemate negation, it has exactly the meaning of another form, namely *any* , as shown in (31).

(31) John didn't solve some problems

a. $\exists$(x) problem(x) & $\neg$ John solved(x)

b. * $\neg\exists$(x) problem(x) & John solved(x)
*John didn't solve any problems*

This observation suggests that an account in terms of ME may be in order; the intuition being that both forms, i.e. *some* and *any* cannot have the same meaning when they occur under clausemate negation. If Uniqueness is to be interpreted in terms of semantic contrast, as discussed above, we may therefore expect that as soon as children realize the existence of *any* along with its correct interpretation; they should stop misinterpreting *some* with respect to negation. The facts regarding the acquisition of *some* and *any*, however, suggest that this is not the case: children are still found to incorrectly interpret *some* with respect to negation, well after they have acquired *any*.

In order to determine when *some* and *any* are acquired, we examined longitudinal data from 10 corpora, available on the CHILDES database (Bloom 70, Bloom 73, Brown, Clark, Demetras, Kuczaj, MacWhinney, Sachs, Snow and Suppes). We examined the files of 14 children and found that *some* and (NPI) *any* were acquired roughly around the age of 2. In fact, we found that *some* was acquired between the ages of 1;6 and 2;6, and that *any* was acquired between the ages of 2;1 and 3;0. We also observed that in the overwhelming majority of cases, children were using NPI *any* in properly licensed contexts (for similar observations see van Der Wal, 1996). Below are some examples from the files in question.

(32) a. giving baby Sarah some cereal (Eve, 1;10)
b. Mommy # you want some more grain (Adam, 2;6)
c. I want some more (Shem, 2;2)
d. # Let's get some milk (Peter, 2;1)

(33) a. Fraser # do you have any glasses ? (Eve, 2;1)
b. Why do-'nt you want any juice ? (Naomi, 3;3)
c. These two don't have any (Nin, 2;10)
d. We don't have any yogurt katie (Nat, 3;0)

Thus, within the logic of the Principle of Contrast if children acquire *some* and *any* (along with the correct interpretation of NPI *any*) around the age of 2, why are they found to still incorrectly use and interpret *some* in the scope of clausemate negation at the age of almost 5 (as the results from our experiments indicate) ? In other words, why would it take almost three years for the Principle of Contrast to become operative ? On the basis of these facts, two conclusions may be drawn: (a) the Principle of Contrast does not hold or needs to be refined (b) the Principle of Contrast does hold but for some reason, children are not sensitive to it. I would like to suggest that the second conclusion is the correct one and I shall explain why. I believe that the key here is to properly define the domain of application of the Principle of Contrast. I think that it is reasonable to assume that learners expect contrast to hold of the input or the PLD (Primary Linguistic Data). I also believe that it is reasonable to assume that children's own productions do not count as input or PLD. The input must be what children hear others produce. Notice now that sentences where *some* is incorrectly used with respect to clausemate negation only occur in children's productions, i.e. they do not occur in the input (adults use *some* correctly). Thus, there is no reason for children to contrast these sentences resulting from their own production with others they may hear in the input. Again, children do not use what they

produce as PLD. There is therefore no reason for the Principle of Contrast to hold in such cases, conclusion (b).

We are now facing the following puzzle: if there is no reason for the Principle of Contrast to apply because children do not use their own production as PLD, how can they ever unlearn their incorrect hypothesis that *some* means *any* in the scope of clausemate negation ? The solution, I believe, is that there *is* a reason for the Principle of Contrast to apply; only, this reason must be learned. In a nutshell, I will argue that children need to learn that *some* and *any* are allomorphs, that's all. UG takes care of the rest. This is the general idea, let me now explain step by step how it works. Here are the scenario and the assumptions:

(a) Children must learn that *some* and *any* are allomorphs.

(b) following Pinker (1986), allomorphs are subject to Uniqueness or ME **(given by UG)**

(c) Once children learn that *some* and *any* are allomorphs, Uniqueness prevents them from assuming that both forms have the same meaning in the scope of clausemate negation **(given by UG)**

(d) as a consequence of Uniqueness or ME, children revise their initial hypothesis regarding the interpretation of *some* hence moving to the adult system **(given by UG)**

(e) No negative evidence is ever needed **(given by UG)**

In light of out previous discussion, I will assume that (b), (c), and (e) require no further explanation. Let me then elaborate on (c) and (e). What needs to be shown regarding (c) is first, that knowledge of the morphological status of *some* and *any* has to be learned and second how such knowledge can be learned. Regarding (e), I need to show how

uniqueness works such that it is children's interpretation of *some* but not that of *any* which gets affected. Let me address these points in turn.

First, we need to show that knowledge of the special morphological status of *some* and *any* must be learned and cannot given by UG. The reason is that if it could be argued that children have innate knowledge of the morphological status of *some* and *any*, it would become mysterious, under our account, why they wouldn't use this knowledge from the start and never incorrectly conjecture that *some* must be interpreted in the scope of clausemate negation. Fortunately, it would make little sense to claim that UG encoded the fact that the forms *some* and *any* were allomorphs in English for the simple reason that UG does not encode language specific information. What is encoded is UG is the possibility of allomorphy. What forms of what languages are allomorphs is a matter which must be settled by learners. In other words, pre-equipped with the knowledge that allomorphy is an option, learners of English will then need to decide that *some* and *any* are good candidates while say, *car* and *dog* aren't. We will come back to the evidence needed to make such a decision. In summary, the fact that *some* and *any* are allomorphs in English needs to be learned.

Next, we need to show how uniqueness would give us the desired result, i.e. correctly affect the interpretation of *some* but not that of *any*. Uniqueness imposes that *some* and *any* cannot both be receive a narrow scope reading with respect to clausemate negation but we need to specify why it is the interpretation of *some* and not that of *any* which must be reanalyzed by children. This situation is closely related to Pinker's *goed* vs. *went* case.

Here the question is to determine which of the two forms must be kept and which must be eliminated. Pinker proposes to let the input be the final arbiter in such situations. In other words, children will hear *went* in the input, but not *goed*, therefore *went* will be kept and it will pre-empt *goed*. In the case of *some* and *any*, the solution I would like to propose is that the arbiter is a UG principle, namely condition X. By condition X, *any*, under its NPI reading, must be interpreted in the scope of negation. It therefore automatically follows that it is the interpretation of *some* which needs to be revised in this case.

Finally, I need to show that there is indeed positive evidence that children can use in order to learn that *some* and *any* are allomorphs. Moreover, I will claim that this evidence not only exists but that it is simple and abundant in the input. Basically, I would like to propose that children can learn that *some* and *any* are allomorphs on the basis of simple questions like the ones in (34).

(34) a. Do you want something to drink ?
b. Do you want anything to drink ?

Although these questions differ in meaning, in the sense of Lakoff (see discussion above) I will assume that children are not sensitive to such a difference. The difference in fact pertains to the speaker's expectations. If the speaker assumes that the listener is thirsty and therefore wants something to drink, she will use (34a). If on the other hand the speakers does not assume that the listener wants to drink, or simply doesn't have an opinion, she will use (34b). The italicized text in (35) indicates the speaker's expectations and her reasons for using *some* or *any*.

(35) a. Do you want something to drink ? *I know you've been in the sun for the past two hours and you must be thirsty.*
b. Do you want anything to drink ? *I know you drank a gallon of soda half an hour ago and I don't expect you to be thirsty.*

Children hearing the questions in (35) will certainly not have access to the italicized part, i.e. the speaker's assumptions and expectations. For children then the questions in (35a) and (35b) will therefore be synonymous. This is where Clark's Principle of Contrast comes into play. Recall that according to this principle, different words must mean different things. In the questions in (35), *something* and *anything*, which are different words, do not contrast in meaning for children (since they do not have access to the italicized parts). Enforcing the Principle of Contrast in this case will result in the assumption that *something* and *anything* or more precisely *some* and *any* cannot be different words, i.e. different lexical items. One way to satisfy this requirement is to treat *some* and *any* as different realizations of the same lexical item, i.e. allomorphs. Thus, the existence of questions like (34) in the child's input, in conjunction with knowledge of the Principle of Contrast, will lead children to deduce that *some* and *any* must be allomorphs.

There is another potentially interesting consequence of this account I believe. We now have a way to explain how children could ever become aware of the subtle contrasts between *some* and *any* discussed by Lakoff. Under the approach advocated here, learning these subtle contrasts can be seen as a consequence of learning that *some* and *any* are allomorphs. Once children learn this fact, on the basis of questions like (34), Mutual Exclusivity (maybe to be subsumed under Contrast, as suggested by Clark 1987) will in turn enforce a contrast between the two allomorphs, resulting in the difference observed

by Lakoff. Thus, learning that *some* and *any* are allomorphs will have a sort of bootstrapping effect in this case.

Finally, I would like to point to two other aspects of the account I have given. First, according to the morphological solution developed here children do not need to hear sentences like *The detective didn't find someone* in wide scope contexts in order to learn that the wide scope reading is available. Rather, on this account, knowledge of the wide scope reading arises entirely as the result of a grammar internal, i.e. I-language process. That is, once children learn that *some* and *any* are allomorphs, Mutual Exclusivity, in conjunction with Condition X, conspire to impose the wide scope reading without children having to witness its existence. The fact that children do not need direct positive evidence in this case, but rather indirect positive evidence (i.e. knowledge of the morphological status of *some* and *any*) is interesting in light of the well know latitude in their linguistic experience. What I mean is that one could reasonably imagine that not every child witnesses sentences like *The detective didn't find someone* used in wide scope situations in the course of their experience. However, it would be harder to imagine that every child didn't hear *some* and *any* used in questions like *Do you want something to drink* ? or *Do you want anything to drink* ?

Second, I believe that the account developed here represents one of the few instances where data from child language can be brought to bear on the formulation of grammatical theory. As we saw, there are different ways to capture the behavior of *some* and *any* theoretically: one is to say that they are separate lexical items and that *some*, as a PPI is

subject to an extended version of Principle B of the Binding Theory (Progovac 1994). Another view is that *some* and *any* are allomorphs, i.e. different morphological realizations of the same lexical element and that the behavior of *some* vis-à-vis clausemate negation is a byproduct of its special morphological relation to *any*. Both of these views are descriptively adequate, i.e. they correctly predict that *some* must be interpreted outside the scope of clausemate negation. However, only the latter provides a solution to the learnability problem regarding children's interpretation of *some*. Thus, the morphological approach, I believe, is explanatory adequate.

Before leaving this topic a remark regarding quantifiers like *a certain N* is in order. *A certain N, like some N*, is a type I QNP which requires a wide scope reading with respect to clausemate negation. An interesting question is whether children would initially interpret *a certain N* in the scope of negation, as they do *some N* and if so, how they would unlearn their incorrect interpretation in this case. Could we extend the morphological approach developed for *some* and *any* and find an allomorph for *a certain N* ? My suspicion is that children would not interpret *a certain N* in the scope of negation to begin with provided that they understand the meaning of the word *certain*. The reason, I believe is that knowing the meaning of *certain* would force a specific (i.e. wide scope) interpretation of the quantifier. That is, unlike *A man is the room* or *Some man is in the room* which would be true if any man was in the room, *A certain man is in the room* can only be true of a specific individual say, Bill Clinton. One may therefore speculate that if children know the meaning of the word *certain* they can correctly interpret *a certain N* when it occurs in the scope of clausemate negation.

Finally, I would like to come back to children's non-adult interpretation of sentences like *The detective didn't find someone / some guys* and *Cookie Monster didn't eat two slices of pizza* and *Every horse didn't jump over the fence*. In the first two cases, we found that children close to the age of 5 still failed to access the relevant adult interpretations and in the case of sentences like *Every horse didn't jump over the fence*, we found that children close to the age of 7 failed to access the relevant adult interpretation, i.e. the narrow scope reading (not > every). A natural question to ask is why children acquire the relevant adult interpretations so late and also why they acquire the wide scope reading of sentences like *The detective didn't find someone / some guys* and *Cookie Monster didn't eat two slices of pizza* around the age of 5 while the narrow scope reading of sentences like *Every horse didn't jump over the fence* seems to be acquired much later, i.e. around the age of 7. What I would like to suggest, regarding sentences like *Every horse didn't jump over the fence* is that the narrow scope reading (i.e. not > every) represents a peripheral property of the grammar of English (for a distinction between core and periphery, see Chomsky 1981, 1985). This claim is justified by the exceptional (i.e. marked) nature of this reading, as we discussed in Chapter I: the narrow scope reading of a quantified subject with respect to sentential negation only obtains with universally quantified subjects, negation needs to occur in its cliticized form, this option is only attested in certain languages (i.e. in English but not in Chinese) etc. To the extent that the narrow scope reading of sentences like *Every horse didn't jump over the fence* represents a peripheral property of the grammar of English and on the assumption that children acquire core properties of their target grammar before peripheral ones, it may be possible to understand why this reading is acquired so late.

Regarding sentences like *The detective didn't find someone / some guys*, I argued in this chapter that children need to learn that *some* and *any* are allomorphs in order to expunge their incorrect narrow scope interpretation and adopt the correct wide scope interpretation. In this case then, one may wonder why it would take until the age of about 5 for children to learn a simple morphological fact about their grammar. Although it is unclear to me exactly why this should be so, let me point out that children around that age seem to experience more general difficulty with the morphology of their language and in particular verbal morphology. Specifically, children around the age of 5 still use overregularized forms of past tense verbs such as *holded* for *held*, *goed* for *went* etc.

## 2.3 Summary

In this chapter, I have tried to show that children's non-adult interpretation of certain sentences containing negation and QNPs does not create any learnability problems. In sentences like *Every horse didn't jump over the fence* and *Cookie Monster didn't eat two slices of pizza* for which two interpretations are available in the adult grammar, we saw that children initially hypothesize only one of these two interpretations and therefore, that they have incomplete, rather than inaccurate knowledge of the adult system. Learning that these sentences allow an extra interpretation not initially hypothesized can be done on the basis of simple positive evidence. Children's interpretation of sentences like *The detective didn't find someone* appear at first sight to be more problematic and pose a potential learnability problem. Here, children need to unlearn the narrow scope reading that they initially assign since it is not available in the adult grammar. In order to arrive at

the adult system of interpretation, i.e. the adult grammar, I have proposed that all children need to do is learn that *some* and *any* are allomorphs - a fact for which we have independent evidence - and that this can be done on the basis of simple positive evidence such as questions containing *some* and *any*. I have shown that once incorporated into children's grammars, knowledge of the special morphological status of *some* and *any* - via Mutual Exclusivity- has the dual effect of compelling them to expunge their incorrect interpretation and adopt the correct one. In sum, our experimental findings do not create any learnability problems since the transition between early and mature grammars can take place solely on the basis of positive evidence.

# CONCLUSION

In summary, our investigation has led us to uncover a new area where the linguistic behavior of children and adults diverge: the comprehension of sentences containing negation and quantified noun phrases (QNPs). This finding raises the following questions (a) How and why do children's interpretation of sentences containing negation and QNPs differ from those of adults and (b) how do children manage to move from their system of interpretation to the adult system ? Regarding the first question, we observed that children's interpretations of sentences containing negation and QNPs are initially determined by the overt syntactic form of these sentences. In other words, we observed that in this particular domain, children initially map overt syntactic scope and semantic scope (the relative interpretation of negation and QNPs) isomorphically. We argued that isomorphism should not be regarded as a learning principle, or as a primitive of any kind, but rather as an emergent property, i.e. as an epiphenomenon; necessarily arising from the interplay between a universally encoded dichotomy splitting the class of QNPs and learnability considerations. Regarding the second question, we showed that it is possible for children to move from their system of interpretation to the adult system solely on the basis of positive evidence. Thus, the observed difference between children and adults does not pose any learnability problems. In sum, we showed that it is not only desirable but also possible to account for the observed difference between children and adults without invoking any differences between the two groups beyond minimal conceptual necessity. To the extent that this goal has been achieved, the present investigation emphasizes the role played by the theory of Universal Grammar and language learnability in helping us understand language development and its biological basis.

# APPENDIX 1

## Experiment 1

**<u>Story 1:</u> The Smurf at the grocery store** (see chapter II)

Puppet: “The smurf didn’t buy every orange.”

**<u>Story 2:</u> The hungry smurf**

Characters and props: a smurf, three slices of pizza, three potato chips.

The smurf gets back home from soccer practice and he’s really hungry. He checks what there is to eat: pizza and potato chips. The smurf considers eating the first slice of pizza but notices that it has black olives on it, which he hates. He then considers eating the two other slices, but they too have black olives on them. The smurf ends up not eating any of the three slices of pizza. He then turns to the three potato chips and eats one. That chip was so big that after eating it, the smurf is full. He considers eating the two other slices but reflects that he is too full to have another bite. In the end, therefore, the smurf ate none of the slices of pizza and one of the three potato chips.

Puppet: “The smurf didn’t eat every potato chip”

**<u>Story 3:</u> The boy cleaning his toys**

Characters and props: a boy, three teddy bears and three space robots.

The boy decides to clean his toys and he grabs a wet rag to wipe them off. First, he considers cleaning his teddy bears but reflects that the wet rag might damage their delicate fur. He therefore decides not to clean them. Next he considers cleaning his three space robots. He cleans the first one and then considers cleaning the two others. The remembers that he had cleaned the second space robot the day before and he decides not to clean it again. Finally, the third robot is the one he just got first his birthday: it is brand new and does not need cleaning. In the end, therefore, the boy cleaned none of the teddy bears and only one of the three space robots.

Puppet: "The boy didn't clean every space robot"

**Story 4: The farmer and the animals**

Characters and props: a farmer, a bucket of grass, three dogs and three horses.

It's lunch time at the farm and the animals are waiting for the farmer to feed them. First, the farmer goes to his three dogs and offers them grass from his bucket. The dogs complain and say they want bones but grass is all the farmer has today. None of the dogs get fed. Next, the farmer goes to the horses. He feeds grass to the first one who was really hungry. The two other horses are hungry too, but they tell the farmer that instead of grass, they would prefer carrots today. Since the farmer has no carrots these two horses don't get fed. In the end, therefore, none of the dogs got fed and only one of the horses did.

Puppet: “The farmer didn’t feed every horse”

**Individual results:**

| Children | Age | Story 1 | Story 2 | Story 3 | Story 4 |
|---|---|---|---|---|---|
| Child 1 | 3;11 | YES | YES | YES | YES |
| Child 2 | 4;1 | YES | YES | YES | YES |
| Child 3 | 4;1 | YES | YES | YES | NO |
| Child 4 | 4;3 | YES | YES | YES | YES |
| Child 5 | 4;4 | NO | YES | YES | YES |
| Child 6 | 4;4 | YES | YES | YES | YES |
| Child 7 | 4;4 | YES | YES | YES | NO |
| Child 8 | 4;5 | YES | YES | YES | YES |
| Child 9 | 4;5 | YES | YES | YES | YES |
| Child 10 | 4;7 | YES | YES | YES | YES |
| Child 11 | 4;10 | YES | YES | YES | YES |
| Child 12 | 4;11 | YES | YES | YES | YES |
| Child 13 | 5;2 | YES | YES | YES | YES |
| Child 14 | 5;4 | YES | YES | YES | YES |
| Child 15 | 5;4 | NO | NO | NO | NO |
| Child 16 | 5;7 | NO | NO | NO | NO |
| Child 17 | 5;8 | YES | YES | YES | YES |
| Child 18 | 5;9 | YES | YES | YES | YES |
| Child 19 | 5;9 | YES | YES | YES | YES |
| Child 20 | 6;0 | YES | YES | YES | NO |

# APPENDIX 2

## Experiment 2

**Story 1:** **The horses and the obstacles** (see chapter II)

Puppet: "Every horse didn't jump over the fence"

**Story 2:** **The boys at the Zoo**

Characters and props: Three boys, a cheetah and a polar bear.

The three boys are at the Zoo and they woud love to pet some of the animals. First they see a Cheetah and approach it but as they get closer, the cheetah starts growling and the boys decide it would't be safe to pet it. Next they move to a polar bear. Two boys pet him but the third one who is impressed by the bear's size decides not to pet him. In the end therefore, none of the boys pet the polar bear and two of the three boys pet the polar bear.

Puppet: "Every boy didn't pet the polar bear"

**Story 3:** **The cavemen and the giant animals**

Characters and props: Three cavemen, a giant turtle and a giant mouse.

The cavemen are looking for something fun to do. They see a giant mouse and a giant turtle and decide to go for a ride on their back. First, they approach the giant mouse and try to get on it but the mouse starts hissing at them. The mouse looks to mean, the cavemen won't ride on it. Next, they approach the giant turtle. The first and then the

second caveman go for a ride on its back. The third caveman thinks that the ride is too slow and that it's no fun. He decides not the ride on the giant mouse. In the end, therefore, none of the cavemen rode on the giant mouse and two of the three cavemen rode on the giant turtle.

Puppet: "Every caveman didn't ride on the giant turtle"

**Story 4:** **The girls in the playground**

Characters and props: three girls, a sandbox, a merry-go-round, a rocking horse and a seesaw.

The three girls have been inside all morning and it is time for them to go out to the playground and play with the new toys. First, they consider playing in the sandbox but since it rained that morning, the sand turned into mud and the girl are afraid they will get their nice dresses dirty. Next, they consider riding on the merry-go-round. The first and the second girl get on it and start riding. The third girl, who would like to ride, remembers that she gets bad headache everytime she starts spinning, so she decides not to ride. In the end, therefore, none of the girls played in the sandbox and two of the three girls rode on the merry-go-round.

Puppet: "Every girl didn't ride on the merry-go-round"

**Individual results:**

| Children | Age | Story 1 | Story 2 | Story 3 | Story 4 |
|---|---|---|---|---|---|
| Child 1 | 4;0 | NO | NO | NO | NO |
| Child 2 | 4;2 | NO | NO | NO | NO |
| Child 3 | 4;5 | NO | NO | NO | NO |
| Child 4 | 5;2 | NO | NO | NO | NO |
| Child 5 | 5;5 | NO | NO | NO | NO |
| Child 6 | 5;6 | NO | NO | NO | NO |
| Child 7 | 5;7 | NO | NO | NO | NO |
| Child 8 | 5;10 | NO | NO | NO | NO |
| Child 9 | 5;11 | NO | NO | NO | NO |
| Child 10 | 5;11 | NO | NO | NO | NO |
| Child 11 | 6;0 | NO | NO | NO | NO |
| Child 12 | 6;2 | NO | NO | NO | NO |
| Child 13 | 6;6 | NO | NO | NO | NO |
| Child 14 | 6;6 | NO | NO | NO | NO |
| Child 15 | 6;7 | NO | NO | NO | NO |
| Child 16 | 6;11 | NO | YES | YES | YES |
| Child 17 | 7;0 | NO | NO | NO | NO |
| Child 18 | 7;0 | NO | NO | NO | NO |
| Child 19 | 7;0 | NO | NO | NO | NO |
| Child 20 | 7;3 | YES | NO | YES | YES |

# APPENDIX 3

## Experiment 3

**Story 1:** **The detective and his friends** (see chapter II)

*Someone* version:

Puppet: "The detective didn't find someone"

*Some N* version:

This version contains two more characters, i.e. two more friends which brings the total number of friends to 4. The rest of the story is identical to the *someone* version apart from the end where the detective ends up finding two guys and failing to find the two others.

Puppet: "The detective didn't find some guys"

**Story 2:** **The magic Troll**

Characters and props: a troll, his friend, four marbles.

*Something* version:

This story is about a troll with magic powers. He can locate and name objects without seeing them. To test his skills, the troll's friends blindfolds him and places four marbles on the floor. The troll must find them all and recognize that they are marbles. The troll starts walking around, with his eyes covered, and he picks up the first marble and correctly identifies it. He spots and identifies two more marbles but fails to spot the fourth one. In the end, therefore, the troll found three of the four marbles.

Puppet: “The troll didn’t find something”

Some N version:

Same characters, same plot. This time, the troll only finds two of the four marbles.

Puppet: “The troll didn’t find some marbles”

**Story 3: The hungry Cheetah**

Characters and props: a cheetah, his friend Joe, a hot dog and a potato chip

*Something* version:

The cheetah is very hungry this morning and he doesn’t have time to go hunting for food so he decides to ask his human friend Jo to give him some food. Jo hasn’t been to the grocery store lately and he only has a hot dog a big potato chip to offer his friend the cheetah. The cheetah complains that this is people’s food and that he needs red meat. Faced with the choice to eat Jo’s food or go hungry, the cheetah decides to eat the hot dog since it probably has some meat in it. After eating the hot dog, the cheetah is still hungry and he considers eating the potato chip but reflects that it really wouldn’t taste good to a cheetah and therefore decides not to eat eat. At the end, therefore, the cheetah ate the hot dog but not the potato chip.

Puppet: “The cheetah didn’t eat something”

Some N version

Same characters and props, same plot.

Puppet: “The cheetah didn’t eat some food”

**Story 4:** **The old man and the lawnmower**

*Someone* version:

Characters and props: an old man, two of his friends, a lawnmower.

The old man and his two friends just finished a barbecue at the old man's house. After eating so much, the friends feel sleepy and they decide to take a nap on the old man's lawn. The old man isn't tired and looks for something to do. He decides to mow the lawn. He begins with the part of the lawn which is the furthest from where his friends are having a nap. After mowing that part, the old man takes a break to clean the mower's blades which are clogged with grass. Meanwhile, one of the two guys taking a nap on the lawn wakes up and realizes that the old man is mowing the lawn. The guy decides that it would be safer to move to where the lawn has already been cut so that there is no risk he would get hit by the mower. The other guy didn't wake up and stays on the part where the grass that hasn't been cut. Meanwhile the old man, who finished cleaning the blades, starts mowing the grass in the area where his friend is having a nap and accidentally hits the guy's foot with the mower. The other guy reflects that he did well by moving to a safer part of the lawn.

Puppet: "The old man didn't hurt someone"

Some N version:

Same plot, different number of characters. There are two more guys. Two get hit by the lawnmower and two don't.

Puppet: "The old man didn't hurt some guys"

**Individual results for Group 1 (*someone/something* version)**

| Children | Age | Story 1 | Story 2 | Story 3 | Story 4 |
|---|---|---|---|---|---|
| Child 1 | 3;11 | NO | NO | YES | YES |
| Child 2 | 4;3 | YES | NO | NO | NO |
| Child 3 | 4;6 | NO | NO | NO | NO |
| Child 4 | 4;8 | NO | NO | YES | NO |
| Child 5 | 4;10 | NO | NO | YES | NO |
| Child 6 | 5;0 | YES | NO | NO | NO |
| Child 7 | 5;1 | NO | NO | NO | NO |
| Child 8 | 5;1 | NO | YES | NO | NO |
| Child 9 | 5;2 | YES | YES | YES | NO |
| Child 10 | 5;2 | YES | NO | YES | NO |
| Child 11 | 5;3 | YES | YES | YES | NO |
| Child 12 | 5;4 | NO | NO | NO | NO |
| Child 13 | 5;6 | NO | NO | NO | NO |
| Child 14 | 5;6 | YES | YES | YES | NO |
| Child 15 | 6;0 | YES | YES | YES | YES |
| Child 16 | 6;1 | YES | YES | YES | YES |
| Child 17 | 6;1 | YES | YES | YES | YES |
| Child 18 | 6;6 | YES | YES | YES | YES |

**Individual results for Group 2 (*some N* version)**

| Children | Age | Story 1 | Story 2 | Story 3 | Story 4 |
|---|---|---|---|---|---|
| Child 1 | 3;10 | NO | NO | NO | NO |
| Child 2 | 4;3 | NO | NO | NO | NO |
| Child 3 | 4;5 | YES | NO | NO | NO |
| Child 4 | 4;9 | YES | YES | YES | YES |
| Child 5 | 4;10 | YES | YES | YES | YES |
| Child 6 | 5;1 | YES | NO | YES | NO |
| Child 7 | 5;4 | YES | YES | YES | YES |
| Child 8 | 5;5 | YES | YES | YES | NO |
| Child 9 | 5;8 | YES | YES | NO | YES |
| Child 10 | 5;8 | NO | NO | YES | NO |
| Child 11 | 5;9 | YES | YES | YES | YES |
| Child 12 | 5;9 | NO | NO | NO | NO |

# APPENDIX 4

## Experiment 4

**Story 1:** **The girls in the playground** (see chapter II)

Puppet: "Some girls won't ride on the merry-go-round"

**Story 2:** **The horses and the obstacles**

Same plot as story 1, experiment 2.

Puppet's prediction: "Some horses won't jump over the fence"

**Story 3:** **The boys at the Zoo.**

Same plot as story 2, experiment 2. In this story however, two boys end up not petting the polar bear because they are impressed by its size.

Puppet's prediction: "Some boys won't pet the polar bear"

**Story 4:** **The cavemen and the giant animals**

Same plot as story 3, experiment 2. In this story however, two of the cavemen decide not to ride on the giant turtle because they think the ride is too slow.

Puppet's prediction: "Some cavemen won't ride on the giant turtle"

**Individual results**

| Children | Age | Story 1 | Story 2 | Story 3 | Story 4 |
|---|---|---|---|---|---|
| Child 1 | 4;0 | YES | YES | YES | YES |
| Child 2 | 4;2 | YES | YES | YES | YES |
| Child 3 | 4;2 | YES | YES | YES | YES |
| Child 4 | 4;5 | YES | YES | YES | YES |
| Child 5 | 4;5 | YES | YES | YES | YES |
| Child 6 | 4;5 | YES | YES | YES | YES |
| Child 7 | 4;5 | YES | YES | YES | YES |
| Child 8 | 4;5 | YES | YES | YES | YES |
| Child 9 | 4;6 | YES | YES | YES | YES |
| Child 10 | 4;6 | YES | YES | YES | YES |
| Child 11 | 4;9 | YES | YES | YES | YES |
| Child 12 | 5;0 | YES | YES | YES | YES |
| Child 13 | 5;3 | YES | YES | YES | YES |
| Child 14 | 5;5 | YES | YES | YES | YES |
| Child 15 | 5;6 | YES | YES | YES | YES |
| Child 16 | 5;7 | YES | YES | YES | YES |
| Child 17 | 5;9 | YES | YES | YES | YES |
| Child 18 | 5;10 | YES | YES | YES | YES |
| Child 19 | 5;11 | YES | YES | YES | YES |
| Child 20 | 6;2 | YES | YES | YES | YES |

# APPENDIX 5

## Experiment 5

**Story 1:** **Cookie Monster and the pizza** (see chapter II)

Puppet: "Cookie Monster didn't eat two slices of pizza"

**Story 2:** **The caveman and the wild horses**

Characters and props: a caveman, his friend and four wild horses.

The caveman is challenged by his friend to try to ride on the back of four wild horses. The caveman approaches the first wild horse, jumps on its back ride it for a short while but eventually gets thrown off. A little shaken, the caveman nonetheless decides to continue riding wild horses and he approaches the second wild horse. Again, he ride on it for a short while until he gets thrown off. This time though, the caveman gets hurt. He then walks to the third and the fourth horses and tells them that he would like to ride them but that he hurts too bad and that he doesn't want to risk another painful fall. In the end, therefore, the caveman rode two of the wild horses but did not ride the two others.

Puppet: "The caveman didn't ride two horses"

**Story 3:** **The detective and his friends**

Same plot as story 1, experiment 3. There are four friends in this version. The detective finds two of them but he doesn't find the two others.

Puppet: “The detective didn’t find two guys”

**Story 4:** **The boy at the Zoo**

Characters and props: a boy, a polar bear, a kangaroo, a cheetah and a tiger.

The boy is at the Zoo and he wants to pet some animals. There are four animals: a polar bear and a kangaroo and a tiger and a cheetah. The boy pets the first pair of animals: the polar bear and the kangaroo. He then considers petting the other two animals, i.e. the tiger and the cheetah but as he gets close to them, they start growling so he ends up not petting them. In the end therefore, the boy pet the polar bear and the kangaroo but the not the tiger and the cheetah.

Puppet: “The boy didn’t pet two animals”

**Individual results**

| Children | Age | Story 1 | Story 2 | Story 3 | Story 4 |
|---|---|---|---|---|---|
| Child 1 | 3;11 | YES | YES | NO | YES |
| Child 2 | 4;1 | NO | NO | NO | NO |
| Child 3 | 4;2 | YES | YES | YES | YES |
| Child 4 | 4;4 | NO | YES | YES | YES |
| Child 5 | 4;4 | NO | NO | NO | NO |
| Child 6 | 4;4 | NO | NO | NO | NO |
| Child 7 | 4;4 | NO | NO | NO | NO |
| Child 8 | 4;4 | NO | NO | NO | NO |
| Child 9 | 4;4 | NO | NO | YES | NO |
| Child 10 | 4;5 | NO | NO | NO | NO |
| Child 11 | 4;8 | YES | NO | YES | YES |
| Child 12 | 4;11 | NO | NO | YES | YES |
| Child 13 | 5;3 | NO | NO | NO | NO |
| Child 14 | 5;4 | NO | NO | YES | NO |
| Child 15 | 5;5 | YES | YES | YES | YES |
| Child 16 | 5;8 | YES | YES | YES | YES |
| Child 17 | 5;8 | YES | YES | YES | YES |
| Child 18 | 5;9 | YES | YES | YES | YES |
| Child 19 | 5;10 | YES | YES | YES | YES |
| Child 20 | 6;1 | YES | YES | YES | NO |

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