COMPLEX WH QUESTIONS AND UNIVERSAL GRAMMARS:

NEW EVIDENCE FROM THE ACQUISITION OF NEGATIVE BARRIERS

A Dissertation Presented

by

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Department of Communication Disorders

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dedication

To my parents

To my late brother Khalid Al-Abdulkarim

To my mentors, Harry N. Seymour and Thomas Roeper

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ABSTRACT

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Four comprehension experiments tested the development of negative barriers in complex embedded WH questions in 40 typically developing female and male 3-6 to 7-0 (year-month) year-old Standard American English speaking children. The purpose was to test acquisition assumptions derived from linguistic theory of barriers to long distance WH movement. Syntactic theories of Relativized Minimality and scope marking or partial WH movement helped to account for negative and WH barriers in child language. Further, evidence of Universal Grammar appeared when negation prevented both long distance WH movement (e.g., “Why did the girl not tell her mom she went to the zoo? =/=> Why-went”) and medial WH answers (e.g., “When did the girl not tell her mom how she broke her bike? =/=> How-[tell]-broke”). Negative barriers to children’s non-English medial answers supported the use of underlying structures observed cross-linguistically. Such structures are part of universal defaults, or non-specific rules, in child grammar. Before the target grammar is fully set for the specific adult rules, a child uses multiple grammars, some of which are universal defaults which get eliminated in the target adult grammar throughout the course of language development. Measures of Theory of Mind and production of complex embedded clauses predicted the development of aspects of embedded WH questions and negative barriers. Results indicated the interrelatedness of the development of complex sentences.

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CHAPTER 1

INTRODUCTION

In recent years, works in contemporary linguistic theory have produced both subtle and obvious insights into the process of acquiring language structures. One of these structures is the acquisition of WH questions beginning with any of the following WH words: who, what, when, where, why, how, or which. Two theoretically and practically important outcomes result from applying linguistic theory in studying child language. One is to find out how early linguistic principles show in child grammar. The other is to account for variations from adult grammars.

By outlining the principles underlying the formulation of WH questions, linguistic theory has provided researchers in language acquisition with some principles to account for the subtleties in acquiring WH questions. Some of these principles constrain certain formulations and interpretations of WH questions. WH movement is a fundamental operation for forming WH questions. In WH movement, a WH word- such as- "what" in (1) is dislocated from inside the sentence- an object position in (1a)- to the left of the sentence, as in (1b), for interrogative interpretation. WH movement

(1) a. You ate what?

b. What$_1$ did you eat $\_t_1\_$?

is not a free process. The principles constraining it are called barriers (e.g.,Chomsky, 1986), in the framework adopted here. A barrier is present when an element in the sentence prevents a WH word from moving to the far left of the sentence.

Linguists have identified at least some of the barriers to WH movement. One is called the WH barrier; it prevents a WH word from moving to the far left of the sentence when another WH occurs in the middle of the sentence. For example, the medial WH word "how" in the question following the story in (2) (de Villiers, Roeper

(2) This boy loved to climb trees in the forest. One day he slipped and fell to the ground. He picked himself up and went home. That night when he had a bath, he found a big bruise on his arm. He said to his Dad, "I must have hurt myself when I fell this afternoon!"

When did he say <u>how</u> he got hurt?

and Vainikka, 1990) prevents "when" from having a position in the embedded clause next to the second verb "hurt." In (2), if "when" were moved from the embedded clause, it would undergo long distance WH movement, i.e., it would have been dislocated across more than one clause to the far left of the sentence. Since "how" acts as a barrier to movement, however, this long distance WH movement is impossible. Hence, the question in (2) cannot have the interpretation: "When-[say]-got hurt=/=>He got hurt in the morning."

Research in the acquisition of complex WH questions has shown that children as young as age 3 honor WH barriers to long distance WH movement. In a series of cross-linguistic experiments on WH movement (Maxfield and Plunkett, 1991), children were sensitive to WH barriers. Specifically, English speaking children prevented long distance WH movement (de Villiers, et. al., 1990).

Another barrier is called the negative barrier. Similar to the WH barrier mechanism, a negative element “not” in the sentence as in (3) prevents the WH word “why” from being moved from the embedded clause. However, little research has been done to explore how negative barriers operate in child grammar. In this study, we explore negative barriers.

(3) Why did the girl <u>not</u> tell her mom she went to the zoo?

An equally important challenge for those studying language acquisition is to account for variations from adult grammars. One puzzle has been to explain how children allow interpretations of some WH questions that are different from those in adult language. Results from the previous studies on WH questions revealed important differences. Children, for example, answered the medial WH word, such as “how” in (2). Though English language does not allow this type of interpretation, other languages do.

Acquisition theory needs to account for child variations in two ways. One is for acquisition theory to develop a model of acquisition that empirically predicts child variations. English speaking children may have some initial state knowledge of abstract rules that coexist in other languages that allow medial WH answers. Acquisition theorists have proposed that such rules must be part of a Universal Grammar (UG), a set of innate principles (e.g., de Villiers, et. al., 1990). Until children fix their grammar to match the adult target, it has been hypothesized that a child goes through developmental stages that transform a child grammar using UG principles to intermediate states of grammar to the target adult grammar (Roeper, 1999; Yang, 2000).

The other way to account for child variations is to identify which principles, as outlined by linguistic theory, constrain child variations, such as medial WH answers. Negative elements, such as "not" in (4), constrain medial WH answers in other languages. If children's medial answers are the result of some underlying universal structures that allow medial answers as in other languages, then, as in those languages, negation should prevent child medial answers.

(4) When did the girl <u>not</u> tell her mom <u>how</u> she broke her bike?

Hence, negative barriers to long distance WH movement and medial WH answers in complex WH questions would yield further evidence for the universality of the principles governing child grammar. Moreover, data on negative barriers could help explain what it takes for a child grammar to transform from intermediate states of grammar to adult grammar.

The present study approaches negative barriers in four ways. One major way contrasts negative questions with affirmative questions for negative barriers. The purpose of this contrast is to find out if children honor negative barriers by providing fewer long distance WH movements or medial WH answers to the negative questions. If they do, then some pre-established UG principles are assumed for at least the age group tested.

A second way in which negative barriers are addressed in this study is to test the difference between different negative barriers. Experiments have been devised to examine the two following differences.

1) The negative "not" is contrasted to the contracted negative "n't." The negative "n't" is an affix to auxiliary verbs, such as "do." As a result of subject-auxiliary inversion in question formation (e.g., "didn't"), it must be evident to the child that "n't" serves some grammatical function. Such evidence helps to differentiate the negative "n't" from "not," and, therefore, it gets set first as a head of a negative phrase and a barrier to long distance WH movement.

2) A contrast is made between "not" and "n't" and the subject negative "nobody." This contrast permits the examination of differences concerning the position of a negative

element. The subject negative “nobody” should be more salient evidence for acquisition due to its syntactic and lexical features.

A third way in approaching negative barriers shows how negative barriers affect medial WH answers. This contrast allows conclusions to be drawn about the principles underlying medial WH answers. One principle is that if fewer medial WH answers occur with negative barriers, then medial WH answers should be a universal feature shared by other languages. Hence, the principles involved should also be part of UG. Another conclusion would be that negative barriers constrain English speaking child medial answers that are incompatible with adult grammars.

The fourth approach taken addresses the location of the negative barrier in reference to the main or embedded clause. Contrasting experiments have been set up in which one contains negative barriers in the main clause, and the other contains the negative barrier in the embedded clause. This contrast could reveal differences between the development of negative barriers in different clause structures, and also might reflect on the development of the underlying structure of embedded clauses in child grammar.

Finding knowledge of these principles among children contributes to solving the puzzle of how children develop complex grammars. This in turn has several implications. The theoretical implications lie in developing an acquisition theory that adequately explains a wide range of child language phenomena under a well-articulated set of principles. The practical implications include a better understanding of child language behaviors.

This introductory chapter is followed by Chapter 2 which provides a background on the linguistic theory, presented first, and then language acquisition theory and previous empirical data. The chapter concludes with a statement of the problem and the research questions and hypotheses. Chapter 3 contains full descriptions of the methodologies followed in this study, including participants, general language measures, and experimental tasks. In Chapter 4, results of the analysis of the experimental data are reported. Chapter 5 contains the discussions of the results as they pertain to the acquisition hypotheses and specific research questions and hypotheses. General theoretical implications are discussed as well.

CHAPTER 2

THEORETICAL BACKGROUND ON WH QUESTIONS

This chapter first provides an introduction to the theory behind some syntactic constraints. The structural representation and formulation of WH questions are described according to the framework of the Principles and Parameters model of generative syntax (Chomsky, 1986). Some theoretical accounts concerning the negative and WH barriers are reviewed. Linguistic assumptions are made based on these accounts. Discussions of theoretical issues and acquisition hypotheses about the development of negative and WH barriers in complex WH questions follow. Specific research questions and hypotheses conclude this chapter.

The chapter is organized as follows. Under Syntactic Structures of Sentences, there is a brief description of lexical (ordinary words) and functional (grammatical functions) categories. This section is an introduction and/or a review in the syntactic analysis of sentences, designed to ensure that the reader understands my assumptions about the underlying structure of WH questions. Under Operations in Sentences: the Formulation of WH Questions, WH movement, a process used in the formulation of WH questions, is illustrated. This study addresses how such syntactic constraints, as negative barriers, affect the occurrence of WH movement. A review of WH and negative barriers is in the sections on Barriers in Complex WH Questions. Previous empirical data and theoretical issues concerning the acquisition of WH and negative barriers are presented under The Acquisition of Barriers in Complex WH Questions.

In this study, I investigate two types of negative barriers in complex WH questions: The first type includes barriers that are structurally located in the main clause. The negative "not" (e.g., "Why did the girl <u>not</u> tell her mom she went to the zoo?") is an example. The other type is barriers structurally located in the embedded clause. Embedded negative phrases are an example, such as “with none of the ladders” (e.g., “When did the girl say that <u>with none of the ladders</u> could she reach the cat?”). Finally, under Statement of the Problem are the acquisition hypotheses, research questions, and empirical hypotheses.

<u>Syntactic Structures of Sentences</u>

In the theory of generative syntax,[1] sentences are structurally represented in terms of their phrase structures creating a hierarchy as in (1a). The intuitive labels

(1) a.

```
        Sentence
         2
Subject     Verb phrase
              2
          Verb      Object
```

b.

```
        IP
       2
     NP    VP
          2
         V     NP
```

represent two kinds of categories: lexical (ordinary words, N, V, etc.) and functional (grammatical functions, Inflectional Phrase (IP)). These are represented in (1b). Lexical and functional categories both represent syntactic constituents and share similar structural

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[1] For an introduction to generative syntax and the sentence structure, see Radford (1990).

elements. The syntactic theory X' (X-bar) theory,[2] an abstract representation of lexical categories, uses the variables X, Y and Z. The purpose of this symbolic system is generalizations and economy of representation of the common structure of lexical categories. The common structure is composed of an underlying Modifier-Head-Complement combination. The modifier is called a specifier as in (2a). X' represents the fact that verbs, nouns, prepositions, and adjectives take a complement to the right in English as in (2a, b, c and d), but not necessarily in other languages.

```
(2)   a.     XP u adjunct                    b.          S
              1       1                                   1
             (VP)    WP                               t 1 u yesterday
          2  (PrepP)                           NP     VPy
        1      1                                t           1       PrepP
      Specifier   Head X'                      John         1          y into the house
        YP           (V)                                    V u
       (NP)             y                                   1       NP
                           Complement                       V      the car
                            ZP                            pushed
                           (NP)


      c.     VP
             1
             V'u
             1       NP
                        this morning
             V'u
             1       PrepP
                        at the café
             V'u
             1       NP
                        coffee
             V
             1
            drink
```

[2] For a review of the X' theory, see Radford (1988).

d. NP
t 1
a N'p
1 who came to the party
N'
1
N
girl

The variable XP (X phrase) stands for the different phrase structures as in (2). The symbol X' (or X-bar) differentiates the head from the other phrase components or levels. The symbol X' was originally created to represent the fact that, besides lexical words, phrases could contain intermediate structures. The structures of a phrase are hierarchically arranged elements. (More on hierarchy is included under the relationship between lexical and functional categories.)

Recursivity is another characteristic of phrase structures. Recursivity is when there is no limit in combining phrases except what is limited by which words can go together. For example, requirements of main verbs are a constraint on how many embedded clauses a sentence could have (e.g., Marantz, 1994). An extreme of recursivity is infinite reproductions of embedded phrases and/or clauses as in (3) where "∞" indicates infinity. In addition to verb constraints, other factors, such as pragmatic appropriateness and limited human performance capacities, could constrain this infinity.

(3) Mary thinks that Bill believes that John remembers that Alice forgot ....∞

The head X' of a phrase, XP, is the main element that carries the syntactic features of the phrase and governs its complement, as in the tree diagram (4a). This abstract head underlies a range of heads of different grammatical phrases. In (4b), for example, the verb "push" would be the head of the verb phrase (VP). The verb head is recursive in that it could take more than one complement or adjunct as in (4b and 5). A specifier is a position in the phrase adjoined above to the left of the head, X', as in (4a) and represented by a different phrase, YP. As shown in (4a&b), a nounphrase (NP), such as John, could occupy the specifier of a VP or S.

(4)

```
a.       XP u Adjunct
          1     1
        (VP)    WP
       2  (PrepP)
     1    1
Specifier    Head X'
  YP          (V)
 (NP)            y
                    Complement
                     ZP
                    (NP)
```

```
b.             S
               1
           t 1 u yesterday
      NP     VPy
        t      1        PrepP
      John     1          y into the house
               V u
               1        NP
               V       the car
             pushed
```

(5)

```
VP
1
V'u
1        NP
            this morning
V'u
1        PrepP
            at the café
V'u
1        NP
            coffee
```

V
l
drink

Phrases have obligatory elements called arguments, such as an object NP, and optional elements called adjuncts, such as an adverb. The complement of the phrase, an obligatory element of the phrase, branches from the head of the phrase. For example, an object NP "the car" in (4b) is assigned the complement of the V "push." Another clause could be a complement of the V as in (6). The optional elements in a phrase have a

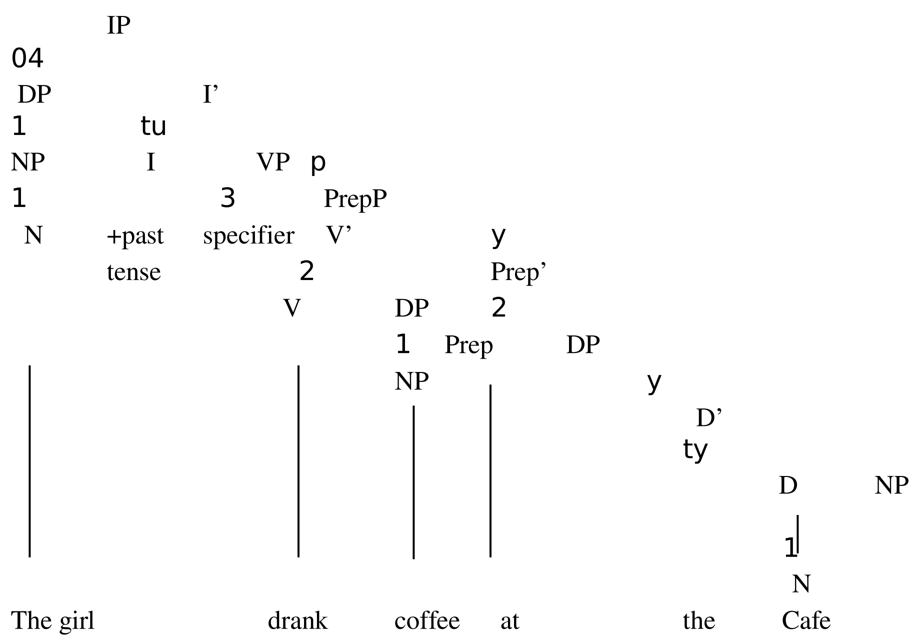
(6)

```
                NP
       t        l
       a         N'p
                l              who came to the party
                 N'
                l
                 N
                girl
```

typical order and modify, different, levels: the verb, the VP, and the sentence. Where they attach in the tree diagram as in (4b) indicates what they modify. In (4b), "into the house" modifies "push," and "yesterday" modifies the whole sentence. The optionality of adjuncts arises from the fact that a sentence could be fully interpreted without them. Generally they add information. They are usually not subject to the requirements of the head as the complement (e.g., Marantz, 1994). A prepositional phrase (PrepP) or an NP could be an adjunct to a VP as "at the café" or "this morning" respectively in (5). An adjunct might be a clause. In (6), a relative clause, "who came to the party," occupies an adjunct position in the NP.

Phrases are subject to some selectional restrictions that determine their distribution in a clause or a sentence. In the NP, VP, or PrepP phrases, other phrases could occupy the specifier, the complement, or the adjunct positions. Their occupancy is determined by some selectional requirements of these phrases. A verb, for example, cannot be used in a sentence for the subject function. An example of what a full sentence looks like under this analysis is shown in the tree diagram in (7a), a format that is used to represent the phrase structures of a sentence. Another format used in generative syntax for a similar purpose is labeled brackets, as in (7b).

(7) a.



b. IP[DP[The girl] I VP[V[drank] DP[coffee] PrepP[Prep[at] DP[D[the] NP[Café]]]]].

Next is a brief description of the different types of lexical and functional categories and their relationships.

Lexical Categories

Lexical categories are heads of phrasal categories (e.g., Haegeman, 1994). They are the structural constituents that are associated directly with lexical elements. An NP contains basically a noun or a pronoun. It could be expanded to contain a determiner or an article as in (8).

(8) NP > Pronoun

he

NP > Noun

girl

NP> Determiner Noun

the girl

this boy

A VP carries a verb as the main element. Verbs could be as simple as describing the event or process, such as "eat," or complex in a way that they describe the content of someone's mind and may require more complex sentence structures, such as "think." An adjectival phrase (AdjP) carries an adjective. Similarly an adverbial phrase (AdvP) carries an adverb. A prepositional phrase (PrepP) carries a preposition besides a NP as its complement (e.g., on the shelf). Lexical categories nest other phrases. For example, an NP could contain an AdjP as in (9a) or a quantifier phrase (QP) as in (9b), and a VP could include an AdvP as in (9c).

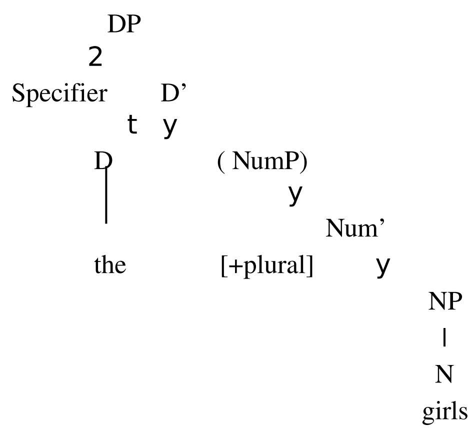
(9)	a.	NP>	AdjP NP
			big cats
	b.	NP>	QP NP
			every boy
	c.	VP>	V AdvP
			go slowly

Functional Categories

Functional categories are the heads of functional phrases and are less transparent than lexical categories. Their abstractness arises from the fact that they are the locus of abstract features that are involved in the formulation and interpretation of a given phrase, clause, or sentence. Like lexical phrases, functional phrases have a head and a specifier. Functional categories might be described in terms of their clause or phrase domains. A functional category that is associated with an NP is called a Determiner phrase (DP). The

DP hosts features that are specific to the NP. Examples are definiteness and the possessive. Such features are coded on the head, Determiner (D'), of the DP as in the tree diagram (10).

(10)



The specifier of the DP, like other functional phrases, hosts other phrases. When an NP moves into the specifier of the DP, it triggers agreement with the head D'; hence interpretable features of, for example, definiteness, must be realized (e.g., Lasnik and Saito, 1984). However, agreement in English is not as strong as in other languages. In rich inflectional languages, like Arabic, agreement is a neccessary feature of DP. Arabic adjectives agree with the noun in number, gender and definiteness. Another property of the DP is the denotation for number as Number phrase (NumP) in (10). In English, nouns are inflected for the plural, whereas in Arabic nouns are inflected for both the dual and plural.

An Inflectional Phrase (IP) replaces the Sentence (S) in the older versions of generative syntax (e.g., Chomsky, 1995). An IP contains the inflectional features of the sentence, such as agreement and tense. Normally such features are realized on the case of the sentence subject if it is a pronoun, such as “he” versus “him,” and the main verb if it is in the third person singular present tense, such as “He sings.” (See the tree diagram in 11.) Tense and agreement inflections, such as the past tense “-*ed*,” the third person singular “-*s*” and the different pronoun cases in English, have motivated the IP in the description of sentences. These bound morphemes in English are realizations of a group of abstract agreement and tense features which are coded on the head Inflection (INFL’) of the IP. The INFL’ has been split into two feature specific heads: Agreement and Tense (e.g., Pollock, 1989). Though English language does not display this phenomenon in a rich form, languages like Arabic, French and German do. For example, in standard Arabic, the verb has a morpheme counterpart for person, gender, and number information besides the past tense morpheme. In Table 2.1, for example, Arabic has 11 forms in the non-past tense and 12 forms in the past tense of the verb “to study” according to the gender, person, and number of the subject pronoun which is obligatorily dropped in this language (i.e. null subject). The null subject motivates the rich verb morphology to compensate for the missing subject information. In contrast, English has only 2 forms in the non-past tense and only 1 in the past tense. English is not, however, a null subject language.

Table 2.1. A comparison of verb inflections in Arabic and English.

Arabic		English	
Non-past tense	**Past tense**	**Non-past tense**	**Past tense**
1. ?adrus	darastu	(I) study	(I) studied
2. (you-Masc.) tadrus	darasta	(you) study	(you) studied
3. (you-Fem.) tadrusin	darasti	(you) study	
4. (he) yadrus	darasa	(he) studies	(he) studied
5. (she) tadrus	darasat	(she) studies	(she) studied
6. (dual-Masc.) yadrusaan	darasaa		
7. (dual-Fem.) tadrusaan	darasataa		
8. (we) nadrus	darasnaa	(we) study	(we) studied
9. (you-Pl. Masc.) tadrusuun	darastuu	(you) study	(you) studied
10. (you-Pl. Fem.) tadrusna	darastunna	(you) study	
11. (They-Masc.) yadrusuun	darasuu	(they) study	(they) studied
12. (They-Fem.) yadrusna	darasna		
11 forms (2 and 5 are similar)	12 forms	2 forms	1 form

Other optional functional features associated with the IP include negation which is designated under its phrase, the negative phrase (NegP) (parenthesized as an optional constituent), within the IP domain, as in (11). The negative phrase is discussed under the negative barriers in the section Barriers in Complex WH Questions below.

(11) IP

```
            2
Specifier        INFL'
                   2
            INFL       (NegP)
                         2
                           N'
                           2
                        N        VP
                       NOT       @

a.  She                          drank coffee
b.  She    did      not          drink coffee
```

When a sentence undergoes some syntactic operations to form, for example, a question or an embedded clause, the complementizer phrase (CP) above the IP as in (12) hosts features necessary for the interpretations of such structural formulations. Next is a description of the complementizer phrase because it is the structure underlying complex WH questions.

<u>The Complementizer Phrase</u> (CP)

The CP is the structural representation of sentence functions other than tense, agreement or negation. These functions include question formation and the formulation of complex sentences containing more than one clause. The CP, then, is the locus of features like interrogation and sentential complementation. Such features, as in every other phrase, are on the head, the Complementizer (C'), of the CP. (See the tree diagram in 12.)

(12) CP

2

Specifier C'

ty

C IP

@

a.	*What*	*did*	she drink?
b.	What	*would*	she buy?
c.		*that*	he returns the book.
d.		*whether*	he came.
e.		*if*	he fixes the car.

As with the IP features, the features of the CP are realized in two ways. One method of feature realization is through the specifier. A lexical element of matching features to the head C' occupies the specifier of CP and induces agreement with the head. For example, an interrogative WH word occupies the specifier of the CP as in (12a) and triggers interrogative agreement with the head C', which is marked with a +WH feature (or +interrogative) if the sentence construction calls for a WH question.

Feature realization can also come through the head C'. To support the +WH feature on the C', subject-auxiliary inversion occurs. In this case, an auxiliary like "did" is inserted in the head C', a process referred to as the Do-support rule, as in (12a) where the CP tree diagram underlies all the examples given in (12 a, b, c, d & e). Otherwise, when the auxiliary is part of the lexical VP in the affirmative sentence, such as *is, was, could, will*, etc., it moves to C' as in (12b) to form the subject-auxiliary inversion. Hence, for each feature or group of features there is a corresponding lexical element that occupies either the specifier or the head of CP.

Features are also realized by a lexical element based in the head C'. An overt complementizer "that" in an embedded sentence, as in (12c), realizes the factivity of an embedded clause. The embedded complementizers "whether" and "if" occupy C' in embedded yes/no questions as in (12d&e).

The heads "that," "whether," and "if" represent an underlying embedded CP in the sentence when a verb takes an embedded clause as its complement instead of an argument NP or PrepP. An embedded CP could also have an empty specifier and head.

Main verbs usually determine whether a sentence could have embedded clauses and what interpretable features the embedded clause might have. In the same manner that a main verb selects the features of its object (e.g., DP), a main verb selects the features of the embedded clause. Such features happen to be encoded on the head C' which gets realized by the full embedded clause (CP and its IP). As such, the specific type of the embedded CP is selected by the main verb. For example, in English some features are overtly encoded on the embedded head C' of CP. For example, "that" marks a declarative clause; "whether," a yes/no interrogative; a WH word (e.g., "what," "when"), an embedded WH question; etc. (Brandner, 1996). Hence verbs are classified according to the complement clause they require. For example, verbs like "think" take declarative complements. The verbs "ask" and "wonder" require an interrogative complement with an embedded WH word. The verb “forget” takes a factive complement, whereas “say” is neutral. Verbs like “think” and “believe” are opaque. They block access to the embedded clause which represents a true or false proposition about the world in the mind of the subject of the main verb. All these feature requirements of main verbs are the syntactic and semantic verb subcategorization features (e.g., Chomsky, 1995; Marantz, 1994)

Henceforth, the focus is on WH questions as an example of the CP construction because the WH questions are the constructions investigated in this dissertation. As opposed to yes/no questions, WH questions have a WH word preceding the sentence, such as “what,” “who,” “which,” “why,” “how,” “where,” and “when.” An example of a simple WH question is illustrated in (13). In the section Operations in Sentences: the Formulation of WH Questions, WH questions are explained in relation to WH movement.

(13) What did mom buy?

Next is a description of how lexical and functional categories interrelate.

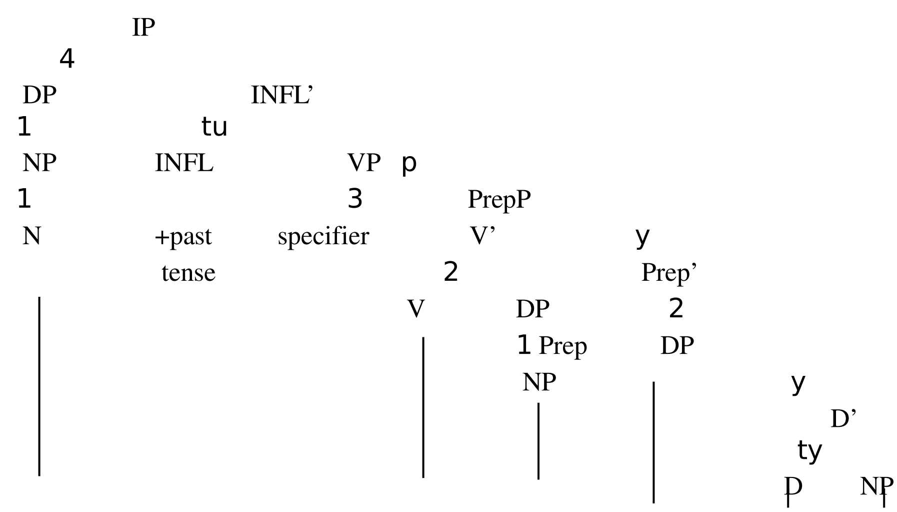
The Relationship between Lexical and Functional Categories within the Sentence Structure

The relationships among lexical categories and functional categories have been modified during the course of the development of generative syntax.[3] There are three possible lexical to functional categories relationships: hierarchical, derivational, and operational relationships.

<u>Hierarchical Relationships</u>

Hierarchical relationships are part of the base structures. In the framework of generative syntax, sentences, clauses, and phrases are parsed in a geometric hierarchical fashion from top to bottom and vice versa, with functional categories being at one end and content words at the other end of the hierarchy. Sentence (14), for example, contains six

(14)



[3] For a review of the early versions of the theory, see Chomsky (1965); for a review of Principles and Parameters see Cullicover (1997); for a review of Government and Binding see Haegeman (1994).

She met Mary at the station

words. However, this information is not sufficient to explain how these words are construed into meaningful yet grammatical structures. On the other hand, when this string of words is viewed through a hierarchically ascending fashion, words become the terminal constituents as is shown by the tree diagram in (14). Words branch from their respective lexical categories, such as a noun head (N') or a verb head (V'). These become the heads of phrasal categories which are the first level phrases, such as NP or VP. The first level phrases, such as VP and NP, branch from the functional categories and phrases, such as INFL' and IP. The hierarchy reflects the types of relationships between and among the different constituents with the higher level phrases dominating the lower ones. This relationship underlies a sentence structure. These grammatical categories are inherently relational features. They are relational in that each phrase level relates the lower phrase to some grammatical functions.

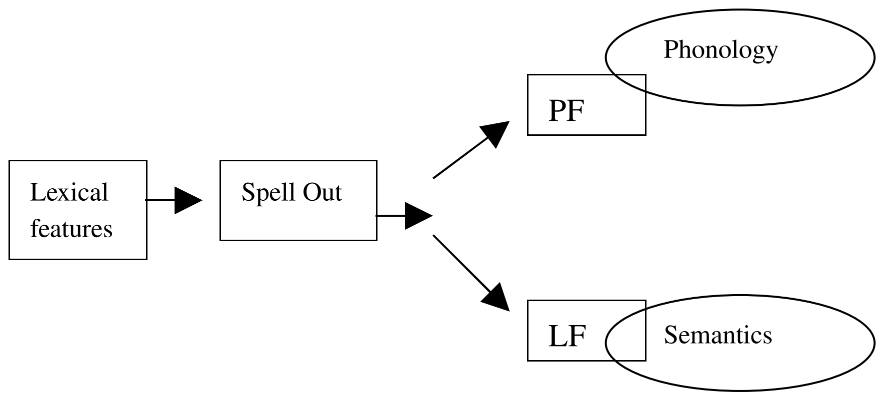
Derivational Relationships

Derivational relationships are another kind of relationship among lexical and functional categories. In the syntactic theory, sentences are described in terms of their derivational representations. To arrive at the sentence forms that are observed in speaking, listening, writing, or reading, certain operations apply to the base structures to derive what is called surface structure. In the Minimalist Program, Deep Structure and Surface Structure developed in the Principles and Parameters theory were substituted by LF and PF (Marantz, 1994; Chomsky, 1995). Throughout the process of sentence formulation, the base structures take different intermediate forms. These involve the Logical Form (LF) and the Phonetic Form (PF). At the Phonetic Form level, all symbols must be interpretable by having phonetic realizations.

At the Logical Form level is the convergence of form and meaning in the process of sentence formulation (Chomsky, 1995). The surface structure output is the input into the Logical Form where further operations necessary for the sentence final interpretation occur. The Logical Form provides the underlying meanings of sentence constituents. At the Logical Form level every constituent in a sentence has to be interpretable or else the sentence is ungrammatical. One function of the Logical Form is to disambiguate the interpretation of a sentence. One surface structure could have more than one underlying Logical Form or vice versa. For example, the sentence "He saw the cat climbing" could mean "he was climbing when he saw the cat" or "the cat was climbing when he saw it" where climbing could be related to the verb "saw" or to the NP "the cat."

The LF and PF are levels of interface between the syntactic module and the semantic or phonological modules as shown in (15). The computation of all symbols in a sentence structure is executed by the computational system. The relationships among the underlying sentence derivations or forms according to recent theories in syntax are shown in the diagram of the sentence underlying structure in (15).

(15)



Operational Relationships

Operational relationships are another form of derivation. Using the sentence constituents, one can describe the different syntactic operations that cause a sentence to change from its underlying structure. These operations are systematic and rule-governed changes that apply to the underlying structure of the sentence to yield variable interpretations, such as formulating an interrogative sentence with WH questions. Sentence (16a) is different from (16b) because of a syntactic operation that substitutes "what" for the object, "Latte" in (16b), and moves "what" to the left of the auxiliary. Hence, this operation is called WH movement. The WH movement construction is used in this dissertation to examine the effect of movement barriers. The next section is devoted to WH movement.

(16) a. What did she drink at the café?

b. She drank Latte.

Operations in Sentences: the Formulation of WH Questions

What Is a WH Question?

WH questions are distinguished from yes/no questions by several features. One concerns the type of answer following either question. A WH question requires a constituent answer for which the WH word substitutes in the question (e.g., Radford, 1988). For example, a "who" substitutes for a NP denoting an individual, a "what" for a NP denoting an inhuman entity, a "where" for a PrepP denoting a place, "when" for an AdvP or a PrepP denoting time, a "why" for a because clause denoting a reason, a "how" for an AdvP, or a PrepP denoting a manner, etc. A yes/no question, on the other hand, is answered by yes or no in general. Though both question types are formed by subject-auxiliary inversion where an auxiliary is moved to the left of the subject, only in WH questions a WH word substitutes the questioned constituent and moves to the left of the auxiliary. This process is called WH movement.

What Is WH Movement?

WH movement is one type of a general sentential operation that dislocates constituents from one position in the sentence to another for different sentence interpretations. The reason for a constituent to move is for the interpretation of functional categories. One type of functional categories carries such features as interrogation. An example of movement in a simple WH question is shown in (17 a&b).

(17) a. You ate <u>what</u>?

b. What$_1$ did you eat _t_1_ ?

c. How$_1$ did the man claim t_1 when$_2$ he fixed the car t_2?

In the sentence (17a), "what" first substitutes an object NP, then it moves to a position in front of the sentence as in (17b). At the site from which a WH word moves, an empty position is left behind denoted by t_1 as in (17b). This is referred to as a gap, or an empty category. A gap is like an open space in a sentence. It is also called a trace, hence t_1. Literally, a trace is a footprint of some entity indicating that it has been there. In this case, the footprint of a moved WH word is an invisible trace with an index of the features of that WH word, indicated by the subscript on t_1. The WH word becomes the antecedent of that trace. Such empty positions are not randomly generated. Rather they have to be related to an overt element, such as a WH word, whether in simple or complex sentences as in (17b & c). Hence the occurrence of empty categories is subject to some conditions. One such licensing condition is the Empty Category Principle (ECP) (Chomsky, 1986; Rizzi, 1990) which stipulates how a trace or an empty category should be related to its antecedent. This concept is further discussed under WH barriers.

Sentence Levels Involved in the Movement of a WH Word

To illustrate WH movement in the formulation of a WH question, several levels (or computations in the Minimalist Program sense) of the sentence representations are needed. One level is when no movement takes place. In the older theory, this is called the Deep Structure where elements are in their original positions in relation to their lexical features. However, a recent theory is the Minimalist Program (Chomsky, 1995) which redefined sentence computation to satisfy purposes of economy of structural representation. Deep Structure in the Minimalist program model would be equivalent to an early stage in the computation of sentences between the lexicon and the Spell-Out levels. For example, in (17a), the WH word "what" substituting an object NP is in the object position following the verb. The second level, the Surface Structure (S-structure), is when overt, or pronounced, movement of the WH word takes place. In the Minimalist Program, the Spell-Out is the level where overt WH movement in the sentence has occurred. The overt WH movement gets spelled out for pronunciation to the Phonetic Form level, or where rules and operations of the phonological component apply, whereas the covert WH movement occurs on the way to Logical Form, the level of semantic interpretation (Marantz, 1994). In (17b), the WH word "what" moves from the object position to the left of the subject of the sentence. To fully realize the interrogative interpretation, an auxiliary such as "do," or a modal like "will" is inserted in the complementizer C' of the main clause. (See also 12 above.) This rule is referred to as the Do-support insertion.

What Are the Reasons for WH Word Movement?

The movement of a WH word to the left of the sentence is motivated by an abstract element in the specifier of the main CP, a WH operator. Other phrases contain operators, such as a negative phrase or a quantifier phrase. An operator takes a domain in the sentence called scope and affects elements in the sentence. For example, introducing a negative operator in "He had some money" would change "some" to "any" in "He didn't have any money." A WH word has to move to the left of the sentence and has to leave a trace, whether overt or covert, to determine the scope of the WH operator over the whole sentence (e.g., Aoun, 1993). So scope is the range of constituents that an element can influence. Thus, to indicate its scope, a WH word takes scope over everything below it that shares covarying features. Different operators determine their relative scopes. Therefore, interaction of scopes could determine which has the dominant scope (Aoun, 1993). This concept underlies barriers to WH movements among others.

WH movement is also described as a process of quantification, a logical formula of how relationships between elements are interpreted. In this case, a fronted WH operator binds variables (traces) by specifying their values. To formulate a question out of a non-interrogative sentence, the WH word has to move to the far left specifier of the sentence to realize the quantificational operator function and then bind its trace within the sentence.

The relationship between the WH operator and its trace is called an *operator-variable* relationship. The trace of the WH word structurally represents the *variable*. A variable denotes the set with which the WH operator covaries; that is, they agree in features. It is a variable because it does not refer to one specific referent in the discourse context, but rather denotes a set of entities that are established in the context of discourse. Likewise, the clause that a WH word precedes stands for a set of propositions that are possible in a situation. Interrogation is about the choice among these sets. For example, the "who" in "Who came to the party?" could refer to a set of individuals, that is, a list, and not to one specific person. Only by moving the WH word to the far left position of the sentence is this relationship realized. However, an operator does not always have a variable (Speas, personal communication, September, 1999). For example, in (18) “might” is a modal operator with the meaning “It is possible that John travels.” It has scope over the whole meaning of the sentence, yet it has no linked variable.

(18) John might travel.

Types of WH Word Movement

Overt Versus Covert WH Word Movement

Movement could be overt (visible), or covert (invisible). Overt movement takes place at the Spell-out level, or S-structure, whereas covert movement is on the way to or at Logical Form. An overt movement is seen in English WH questions as in (17b) above. In English, WH movement is obligatory. In (19a), “who” moves overtly to the left. However, in other languages, such as Chinese, WH movement is covert as in (19b) (e.g., Huang, 1982). There is a Logical Form that invisibly moves “what” to the front of the sentence.

(54) a. Who came to the party?

b. John bought what?

c. Who bought what?

d. Mary bought a recorder, John bought a VCR, etc.

In English, covert movement is possible. Covert movement is motivated to realize the WH quantificational value over the proposition encoded by the clause. An example is in multiple WH questions. In (19c), the WH word "what" must move covertly and adjoin to the specifier of CP to get the interrogative interpretation of "who." The two WH words get merged by a process called WH-absorption in one current theory (e.g., Haegeman, 1994). This process transforms the two WH words into one quantification that binds two free variables. The question is parsed into a paired reading. That is, "who" quantifies over a set of people and "what" over a set of things bought. An answer to (19c) would be a paired answer as in (19d).

Short Distance Versus Long Distance Movements

In English, WH questions involve roughly a three-step process: substitution of the constituent under interrogation with a WH word, movement of the WH word to the far left of the sentence, and substitution of the specifier of the main CP with that WH word.

To reach the far left of the sentence, a WH word could undergo a one-step movement as in simple sentences such as (20a). This is referred to as short distance movement when it occurs within one clause. Local movement is another term.

(20) a. What$_1$ did you buy _t$_1$_?

b. What$_1$ did John think <u>how$_2$</u> Mary ate _t$_1$_?

c. What$_1$ did John think [Spec t$_1$] Mary bought _t$_1$_?

However, the one-step movement becomes long distance movement in multi-clausal sentences when the WH word bypasses an intermediate filled specifier as in (20b). The long distance movement could be cyclic movement since a WH word moves in sequence from the lowest to the next higher specifier position as in (20c). When the movement crosses clause boundaries it is called successive cyclic movement (e.g., Chomsky, 1986). More of the long distance movement is discussed below under Complex WH Questions.

In all movement types, a trace of the WH word is always left behind. The trace is a place holder that codes features necessary to link the WH word to its trace in one respect and the WH word to the referent in context in another respect. This means that the gap that a WH word left behind still carries its lexical features. This relationship, captured in the label antecedent-trace, forms a chain between the WH word at the left of the sentence and its trace even across clausal boundaries as in (20b&c).

Complex WH Questions

WH questions could be divided into two types according to their complexity: simple WH questions and complex WH questions. Simple WH questions are composed of only one clause. The WH word moves to the left of the auxiliary within a single clause. Complex WH questions consist of multiple clauses. One clause or more is subordinated by a main verb.

A complex WH question is formed of one main clause and multiple embedded clauses, or complement clauses, as in (21a) where the main verb "think" subordinates two embedded clauses.

(21) a. *What*$_1$ did Mary think [$_{\text{embedded clause 1}}$that her mom said [$_{\text{embedded clause 2}}$she bought t_1]]?

b. *Who*$_1$ did the man ask t_1 [*what*$_2$ to buy t_2]?

c. When did the boy say [*whether* he broke the toy]?

d. *When*$_1$ did the boy tell his mom [that he got hurt t_1] ?

However, embedded WH questions could take different forms. A declarative clause could be subordinated by a main WH question as in (21a). An embedded WH question could follow an interrogative verb like "ask," a verb that takes an embedded question as in (21b). In this type of question the medial WH word must not move out of its embedded position since it has a +WH feature as required by the main verb. Another type of embedded question is an embedded yes/no question as in (21c) where a main WH question subordinates a yes/no question marked by "whether."

Complex WH questions are the constructions for long distance movement. In (21a), the WH word "what" undergoes a long distance movement which involves more than one clause by crossing the boundaries of the embedded clauses to the main clause. In (21d), the long distance movement is one of two options. A short distance movement is the second option. The distinction between the two is reflected in how to answer the question in (21d). A long distance answer is: "The boy told his mom that he got hurt [*when*?=> in the morning]." A short distance answer is: "The boy told his mom [*when* ? => in the evening] that he got hurt." The short distance answer constrained within one clause plays a role in the definition of barriers to WH movement. In (21b), for example, "who" can only move a short distance within the main clause. The medial "what" prevents it from moving to the embedded, or complement, clause. The interpretation of

WH questions, therefore, is an indicator of their movement patterns whether short distance or long distance.

Long distance WH movement is restricted. Certain elements in the sentence could prevent or block long distance WH movement. Such elements include the negative barriers and the WH barriers. In fact, these kinds of barriers are also used to argue for the WH movement phenomenon. In the next section, the concept of barriers is described.

Barriers in Complex WH Questions

Background

In the syntactic theory of Government and Binding, barriers are operational definitions of elements that block movement by filling the position through which the movable element must move. For example, in (22), "what" prevents "how" moving from a position in the embedded clause. Therefore, long distance movement of "how" is not possible (e.g., how-bake?). Without "what," it is possible to answer "How did John know to bake a cake?" => with chocolate. So it is clear that "what" is the barrier.

(22) How$_2$ did John know what$_1$ to bake t$_1$?

How is this structurally represented? If movement is local, then the WH word must move through the same position that "what" is in, and, therefore, "how" is blocked. Barriers then constrain how a WH word is linked to its trace. Barriers create islands (Ross, 1967). Radford's (1988) analogy captures that notion. "The general idea behind this picturesque metaphor [of islands] is that once you're marooned on an island, you're stuck there, and can't be got off the island by any movement rule at all." (p. 487)

Barriers are named after their elements, such as negative and WH barriers. A negative barrier is when a negative element, such as "not" as in (23), induces the blocking effect; a WH barrier is when a medial WH word is the blocking element as in (22). Barriers could also be located in the main clause, such as the negative "not", or in the embedded clause, such as the medial WH word barrier as in (22).

(23) Why$_1$ did John not tell his mom t_1 he baked a cake?

The concept of barriers, articulated in the work of Chomsky (1986), was motivated to regulate local relationships, such as the one between a moved WH word and its trace. The idea is to restrict to a minimum the domain where the link of moved elements and their traces is functional, thus called "minimality." That is, the link between an antecedent, such as a WH word, and its trace should satisfy local clause conditions. To satisfy local conditions, the link should not be interrupted within the same clause by another possible antecedent. Under this model, the link should be checked in each successive clause for a blocking element when the chain extends for more than one clause, such as in embedded clauses. In Chomsky's generalized minimality, an antecedent of any kind, either a head, such as a verb, or a specifier, such as a WH word, could block the chain within the same or successive clauses.

A relationship between a WH word, an antecedent, and its trace could not be held over a barrier since it would violate some principles that control relationships between a moved element and its trace. The Empty Category Principle (ECP) (Chomsky, 1986) is a condition on how traces are governed by their antecedents. A trace should be free to be linked to its antecedent of either kind: an argument WH word, such as "what," or an adjunct WH word, such as "how." Another constraint on the distance of movement is Subjacency which has a weaker effect than the Empty Category Principle (Chomsky, 1986). It determines how far a WH word can be moved. As such, Subjacency gave rise to the concept of cyclic WH movement. Cyclic movement in contrast to one-step movement is when a WH word, such as "how" in (24a), moves in steps from one clause boundary to another given that each specifier position of the next higher CP is empty. However, when an intermediate position is filled, such as "when" in (24b), moving across this item in one-step violates Subjacency condition and is ,therefore, prohibited as indicated by the asterisk.

(24) a. How$_1$ did Mary say [$_{CP}$ [specifier] [C' that John believed[$_{CP}$ [specifier] [C' that Bill

: :t$_1$:t$_1$

z----------- z-----------------z-------

fixed the car t$_1$?

------m

b. How$_1$ did Mary say [$_{CP}$ [specifier] [C' that John believed[$_{CP}$ [*when*] [C' Bill

:

z-------------------------------=------

fixed the car t$_1$?

------m

Rizzi followed this concept of barriers with the influential work *Relativized Minimality* (1990). Rizzi revised minimality. He reduced the blocking effect from being induced by any intervening element to an element of the same kind as the antecedent. For example, only a specifier, such as a medial WH word in an embedded question, blocks an antecedent WH word in the main clause from being linked to a trace in the embedded clause as in (24b). Likewise, only an intermediate head, such as a verb, intervenes in the chain of another head and its trace. So the barrier effect depends on the kind of the intervening element. The antecedent and the intervening element have to be of the same kind and occupy similar syntactic positions in the sentence, that is heads or specifiers. Therefore, this concept of minimality was described as Relativized Minimality.

Further, in his description of barriers, Rizzi (1990; 1992) distinguished two types of WH words based on their asymmetrical behaviors in the sentence. They were adjuncts, such as “how” and “why,” and arguments, such as “who” and “what.” Hence, a hypothesis called *adjunct-argument asymmetry* was proposed to describe such behaviors. This distinction indicates the syntactic position and semantic features of WH words in the sentence structure. (For a representation of arguments (or complements) and adjuncts, see (2) above.)

An argument refers to an NP complement, such as an object. An object NP is an argument and a complement of the verb because the verb selects it, and as such a WH word that substitutes for it is called an argument WH word. These include "what," "who," and "which." Arguments are referential because they refer to elements in an event or situation.

Adjuncts, such as adverbs, are optional elements that substitute adjoined constituents in the sentence. Examples of adjunct WH words are "how," "why," "when," and "where." Adjuncts are non-referential but qualify events by, for example, their manner ("how"), temporal ("when") or spatial ("where") feature. "When" and "where" could, however, substitute for an argument constituent. For example, the verb "put" takes a PrepP (e.g., "on the shelf") as its complement which is not an adjunct. "Where" and "when" range over individuals, such as "this morning," "now," "then," "here," and "there;" however, "why" and "how" range over propositions (Aoun, 1993).

According to the adjunct-argument asymmetry hypothesis, only adjunct WH words are subject to movement barriers. In the case of argument WH words, the trace (t_1) that a WH word like "what" leaves when it is moved from the object position (e.g., "What did he say how he fixed t_1?") is governed by the WH word to the left of the sentence. They share similar referents. As such, the relationship between the WH antecedent and its trace is binding, that is they are co-referential. Moreover, since a trace stands for a verb argument, the verb "fixed" governs the trace via verb subcategorization. Hence, when an intervening barrier is present, such as "how," the link between the argument WH word "what" and its trace is not affected because the trace is also governed by the verb. In this case the argument WH word, according to Rizzi (1990), could be moved in one long step to the left of the sentence.

Adjuncts, however, only have antecedent relations with their traces since they are not referential and not selected by a verb as a complement. Antecedent relations are sensitive to Relativized Minimality and thus WH and negative barriers. An intervening barrier, such as a medial "what," in "How did John say what to bake?" prevents the adjunct WH word "how" at the far left of the sentence from linking to a trace in the embedded clause. One reason is that the medial WH word "what" could be a possible antecedent to an embedded trace. A more general reason is that the WH barrier "what" is an operator as well as the initial WH word "how." The interaction of operators determines their scopes. So when two operators interact in the sentence to determine their scopes, the initial WH word would not have a trace in the embedded clause, or else violation of the Empty Category Principle that controls what traces are left results and the sentence becomes ungrammatical (e.g., Aoun, 1993). The embedded clause becomes the domain of another operator, such as the WH operator indicated by the medial WH word "what." (A similar mechanism accounts for the negative operator which is illustrated under the negative barriers below.)

Power and selectivity characterize barriers. Weak, selective barriers are selective of which WH words to block. Only adjunct WH words, such as "how" or "why," are subject to local movement barriers. WH barriers, as well as negative barriers, are examples of weak barriers (e.g., see Cinque, 1990). In (25a), the barrier "when" does not prevent the argument which-phrase from a long distance movement (i.e. "John said he would like to sell the white house next month."), but it does do so for the adjunct "how" in (25b). (An asterisk indicates an ungrammatical sentence.) Strong, non-selective barriers, on the other hand, block all types of WH words including the discourse-linked WH phrases. An example is the complex NP barrier, "the plan to sell," as in (26).

(25) a. Which house$_1$ did John say when he would like to sell t_1?

b. How$_1$ did John say when he would like to sell the house *t_1?

(26) *Which house$_1$ did John like the plan to sell t_1?

Since the negative and WH barriers are the focus in this study, certain linguistic assumptions need to be made from which some acquisition hypotheses would follow. In the following subsections are specific accounts of the WH barriers and negative barriers.

WH Barriers

WH barriers were the major construction behind the development of the minimality theory. Rizzi's (1990) Relativized Minimality was a theory to regulate the behavior of barriers in a structural or syntactic format. A WH barrier occurs in the context of embedded WH questions with a medial WH word as in (27). A medial WH word blocks the long distance movement of an initial WH word. That is, the initial WH word, such as "when" in (27a), cannot be construed with the embedded clause "he caught the fish at night." In this context, "when" can only be construed with the main clause "the man said (*when?*) at midnight." The WH barrier effect, however, varies depending on the type of the WH word. Adjuncts are blocked by any medial WH word; arguments are blocked only by arguments. As mentioned earlier, this differentiating behavior is the argument-adjunct asymmetry (Rizzi, 1992). Examples in (27) illustrate the different possible combinations of initial and medial adjunct or argument WH words.

(27) <u>Adjunct – adjunct WH word pair</u>:

a. When did the man say how he caught the fish?

Adjunct-argument WH word pair:

b. How did the painter ask who he should paint?

Argument-argument WH word pair:

c. Who did the woman wonder what she should buy?

Argument-adjunct WH word pair:

d. Who did the girl think where she would meet?

In (27a&b), an adjunct bypassing a medial adjunct or argument WH word induces ungrammaticality. This means that such construal is uninterpretable by a native speaker. On the other hand, in (27c), the argument "who" is only blocked by a medial WH argument "what," but not by a medial WH adjunct as in (27d). In (27d), the argument "who" could bypass the medial adjunct WH word "where" to be construed with the embedded clause, "she would meet (*who*)," producing only decreased acceptability by some speakers (e.g., Rizzi, 1990).

As discussed under the argument-adjunct asymmetry above, the Empty Category Principle (Chomsky, 1986; Rizzi, 1990) is the licensing condition that stipulates how a trace should be related to its WH argument or adjunct antecedent. As for arguments, a verb, such as "meet" in (27d), assigns a semantic meaning to an object-theme which allows the direct connection between the two. In this case, an emebdded trace in (27d) has two connecting mechanisms: one is via the verb subcategorization and the other is via the co-referential index with "who," also called antecedent government.[4] If the latter connection is interrupted, an argument has the verb connection.

Adjuncts only have the referential index connection; hence, they could be interrupted as in (27a&b). According to the Empty Category Principle, this relationship is restricted between the WH word and its trace. It is local in that the preceding WH word must be connected to its trace within the same clause. If an intervening element occurs, such as a medial WH word as in (27a&b), antecedent-government relations could not hold between the adjunct WH word and a trace in the embedded clause. The initial WH word is forced to have its trace locally within the same clause, the main clause in (27a). That is, in (27a), "when" could only have the meaning "the man said (*when?*);" the meaning "the man caught the fish (*when?*)" is not permissible.

In general the linguistic literature on WH barriers has been based on judgmental data. However, acquisition theory provided controlled data that tested these accounts. WH barriers were found to be effective in child grammar (de Villiers, et. al., 1990). The findings are discussed under the Acquisition of Barriers in Complex WH Questions.

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[4] In addition to referential index, constituent command (C-command) is another relation between a WH word and its trace. C-command is one type of structural relation among constituents in generative syntax. The term constituent-command arises from the fact that the C-commanded elements must fall within the same constituent, such as a VP or IP, as the antecedent. For example, when a verb is in a c-command relationship with its object NP, both the V and the NP are members within the constituent VP, or their dominating node. Geometrically, this relation is determined by ascending the tree diagram from the V going upward till the dominating node is reached, the VP; then the direction should go downward to the NP which should be C-commanded by V.

Negative Barriers

Negation has a similar effect on adjunct WH words. WH movement is constrained by the presence of a negative phrase in the main clause. The negative barriers examined in this study are of two types: the negatives “not” and ”n’t” and negative subjects, such as “nobody.” Before a discussion of the negative barriers, the negative phrase is described.

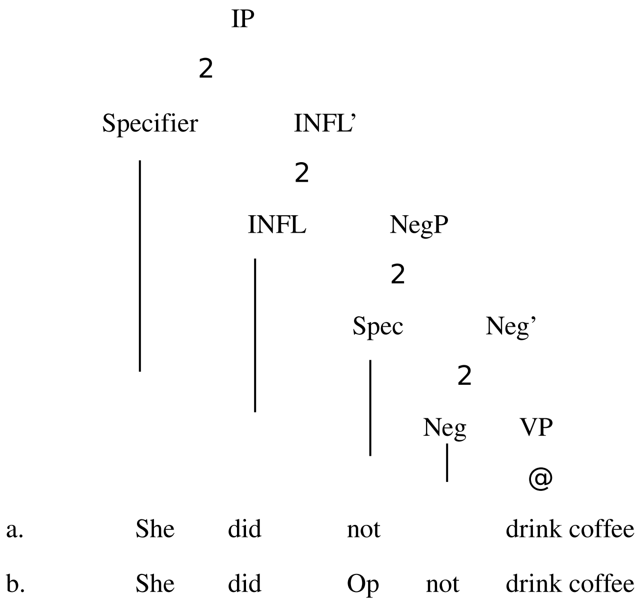
The Structure of the Negative Phrase

The negative phrase is classified as a functional category for several reasons. It is a closed class since it has few members, it is above VP as in (28), and it has an operator (Speas, personal communication, September 15, 1999.). The negative element “not” occupies an independent phrase constituent, the negative phrase (NegP). The NegP is located within the IP below INFL’ as in the tree diagram in (28). [5] It consists of a specifier and a head, Neg’. According to the descriptions of the NegP (Rizzi, 1990; Haegeman, 1995), the negative element “not” is an adjunct that occupies the specifier

[5] The position of NegP in relation to INFL has been argued in the syntactic theory. There are basically two proposals. In Pollock’s (1989) descriptions motivated by French clause structures, NegP is sandwiched between Tense and Agreement in INFL; in later descriptions, NegP is higher than INFL (Pollock, 1993 cited in Haegeman, 1995). In Chomsky’s descriptions, NegP occupies a position below and outside of INFL. For expository reasons, I assume the latter proposal. However, the position of NegP in relation to INFL is argued to vary crosslinguistically (e.g., Pollock, 1993; Ouhalla, 1991).

position of the NegP as in (28a), rather than the head. However, the negative “n’t” is the head of NegP.

(28)



A different view, however, comes from several syntactic and semantic analyses where “not” is analyzed as the head of NegP (e.g., Ouhalla, 1991; Potsdam, 1997; Rullman, 1995) and the specifier of NegP is an abstract operator (Op) as in (28b) (e.g., Ouhalla, 1991).[6] One example for this argument is in (29). The negative “not” in the

[6] Although it appears that Ouhalla’s (1991) analysis describes a typology that would include Arabic data, whereas Haegeman’s (1995) typology would include Dutch data, the analysis of “not” as a specifier of NegP seems a counter description of maximal projections in the theory of generative syntax. According to the theory, only maximal projections, that is functional categories like DP, could occupy a specifier position, and individual words, such as “not,” are not maximal projections, and hence it should be a head (also Speas, personal communication, September 15, 1999). Therefore, for consistency in the description and application of this theoretical model to the data and its implication for the acquisition theory, “not” and “n’t” are assumed heads of NegP.

However, Ouhalla’s account of the differene between the two as a reflection of a morphophonetic rule that applies to attach “n’t” to the auxiliary might not seem sufficient to cover all the syntactic distributions of “not” and “n’t”. According to Peggy Speas (personal communication, September 15, 1999), a couple of syntactic constructions might show that “not” and “n’t” behave in different ways as in the sentence does not allow the main verb to covertly move to INFL to realize its Tense and Agreement features. Hence a Do-insertion occurs as in (29a) in contrast to the affirmative example in (29b). The negative “n’t” is considered an affixal counterpart

(29) a. He didn’t like the movie.

b. He liked the movie.

of “not” that attaches to aspectual elements or modals (Ouhalla, 1991).[7] The prediction then is that both “not” and “n’t” do not block long distance movement of WH words.

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following examples:

(i) a. *Did not you eat a sandwich.
b. Didn’t you eat a sandwich.

(ii) a. I tried not to get there early.
b. I tried to not get there early.
c. *I tried to n’t get there early.
d. *I tried n’t get there early.

The minimal pair examples in (i) and (ii) show that the two negative morphosyntactic forms seem to have different distributions. Whereas in (ib) “n’t” is possible when inverting the subject *you* with the auxiliary “did,” it is not the case with “not” in (ia). Similarly in infinitival constructions, only “not” seems to be allowed above or below the infinitival *to* in (iia&b). One might conclude from this piece of data that the distinction might not be subject to just a morphophonemic rule. Other morphosyntactic accounts are needed to account for the difference in the distribution of “not” and “n’t”. For example, it could be a property of the auxiliary in (i) or the infinitive in (ii).

[7] Though both Haegeman (1995) and Ouhalla (1990) agree that negation is cross-linguistically expressed in NegP and variation is restricted to the lexical realization of the specifier or head of NegP, Haegeman also differs from Ouhalla in the treatment of negation in parallel with interrogation, such as WH questions. For example, Haegeman argued that a WH feature and a negative feature could be hosted either by INFL or C’; as such each negative sentence does not necessarily contain a NegP.

According to Relativized Minimality, heads only block heads and specifiers only block specifiers. A negative abstract operator in the specifier of NegP (which also marks polarity items) is the barrier.

The question regarding the status of "not" as the head of NegP does not seem to affect the integrity of Rizzi's Relativized Minimality. Therefore, for concreteness, Rizzi's approach is adapted as described in Relativized Minimality (1990) with the modified assumption that "not" is the head of NegP while the specifier of NegP is an abstract operator that induces barrier effects. Under Relativized Minimality (Rizzi, 1990; 1992), adjuncts are blocked by adjuncts, and since the specifier of NegP, visible or non-visible, is an adjunct, then it blocks adjunct WH movements.

Other negative elements that seem to be less controversial as to their specifier or head status are the negative subjects, such as "nobody," "no one," and "no person." Negative subjects also give rise to a negative barrier effect. Negative subjects are specifiers of NegP. "Nobody" is a negative operator that should be a barrier to long distance WH movement (e.g., Rizzi, 1990). Negative subjects like "nobody" are conjunction quantifiers that range over a set of individuals introduced in the context and produce negative polarity items (e.g., Mary, John, and Bill saw a movie. ≠ Nobody saw any movie.). This effect is also structurally reflected in the wide scope a negative quantifier would have over a sentence as indicated by the negative polarity item, "any."

Like “not” and “n’t,” the scope of a negative subject “nobody” intervenes with the movement of a WH word out of that scope; therefore, a negative barrier effect results.[8]

Accounts of the Negative Barrier

The effect of the negative barrier arises in contexts where a WH question interacts with negation. This phenomenon is regulated by the principles of Relativized Minimality (Rizzi, 1990). According to Relativized Minimality, negation prevents links between a WH word that undergoes movement and its trace. The negative barrier mechanism works as follows. On a par with WH movement,[9] it is proposed that the negative operator moves at LF, that is covertly, to the left of the sentence to realize its scope over the whole sentence. Hence the negative element, such as “not,” negates the whole sentence. Simultaneously, this movement results in an operator-variable link as with the WH word movement. Traces are necessary to determine the scope of an operator (e.g., Aoun,

[8] However, negative subjects like “nobody” and “no one” occupy the sentence subject position, the specifier of IP, but not NegP, on the surface structural distribution. The theoretical problem is how to structurally account for their negative barrier effect on WH movement when they are outside of the specifier of NegP. Different analyses were proposed as options. Rizzi (1990), for example, suggested a few. One is to consider the negative subject as lowering covertly to the specifier of NegP, hence blocking WH movement. Another option adapted by Haegeman (1995) is to consider the specifier of IP as a position that could host an operator, such as a negative operator. However, it is not unreasonable to assume that a negative subject leaves behind a trace of negative features in the specifier of NegP on its way to the specifier of IP. As such the specifier of NegP holds as a blocking element.

[9] For a full discussion of how negation and WH movement are accounted for by a similar analysis, see Haegeman (1995).

1993). The variable in the negation context is created in the NegP in place of the moved operator.

When negation occurs in a sentence with a WH movement, the negative operator competes with the WH question operator for the wide scope. Structurally, a WH word cannot cyclically move through the specifier of a NegP because it is occupied. The result of the interaction of the negative and WH operators is that the WH operator cannot have a trace within the negative scope, or else the Empty Category Principle is violated (Aoun, 1993; Lasnik and Saito, 1984). This is illustrated in (30), adapted from Rizzi (1990).

(30) . . . X (WH Operator) ... [Z (Neg Operator)... Y (WH trace)]
:
z---------=----------m

The tree diagram in (31a) illustrates the possibility of cyclic long distance WH movement of the adjunct WH word "how" when no negation is present. That is, the WH "how" can be construed with the embedded clause indicated by the trace t_1 to mean "He claimed he fixed the car by using his tools." Note that short distance WH movement is

(31) a. CP

Operator$_1$

How$_1$ C'

C IP

did (t$_1$)

he INFL'

INFL VP

V'

V CP

claim

t_1 C'

2

C IP u t_1

2

he INFL'

2

INFL VP

1

V'

2

V NP

fixed the car

b. CP

Operator$_1$2

How$_1$ C'

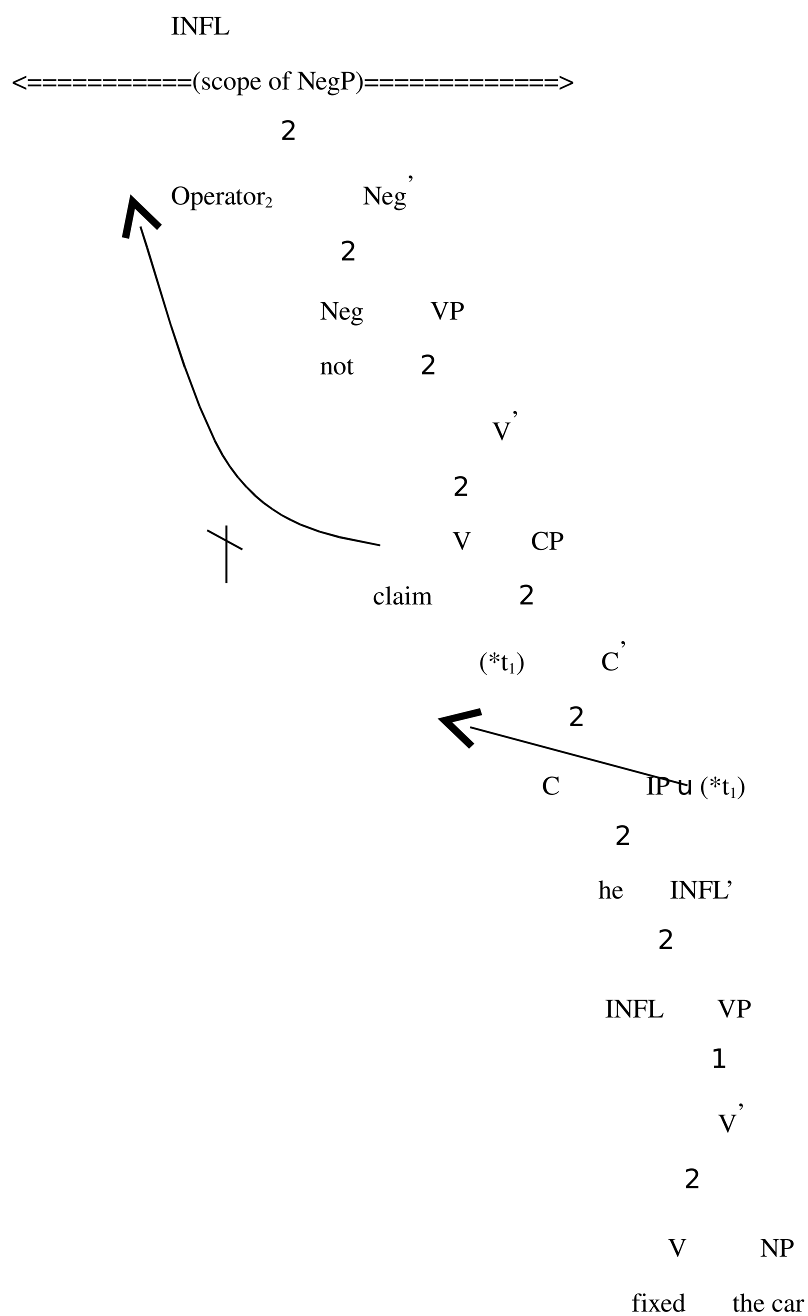
2

C IP u

did 2 t_1

he INFL'

2



possible for this question as indicated by the optional (t_1) adjoined at IP. Cyclic long distance WH movement is, however, ruled out with negation in (31b). In (31b), for cyclic WH movement to occur, the adjunct “how” has to move through the specifier of NegP because it is an adjunct position, but this position is not free because the negative operator occupies the specifier of NegP (Operator_2). At the same time, this specifier position is the first highest possible operator to connect to "$*t_1$" in the embedded specifier of CP. However, such an operator is not an appropriate antecedent. This is an example where the negative operator intervenes with the initial WH operator (Operator_1). Therefore, the lower asterisked traces ($*t_1$) are ungrammatical. Hence, only one interpretation is grammatical, that is, "He did not claim by writing; he claimed by calling." This reading mirrors the short distance WH movement.

In the syntactic theory, such as Rizzi's (1990), the account of negative barriers parallels WH barriers. They both have operators which have scopes. They prevent connections of other operators to elements in the embedded clause under their scope. However, contrasting semantic views about the nature of negative barriers do exist. It is necessary to contrast the two views since either influences the assumptions of adult forms and the emergence of acquisition hypotheses concerning the development of negative and WH barriers. For example, if both barriers share similar forms as in syntax, then one could predict that if a child learns the structure of one form, she could learn the structure of the other. For concreteness, one analysis of each account is represented. An analysis from the syntactic account comes from Rizzi's Relativized Minimality (1990). As for the semantic account, an analysis adapted by Rullman (1995) is used. These are described in the following.

The Syntactic Account

Driven by the principle of economy in the recent theory of generative syntax, syntacticians try to generalize principles for data that form a plausible natural class, such as negative and WH barriers. In an attempt to unify the syntactic account of negative and WH barriers, Rizzi (1990) extended the principles of Relativized Minimality to analyze barriers induced by both intervening WH words and negative phrases. This came to be a distinguishing feature of the syntactic approach.

In the case of a WH barrier, the intervening WH word in the medial specifier position blocks movement of another WH word from within its domain. Structurally represented, the medial WH word occupies the specifier position of the embedded CP. This position is filled which makes it unavailable for another WH word to move through. For example, the intervening WH word "whether" in sentence (32a) prevents the adjunct "how" from landing in the medial specifier before it moves to the left of the main clause, a movement that would leave an improper trace. Hence, two violations occur: One of Relativized Minimality and the other of the Empty Category Principle, the condition on stranded traces.

(32) a. **How*$_1$ do you wonder [<u>whether</u> [we believe [(t'_1) [we can help Bill t_1]]]]

(Rizzi, 1990, p. 95 (45))

b. **Why* $_1$ <u>don't</u> you think [*t'* $_1$ [we can help him t_1]]? (Rizzi, 1990, p. 83 (22))

In the case of a negative barrier, Rizzi (1992) assumed a similar structural account. A sentential negative operator fills the specifier of the NegP as in (33). This negative operator, as the medial WH word, blocks the upward movement of an embedded WH word since the specifier position of NegP is filled, a possible landing site for the WH word. For example, in sentences (32b and 33), the negative element "not" intervenes in the link between the WH word "why" and the intermediate trace *t'*. The WH word "why" has to have a trace above NegP at the IP level as is shown in the tree diagram in (33). Therefore, long distance WH movement is prevented in the presence of negation.

(33) CP

Operator1 2

Why$_1$ C'

2

C IP u

don't 2 t_1

you INFL'

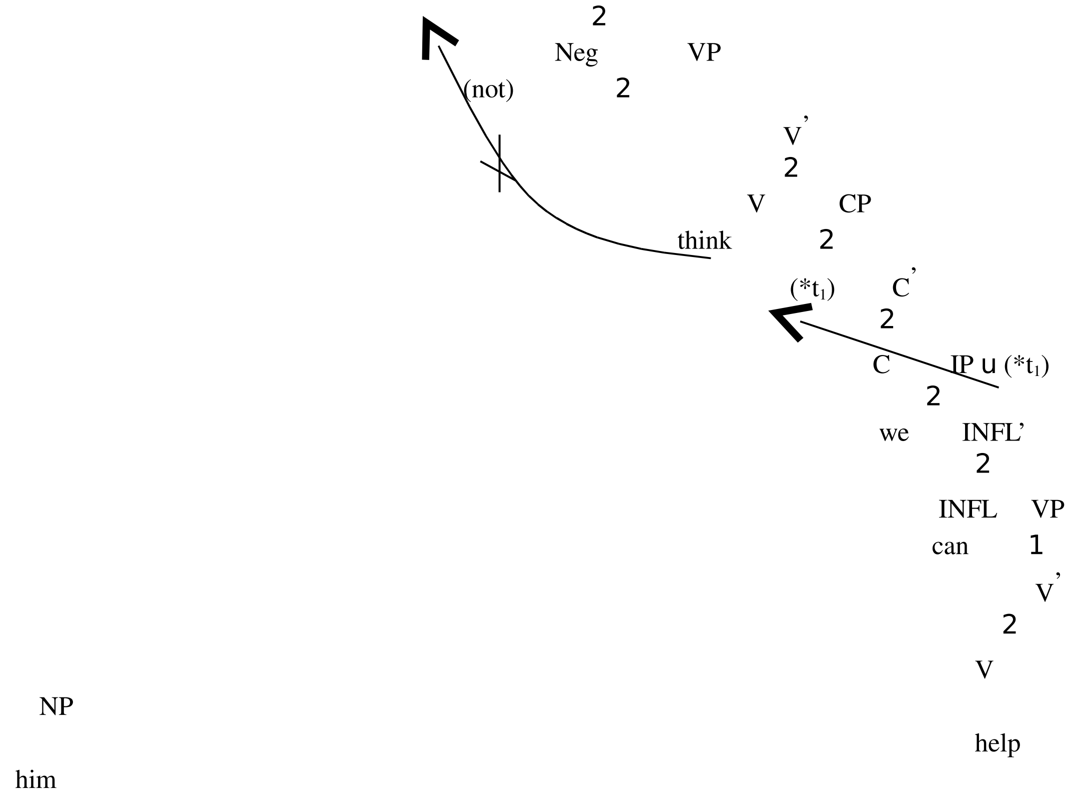
2

INFL

<===========(scope of NegP)=============>

2

Operator$_2$ Neg'

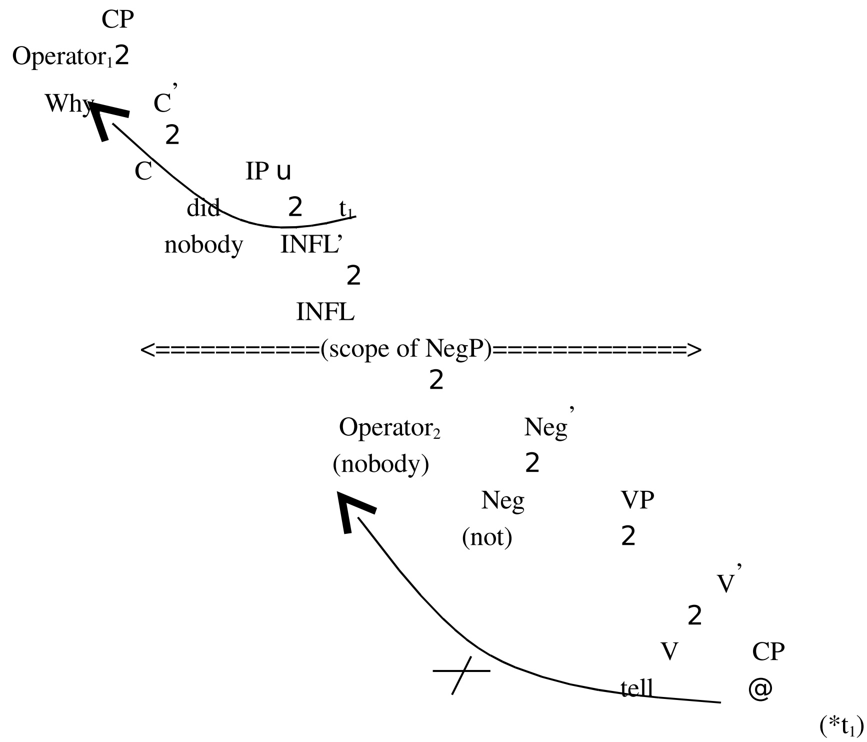


A syntactic account like Rizzi's would predict that short distance WH movement from a negated sentence is possible, but not long distance WH movement across that negation. Likewise a medial WH word movement across negation is not possible. In sentence (34a), for example, which is similar to the ones used in the experiments of this study, movement is possible from the main clause (i.e. short distance=>why-tell), but not from the embedded one (i.e. long distance=>Why-took a bath).

(34) a. Why_1 didn't he tell his Mom t_1 he took a bath $(*t_1)$?

b. Why_1 did nobody tell the teacher they were late $(*t_1)$?

c.



As for the negative subject "nobody," similar accounts hold. In (34b), long distance WH movement (i.e. why-late) is not possible. "Nobody" prevents a WH word from moving through the specifier of NegP since it is the specifier of NegP as in (34b&c). The only difference between the negative "not" and "nobody" is that "nobody" is an overt specifier of NegP. The negative "nobody" is the subject of the sentence. So it is in the specifier position from the outset. "Nobody" also negates individuals in a context, whereas, "not" or "n't" negate propositions. All these factors predict that "nobody" is a more salient operator which would emerge early in child grammar.

The Semantic Account

Rullman (1995) suggested an alternative semantic analysis to the negative barrier while assuming the syntactic analysis for WH barriers. Rullman argued that WH barriers block adjunct long distance WH movements for syntactic reasons and negative barriers block long distance movement for purely semantic reasons.[10] The movement of an adjunct WH word over negation prevents it from having a well-formed semantic interpretation. So the negative effect is a condition on the interpretation of the WH word rather than on movement.

Rullman argued that for semantic reasons it is not sensible to ask:

(35) How far didn't he run?

Essentially, the semantic argument is that it is not meaningful to ask this question if no distance is specified against which one can measure something. In general, a question contains an operator, the maximality operator, that picks out the highest degree of a set of degrees ordered in a linear relation (e.g., distance in miles).[11] For example, in the

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[10] Dayal (1998) also used semantic and discourse accounts to explain how negation blocks partial movement, a form of long distance movement.

[11] For questions involving individuals, the maximal operator takes the form of exhaustiveness and picks out a specific individual in a set of individuals. For a full review of the maximality operator, see Rullman

affirmative in (36), the true answer is “7 miles per hour” even if it is true that Bill is capable of running less than that. The maximality operator selects the maximal degree of speed in the set of all degrees.[12]

(36) How fast can Bill run?

Therefore, movement out of a negative scope is blocked because of the maximality requirement associated with questions. With negation, there is no maximal value for the scale or set of degrees, that is, there are no maximal-minimal values for sets of degrees. Hence the question is uninterpretable. Negative elements are downward entailing quantifiers. That is, inferences are made from a set to a subset (e.g., if Bill could run 7 miles, then the inference is that he could run 5, 4, or 3 miles, etc.). Therefore, maximality degrees are not defined since scales are reversed, and as a result, the maximum degree on a scale is not defined.

(1995).

[12] For a counter-evidence of the maximality operator in the semantics of WH questions independent of negative barrier effects, see Beck (1996). For example, Beck argued that WH questions could have also a minimum interpretation which is called for by the predicate in examples like (i). A minimal answer is 3 eggs which is sufficient for the question interpretation without the exhaustive answer. Beck argued for a syntactic explanation for the negative barrier effect.

(i) How many eggs are sufficient to make a cake?

When Rullman, however, tried to explain the reasons why adjuncts, such as “why” and “how,” could not be moved across negation, he referred to discourse factors. Rullman argued that WH words of the kind “where,” “when,” “who,” and “what” could be discourse-linked. That is, a WH word quantifies over a set that is pre-established in the discourse context. As such, they are less sensitive to negative effects on interpretations. This is related to the type of their referents and their role in the discourse. “Who,” “where,” and “when,” for example, stand for people, places, and times that constitute the domain of the discourse, but “why” and “how” refer to reasons and manners which are not centered in the discourse. Rullman argued that because “why” cannot be discourse-linked, the question in (37) requires the sum of all the

(37) *Why (do you think) Carol did not come to the party? (p. 211)

reasons *x* such that Carol did not come to the party because of *x*. This sum could be infinite and includes irrelevant reasons which are pragmatically not possible. The reason is that “why” cannot be easily discourse-linked.

Rullman, however, did not directly address the effect of the interaction of negation and maximality on different types of movement. Specifically, he did not discuss the different effects of negation on WH word long distance and short distance movements. He did not address this issue from a structural point of view, as is the case in the syntactic account. As such, he did not show explicitly how his analysis would differentiate the two meanings in the example in (38). One meaning is the short distance

(38) Why didn't she tell her mom she went to the zoo?

of "why": "Because her mom was watching her favorite TV show." The other is the long distance of "why": "Because she wanted to feed the animals." In this example, which is similar to the ones used in this study on negation, movement is possible from the main clause, but not from the embedded one. Rullman's analysis makes no predictions regarding the difference between the two movements. That is, Rullman's account does not predict a difference between long distance and short distance movements with respect to negative barriers. It also predicts that barrier effects of negative and WH words would appear differently, since it assumes WH barriers are syntactic while negative barriers are semantic in nature.[13]

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[13] Other works suggest another set of syntactic-semantic constraints and discourse factors which both expand and restrict the possibility of movement out of the scope of negation. For example, Kuno and Takami (1997) provided examples of the following kinds to show that a WH word could be moved over negation regardless of whether it is an adjunct or argument. In (i), WH adjuncts are extracted over negation. Unlike Rizzi (1990; 1992), Kuno and Takami argued that extraction of arguments could also be unacceptable as is shown in (iib).

(i) a. How much money$_i$ wasn't he willing to contribute e_i?
b. And how slow$_i$ shouldn't I be driving e_i now?

(ii) a. In which room didn't they put a copy of the Bible?
b. ??/* In which filing cabinet didn't he put the document?

In brief, syntactic theory provides similar structural representations for the negative and WH barriers when interaction of operators prevents long distance WH movement. The semantic theory, on the other hand, defines separate interpretations for the WH and negative barriers. However, the semantic account, with unavailable semantic explanation, used the discourse account to explain the effect of negation. This aspect of the account marks its weakness and its inconsistency in predicting all the negative barrier effects on different WH words.

However, in the syntactic theory, semantic interpretations operate not in an all-or-none way but in an interactive fashion with respect to syntactic structures. In the semantic-syntactic interface at the LF level, the role of semantic features in the interpretation of syntactic structures is apparent when syntactic rules are sensitive to the

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Kuno and Takami (1997) proposed that the reason a WH word cannot be moved from the domain of negation is because of a ban against moving a WH word which happens to be the focus of negation out of the scope of that negation. For example, in (iib), the argument "in which filing cabinet" is the focus of negation because the sentence can only mean "He put the document somewhere, but it wasn't in the filing cabinet." (p. 561). In contrast, "in which room" in (ia) is ambiguous between being the focus of negation (i.e. "They put a copy of the Bible somewhere, but it wasn't in room 325." (p. 561)), or not the focus of negation (i.e. "In room 325, they didn't put a copy of the Bible." (p. 561)) which is the most common reading. A discourse constraint was also suggested by Kuno and Takami and called "ban on questions that solicit uninformative answers" which was about questions that could have an infinite set of answers which make them pragmatically implausible. An example is given in (iii).

(iii) *How much don't you weigh? (p. 569)

It is of course very interesting to ask how children acquire these discourse constraints. These examples, however, do not change the fact that the core cases of negative barriers remain. Kuno and Takami (1997), similar to Rullman (1995), did not discuss how negation interacts with short or long distance movements. They also did not relate the negative barrier to the WH barrier effects. A convincing argument would be if they had addressed Rizzi's examples like (35). In this analysis the focus is precisely on those cases where the child and the adult both exhibit negative barriers. In the early instances, where children do not show barrier effects, it is argued that it is for syntactic reasons of adjunction, rather than semantic reasons of discourse construction, although logically, the child might construe the discourse differently.

semantic type of, for example, a WH trace - that is, whether it is an adjunct or argument, and, hence, gets affected or not by negation. Therefore, semantic features do play a role within the syntactic analyses. The challenge for the theory is to account for children's acquisition of the interface of the semantic features.

First Summary of Linguistic Assumptions about Negative and WH Barriers

The review of the linguistic accounts on negative and WH barriers lead to several research assumptions. These assumptions would also lead to specific acquisition hypotheses. Such assumptions are, however, based on adult fully developed forms which would be a reference point to compare child data. Such comparisons would help to test predictions made about the development of child forms. The assumptions would be expanded as more linguistic accounts are reviewed in reference to WH movement and negation in the next sections. These assumptions would then be connected to specific acquisition hypotheses after reviewing the acquisition accounts on complex WH questions. The linguistic initial assumptions about negative barriers are summarized as follows:

Universal Grammar Assumption

The NegP and negative barriers are universal.

Negative Barrier Assumption

The NegP is a barrier to long distance WH movement. This barrier effect is structurally represented as is shown in (35a,b&c above). A negative operator in the specifier of NegP prevents an adjunct WH word, another operator, from moving through it since adjunct movement operates locally and cyclically through relevant positions.

The Functional-Lexical Differentiation of the Negative Elements Assumption

The three negative elements reviewed- the negatives “not,” “n’t,” and “nobody”- differ due to some functional and lexical features.

a. The negative “not” is a head of NegP. The whole NegP with “not” could be an adjunct to VP (e.g., Zanuttini, 1989).

b. The negative “n’t,” a head of NegP, undergoes contraction that operates on NegP and incorporation by the Do-insertion rule with INFL the head of IP. Incorporation operates on universal (or Universal Grammar) projections, such as NegP.

c. The negative subject “nobody” is the subject of a sentence and must be a specifier of NegP. Therefore, the negative “nobody” cannot be an adjunct. It is also a quantifier (Beck, 1996). If a quantifier phrase is a barrier, then a child should realize it immediately. Such differences would lead to acquisition hypotheses that predict the negative elements have different blocking effects.

The Parallelism of Negative and WH Barriers

According to syntactic theory, negative and WH barriers operate structurally. A negative or a WH operator in the specifier of NegP or CP prevents an adjunct WH word, another operator, from moving through it since adjunct movement operates locally and cyclically through relevant positions. Such parallelism would lead to acquisition hypotheses that predict similar effects for the negative and WH barriers.

Syntactic theory also accounts for negative barriers to another form of long distance WH movement, partial WH movement. Though not a WH movement in English, partial WH movement or medial answers are observed in child English (e.g., de Villiers, et. al., 1990). It is necessary to review the updated syntactic accounts on partial WH movement since earlier acquisition accounts on English child partial WH movement followed older analyses of partial WH movement. In the older analyses, the relationship between the medial WH word and the main clause is via co-indexation (i.e. a non-movement co-referencing) but not covert movement as in the recent analyses. However, the movement analysis would have indication for negative barriers. In the next section, accounts on partial WH movement are reviewed.

Negative Barriers to Partial WH Movement

Partial WH movement is a feature in languages other than English, such as German. However, English speaking children demonstrate a similar phenomenon in complex WH questions with embedded WH words (e.g., "When did he say <u>how</u> he broke the toy?"). They answer "how." Before the account on negative barriers to partial WH movement is reviewed, partial WH movement is described.

<u>Partial WH Movement</u>

Partial WH movement is a different form of long distance WH movement formulated by speakers of languages other than English, such as German. For example, the initial WH word “who” (underlined) in (39a) and the medial WH word “who” (underlined) in (39b) might have the same interpretation (i.e. who-ask-to paint => the cat). In (39a) “who” underwent an overt long distance WH movement indicated by its

(39) a. Who$_1$ did the painter ask to paint t$_1$?

b. [who$_1$] How did the painter ask who$_1$ to paint t$_1$?

trace “t$_1$.” However, in (39 b) “who” has moved partially to the middle of the sentence as indicated by the solid line. This is called partial WH movement. To obtain the same interpretation of sentence (39a), “who” has to move covertly to the left of the sentence, as indicated by the dotted line, to get the wide scope interpretation in relation to the main verb as indicated by [who$_1$] and the embedded trace “t$_1$.” The interpretation of medial WH words as in (39b) is not possible in English.

Partial WH movement is a universal possibility (i.e. in Universal Grammar) though languages may differ as to whether it is used (e.g., Dayal, 1996, 1998). Each quantificational operator, such as a WH word or a quantifier, has a scope over a proposition. For a WH operator to get to a scope position, as has been discussed above, it moves to the specifier of the CP either overtly or covertly at LF, the Logical Form. This full or partial movement is subject to specific language parameters. The difference is indicated by the position of the WH word that takes scope over the main question.

Partial WH movement construction is a form of sentence subordination since it refers to how an embedded WH question is interpreted as the main question whose scope is marked by an initial WH word. The initial WH word is semantically vacuous and functions as an expletive or a scope marker. Thus, this phenomenon is referred to as scope marking. Partial WH movement is further specified in the languages that allow such constructions.

Characteristics of Partial WH Movement in German

The sentence in (40) is a German example of scope marking and partial WH movement. In German, a semantically empty WH word, "*was*," occupies the far left of the sentence. This scope marker functions as an expletive, that is, non-referential, which is base-generated in the specifier of the main CP. "*Was*" is only a WH part with no quantificational force; it needs to be co-indexed with an existential quantifier in the embedded CP (Brandner, 1996). This co-indexation is necessary for the medial WH word, a WH expression with lexical content, to move covertly and replace "*was*"[14] (Beck and Berman, 1996).

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[14] An alternative analysis is found in the early works on scope marking (e.g., MacDaniel, 1989). Instead of expressing covert movement, a medial WH word is linked to the scope marker via a chain at the surface structure. The expletive replacement approach via covert movement avoids theoretical problems with McDaniel's analysis (e.g., Dayal, 1996).

(40) Was$_1$ glaubt du wer$_1$ gekommen ist?
what believe you who come is

As in any WH movement, the covert movement of the medial WH word in (40) takes place to satisfy the requirements of the interrogative feature of the main clause that is coded by the scope marker. The medial WH word becomes a question operator only when it moves to the main specifier position in CP (Brandner, 1996). To do so, the WH word has to undergo partial movement to the medial CP position and not remain in situ even if its scope is indicated by a scope marker (Müller, 1996). Otherwise, the result is ungrammatical as in (41a) from von Stechow (1996). Partial movement, however, is not allowed if the position of the scope marker is occupied by a WH word with lexical content as in (41b) from Müller (1996, p. 185, example 12c).[15]

(41) a. *Was$_1$ glaubst du daS Fritz wen$_1$ besucht hat?
what$_1$ believe you that F. whom$_1$ visited has

b.*Wer$_2$ glaubt t$_2$, wann$_1$ (daS) sie t$_1$ gekommen ist?
who thinks when (that) she come is

In German, partial WH movement is only possible with verbs that select a complement clause with a non-interrogative feature, that is [-WH] (Brandner, 1996; von

[15] Fanselow and Mahajan (2000) indicated that this construction was possible for partial WH movement in a German dialect though they did not describe the phenomenon.

Stechow, 1996). In accordance with the requirements of sentence interpretation, a WH word that occupies a [-WH] complement has to move to a specifier with an interrogative feature [+WH] to obtain the wide scope of the sentence. Predicates, such as the verbs "ask" and "wonder," which only select interrogative clauses are not allowed in the partial movement constructions. In (42a&b) from von Stechow (1996, p. 6, examples 7a&b), a partial WH movement with verbs that do not select interrogative clauses, "*glaubt*"

(42) a. Was glaubt du wer gekommen ist?
what think you who come is

b. *Was fragst du wer gekommen ist?
what ask you who come is

(thinks), is acceptable, but not with verbs that do select interrogative clauses, "*fragst*" (ask). This constraint is a Universal Grammar principle, WH Criterion (e.g., Lasnik and Saito, 1984). This principle requires that every WH word should be visible, no later than the Logical Form, in a position that hosts a [+WH] operator which is marked by a [+WH] feature on the head C' of the main or embedded CP. In partial WH movement, for example, the medial WH word in (42a) has to move at LF to the main clause by replacing "*was*" to be visible in a [+WH] position and realize the wide scope of the sentence. An empty [+WH] position is also banned by this principle. In (42b), a WH word like "*wer*" (who) is not allowed to move out of the complement of the verb "*fragst*" (ask) that requires an interrogative clause. Therefore, partial WH movement is ungrammatical in this example.

Some verbs in German only take partial WH movement, such as “decide,” whereas others only allow long distance WH movement, such as “remember.” The latter might have to do with the truth value of the embedded clause. In long distance movement, the subject of the main clause might have a true or false presupposition of the embedded clause, whereas in the partial movement construction, a true presupposition is required from the point view of the subject. (See Lutz and Müller (Eds.), *Papers on Scope Marking*, 1996.) Infinitival interrogatives are also disallowed in German as in (43) from Höle (1996, p. 41, example 10d).

(43) *Was glaubt sie, auf wesen Hilfe sich verlassen zu können?
what thinks she on whose help self rely to can

A further question is whether it is theoretically, and hence empirically, possible to relate the partial WH movement feature to English language. This question is necessary to ask since the answer would bear on how to explain partial WH movement in child English.

English Language and Partial WH Movement

Languages exhibit parametric variations concerning expressing the scope of a WH word when it is an operator (Haegemann, 1995). To mark a scope of a WH word, two mechanisms are needed. One is a question operator in the main clause; the other is a link of the operator to a WH word. In partial WH movement, the scope marker is linked to the medial WH word via covert movement to the main clause as in (40) above to express the wide scope of the medial WH word.

However, marking the scope of a WH word is not necessarily overt. A scope marker could be covert. In multiple questions in English as in (44a), only one WH word "where" overtly marks the scope of the WH operator, whereas the other WH word "what" is in situ, that is the pre-movement position. The WH word in situ denotes a wide scope

(44) a.[Op_1 $Where_2$] did they buy $what_1$ t_2?
b. Mary bought a camcorder from Circuit City, John bought a CD player from K-mart, etc.

reading reflected in paired readings as in (44 b). In other words, the question requires answering both WH words. The WH word in situ must have a scope indicator. Such scope could be determined by a covert WH scope marker (Op_1) that is adjoined to the initial WH word as in (44a). The surface distribution of WH words reflects their rank order concerning their interpretation in the sentence. The WH words at the far left have the priority for interpretation (cf. WH superiority, Lasnik and Saito, 1984).

The “if” case is more evidence of covert WH operators in English (Haegmann, 1995). In (45), the head “if” occupies the embedded C’ position; however, a covert WH operator is in the specifier position. This is indicated by a WH barrier that blocks long

(45) When$_1$ did the boy ask t_1 [$_{CP}$ Op [if] [$_{IP}$ his Mom cooked dinner *t_1]]?

distance WH movement of the initial WH word as indicated by an asterisk. Hence, the question in (45) cannot mean (when-asked-cooked,) but can only mean (when-asked.) As such, a covert scope marker is theoretically and empirically possible in English. However, scope marking and partial WH movement as in German are not manifested in English.[16]

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[16] In the descriptions of scope marking mechanisms, one might conclude that scope marking could be representational as a result of co-indexation between the scope marker and the medial WH word, as in Hindi, or a derivational scope marking as a result of movement, such as German. Dayal, in an attempt to generalize her analysis of Hindi to other languages, argues for an indirect scope marking analysis for English. According to Dayal, sequential questions seem to satisfy this analyis as in (i).

(i) What do you think? Who came to the party?

However, a counter argument comes from Speas and Roeper (September 15, 1999) who suggested that examples like (ii) have an NP that could not subcategorize for a CP, hence they concluded it is not scope marking structure in English. The question is a paraphrase to “what do you think?” Inversion, as in (iii), in the second CP is another argument that sequential questions in English are not a scope marking construction. In fact when no inversion is used, the sentence is ungrammatical as in (iiib). Inversion in the second CP is evidence of non-subordination and that the two sentences are independent. It is possible that in the early stages of development children could have this analysis.

(ii) What’s your opinion? Who will Mary meet?
(iii) a. What do you think? What did she buy?
b. What do you think? *What she bought?

Some linguists suggest that partial WH movement is similar to and could be a default[17] of long distance WH movement (e.g., Brandner, 1996; Fanselow and Mahajan, 2000); see also examples (39a&b) above. Previous acquisition evidence has pointed to partial WH movement as a default (e.g., de Villiers, et. al., 1990). The covert movement of the medial WH word in partial WH movement parallels long distance WH movement at the level of interpretation (Dayal, 1996). Why does German, then, use partial WH movement instead of long distance movement? Scope marking and partial WH movement are possible with certain verbs for some semantic reasons (e.g., Fanselow and Mahajan, 2000; Kratzer, personal communication, October 20, 1999). In English, however, verb subordination is restricted. For example, English does not allow the complementizer "that" in "He said <u>what</u> [*that] he fixed" when a WH word, "what," occupies the medial specifier position. This is referred to as the Doubly Filled Comp filter constraint (e.g., Lasnik and Saito, 1984). In German "that" (*dass*) is optional in partial WH movement and obligatory in long distance WH movement.

However, an overlap of restrictiveness occurs. In English, the main WH word cannot be coindexed with two elements, its trace and a medial WH word. Similarly, in German, unlike the scope marker, "*was*," a WH word with lexical content cannot license a medial WH word as in (46) from Brandner (1996, p. 103, example 48) because of

[17] Default is used in child grammar when a failure to project a specific rule that is required by a given grammar occurs. Instead other non-specific rules get projected in a given context. Default also refers to absence of operators, such as a Tense and Agreement operator or a WH operator.

(46) *Warum$_1$ hat Maria t_1 geglaubt wen$_1$ Peter t_1 nicht eingeladen hat?
why has Maria believed who Peter not invited has

constraints on co-indexation relations. In (46), for example, "why" is coindexed with its trace in the main clause, for quantificational interpretations, and with "who" which is a different element. However, English speaking children do not seem to obey this restrictiveness on co-indexation shared by both languages and manifest partial WH movement with such constructions. Such data is discussed under the Acquisition of WH Barriers below.

Comparisons of English and German reveal that, in English, there are no direct similarities to German scope marking and partial WH movement which function according to specific language parameters.[18] Partial WH movement is also described as a default to long distance WH movement even within its language and among adult speakers. Next is a review of the syntactic account on how negative barriers block partial WH movement.

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[18] A big difference between English and German is that English has subject-verb-object (SVO) word order, but German has SOV. So a final clause seems to be extraposed as in the English case:

It seems that Bill is here.

So, German seems to have an extraposed strategy which would make the complement clause more like an adjunct and a trace (es) is left behind after extraposing the complement clause to the left of the verb as in (ii).

(ii) Ich weiss dass Hanns es glaubt dass du gekommen bist
I know that Hanns it believes that you came

Barriers to Partial WH Movement

Partial WH movement, similar to long distance WH movement of adjunct WH words, is subject to barriers and the constraint Relativized Minimality (Brandner, 1996). Partial WH movement cannot be a one-step long distance; rather, it is constrained to cyclic movements. In multiple embedded clauses as in (47), the scope marker, "*was*," in German appears in the embedded clause with an empty intermediate specifier because the link between "*was*" and the WH word that undergoes covert movements to the main clause must not exceed one clause. This seems to be a natural consequence of Relativized Minimality since, unlike argument WH words, "*was*" cannot have long distance link because of lack of a referential index. Like adjuncts, "was" is constrained to local and cyclic relationships with its traces or coindexed elements.

(47) *Was* glaubst du *was* Marie glaubt wen Hans besucht hat?
what believe you what M. believes whom H. visited has

Hence, partial Wh movement is more sensitive to weak and strong barriers than long distance WH movement. For example, partial WH movement is blocked by factive verbs, complex NP barriers, and subject clauses. In (48a&b) from Müller (1996, p. 188, example 19a&b), partial WH movement is ungrammatical when WH movement originates from a complex NP. In contrast, long distance WH movement of an argument is marginal. However, unlike adjunct WH words and their traces, a scope marker cannot occur in the same clause with the WH word that it is co-indexed with as in (48c) from von Stechow (1996, p. 7, example 8). Otherwise an anti-locality condition is violated (Müller, 1996; von Stechow, 1996).

(48) a. *Was hast du [$_{NP}$ ein Gerücht t_3] ghört [$_{CP3}$ wen$_1$ Ede t_1 mag]?
what have you a rumour heard who Ede likes

b. ?? Wen$_1$ hast du [$_{NP}$ ein Gerücht t_3] ghört [$_{CP3}$ t'_1 dass Ede t_1 mag]?
who have you a rumour heard that E. likes

c. *Was ist wer gekommen?
what is who come

The negative barriers to partial WH movement compare to long distance WH movement of adjunct WH words discussed above. Since negative barriers are the focus in this dissertation and partial WH movement is a phenomenon in child English, accounts of the negative barriers to partial WH movement are reviewed in the next section.

<u>Negative Barriers to Partial WH Movement</u>

Similar to long distance WH movement, syntactic and semantic accounts of negative barriers to partial WH movement are suggested. First is the syntactic account (e.g., Beck, 1996). In partial WH movement negation blocks the covert movement of the medial WH word to the specifier of the main clause as in (49a) indicated by an asterisk (from Müller, 1996, p. 188, example 18a). In (49a), the trace of the medial WH word which undergoes covert WH movement to substitute the scope marker "*was*" must have its antecedent, "*was*," within the domain of the negative scope (Beck and Berman, 1996). The domain of the scope of the negative "*nicht*" in this case includes the whole IP, or the main clause, that contains, or dominates, the negative phrase. Müller (1996) argued that partial WH movement is more costly than overt long distance WH movement in the context of negation. In the case of overt long distance WH movement, a negative barrier is violated only once. However, in partial WH movement, it is violated twice: once at S-structure, or before Spell-Out, when the medial WH word forms a chain with the scope marker; the second time at the Logical Form when the medial WH word is covertly moved to be interpreted as the main question.

(49) a. *Was glaubst du *nicht* wen (daS) Hans t getroffen hat?

what think you not whom (that) Hans met has

b. *Wen$_1$ glaubst du *nicht* wen$_1$ Hans getroffen hat?

whom think you not whom H. met has

Negative barriers are used to indicate that the medial WH word moves covertly to the main clause in partial WH movement constructions. The negative barrier effect correlates with negative barriers to long distance WH movement where a WH word moves overtly to the main clause. A similar effect is shown in copy questions as in (49b) that are considered default to long distance WH movement. For example, in copy questions, the initial WH word is a copy and, similar to a scope marker, is a semantically empty WH part of the medial WH word (Brandner, 1996). In this case the medial WH word is the one that has the wide scope of the sentence. Copy questions were also in child English (e.g., Thornton, 1990). The argument is that partial WH movement and copy questions are defaults to long distance WH movement. In copy questions and long distance WH movement questions the medial WH word moves overtly to the main clause. Since negative barriers affect all three, the medial WH word in partial WH movement must move covertly to the main clause.

Dayal (1996; 1998), on the other hand, called for a non-structural account. Her account is basically similar to Rullman's (1995) semantic/discourse account. According to Dayal, negative WH questions are possible when they are discourse linked. For example, in (50a) one presupposes knowledge of the set of people who came to the party, hence a negative question is possible. However, in (50b), the WH question can be answered without knowing the set of people over whom "who" quantifies (both examples are from Dayal). Dayal argued that if negation requires discourse linking of the WH word, then the scope marker in partial WH movement is no longer a free variable that could select from a set of propositions.

(50) a. Who didn't come to the party?

b. Who came to the party?

However, a counter example is provided by Beck and Berman (1996) to show that negative asymmetry in (51) is independent of discourse linking. The context of (51) is that a party of *x* for which a list of possible guests is considered for invitation. The covert WH partial movement in (51a) is banned when negation is present in (51b), but not in the overt long distance WH movement case in (51c).[19] However, unlike long distance WH movement in English, the negative barrier to partial WH movement wipes out the argument/adjunct asymmetry. In (51b) an argument is blocked, "*wer*" (who), but in (51d) from Rizzi (1992), an adjunct WH word, "*wie*" (how), is blocked. One explanation is that the expletive scope marker "*was*" does not carry a referential index; it is only a structural index in reference to the interpretational distribution of the medial WH word. Hence, its relationship with the medial WH word is subject to the negative barrier.

[19] A similar distinction between long and partial WH movements was reported by Rizzi (1992) though in reference to surface structure chain links analysis by McDaniel (1989).

(51) a. Was meint Hans, wer kommen wird?
what thinks H. who come will
'Who does H. think will come?'

b. *Was meint H. nicht, wer kommen wird?
what thinks H. not who come will

c. Wer meint H. nicht daS kommen wird?
who thinks H. not that come will

d. *Was hast du nicht gesagt wie sie geschlafen hat?
what you not say how she slept

However, similar to the syntactic account on negative barriers to long distance WH movement, the syntactic account on partial WH movement provides similar structural representations for negative barriers to a group of WH movement that exceed one clause. The semantic/discourse accounts do not address structural features of complex WH questions.

The review of the accounts on the negative barriers to partial WH movement lead to expansion on the previously listed First Summary of Linguistic Assumptions about Negative and WH Barriers. These are relisted with some expansions below.

Second Summary of Linguistic Assumptions about Negative and WH Barriers

The review of the linguistic accounts on negative barriers to partial WH movement lead to expansion on the previous research assumptions since they would affect the specific acquisition hypotheses made. The expanded linguistic assumptions about negative barriers are summarized as follows:

Universal Grammar Assumption

The NegP and negative barriers are universal. Negation is a barrier to long distance WH movement and cross-linguistically to partial WH movement.

Negative Barrier Assumption

The NegP is a barrier to long distance WH movement. The NegP is also a barrier to covert movement to the main clause and partial WH movement. For both movements, the negative barrier is structurally represented. A negative operator in the specifier of NegP prevents an adjunct WH word, another operator, from moving through it since adjunct movement operates locally and cyclically through relevant positions. In the partial WH movement case, the scope marker is also subject to negative barriers since it is an adjunct.

The Functional-Lexical Differentiation of the Negative Elements Assumption

The three negative elements reviewed- the negatives “not,” “n’t,” and “nobody”- differ due to some functional and lexical features.

a. The negative “not” is a head of NegP. The whole NegP with “not” could be an adjunct to VP (e.g., Zanuttini, 1989).

b. The negative “n’t,” a head of NegP, undergoes contraction that operates on NegP and incorporation by the Do-insertion rule with INFL the head of IP. Incorporation operates on universal (or Universal Grammar) projections, such as NegP.

c. The negative subject “nobody” is the subject of a sentence and must be a specifier of NegP. Therefore, the negative “nobody” cannot be an adjunct. It is also a quantifier (Beck, 1996). If a quantifier phrase is a barrier, then a child should realize it immediately.

Such differences would lead to acquisition hypotheses that predict the negative elements to have different blocking effects.

<u>The Parallelism of Negative and WH Barriers</u>

According to syntactic theory, negative and WH barriers operate structurally. A negative or a WH operator in the specifier of NegP or CP prevents an adjunct WH word, another operator, from moving through it since adjunct movement operates locally and cyclically through relevant positions. Such parallelism would lead to acquisition hypotheses that predict similar effects for the negative and WH barriers.

Universal Defaults

Partial WH movement as well as copy WH questions are possible defaults to long distance WH movement since they share similar underlying structures and movement operations and are subject to negative barriers.

Another form of negative barriers takes place in the embedded clause. It seems intriguing to test the effect of such negative barriers in child grammar for two reasons. One is to test the development of negative operators in general. The other concerns the difference between barriers in the main clause versus the embedded clause. The latter could also reveal the development of some aspects of the embedded complementizer phrase (CP) underlying the embedded clause structure. An analysis of the embedded negative phrases follows.

Embedded Negative Phrases

Before discussing negative barriers of embedded negative phrases, a description of the embedded complementizer phrase (CP) is given first since it is the locus of embedded negative phrases.

<u>The Embedded Complementizer Phrase</u> (CP)

Complementizer phrases (CP's), including embedded CP's, could have positions other than the specifier or the head to host preposed phrases, such as an embedded negative phrase. An analysis of the fine structure of CP is Rizzi's split CP (1996).[20] The motivation for this modified configuration of the CP was to resolve some structural distributions of elements that interact as part of the sentence formulation and interpretation.

Rizzi's Split CP (1996; also Müller and Sternefeld, 1993) has provided a fine-grained analysis of the components of the CP, some of which he thought to be the interface between the representations of propositions and discourse. Rizzi distinguished inter- and intra- features of the CP system which Penner (1996) described as the external

[20] Another proposal for the position of the preposed elements is adjunction to IP (Lasnik, and Saito, 1984). However, this analysis faces the problem of accounting for the negative barrierhood. If adjoined, then it should behave like scrambling that has no barrier effect (Muller and Sternefeld, 1993). In fact the analysis of adjunction has been proposed to account for the lack of barrierhood in child grammar (e.g., de Villiers, 1991).

and internal features. The external features concerning the interface of the CP with domains outside of the sentential proposition involve interrogatives, exclamatives, declaratives, relatives, and referentiality, such as factivity, and the co-indexation of discourse-linked WH NP phrases (Penner, 1996). Rizzi designated these features under Force projection. They are operators in nature and scope markers that host quantificational phrases, such as WH words. They also have interpretive functions of the CP categories. For example, the external features associated with the CP are illocutionary, that is, relating to discourse. These features, occasionally expressed by overt morphemes, trigger movement. The internal features, on the other hand, refer to finiteness, such as the content of the IP. These include tense, verb agreement and overt subjects. Finiteness is exemplified by the co-occurence of the complementizer "that" and tensed clauses in English. IP represent propositions about possible worlds whereas a VP concerns event structure.

Functions other than the selectional requirements of force and finiteness are present in the CP system. Sandwiched between the force/finiteness phrases are topicalization and focus. This is when the CP is said to split to accommodate a Topic phrase (TopP) and a Focus phrase (FocP) when required by an element marked +Top or +Foc[21] as shown in the tree diagram in (52). A medial WH word "what" is an example

(52) CP
2
Specifier Force
@
TopP
2
Topic'
2
Topic FocP
2
what Focus'
2
Focus Finiteness
[+WH] @
VP
@
(He said) he fixed

of a +Focus element that is hosted by FocP. However, two foci, such as a WH word and a focus phrase, cannot co-occur in the same clause position as indicated by an asterisk in (53). One reason is that a FocP hosts a quantificational operator, such as a WH operator. The co-occurrence of multiple operators is restricted due to scope interference which is similar to the idea of barriers and Relativized Minimality discussed above. For this reason, a WH word or its trace cannot co-occur with, for example, a negative phrase in the

[21] For concreteness, the differences and distributional constraints of the Top/Foc phrases are not discussed. However, Rizzi's account of the CP clause did not include some aspects that would have been beneficial to relate to the acquisition theory of CP. First his proposal is not a movement theory. It is a theory of representation. He even restricted his Relativized Minimality to a locality principle on representation rather than being a theory of movement as was introduced in *Relativized Minimality* (1990). There is also no explicit treatment of multiple WH questions and partial WH movement as attested to in languages like Hungari and German. There is also no distinction made, if there is one, between main CP and embedded CP, a distinction that would have consequences for the acquisition theory.

medial FocP. Hence, WH long distance movement should be banned. However, Rizzi's split CP is a hypothesis of the representation of the CP structure, and not explicitly about barriers to movement.[22] An account, based on principles like Relativized Minimality, might explain how negative elements in the embedded CP block long distance WH movement. The embedded negative phrases are discussed next.

(53) *John said what only this boy he would give.

Descriptions of the Embedded Negative Phrases

For the description and nature of embedded negative phrases, the analysis proposed by Haegeman (1995) is used for this research. Haegeman distinguished two groups of negative phrases: Negative constituents and negative phrases that contain operators, henceforth referred to as negative operators. Negative constituents are not operators and hence do not trigger subject-auxiliary inversion when preposed to the medial sentence position because they do not require a relation with a head of the same

[22] It might seem contradictory how a negative operator occupies a FocP in the embedded clause but not the FocP in a main clause which would produce a similar effect on long distance WH movement and also makes short distance WH movement, the target, of all adjunct WH words impossible. However, the FocP position is a position for moved elements. A preposed negative phrase is one, and a WH word that undergoes long distance movement is another. It is assumed that the NegP in the main clause is base generated under Finiteness (or IP according to Pollock, 1989) and does not move. Hence, short distance movement is possible.

features. As such, they are predicted not to be a barrier to long distance WH movement. Some of these are “not long ago,” “not far away,” “not far from here,” etc. These are referential like topics, or NP’s, that is, they refer to specific moments or places.

The negative operators, however, are always present in a sentence that contains a + negative feature. Negative operators parallel WH operators in several syntactic respects. One operation is inversion. As with WH operators, negative operators induce subject-auxiliary inversion when preposed as shown in the minimal pair in (54a&b). A negative operator in the specifier of a maximal projection, such as CP, must agree with

(54) a. With none of the nets could he catch the lizard.

b. With which net could he catch the lizard?

c. With none of the nets could he catch any lizard.

the head of that functional category (c.f. Affective Operators Criterion, e.g., Haegeman, 1995). Hence, the negative element on its way to the specifier position of the CP moves through the heads of IP and CP where a negative feature is copied for agreement. Negative operators that trigger inversion are in A’ specifier position, that is, the specifier of CP, and hence have scope over the whole clause. As such, they introduce a negative clause or sentence. Negative phrases have operators even if they are embedded in PrepP as in (54a) (e.g., Drubig, 1992). These include “not always,” “not many times,” “not often,” “under no circumstances,” etc.

Rizzi (1990a) accounted for how inversion could occur with embedded negative phrases but not with embedded WH words. In embedded negative phrases, the negative feature is not selected by a verb,[23] such as "say" which is used in this study, and therefore the head C of CP is accessible for subject-auxiliary inversion. When a NegP is in the operator position in CP, subject-auxiliary inversion applies to transfer the +Neg feature to C from NegP under INFL to meet the requirements of specifier-head agreement (cf. Affective Operator Criterion, e.g., Haegeman, 1995).

Negative operators also license negative polarity items, such as "any" in (54c), which could be a test of Haegeman's distinction of the two negative types. In (55a&b), a negative polarity item, "any," is not allowed with negative constituents in embedded clauses indicating absence of negative operators. However, the presence of a negative operator licenses a negative polarity item in (55c&d). Such examples are similar to the ones used in the experiments of this dissertation to investigate the barrier effect of embedded preposed negatives.

(55) a. *The boy said <u>that</u> *not far away* he saw <u>any</u> fox in the woods.

b. *The boys said <u>that</u> not far from the edge of the water they caught <u>any</u> fish.

c. The boy said <u>that</u> *never in his dreams* would he win <u>any</u> prize.

d. The girl said <u>that</u> with none of the ladders could she reach any cat on the tree.

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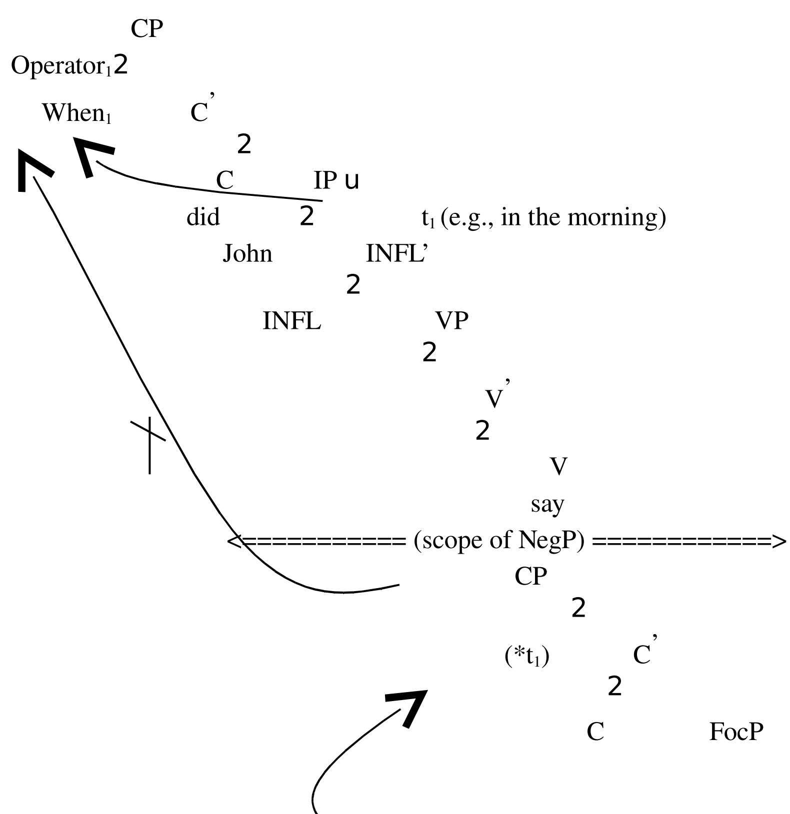
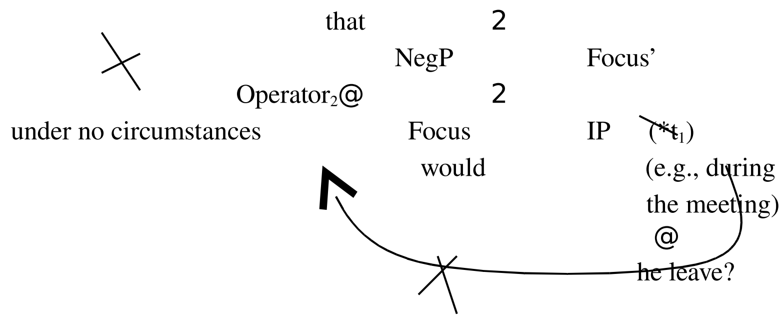
[23] For counter examples, see Drubig (1992).

As for the position of preposed negatives, Haegeman (1995) proposed that the presence of an overt “that” underlined in (55a-d) shows that the NegP is preposed to a specifier of another functional category, FocP or TopP, dominated by CP as shown in the tree diagram (52). Negative operators move to FocP because it hosts operator features. A negative constituent, the non-operator type, moves to TopP which hosts elements only with referential features. A FocP is also a position for a WH operator in Rizzi’s split CP structure. Hence, a negative operator could interfere with the WH operator for such a position.

The negative operators then are supposed to be barriers to long distance WH movement. Principles of Relativized Minimality apply. In (56), for example, the initial WH word “when” cannot have a trace (t_1) in the embedded clause, that is, long distance movement as indicated by (X) (that is, when-said-leave=> during the meeting), but it can only mean time in reference to the main clause event (that is, when-said=> in the morning). For the embedded WH word to move from the embedded clause, it needs to bypass the medial FocP position. However, a negative operator occupies this position. At the same time, the initial WH word cannot connect to its trace within the domain of the negative operator. Therefore, only short distance WH movement is possible (that is, when-said=> in the morning).

(56) .


CP
Operator$_1$
When$_1$
C'
C
IP
did
t$_1$ (e.g., in the morning)
John
INFL'
INFL
VP
V'
V
say
<=========== (scope of NegP) ===========>
CP
(*t$_1$)
C'
C
FocP



Now that this review of the embedded negative phrase barriers to long distance WH movement is provided a third summary of linguistic assumptions is possible.

Third Summary of Linguistic Assumptions about Negative and WH Barriers

The review of the linguistic accounts of the embedded negative phrase barriers to long distance WH movement lead to an expansion on the previous research assumptions which would lead to the specific acquisition hypotheses. The expanded linguistic assumptions about negative barriers are summarized as follows:

Universal Grammar Assumption

The NegP is universal. A negative operator occupies an operator position whether in the main or embedded clause. Negative barriers are universal. Negative operators are barriers to long distance WH movement and cross-linguistically to partial WH movement.

Negative Barrier Assumption

The NegP is a barrier to long distance WH movement. The NegP is also a barrier to covert movement to the main clause and partial WH movement. For both movements, the negative barrier is structurally represented. A negative operator in the specifier of NegP, or FocP in the embedded clause, prevents an adjunct WH word, another operator, from moving through it since adjunct movement operates locally and cyclically through relevant positions. In the partial WH movement case, the scope marker is subject to negative barriers since it is an adjunct.

The Functional-Lexical Differentiation of the Negative Elements Assumption

The four negative elements reviewed- the negatives “not,” “n’t,” “nobody,” and the embedded negative phrase, such as “not often”- differ due to some functional and lexical features.

a. The negative “not” is a head of NegP. The whole NegP with “not” could be an adjunct to VP (e.g., Zanuttini, 1989).

b. The negative “n’t,” a head of NegP, undergoes contraction that operates on NegP and incorporation by the Do-insertion rule with INFL the head of IP. Incorporation operates on universal (or Universal Grammar) projections, such as NegP.

c. The negative subject “nobody” is the subject of a sentence and must be a specifier of NegP. Therefore, the negative “nobody” cannot be an adjunct. It is also a quantifier (Beck, 1996). If a quantifier phrase is a barrier, then a child should realize it immediately.

d. The embedded negative phrase “not often” or “with none of the ladders” has a negative operator as indicated by inversion and negative polarity items. When it is preposed in the embedded clause, it must move to an operator position, such as the specifier of FocP, and hence is a barrier to long distance WH movement. Since embedded negative phrases are usually contained within a prepositional phrase and the specifier position of FocP is an adjunct, embedded negative phrases could also be adjuncts if the negative operator is not realized and, hence, not be barriers, especially in child grammar.

Such differences would lead to acquisition hypotheses that predict the negative elements to have different blocking effects.

The Parallelism of Negative and WH Barriers

According to syntactic theory, negative and WH barriers operate structurally. A negative or a WH operator in the specifier of NegP or CP prevents an adjunct WH word, another operator, from moving through it since adjunct movement operates locally and cyclically through relevant positions. Such parallelism would lead to acquisition hypotheses that predict similar effects for the negative and WH barriers.

Universal Defaults

Partial WH movement as well as copy WH questions are possible defaults to long distance WH movement since they share similar underlying structures and movement operations and are subject to negative barriers.

Next are discussions of the acquisition of barriers to WH movements.

The Acquisition of Barriers in Complex WH Questions

Introduction

The human species is genetically predisposed to acquire language, one of the most specific and complex communication systems. This genetic predisposition is expressed in some neural substrates functioning as the tools to analyze language input. To be activated, these neural substrates need some stimulation, that is, data input. Analyzing data input promotes the development of cognitive systems including language. Linguistic knowledge is different from general world knowledge. World knowledge concerns information about world components and their relationships. For example, world knowledge could determine whether it is sensible to ascribe a capacity, physical or cognitive, to an entity. Another form of that knowledge relates to the realizations of the limitations of spaces and times. For example, a day could not exceed 24 hours; a person could not be simultaneously in two places or at two time intervals, etc.

Linguistic knowledge is a specific cognitive knowledge that is abstract in nature. The theory of generative syntax describes language by a set of modular principles and parameters that constrain our language input and output. The principles and parameters are representational and operational functions of different interrelated modules. Moreover, universal grammar (UG) is comprised of a set of innate principles. These principles are a set of possible grammars, the range of which linguistic theory and theories of acquisition try to describe.

The theories also try to specify grammars. A set of parameters acquired by virtue of experiencing natural language input makes a specific language grammar. This set of parameters varies from language to language. An example of a language parameter is word order. The linear order of words in a sentence is not fixed across languages. For example, in English the word order of a sentence follows the subject-verb-object (SVO) pattern, whereas in Arabic it is VSO. Similarly an adjective precedes the noun in English (e.g., red apple), but follows the noun in Arabic (e.g., "*tuffaHah hamra*" apple red). A child, therefore, has to adjust a universal principle of a default word order to fit the word order in her language input. Fortunately, to account for an infinite number of language input and output data, a child needs to acquire only a finite set of principles which she can use to set parameters according to her specific language input. It seems worthwhile to raise some questions about how children acquire this knowledge system, in part because of the implications the answers hav- when such a system is challenged in some children.

One of the goals of acquisition theory is to provide explanations for two fundamental acquisition issues. One is directly related to the integrity of the core innateness hypothesis. Acquisition theory needs to account for the non-adult language behaviors as a by-product of a developing system that is innate and universally rule-governed. The other issue for acquisition theory is to describe a "recipe" of how and what is crucial to the process of learning a language. The two issues are challenging and require sophisticated research designs and fine-grained analyses. The result of such analyses should yield a set of parsimonious rules that describe and predict child language. Predictability is a basic scientific outcome of studying behaviors or any phenomenon.

Syntactic barriers to WH movement in complex WH questions are part of the principles and parameters of the syntactic module. The linguistic descriptions of how these barriers are represented in adult grammar are mostly based on linguists' judgments. Thus it seems a reasonable endeavor to examine the theoretical assumptions about barriers by examining data from controlled elicitation tasks. Testing barriers among children helps to explain how such a system develops on the basis of input data available to the language learner. One question concerns whether these barriers are present as early as three years old in the grammar of English speaking children. If the answer is yes, one would assume syntactic barriers to be part of the core grammar, or UG, with which a child is pre-equipped to process a specific language input.

Previous research in acquisition has revealed that children have some sensitivity to WH barriers. In the following sections, previous data on WH barriers are summarized and their theoretical implications are discussed. Though little data is available on negative barriers and no data on embedded negative phrase barriers, an introduction to these types of barrier follows with a discussion of their theoretical implications for language acquisition.

Barriers to WH Movement in Child Grammar

Data on syntactic barriers provide empirical evidence to address a very fundamental and long standing question in language acquisition, that is, whether language is an innate system or a by-product of general cognitive development. The innateness proposition predicts that children would demonstrate sensitivity to syntactic barriers as early age 3, and children this young indeed have shown sensitivity to barriers to WH movement. Immediately below is a discussion of the WH barrier in child grammar.

WH Barriers in Child Grammar

Previous Studies

In a series of cross-linguistic experiments on WH movement (Maxfield and Plunkett, 1991), children were shown to be sensitive to WH barriers. Specifically, when they were presented with complex WH questions following short stories as in (57), children respected the presence of a medial WH word, such as "how," and answered "when" in

(57) This boy loved to climb trees in the forest. One day he slipped and fell to the ground. He picked himself up and went home. That night when he had a bath, he found a big bruise on his arm. He said to his Dad, "I must have hurt myself when I fell this afternoon!"

When did he say how he got hurt?

relation to the main clause. For (57), at least two answers were made possible from the story. One was the time of when the boy said something happened to him. The choice of this answer, which was the children's preference, indicates a short distance WH movement and also respect of the medial WH barrier, "how." The other is the time when the boy got hurt. This answer indicates a long distance WH movement and lack of respect of the medial WH barrier, "how." Based on these results, English speaking children showed evidence of blocking long distance WH movement across medial WH words (de Villiers, et. al., 1990). Children, like adults, blocked long distance WH movement of adjunct WH words across medial WH adjunct and argument barriers. Likewise, they blocked long distance movement of argument WH words across WH argument barriers (Weverink, 1991). (See Table 2.2 for examples.)

However, children's answers to the WH questions in those studies were not perfectly compatible with those expected of the English speaking adults. In some instances children do allow movement across WH barriers. A summary of child data reported in de Villiers, Roeper and Vainikka (1990) is shown in Table 2.2. The data is presented according to the condition of the initial and medial WH words and the types and proportions of WH movement answers. Children gave four answer types. They were short distance, long distance, medial WH answers (or partial WH movement),[24] and single clause answers where the medial WH word is reconstructed in reference only to the complement clause. (For full descriptions of the answers in relation to this study, see Chapter 4: Results, under Experiments 1 and 3; see also descriptions under Operations in Sentences: the Formulation of WH Questions and Partial WH Movement above.)

In Table 2.2, the control conditions (58 & 61), adjunct-0 and argument-0, received the greatest number of long distance answers. This type of answer is also possible for adult English speakers. As has been described under WH Barriers, an absent medial WH word makes the specifier of the medial CP position available for a cyclic WH word movement from its original position in the embedded clause. Hence, LD analysis causes no violations of strong constraints, such as the Empty Category Principle which disallows improperly governed traces. (See discussions above on WH barriers under Barriers in Complex WH Questions.)

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[24] Medial WH answers and partial WH movement are assumed to be interchangeable. Henceforth, the term *medial answers* is used.

Table 2.2. Answers allowed to WH questions with different medial WH barriers by English speaking children.

(SD=short distance; LD=long distance; medial= medial WH answers or partial WH movement) (N= 25; age: 3.7 to 6.11 year olds)

Condition	The Sentence	Types of WH answers and their proportions per question provided by English speaking children			
		SD	LD	Medial	Single clause
Adjunct-0	58. When did the boy say he hurt himself?	50% (When-say)	44% (When-hurt)	NA	NA
Adjunct-argument	59. How did the girl ask who to paint?	23% (How-ask)	8% (How-paint)	36% (Who-ask-paint)	31% (Who-paint)
Adjunct-adjunct	60. When did the clown say how he caught the ball?	44% (When-say)	6% (When-caught)	40% (How-say-caught)	10% (How-caught)
Argument-0	61. Who did the girl ask to help?	68% (Who-ask)	32% (Who-help)	NA	NA
Argument-argument	62. Who did the girl ask what to throw?	70% (Who-ask)	2% (Who-throw)	28% (What-ask-throw)	0% (What-throw)
Argument-adjunct	63. Who did Big bird ask how to paint?	65% (Who-ask)	30% (Who-paint)	0% (Who-ask-paint)	4% (How-paint)

The medial WH words in conditions (59, 60, 62 & 63), however, make only short distance movement permissible in adult grammar. Except for the argument-adjunct in (63), children blocked LD answers. Moreover, children demonstrated argument-adjunct asymmetry as described in Relativized Minimality when they blocked LD answers with a medial argument more than with a medial adjunct (compare 62 to 63). Children's distinction between arguments and adjuncts demonstrated evidence of an early knowledge of the concept of barriers. Arguments are referential and required by verbs which make them visible traces. Children seem to understand that traces of arguments are required by verbs and are part of an argument chain formed by the verb and the initial WH word (see WH Barriers; May, 1985). However, adjuncts do not stand for a verb argument because they are optional modifiers in the sentence. Therefore, a child has only a chain formation between an adjunct and its trace in the embedded clause which is subject to barriers. Hence, adjunct WH words had fewer long distance movement answers as in (59) and (60).

Thus, children seemed attentive to the properties of the WH element in a specifier position because barriers showed depending on the WH elements. Children, therefore, demonstrated knowledge that an empty category, a trace, must be properly governed by or related to a verb or an antecedent WH operator, such as an adjunct, that does not have an intervening operator or else the Empty Category Principle is violated (Rizzi, 1990). At the same time, children indicated knowledge of operators. Barriers are a result of operators' interaction and competition for the sentence scope. (For more information, see discussions under <u>Barriers in Complex WH Questions</u> above.)

However, unlike adults, children demonstrated two answers that are not allowed in adult English grammar. These were single clause answers and medial WH answers. These results are explained next for their implications on language learning.

Single Clause Answers

Single clause answers are indicated by answering the medial WH word, such as "who" in (59), with reference only to the complement clause and no overt indication of analyzing the WH main clause. That is, the question "How did the girl ask who to paint?" is interpreted as "Who to paint?" Out of all the conditions listed in Table 2.2, the adjunct-argument condition in (59) received most of the single clause answers (31%). This behavior needs to be directly addressed in the acquisition theory. Single clause answers could reveal the development of embedded questions. They reflect the fact that early children's structures are transparent to events in discourse. In other words, children are biased towards the embedded event which is reality, but not the telling of the event.[25]

This phenomenon is explained under discourse inference. Inference is an "unbounded" powerful cognitive operation (e.g., de Villiers, et. al., 1990) that might compete in younger children with syntactic principles, and hence reduce the barrier of a medial WH. Under this kind of analysis (e.g., de Villiers, et. al., 1990), the question is connected via inference, but not grammatical structure, to another sentence. This

[25] For arguments refuting extra-grammatical processes, such as memory limitations, see de Villiers, Roeper and Vainikka, 1991.

tendency becomes apparent with argument WH words which usually have discourse referents. For example, in (64) it is possible to answer with (64b) where

(64) How did the girl break her bike?

a. The girl broke her bike.
b. She hit a wall.

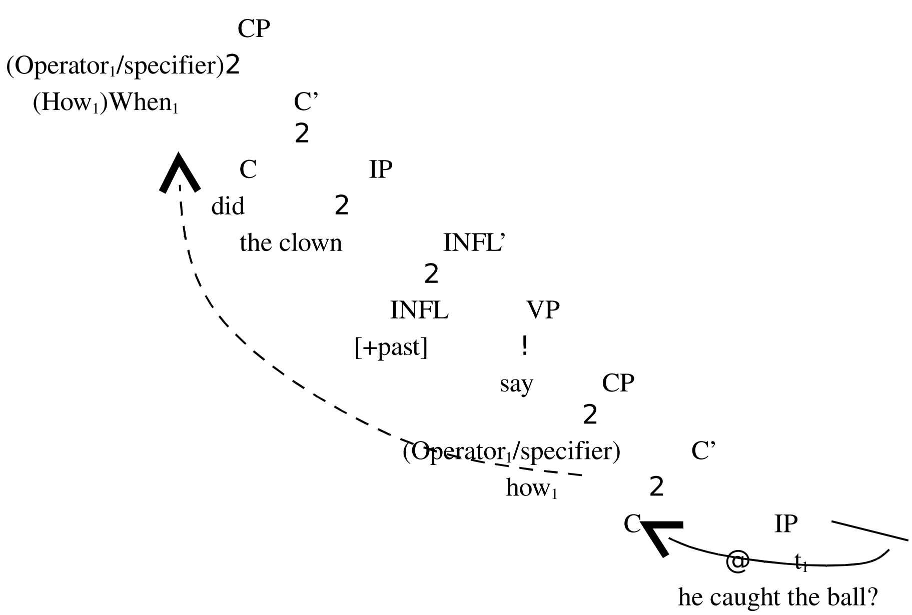
"how" is connected across discourse to another sentence (64a). While this can be achieved for single WH questions, the same analysis is not possible for embedded WH questions in adult grammar. In (65), only the main question with "where" can be answered (e.g., "at the store"), but not the embedded clause. The medial WH barrier blocks inference and discourse linking beyond the sentence boundaries. However, younger children showed some discourse inference in sentences like (59) and (60) in Table 2.2. Whether other barriers, such as negation, could constrain this discourse preference is tested in this study. (More discussion of data on single clause answers from this study is found in Chapter 5: Discussion under Question 3.)

(65) Where did the girl tell her mom how she broke her bike?
She told her mom at the store.

Medial WH Answers

Another child answer not found in adult English is the medial WH answer or partial WH movement. In the medial WH answer, a medial WH word has scope over the main verb as shown in (59) the adjunct-argument, (60) the adjunct-adjunct, and (62) the argument-argument. For example, the medial WH word “how” in (60) repeated in the sentence tree diagram (66) has partially and overtly moved (solid line) to the medial CP, or middle of the sentence. It is assumed to have continued movement covertly (dotted line) to the main clause. (For more on this process, see Partial WH Movement above.) An

(66)



acquisition hypothesis emerged suggesting that child medial WH answers are given by UG principles that are shared with other languages. Medial WH answers also appear in German as well as other languages. Besides children's awareness of principles of Relativized Minimality and the Empty Category Principle, medial WH answers have been more evidence for the innateness proposition that children have knowledge of UG principles.

Child medial WH answers were reported in production and judgmental studies. In Table 2.3, a summary is provided of some studies on embedded WH questions using comprehension, production, and judgmental data. Similar to de Villiers, Roeper and Vainikka (1990), Weverink (1990) found that children respected WH barriers. Thornton (1990) reported English speaking children copying the medial WH word onto the initial sentence position and medial WH questions in language production tasks. Thornton found other features in child production that were only compatible with cross-linguistic grammars. Children violated "That-trace" effect in their production of medial WH questions. In English, an overt "that" as in "When did the clown say how (*that) he caught the ball?" does not allow a medial WH word, such as "how," because it would prevent the WH word from being connected to its trace below "that." Hence this phenomenon was called the That-trace effect and the principle controlling it is called the Doubly-Filled Comp Filter (e.g., Lasnik and Saito, 1984). This result correlated with the medial WH answers and WH copying structures.

McDaniel (1994) reported similar results. When supplying grammaticality judgments, children allowed That-trace effect violations to embedded WH questions. This lead McDaniel (1994, 1989) to propose that medial WH answers are an aspect of UG because the same phenomenon and lack of That-trace effect are exhibited in languages like Romani and some dialects of German. Fanselow and Mahajan (2000) also showed that copying, partial WH movement, and That-trace effect all appear in some dialects of adult German. These cross-linguistic facts reinforce the acquisition hypothesis that the principles a child uses to analyze sentences are given by UG.

Table 2.3. Summary of some experimental studies on the acquisition of embedded WH questions

Acquisition Theory and Medial WH Answers

Although some children's syntactic behaviors were incompatible with adult English language, such as medial WH answers or null subjects (e.g., "(She) eat cookie.") (e.g., Bloom, 1990), they were compatible cross-linguistically. Such acquisition data lead acquisition theorists to propose that the principles involved in making these crosslinguistic syntactic behaviors must be given by UG. Furthermore, hypotheses about how a child learns a language were developed. The hypotheses propose a logical sequence of developmental stages that transform a child grammar from UG principles to intermediate states of grammar to adult grammar.

There is an assumption that children are pre-equipped with UG. UG (Universal Grammar) is a set of unspecified, or default, settings that are a logical subset of possible grammars (Penner and Roeper, 1997). Roeper (2000) defined UG as a minimal default grammar of universal structures with no particular language information. The UG set of principles is assumed to have limited variations (e.g., Hyams, 1987). The set gets redefined by particular grammar input (Penner and Roeper, 1997). Redefining the default set results in intermediate grammars. They are intermediate because they are incompatible with the target grammar and less complex than the target grammar since they miss a structure or an operation (Penner and Roeper, 1997). However, they remain default grammars till they match the adult grammar.

What Are the Default Grammars?

Default in child grammars is a failure to project a specific rule that is required by a given grammar. Instead, other non-specific rules get projected in a given context. One context of a mismatch between a specific rule and default in child grammars is the lack of operators, or lack of sufficient information to the child to project operators. An example is the default to an accusative pronoun (e.g., “me go.”) when a nominative (e.g., “I go.”) is required (e.g., Abdulkarim, 1996). In this case, the operator of the agreement/tense node is not projected.

During the development of complex WH questions, long distance WH movement seems to show up first. It remains the default that generalizes, as a result of rule productivity, to all WH words in a specifier position until other aspects of complex sentences get fixed (e.g., Penner and Roeper, 1997). Partial WH movement and copying are suggested default movements of long distance movement (e.g., Fanselow and Mahajan, 2000). The default WH movements are determined by insufficient information in child grammar about verb subcategorization in English which disallows partial WH movement (e.g., Roeper and de Villiers, 1991). Such default movement settings are part of universally based grammars or UG. Children use default representations and WH movements until decisions are made about a target grammar. Meanwhile, they demonstrate intermediate states of grammar.

Intermediate States of Grammar

During the course of language acquisition, children are assumed to go through intermediate states of grammar which were found to be similar to adult grammars in other languages (e.g., Hyams, 1987; Penner and Roeper, 1997). This led some psycholinguists and linguists to the concept that children have access to multiple grammars (e.g., Roeper, 1999, and class discussions, Spring, 1998; Roeper and Rohrbacher, 1999; Yang, 2000; Muller, 1996; Hyams, 1987; Deprez and Pierce, 1993). This proposal became articulated in Roeper's "Theoretical Bilingualism" (2000) and Yang's "Multiple Grammars" (2000) concepts. The concept of multiple grammars was motivated to solve the problem of variant child grammar and to dismiss the concept of optional rules in child grammar (e.g., Wexler, 1994). Dissatisfied with then current hypotheses, such as optional rules and triggering hypothesis, Roeper and Yang each redefined optional rules in child grammar into the concept of multiple grammars. They both argued that optional rules could not be accounted for within a single grammar. For example, Roeper (1999) argued that the present third person singular –*s* (e.g., "She sing<u>s</u>.") is not sufficient evidence that agreement is obligatory in English. In accounting for null subjects, Roeper and Rohrbacher (1999) suggested that children use two grammars, one with inflections for finite clauses and one without inflection for non-finite clauses. Furthermore, Yang (2000) refuted the hypothesis of triggering experience where one sentence is claimed to be a sufficient evidence for the child to set a rule. He showed that empirical data of language development of several structures follow a gradual pattern over time dependent on frequency of input (Yang, 2000). He explained that a child has to select from competing grammars originating in UG.

However, there are constraints on possible grammars that a child could select from. One constraint concerns the compatibility of input data with a possible grammar. A child needs to match a grammar to a range of data (e.g., Hyams, 1987). Yang (2000) assumed that if a grammar is not compatible with a given sentence, the grammar gets penalized, that is, it does not count towards the target grammar. However, checking input compatibility with different grammars is a gradual process which Yang used a synthesis of UG and learning mechanisms to explain. Learning grammars takes the form of parameter interactions. Parameters are interlinked such that setting one limits the other; however, this elimination process needs to procrastinate since a parameter is irreversible once eliminated as part of the target grammar (Roeper, 1999; also Chomsky, 1995 for the concept of procrastination of rules). Imperfect adult bilingualism is an example. Because the parameters have already been selected for a speaker's dominant language, it becomes harder to re-select parameters for the second language. However, UG principles could still be available to adults though without the same plasticity as in children. Evidence comes from second language learners who showed similar stages to children learning their first language (e.g., Hanania, 1974).

Medial WH Answers and the Intermediate States of Grammar

The hypothesis of multiple grammars that outlines the intermediate states grammar predicts medial WH answers. English speaking children use medial WH answers even though medial answers are not available in adult English input. Partial WH movement is also limited in German to certain verbs. The idea is that child medial WH answers are derived by default from underlying UG principles at a stage where grammars compete for analyzing multiple WH words in complex WH questions. For example, de Villiers, Roeper and Vainikka (1990) suggested the analysis of partial WH movement in German, as outlined in McDaniel (1989),[26] to underlie child medial WH answers. Hence, it must be a default setting of WH movement in child grammar.

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[26] However, this specific analysis defines partial movement as a chain link between a scope marker in the main clause and a medial WH word. The chain link must be at S-structure of the sentence. That is an overt relationship between elements in their structural positions. According to this analysis, no covert movement of the medial WH word to the main clause occurs. The main scope of the medial WH word is achieved via the link with the scope marker. A more recent analysis of scope marking, however, has been developed. The newer analysis abandoned the chain link and assumed that the medial WH word undergoes covert movement to the main clause to achieve the wide scope of the sentence (e.g., Muller, 1996; Beck and Berman, 1996).

Another default analysis underlying child medial WH answers could be that every moved WH word must be +quantificational, that is, a WH operator, which should be answered as in the tree diagram in (66) above (de Villiers, et. al., 1990). A WH word becomes an operator only when it is moved to a specifier position in CP (Brandner, 1996). Therefore, children answer the medial WH word. However, as in German, English speaking children did not answer WH words in situ as in (67) (de Villiers, et. al., 1990). The same underlying principle shows in German

(64) How did the girl decide to wear <u>what</u>?

where the overt partial WH movement to the medial position is obligatory. That is, the WH word has to undergo partial movement to the medial CP position and not remain in situ in its original position, such as an object of a verb, in the embedded clause even if its scope is indicated by a scope marker in the main clause (Müller, 1996). Therefore, partial movement is ungrammatical if a WH word remains in situ where a WH operator part is not activated.[27]

More evidence is needed, however, to support the finding that the partial WH movement analysis in child grammar is a UG phenomenon. Partial WH movement in several languages, such as German, is blocked by negation. Based on the hypothesis that child medial WH answers are driven by default UG principles, children are predicted to block medial WH answers with negation. Such evidence would support the UG hypothesis of medial WH answers. The UG hypothesis can explain how an English

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[27] Movement of the WH feature of the medial WH word also finds its account in Universal principles. Under the principle of feature movement in the *Minimalist Program* (Chomsky, 1995), to determine its scope the whole WH word does not need to move to the left periphery of a proposition. According to Chomsky, a WH word has a WH feature, an indefinite element, such as a person, a place, or an object, and a restrictive feature about whether the WH word is ± animate or ± human. By default, movement affects only the WH feature. For overt WH movement, morphophonetic rules (for Phonetic Form convergence), which is subject to specific language parameters, force the whole WH word to overtly move to realize the interrogative head in CP. In English, for example, the WH word “whose cat” in (i) has to move with its possessive *‘s* and its complement, *cat*, because to move only the WH feature “who” or the determiner (D) *‘s* is constrained by a morphophonological rule of the determiner. Violation of this rule is referred to as violation of the Left Branch Condition since only the left periphery of the WH word, that is *who*, is moved. According to Chomsky, the principle that moves only the formal features of a lexical item also moves extra material when it is phonetically realized in adaptation to performance factors, such as sensorimotor mechanisms, extraneous to language core systems. In simple terms, what is heard is what should be moved.

(i) Who do you think’s cat came up on the building?

However, in (i) (Gavrusena, 1997), children only moved the WH feature *who* out of the entire DP and left behind the possessive *‘s* and the complement. In English, when a WH word moves, it takes the entire WH word features, including the entire DP, since the WH word substitutes for a constituent. What children did is a dissociation of Chomsky’s formal feature movement and phonetic form. It also seems that children’s computational principles are independent of external performance requirements. A default rule to move the formal WH feature to the interrogative head C’ of CP seems to be the rule operating in the children’s output possibly for both overt and covert movement. This is also an example of default UG rules.

speaking child who has never heard German must have access to some universal default representations which are eliminated in his mother language.

Moreover, negation must block other default WH movements children use that are similar to those in languages with partial WH movement. Copying of the medial WH word to the initial sentence position is a possible default analysis in child English production and comprehension data (see Table 2.3) (e.g., de Villiers, et. al., 1990). Copying is also a default analysis of long distance analysis in German (e.g., Fanselow and Mahajan, 2000). Children blocked long distance analyses of adjunct WH questions with medial copies as in (68) like those with non-medial copies (e.g., Abdulkarim and Roeper, 1997).

(68) Why did the boy (not) tell his mom (why) he took a bath?

In German copy questions, the WH word copy in the sentence-initial position could be a semantically empty WH feature (e.g., Brandner, 1996) that is linked to the medial WH word with lexical features.[28] An initial copy might have become restricted in

[28] The intermediate copy of a WH word in child production data (e.g., Thornton, 1990) reflects a general strategy which is similar to clitic doubling as in (i). That is, a copy is left when an element is moved from its original position in the sentence. For example, the object NP in (i) has to move covertly to realize its

(i) I ate it the falafel.

accusative case features, but it is spelled out as “it” (Richards, April 15, 1998.). This strategy could be explained within Chomsky’s (1995) copy and delete transformation. Children seem to copy but not delete. One reason is that they need to have the trace overt which carries the features of agreement to both the local specifier and head of CP and also the matrix specifier and head. To have a visible trace might have a

German by some morphophonological rules and verb subcategorization requirements and got substituted by the scope marker, “was.”

On the other hand, child medial WH answers are not a perfect match to those in other languages, such as German, Hindi (Dayal, 1996), or Iraqi Arabic (Wahba, 1991). In German, for example, partial movement is not allowed if the position of the scope marker is occupied by another WH word (Müller, 1996). Yet children allowed partial movement in questions with an initial WH word with lexical content (e.g., de Villiers, et. al., 1990). Though infinitival interrogatives are disallowed in German as in (69) from Höle (1996p. 41, example 10d), children allowed partial movement with embedded infinitives (see (59) & (62) in Table 2.2).

(69) *Was glaubt sie, auf wesen Hilfe sich verlassen zu können?
what thinks she on whose help self rely to can

Until children have sufficient information about verb subcategorizations, children would allow partial movement responses with verbs that subcategorize for +WH predicates, such as “ask” (or “wonder”), that disallow WH words to move out of their embedded clauses (see Table 2.2). In German, however, no scope marking is allowed with +WH predicates (e.g., “ask” and “wonder”).

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consequence in sentence interpretation, such as WH word linking to its trace via binding.

Though argument-adjunct asymmetry is wiped out in German partial WH movement, children showed the argument-adjunct asymmetry in medial WH answers as in Table 2.2. While medial WH arguments received most medial WH answers, medial adjuncts received medial WH answers only with an initial adjunct in the sentence, and adjuncts were most affected by WH barriers (see Table 2.2). Though not yet tested in child grammar, negation is a barrier to both adjunct and argument partial WH movement. (See descriptions of German under Partial WH Movement above.)

Such incompatibilities with adult language partial movement could be accounted for by, for example, Yang's (2000) learning mechanism. In a sentence with partial WH movement several parameters come into play. Adult language is the full computation (in the Minimalist Program sense, e.g., Marantz, 1994) of all parameters concerned. However, child language acquisition depends on computations of default grammar classes. That is, children might use one or more parameters or rules of a fully developed set of computed parameters in adult language. Therefore, child grammar is less specific since it involves the use of UG for selecting possible grammars that are tested for compatibility with the input data.

Learnability Factors in the Acquisition of Complex WH Questions

Researchers in language acquisition suggested some coincidental features that could bring about the development of embedded sentences including complex WH questions. These features include the development of the concept of operators and specifiers as pertains to movement, semantic features and subcategorization requirements of verbs, development of WH word paradigms, and some specific linguistic-cognitive features. Before the development of the fully projected CP category that underlies complex WH questions, a child's CP takes patterns different from those of adults. (For a review of the CP structure, see descriptions of the Complementizer Phrase under Syntactic Structures of Sentences and Embedded Negative Phrases above.) These patterns reflect a set of default UG settings forming the core grammar. Evidence is needed to specify the default settings (Penner and Roeper, 1997).

The Development of Operators

An operator entails an operator-variable relationship where a WH word is related to an interrogative operator that quantifies over a set of entities in the discourse context. (For more descriptions on WH operators, see sections Operations in Sentences: the Formulation of WH Questions and Barriers in Complex WH Questions above). For example, in (70) (Roeper, personal communication, September 15, 1999) a set of objects is introduced in a discourse context followed by a "what" question. A referential interpretation- an early child answer (also called non-exhaustive reading)- is when "what" refers to one object. A variable interpretation, an adult response (also referred to as exhaustive reading), is when the whole set is substituted for by "what."

(70) Context: John bought a cake, a book, and flowers.

Q: What did John buy?

Child: Flowers (What= non-variable)
Adult: a cake, a book, and flowers (What= variable)

One hypothesis that might explain early child "non-variable" analysis in embedded WH questions is concord. Feature relations between elements in the sentence, such as specifiers and heads of both lexical and functional phrases, could take two forms. One is concord, and the other is agreement. They are achieved via two possible operations. Movement is an operation that realizes agreement relations where a lexical element, such as a WH word, moves to a specifier of CP and an auxiliary to the head C of CP. Recursive structures realize concord (Roeper, personal communication, February 20, 2000). Under concord, two or more elements could agree in features without movement, and hence, no operator-variable relationship is needed. For example, negative concord between negative elements in negative sentences is generated as an alternative to the early lack of negative operator-variable relationships.

Concord appears easier than agreement because it does not require movement. Under concord, a main CP with +WH feature is recursive much like the conjunction "and," and it generates either a specific WH word or a WH feature which is then filled (e.g., CP +WH=> [CP +WH [CP +WH]]). During the early development of CP, partial WH movement could be a kind of interrogative concord between a scope marker and a medial WH word (e.g., Brandner, 1996). According to this hypothesis, children might first get the interrogative concord relations. Then the WH operator-variable relationship, as well as negative polarity, emerges where the main WH operator ("when"), as in (71), binds and dominates a variable (x) expressed by the whole proposition to its right.

(71) a. When did you say $_x$ who came to the party?

b. When [+WH operator]
the variable$_x$ ranges over a set of propositions:
[you said who came to the party in the morning]
[you said who came to the party in the evening]
[you said who came to the party after Mary had left]
etc.

Evidence of concord via recursive structures in early child complex WH questions is possible. The That-trace effect is one example where a recursive embedded CP might be projected via adjunction to the main V or VP. Fanselow and Mahajan (2000) suggested projection of two CP's to account for the same effect in some adult German dialects. They used that to explain how the Doubly-Filled Comp Filter principle that disallows adjacent WH word and “that” (e.g., “He said what (*that) he bought.”) might be avoided. Both the Doubly-Filled Comp Filter principle and recursive rules are considered universal. The fact that one embedded specifier has a WH word, a +WH element, whereas a head C has “that,” an element indicating a factive proposition, indicates that they occur in two different CP’s because they do not agree. In partial WH movement, embedded clauses are factive and quantificational; hence, both elements are allowed but accommodated by recursive CP’s.

Copying of a medial WH word is another possible example of a recursive structure achieving concord relations between an embedded specifier and its head without being a direct complement of the main verb which requires that an overt WH trace must be deleted. (See Table 2.3 for examples of child WH copy answers.) If verb subcategorization features restrict recursive embedded structures, such as an embedded CP (Marantz, 1994), then one would expect that development of full verb subcategorization requirements would eliminate recursive structures because concord relations get reset as agreement relations that require movement. As a result, operator-variable relations emerge.

A consequence of the emergence of operators is one structurally salient mechanism, namely, long distance WH movement. Since learning the features of embedded sentences, such as the CP, is context dependent, and learning is embedded in situations, a child needs input for long distance WH movement. Therefore, an example of input would be to hear a long distance WH question as in (72). However, long

(72) Adult: What$_1$ did you say [$_{CP}$ you want for lunch t$_1$]?
Target response: I want a peanut butter sandwich for lunch.

distance WH movement could be learned by lexical classes (e.g., Roeper, 1999). For example, argument WH words precede adjunct WH words. This distinction is captured by the argument-adjunct asymmetry (e.g., Rizzi, 1992) which arises from their formal properties and semantic features. Arguments, for example, are complements of a verb and have referential properties which make them undergo long distance movement overriding adjunct WH barriers. (See discussions under Barriers in Complex WH Questions.) In Table 2.2, for example, with a medial adjunct, argument WH words received more long distance movement than adjuncts.

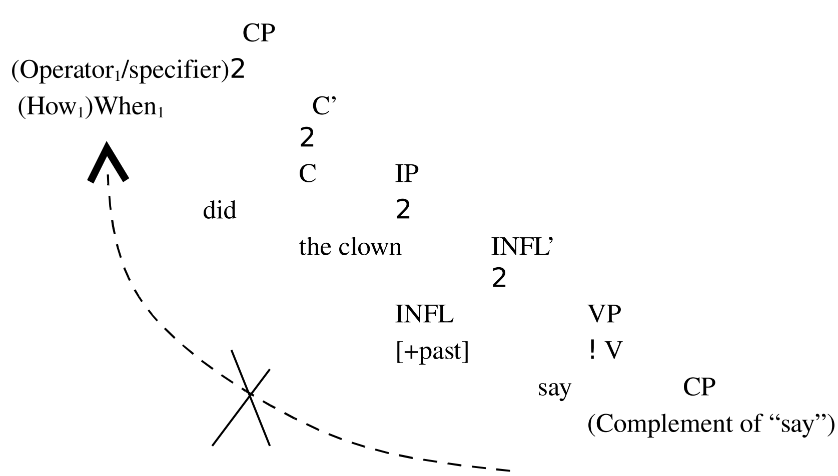
Properties of Lexical Entries

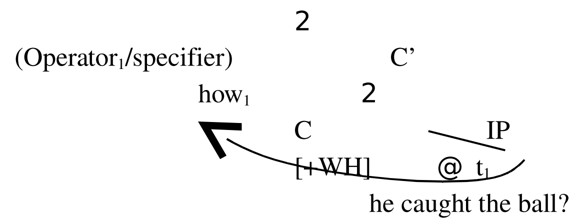
Semantic features and subcategorization requirements of main verbs could play a role in the development of WH movement and embedded clauses, or embedded CP’s (e.g., Roeper and de Villiers, 1994; de Villiers, 1991). It is assumed that grammars are learned by lexical and semantic features of lexical classes (e.g., Roeper, 1999). The arrangement of grammars into lexical classes has been an aspect in the Minimalist Program, a recent development of the syntactic theory. Syntactic structures, instead of phrase structure rules, such as X' theory, have been redefined in terms of the lexical and semantic features of lexical items or what Chomsky (1995) called Formal Features. As such, sets of lexical resources initiate base derivations. Then lexical items and their features are computed into different level structures, such as Spell-out and then into the Logical Form and Phonetic Form levels (Marantz, 1994; see also the above subsections: The Relationship between Lexical and Functional Categories within the Sentence Structure and What is WH Movement). Lexical semantic properties refer to the semantic features of arguments specified by a verb. This is called semantic selection. The verb "rationalize," for example, takes an agent that shares the properties of +human.

Subcategorization concerns the structural, or formal, properties of the constituents selected by a verb, such as an NP or a complement clause, thus called constituent selection. The verb "ask," for example, selects an NP or an embedded question, but "wonder" only selects an embedded question (Chomsky, 1995). According to Chomsky, subcategorization evidence, such as hearing an unfamiliar verb (e.g., "think") with a complement clause (e.g., "think that the earth is flat"), might provide information about the verb meanings. In this case the verb expresses propositional attitudes.

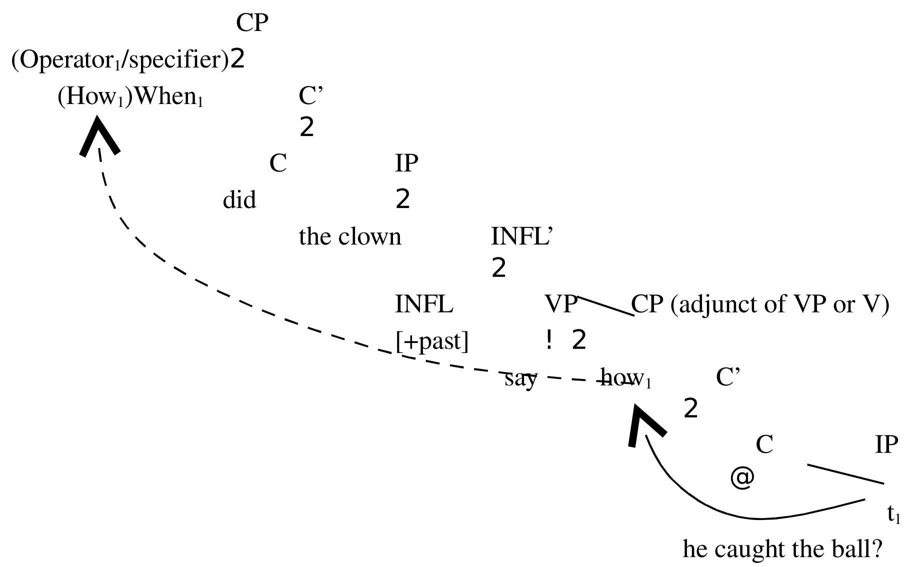
How do verb subcategorization features, for example, affect the type of WH movement allowed? Two possible underlying structures might be responsible for absence or presence of partial WH movement. They are illustrated in (73a&b). In the (73a) structure, the second clause is a complement that has to meet the requirements of the main verb. This means that the specifier and head of the embedded CP, or clause, has to agree with the features of the verb. So if the complement contains a WH word, agreement is achieved by movement of the WH word to the embedded specifier of the embedded CP. However, the WH word is not allowed to move from there to the main clause (indicated by a X). Hence, no partial movement is allowed. This underlying structure represents adult English. In the (73b) structure, the second clause is adjoined at the VP level, or V, of the main verb. Adjunction is not subject to verb subcategorization requirements. Therefore, a medial WH word can move covertly to the main clause (indicated by the dotted line). Structures similar to (73b), which underlie cross-linguistic partial WH movement, are used to explain medial WH answers in child English (e.g., Roeper and de Villiers, 1994). Long distance movement also follows similar mechanisms (e.g., Marantz, 1994; Fanselow and Mahajan, 2000).

(73) a.





b.



Complement clause adjunction could explain other WH phenomena in both German and child English, such as the "That-trace" effect where both a medial WH word and the complementizer "that" appear in the embedded clause (e.g., "He said what (*that) he bought.), and WH copying. In the That-trace effect case, adjunction of the second clause avoids the Doubly-Filled Comp Filter constraint on having both an overt specifier, such as a WH word, and an overt complementizer "that."[29] Adjunction could be underlying WH copying, attested in child grammar (e.g., Thornton, 1990; McDaniel,

[29] Fanselow and Mahajan (2000) reported dialects of German that do not respect the Doubly-Filled Comp Filter. The solution they suggested was that two embedded CP's are projected to satisfy the constraint.

1994; also see Table 2.3 for examples). In copying (e.g., "Who do you think who has a hat?"), the phonetic features of a WH word are left behind in a medial specifier of an embedded CP (e.g., Chomsky, 1995; Marantz, 1994; Fanselow and Mahajan, 2000). Copying of a medial WH word occurs when rules that delete a medial copy as a result of movement before the Spell Out of a sentence structure do not apply. One possible reason is that a copy of a WH word is left in the medial position of the sentence because the medial WH word is an overt trace that is not directly subcategorized (governed) by the main verb and the antecedent, or sentence initial, WH word.[30]

When no sufficient information about verb subcategorization is available to a child, complements could be analyzed as adjuncts to the main verb as in German. Hence, medial WH words get moved. Adjunction seems the default operation since it meets the minimal requirement features of verbs (Penner and Roeper, 1997). A fully subordinated clause has to meet verb subcategorization features. Indicators of the lack of verb subcategorization features are found in different acquisition data. For example, that children allowed long distance and medial WH answers out of the verb "ask" suggests that children did not develop the subcategorization requirements of such verbs (see Table 2.2; Roeper and de Villiers, 1991). In a full subordination structure, moving an embedded

[30] Another analysis comes from German (Fanselow and Mahajan, 2000). In German, an intermediate overt WH copy has to be present when the complementizer "*dass*," "that," is not present. Deletion of intermediate copies is a violation of a requirement of German CP's where material in the specifier of CP has to agree and cliticize onto the head C. So a copy of a WH word cliticizes onto the head C and fills CP.

WH word out of the verb "ask" which takes +WH feature is a violation of UG because the WH word is licensed in that position and cannot be an overt trace. Another example is the absence of subject-auxiliary inversion in the early stages (de Villiers, 1991). Using data from CHILDES (Child Language Data Exchange System), de Villiers (1991) observed a correlation in later stages between inversion and embedded medial WH words. De Villiers argued that this was a result of reanalyzing the medial WH word as a CP projection subcategorized and lexically governed by the verb in the main sentence. Roeper and de Villiers (1991), for example, proposed that non-adult patterns of WH questions, such as lack of auxiliary inversion, WH copying, and non-subcategorization of indirect questions, are accounted for by adjunction of the embedded clause.

However, once full verb subordination is specified, embedded WH questions would be selected and would agree with the main verb subcategorization and semantic requirements. As such, adjunction as a default structure gets eliminated, and restrictions on long distance movement and medial WH answers apply. For example, children were found to give medial WH answers only with verbs whose subcategorization frames they had not learned (McDaniel, 1994). Children first dropped medial WH answers with verbs that take +WH complement like "wonder" (e.g., Weissenborn, Roeper, and de Villiers, 1991; Perez-Leroux, 1991). Subcategorization features are also acquired verb by verb (e.g., Roeper and de Villiers, 1991; Roeper, 1999).

Another example of lexical properties is the acquisition of WH word classes. According to Roeper (2000) different grammars can be localized in lexical classes. For example, children do not acquire the whole class of WH words in complex structures simultaneously. Argument WH words, “who” and “what,” are learned earlier than the adjunct WH word, “how” (e.g., de Villiers, 1991). Therefore, elements are justified in a one-by-one fashion, such as a WH word by a WH word, verb by verb, etc. (e.g., Roeper and de Villiers, 1991).

Children develop WH words in reference to their WH features and lexical contents (e.g., Chomsky, 1964; Sloan, 1998). For example, the WH word “who” is composed of a WH feature and the indefinite pronoun “someone.” Likewise, “what” consists of a WH feature and “something.”[31] Therefore, when analyzing embedded WH questions, children might treat the main WH word as a WH feature, or operator, that serves as a scope marker, and the medial WH word as the lexical variable. The lexical variable feature might also be acquired in a sequence determined by the type of the WH word. Argument WH words are transparent variables in that a WH word like “what” always refers to “something of the kind x” in a set in the discourse context. When a medial argument co-occurs with an initial adjunct as in Table 2.2, children might reconstruct the main WH

[31] This compositional analysis of WH words works in question interpretation as follows: one model of question interpretation involves reconstruction of the WH trace, the variable, and its antecedent, the WH operator, at the Logical Form (e.g., Sloan, 1998; Beck, 1996). The WH word is moved like an NP and leaves a variable in its pre-movement position which is bound by the WH operator in the specifier position of CP. Within this type of WH question interpretation, the whole WH word is reconstructed in its pre-movement position. For a semantic discussion of this type of WH interpretation, see Heim (1987).

word as a question operator, or a scope marker, and the true variable would be the medial argument. The increased medial WH answers in the adjunct-argument condition in Table 2.2 showed that. However, knowledge of the full features of WH words would help to eliminate medial WH answers.

What Does Cognitive-Semantic Capacity Have to Do with Embedded Sentences?

Another factor related to the development of full subordination is related to an aspect of cognitive development called Theory of Mind (ToM) (de Villiers, 1995a). This cognitive ability represents knowledge of others' content of mind or beliefs and the ability to separate these beliefs, whether true or false, from one's own beliefs (e.g., Flavell, 1993; Woolley and Wellman, 1993; Montgomery, 1992). An example of a context where a Theory of Mind ability comes into action is in a world situation where individuals A and B share knowledge about the location of an object X. However, A changes the location when B is not present in that world situation. C, for example the child observer, has the knowledge of the old and new locations of X. With a Theory of Mind, C would not attribute the knowledge of the new location to B. This kind of cognitive capacity is suggested to be interconnected with the development of embedded sentences (e.g., de Villiers, 1995a, 1995b). One hypothesis is that syntactic subordination is evidence for semantic-cognitive representations, such as false beliefs. The question is how Theory of Mind capacity relates to the development of embedded sentences.

The correlation of the development of embedded sentences and Theory of Mind has been reported in previous research (e.g., de Villiers, 1995a). For example, the development of understanding mental representations at age 4 co-occurs with the formulation of embedded propositions in complex sentences. The development of embedded clauses with verbs of mental states, such as "think," could provide the child with a means for understanding and communicating distinctions between knowledge of world events and false beliefs, or semantically, among possible worlds (de Villiers, 1995a). For example, de Villiers (1995a) found that 3 year old children who failed false-belief tasks allowed referential substitutions of NP's (underlined in (74)) in embedded propositions of main intentional verbs (e.g., "think") where only a mother knows that a silver box she bought was a birthday present containing candy for her daughter. Referential substitutions under intentional verbs would only be possible for the mother in the following sentence:

(74) The mother (*the daughter) *knows* <u>the candy</u> is on the shelf.

It seems that 3 year old children do not have an understanding that another person could have a false belief that is independent from their own. Hence, they allow inferences to cross the boundaries of propositions that represent another person's belief (de Villiers, 1995a, 1995b). De Villiers (1995b) commented that such a mistake "lies beyond the syntax of complements: that the semantics are still unclear because they depend on concepts that have yet to mature" (p.10). As such, the level of the interaction between Theory of Mind and language complex constructions is assumed to be at the conceptual-intentional interface. The semantic representations of complements "have an interpretation in terms of other systems of the mind/brain involved in thought, referring, planning, and so on" (Chomsky, 1995, p 21). As such, complements of verbs that take propositional attitudes correspond to embedded mental propositions, such as beliefs about world situations.

Further correlations were found in different syntactic constructions and across child populations. Theory of Mind capacity has been reported to coincide with sequence of tense in embedded sentences (Hollebrandse, 1999). In oral deaf children, Theory of Mind was delayed. Lack of typical language development was suggested as a factor (de Villiers and de Villiers, 1998). Since Theory of Mind has been reported to correlate with a range of linguistic data and marks some developmental stages in embedded sentences, it would be reasonable to use Theory of Mind tasks in this study as one of the general language measures. Results on Theory of Mind tasks, as well as age and other language measures, could be used to place children into groups for purposes of statistical and developmental comparisons.

Summary of the Acquisition Studies on WH Barriers

Findings of the acquisition studies on WH barriers could be summarized as follows:

a. Children honored WH barriers to long distance WH movement and related principles, Relativized Minimality and argument-adjunct asymmetry.

b. Children demonstrated medial WH answers and manifested other related features of "That-trace" effect and WH copying which could share underlying syntactic analyses and principles of partial WH movement in other languages, such as, German.

c. Several hypotheses emerged to explain WH barriers as part of the development of embedded clauses. These include:

Universal Grammar hypothesis: WH barriers are a universal feature.

The default grammar hypothesis: Non-adult forms, such as medial WH answers, are default UG settings that result from the lack of sufficient information about the specific adult grammar. Adjunction of embedded clauses, for example, is a default setting. The intermediate states grammar: Some stages of language development manifest the use of default grammatical settings, such as medial WH answers and adjunction of embedded clauses. These misanalyses are consistent with UG underspecified settings. Learning factors hypotheses: Several factors were suggested to provide information to the child about the specific grammar of subordination. These factors generalize to lexical resources like verb subcategorization requirements, lexical classes of WH words, and intentional verbs.

Negative Barriers in Child Grammar

Few studies have examined the acquisition of the negative barriers to long distance WH movement. In a pilot experiment on the negative "not," children showed negative barriers in negative "why" questions[32] as in (75b) (Abdulkarim and Roeper,

[32] "Why" is argued to be a WH word that is reconstructed as a "because" clause (e.g., Sigrid Beck, personal communication, Ocotber 15, 1997); hence it is different from WH words that undergo movement. However, it is uncontroversial that "why" is a WH word that occupies Spec,CP since it triggers inversion and satisfies the selectional requirements of verbs like "wonder" or "ask" (Cullicover, 1996).

1997) in contrast to affirmative questions as in (75a). Negative barrier is also shown in the tree diagram in (75c). Negation was a barrier to long distance WH movement in all groups tested (see Table 2.4). Within-subject effects were significantly different ($p=.000$). Also, no main effects for age, language, or child and adult groups were found. The negative barrier was predicted from age ($p<.05$) for the English speaking children. These results support the hypothesis of the universality of the negative barrier (e.g., Haegeman, 1995; Ouhalla, 1991).

(75) a. Why did the boy say **t** he took a bath **t**?

b. Why did the boy **not** tell his mom **t** he took a bath *__**t**__?

c.
CP
Operator$_1$ 2
Why$_1$ C'
2
C IP u
did 2 t$_1$(e.g., Because she was asleep)
the boy INFL'
2
INFL
<===========(scope of NegP)============>
2
Operator$_2$ Neg'
2
Neg VP
not 2
V'
| 2
V NP CP
tell his mom
2
(*t$_1$) C'
2
C IP u

@(*t_1)
he took a
bath?

Table 2.4. Negative barriers to long distance movement in the responses of English and Arabic speaking children and adult controls.
(LD: long distance movement; SD: short distance movement)

Age	Why did the boy tell his mom he took a bath? (a)		Why did the boy not tell his mom he took a bath? (b)	
English	Types of WH answers and their proportions per question provided by English speaking children			
	LD	SD	LD	SD
3 (N=6)	69.4%	30.5%	38.9%	61%
4 (N=9)	92.6%	7.4%	14.8%	85.2%
5 (N=17)	96%	3.9%	7.8%	92%
Adults (N=21)	88.9%	11%	0%	100%
Arabic	Types of WH answers and their proportions per question provided by Arabic speaking children			
	LD	SD	LD	SD
4 (N=3)	88.9%	11%	11%	88.9%
5 (N=6)	88.9%	11%	11%	88.9%

Negative Barriers and WH Barriers

As discussed under the Negative Barriers above, linguists have debated negative barriers in terms of their syntactic or semantic status. According to the syntactic theory, negative barriers parallel WH barriers. The behavior of WH barriers in a range of experiments (see papers in Maxfield and Plunkett, 1991) showed cross-linguistic WH barriers similar to the negative barriers. Children blocked long distance WH movement of adjunct WH words when a medial adjunct was present (see Table 2.5). As predicted by the syntactic account (e.g., Rizzi, 1990; Abdulkarim and Roeper, 1997), WH and negative barriers as shown in Tables 2.4 and 2.5 emerge simultaneously.

However, one needs to know how WH barriers parallel negative barriers in the same study group. In addition, since both barriers have operators, one needs to find out how the WH barriers and negative barriers interact in the same sentence (e.g., "Where did the girl not tell her mom how she broke her bike?"). As has been discussed under the Acquisition of WH Barriers, children's medial WH answers show default UG settings that are different from English. However, medial WH answers are subject to negative barriers in languages with partial WH movement (e.g German). According to the hypothesis that children go through stages of intermediate default grammars, children are predicted to block medial WH answers in negative WH questions with medial WH words. If so, then negative barriers to medial WH answers suggest children's understanding of NegP structure have operators that compete for scope with the WH operator.

Table 2.5. WH barriers to long distance movement of adjunct WH words.
(SD=short distance; LD=long distance) (N= 25; age: 3.7 to 6.8 year olds) (de Villiers, et. al., 1990)

The Sentence	Types of WH answers and their proportions per question provided by English speaking children	
	SD	LD

76. When did the boy say he hurt himself? (Adjunct - 0)	50% (When-say)	44% (When-hurt)
77. How did the girl ask who to paint? (Adjunct - argument)	23% (How-ask)	8% (How-paint)
78. When did the clown say how he caught the ball? (Adjunct - adjunct)	44% (When-say)	6% (When-caught)

The Development of the Negative Operator

According to the syntactic theory, negative operator is assumed to parallel WH operator. Therefore, the development of negative barriers could be an aspect of the development of the syntax of complex sentences. Syntax is assumed to be the core grammatical module (e.g., Chomsky, 1995). Early emergence of the NegP within IP, the locus of NegP in adult grammar (e.g., Polluck, 1989), was found in the correct placement of negation with respect to the main verb by 2 and 3 year olds (Deprez and Pierce, 1993). Similar to the WH operator, prior to the setting of the negative operator, negative concord is the assumed default UG setting for negation. (See also discussions of the Development of Operators above.) Under negative concord, NegP is not treated as an operator or a barrier.

As has been suggested for the WH barrier (e.g., de Villiers, et. al., 1990; Roeper and de Villiers, 1991), children might adjoin the negative "not" in the early stages. By adjunction, negation could only be a lexical feature and not an operator. The adjunction hypothesis then predicts an early stage in which “not” is not a barrier (or is a weak barrier) to long distance WH movement. The negative “not” as a VP adjunct is also a possible representation in adult grammar (e.g., Zanuttini, 1989). Adjunct negatives (underlined in (79)) that allow long distance WH movement can be found in adult language indicating a possible UG setting that gets restricted (e.g., Long distance = when-leave=> at age 16; Speas, personal communication, October 15, 1998).

(79) When$_1$ did the girl tell her Mom <u>in no uncertain terms</u> that she would leave home t_1?

In the early stages under the lack of negative operators, sentential negation, such as the negative "not" as in “She did not sing,” might be an instance of anaphoric negation where the negative element negates a prior sentence in discourse (e.g., [You didn’t see the car] No I see car=> No, in fact, I did see the car) (Deprez and Pierce, 1993). This analysis might be on a par with discourse-linking for early single clause answers to embedded WH questions (see discussion under Single Clause Answers above). Under this kind of analysis (e.g., de Villiers, et. al., 1990), the question is connected via inference to another sentence in discourse. However, this stage is more likely in children younger than the group tested in this study.

Moreover, in the early stages, the negative "n't" is a weak clitic that is associated with subject-auxiliary inversion which involves movement of the auxiliary to INFL in the affirmative or C of CP in the interrogative sentences. Early inversion is overgeneralized till the age of 4. However, inversion is set after 4 years old, especially for adjunct WH questions where the auxiliary moves to C, the head of CP, to realize the feature of a [+WH] operator (Deprez and Pierce, 1993). According to the agreement requirements of the Affective operators, such as the WH and negative operators (e.g., Rizzi, 1991; Haegemann, 1995), the head and the specifier of a WH operator or a negative operator must agree. Hence, an auxiliary moves to C to agree with the specifier, the WH word. The negative “n't” undergoes incorporation rule, gets cliticized onto an auxiliary and moves to C. Therefore, by evidence from the incorporation rule and the auxiliary "do"- the head of the WH operator in WH questions- the scope of the negative "n't"- the head of a NegP- gets set and becomes a barrier.

Haegeman (1995) and Ouhalla (1991) proposed that the NegP is universal and that variations are captured in the realization of heads or specifiers or both of the NegP. In child English, for example, early negative sentences are sentence initial (e.g., No I see truck => I don't see a truck) (Klima and Bellugi, 1966). This stage correlates with null subjects or pro drop (e.g., Deprez and Pierce, 1993). The correlation is found cross-linguistically in, for example, Arabic language, where pro drop is obligatory and the negative is also sentence initial and blocks LD WH movement (Abdulkarim and Roeper, 1997). The child is dependent on the input data to decide which UG setting to choose.

Based on syntactic theory, the claims are that English realizes “not” as the head of NegP (e.g., Rullman, 1995; Potsdam, 1997; Ouhalla, 1991) but the specifier of NegP is an abstract operator. Children need to set the parameter of an English NegP where “not” and “n’t” are the heads and the specifier of NegP becomes an operator. Then, NegP emerges as a full functional category (or maximal projection). A consequence of the operator setting of the NegP is the negative barrier to long distance WH movement. Also, negative polarity items emerge (e.g., “He did<u>n’t</u> read <u>any</u> book.”). The negative operator prevents any higher WH word from connecting with (or antecedent governing) its trace within the scope of negation. (See the tree diagram in (79c) and discussions under Negative Barriers above.)

Similar to the WH operator, the negative operator is learned by lexical classes. According to the linguistic discussions and assumptions under Negative Barriers above, the negative “not,” “n’t,” and “nobody” differ due to some functional and lexical features which summarize as follows:

a. The negative “not” is a head of NegP. The whole NegP with “not” could be an adjunct to VP as in (80a) (e.g., Zanuttini, 1989) instead of a complement of IP as in (80b). In (80a), NegP does not have an operator, thus not a barrier; in (80b), the operator of NegP is a barrier.

```
(80)    a.                IP
                        2
                   He           INFL'
                                2
                          INFL          VP
                           did          2
                        (adjunct)=>NegP         VP
                                2               @
                                        Neg     fix the car
                                        not

        b.                IP
                        2
                   He           INFL'
                                2
                          INFL          NegP <= (complement)
                           did          2
                                Operator        Neg'
                                                2
                                            Neg         VP
                                            not         @
                                                        fix the car
```

b. The negative “n’t,” also a head of NegP, undergoes contraction as in (81a) that operates on NegP, and incorporation with C the head of CP as in (81b) subject to the Do-insertion rule. Incorporation operates on universal (or Universal Grammar) projections, such as NegP. Since heads only attract heads (e.g., Rizzi, 1990), the auxiliary, a head of CP, indicates that “n’t” is a head of a negative projection. This becomes evidence for the child to set the NegP for “n’t.” Hence, “n’t” barrier is expected to emerge in child grammar earlier than “not” and block long distance movement as indicated by (X) in (81). This evidence would also show that children could have some sense of abstract operators.

```
(81)                    CP
                        2
              Why1              C'
                            2
   (b) Incorporation=> n't + C        IP
                    didn't       @
                          she        NegP <= (complement)
                                  2
                   (barrier)=>Operator     Neg'
                                            2
                                   Neg            VP
              (a) Contraction=> not=> n't         @
                                       tell her mom     CP
                                                   @ (*t1)
                                                 she went to the zoo
```

c. The negative subject “nobody” is the subject of a sentence and must be a specifier of NegP. Therefore, the negative “nobody” cannot be an adjunct. It is also a quantifier (Beck, 1996). If a quantifier phrase is a barrier, then a child should realize it immediately.

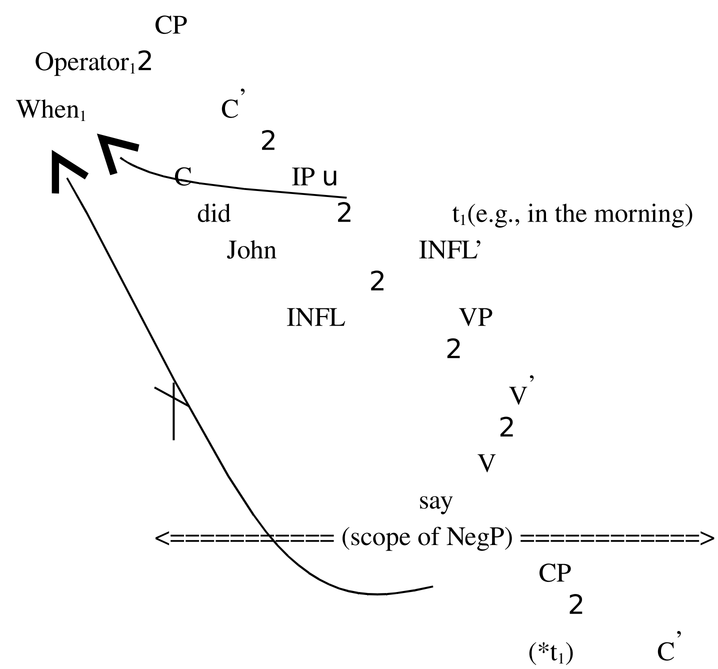
Next is a discussion of another type of negative barriers: negative phrases in embedded WH questions.

Embedded Negative Phrases

Another aspect of negation that has not been examined in child grammar is negative phrases in embedded WH questions. According to syntactic theory (Haegeman, 1995), preposed embedded negative phrases, such as “under no circumstances” in (82a), are argued to be barriers to long distance WH movement. That is, one can only answer (when say=> in the morning) but not (when would leave=> during the talk), as indicated by the crossed line in (82b). (For more on embedded negative phrases, see descriptions of Embedded Negative Phrases above.)

(82) a. When$_1$ did John say that <u>under no circumstances</u> would he leave *t_1?

b.



2
C FocP
that 2
NegP Focus’
Operator$_2$@ 2
under no circumstances Focus IP (*t_1)
would @
he
leave?

If children develop the negative barrier as a UG setting, then one would predict that children would treat a preposed negative phrase in embedded WH questions as a NegP with an operator and a barrier to long distance WH movement as is shown in (82b).

Prior to the operator stage, as with the other negative barriers, embedded negative phrases could be adjoined in the embedded CP structure. As such, they would not be barriers because they do not occupy a position in the embedded clause that hosts an operator, such as FocP as in (82b). It is hypothesized that later in development embedded negative phrases would be barriers. This should co-occur with children developing the structure of the embedded clause. Rizzi’s (1996) split CP provides the structural representation for the embedded clause. A fully projected embedded CP has a position for elements that are operators, such as the WH or negative operators. This position is called Focus phrase under the split CP hypothesis as in (82b). (For more on the nature of the split CP structure, see Embedded Negative Phrases; also Rizzi, 1996.)

When two operators compete for one position in the Focus phrase, one has to be disallowed from that position. The two operators in this case are the negative operator of the preposed negative phrase and the WH operator of the initial WH word. The negative phrase determines the scope over the embedded clause as indicated in (82b). For long distance WH movement of the initial WH word “when” to occur in (82b), the initial WH word has to have its trace in the embedded clause and has to move through the specifier position of the embedded Focus phrase. A negative phrase should prevent that from happening as indicated by the two crosses in (82b).

Input sentences, however, are needed to set the parameter of the embedded NegP. A possible scenario is when a mother uses it with her child for emphasis (e.g., an irritated mother (at the store): “(I told you) none of these toys would I buy you.”). To test the barrier of preposed embedded negative phrases to long distance WH movement, two groups of preposed negative phrases need to be contrasted. There are negative phrases that carry a negative operator versus the negative phrases that do not, also called negative constituents (see descriptions of Embedded Negative Phrases above; also Haegeman, 1995). Preposed negative constituents are predicted to be weak barriers to long distance WH movement.

Summary of the Acquisition Studies on Negative Barriers

Findings of the acquisition studies on negative barriers could be summarized as follows:

a. Children of 3 to 5 years old honored negative barriers to long distance WH movement and related principles, such as Relativized Minimality.

b. Children demonstrated fewer long distance WH movements across studies on negative and WH barriers suggesting parallel development.

c. Hypotheses similar to those for WH barriers emerged to explain negative barriers as part of the development of embedded clauses:

   Universal Grammar hypothesis: Negative barriers are a universal feature.

   The default grammar hypothesis: Non-adult forms, such as the early adjunction of the NegP with "not," are default UG settings that result from the lack of sufficient information about the specific grammar.

   The intermediate states grammar: Some stages of language development manifest the use of default grammatical settings, such as the adjunction of NegP. Such mis-analyses are consistent with UG rules.

Learning factors hypotheses: Several factors were suggested to provide information to the child about the specific grammar of NegP. These factors generalize to lexical and functional features of the NegP's: "not," "n't," and "nobody."

Development of NegP and negative operators: NegP is predicted to be a barrier to medial WH answers if both negative and WH operators are present in child grammar. An embedded NegP is predicted to be a barrier to long distance WH movement if an operator is present in a child grammar.

Statement of the Problem

Unlike WH barriers, little research has been done on the acquisition of negative barriers in embedded WH questions. In the few studies that have been done on WH and negative barriers, children showed sensitivity to barriers as early as 3 years old. Those studies led to more theoretical and empirical questions that called for further experimental data. Some questions concern whether children develop forms of negation at different stages. The development of the underlying structure of abstract versus overt operators is another question that needs to be examined. What effect negative barriers would have on child medial WH answers is a question whose answer would provide significant evidence for UG. Embedded negative barriers also raise acquisition questions not yet answered. For both kinds of barriers in the main or embedded clause, access to the embedded clause for long distance WH movement should be blocked. Acquisition data on negative barriers would help to define the development of negative barriers and their underlying structures in child grammar and, hence, would provide new evidence for the acquisition theory.

Purpose of the Study

The purpose of this study is to investigate the acquisition of a range of negative barriers to long distance WH movement and medial WH answers. I seek to discover how acquisition data bear on the acquisition issues and linguistic hypotheses reviewed and developed in this chapter. Linguistic theory provides descriptions of the possible grammars, many of which are based on adult judgments of specific language data, but are assumed to represent some universal features of language. Acquisition theory needs to articulate a model of how such universal features of language are acquired. One model adapted in this dissertation is that UG makes such grammars or settings available to the language learner who tries to match them to the linguistic input in her/his environment. This view is tested against the development of negative barriers to long distance WH movement and medial WH answers.

Acquisition Hypotheses and Predictions, Research Questions and Empirical Hypotheses

The linguistic assumptions summarized under the review of the linguistic theory and the discussions of the acquisition findings lead to the research questions in this study. Moreover, some acquisition hypotheses and predictions of the development of negative barriers emerged from the summary of the linguistic assumptions and the acquisition studies. These are presented first.

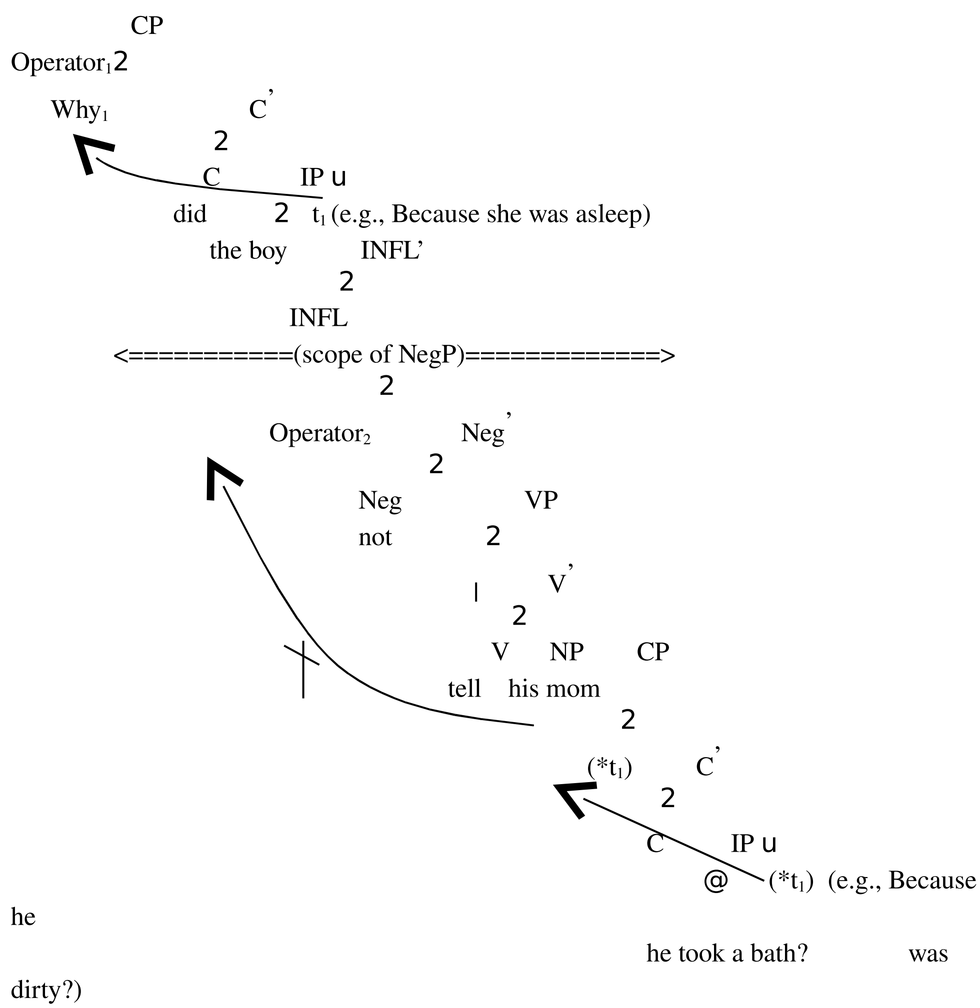
Universal Grammar Hypothesis

The NegP is universal and variations are captured in the realization of heads or specifiers or both of the NegP. For example, in English, either the head, such as "not" and "n't," or the specifier, such as "nobody," is realized, whereas in French, both are realized (e.g., "Je ne mange pas."). A child has to set a NegP with an operator according to available information from specific language input. A negative operator which is a barrier to long distance WH movement occupies a specifier position whether in the main or embedded clause as shown in (83).

Predictions

If children blocked long distance WH movement and medial WH answers, then they would treat NegP as an operator which is the adult form as illustrated in (83). If children did not block long distance WH movement or medial WH answers, they might analyze NegP as an adjunct.

(83)



The Negative Barrier Hypothesis

The NegP is a barrier to long distance WH movement. The NegP is also a barrier to the covert movement to the main clause in partial WH movement. For both movements, the negative barrier is structurally represented. A negative operator in the specifier of NegP as in (83), or FocP in the embedded clause as in (84), prevents an adjunct WH word, another operator, from moving through it since adjunct movement operates locally and cyclically through relevant specifier positions. Negative barriers should also block all kinds of analyses that depend on the embedded clause, such as single clause analyses, hence, it should be a barrier to discourse inference.

Predictions

In child grammar NegP would be a barrier to:

a. Long distance WH movement;

b. Medial WH answers;

c. Discourse inference in complex WH questions; that is, fewer single clause answers would be produced.

(84) CP

Operator$_1$2

When$_1$ C'

2

C IP u

did 2 t_1(e.g., in the morning)

the girl INFL'

2

INFL VP

@

tell her dad

<=========== (scope of NegP) ===========>

CP

2

(*t_1) C'

2

C FocP

that 2

NegP Focus'

Operator$_2$@ 2

with none of the ladders Focus IP

could @ (*t_1)

(e.g , at

dinnertime)

she reach the cat?

The Hypothesis of Functional-Lexical Differentiation of the Negative Elements

The four negative elements reviewed, the negatives “not,” “n’t,” “nobody,” and the embedded negative phrase, such as “with none of the ladders,” differ due to some functional and lexical features.

a. The negative “not” is a head of NegP. The whole NegP with “not” could be an adjunct to VP as in (85a) (e.g., Zanuttini, 1989) instead of a complement of IP as in (85b). In (85a), NegP does not have an operator, thus not a barrier. However, in (85b), the operator of NegP is a barrier.

(85) a. IP
2
He INFL’
2
INFL VP
did 2
(adjunct)=>NegPVP
2 @
Neg fix the car
not

b. IP
2
He INFL’
2

INFL NegP <= (complement)
did 2
(barrier)=>Operator Neg'
2
Neg VP
not @
fix the car

Prediction

Long distance movement and late emergence of the negative "not" would be possible.

b. The negative "n't," a head of NegP, as shown in (86), undergoes contraction that operates on NegP and incorporation with C, the head of CP (or INFL, the head of IP) where an auxiliary, such as the Do-insertion rule, applies. Incorporation also operates on Universal Grammar projections, such as NegP.

Prediction

A child must assume NegP as in (85b) and (86) early in order to incorporate. Incorporation shows how a child uses evidence in acquisition. The negative "n't" would block long distance movement earlier than "not."

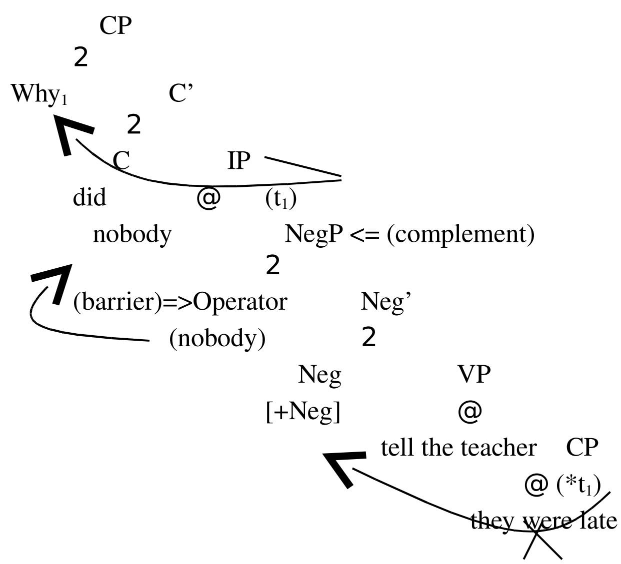
(86) CP
2
Why$_1$ C'
2
(b) Incorporation=> n't + C IP
didn't @
she NegP <= (complement)
2
(barrier)=>Operator Neg'
2
Neg VP
(a) Contraction=> not=> n't @
tell her mom CP
@ (*t$_1$)
she went to the zoo

c. The negative subject "nobody" is the subject of a sentence and must be a specifier of NegP as in (87). Therefore, the negative "nobody" cannot be an adjunct. It is also a quantifier (Beck, 1996). If a quantifier phrase is a barrier, then a child should realize it immediately.

Prediction

If a child recognized "nobody" as a specifier and, hence, an operator of NegP, then it should be an immediate barrier to long distance WH movement. However, if specifier is not an automatic barrier, then a child would not see the operator status of "nobody" and could adjoin it as an adverb, and hence specifier would not be a barrier. Unlike “not” and “n’t,” “nobody” is predicted to emerge earlier and have a different barrier pattern.

(87)



d. The embedded negative phrase, such as “not often” or “with none of the ladders,” has a negative operator as indicated by inversion and negative polarity items. When it is preposed in the embedded clause, it must move to an operator position, such as the specifier of FocP, as in (88) and, hence, be a barrier to long distance WH movement as in (88a). Since embedded negative phrases are most of the time contained within PreP's, they could be analyzed as adjuncts if the negative operator is not realized as in (88b). Hence, they would not be barriers, especially in child grammar.

Prediction

If a child realized the operator in embedded negatives as in (88a), then embedded negative phrases would be barriers to long distance WH movement. If a child analyzed embedded negatives as adjuncts as in (88b), then long distance WH movement would be possible.

(88) CP

Operator$_1$ 2

When$_1$ C'

2

C IP u

did 2 t$_1$(e.g., in the morning)

the girl INFL'

2

INFL VP

2

VP

@

tell her dad

<=========== (scope of NegP) ===========>

CP

2

(*t$_1$) C'

2

C ~~FocP~~

that Spec2 (b) No barrier=>Adjunct
NegP Focus’
(a) Barrier => Operator$_2$@ 2
with none of the ladders Focus IP (*t_1)
could @
she reach the cat?

The Hypothesis of the Parallelism of Negative and WH Barriers

According to the syntactic theory, negative and WH barriers operate structurally. A negative or a WH operator in the specifier of NegP or CP prevents an adjunct WH word which is an operator from moving through it since adjunct movement operates locally and cyclically through relevant positions. Such parallelism would lead to acquisition hypotheses that predict similar effects for the negative and WH barriers.

Predictions

WH barriers and negative barriers should both block long distance WH movement.

Universal Defaults and Intermediate States Grammar Hypothesis

Default grammar exists when a child exhibits analyses not in her target grammar. Partial WH movement underlies medial WH answers which are possible UG default covert movement of overt long distance WH movement that a child uses before sufficient information is available to restrict it. Covert movement is subject to negative barriers as long distance movement and in languages other than English.

Multiple grammars exist when two forms are present in child grammar for the same structure. Two NegP's exist: one is the adjunct "not," and the other is the complement NegP of IP "n't" and "nobody." Two types of movements exist: long distance WH movement and partial WH movement.

Predictions

If medial answers in child English were default movements to long distance movement and if the child was aware of the covert movement which is cross-linguistically blocked by NegP, then NegP should be a barrier to child medial WH answers. However, if medial answers were not blocked, then the child did not understand negative barriers, and/or the covert movement analysis would not be valid.

The NegP with "not" could remain as an adjunct as in (85a) if one assumes multiple grammar use.

Research Questions and Empirical Acquisition Hypotheses

To obtain empirical data on the development of negative barriers to test the above acquisition hypotheses and predictions, the following research questions and empirical hypotheses were addressed in the study:

1. Do the negative barriers “not and “n’t” block WH word long distance analysis?

Empirical acquisition hypotheses:

Hypothesis 1: Depending on the age of children, a negative “not” or “n’t” is a barrier to long distance analysis.

Hypothesis 2: The negative “n’t” emerges before “not” as head of the negative phrase.

2. Does the negative subject “nobody” block WH word long distance analysis?

Empirical acquisition hypotheses:

Hypothesis 1: A negative subject, “nobody,” is a barrier to long distance analysis.

Hypothesis 2: A negative subject, "nobody," emerges before the negatives "not" and "n't."

3. Does the negative barrier "not" block medial WH answers?

Empirical acquisition hypotheses:

Hypothesis 1: The negative "not" is a barrier to medial WH answers (partial WH movement).

Hypothesis 2: The negative "not" induces more SD analyses in questions with medial WH words than the affirmative due to the cumulative effects of the negative barrier "not" and the WH barrier.

4. Does a negative phrase in the initial position of an embedded clause block WH word long distance analysis?

Empirical acquisition hypotheses:

Hypothesis 1: A negative phrase with an operator preposed to the initial position of an embedded clause (or the middle of a two-clause sentence) is a barrier to WH word long distance analysis.

Hypothesis 2: A negative constituent preposed to the initial position of an embedded clause (or the middle of a two-clause sentence) is not a barrier to WH word long distance analysis.

CHAPTER 3

METHODS

Four comprehension experiments were designed to test the four research questions and empirical acquisition hypotheses raised in Chapter 2. The experiments and some language elicitation tasks would provide controlled empirical data to test the predictions of the acquisition hypotheses about the development of negative barriers. Each experiment addressed the following empirical hypotheses:

Experiment 1

Hypothesis 1: Depending on the age of children, a negative "not" or "n't" is a barrier to long distance analysis.

Hypothesis 2: The negative "n't" emerges before "not" as head of the negative phrase.

Experiment 2

Hypothesis 1: A negative subject, "nobody," is a barrier to long distance analysis.

Hypothesis 2: A negative subject, "nobody," emerges before the negatives "not" and "n't."

Experiment 3

Hypothesis 1: The negative "not" is a barrier to medial WH answers (partial WH movement).

Hypothesis 2: The negative "not" induces more SD analyses in questions with medial WH words than the affirmative due to the cumulative effects of the negative barrier "not" and the WH barrier.

Experiment 4

Hypothesis 1: A negative phrase with an operator preposed to the initial position of an embedded clause (or the middle of a two-clause sentence) is a barrier to WH word long distance analysis.

Hypothesis 2: A negative constituent preposed to the initial position of an embedded clause (or the middle of a two-clause sentence) is not a barrier to WH word long distance analysis.

Before the descriptions of the experiments, descriptions are provided on the following methods: the criteria for the selection of the participants; language production and cognitive measures; and the procedures of the experiments and of the data analysis. Following that, the design of each experiment is fully described.

Participants

A total of 40 children (20 females and 20 males) participated in the study. There were four age groups with ten English speaking children in each age group (ages expressed in years and months): Group one ranges in age from 3-6 years old to 4 years old; group two ranges in age from 4 to 5; group three ranges from 5 to 6; and group four ranges from 6 to 7. Age ranges follow the commonly and arbitrarily used 1 year chronological age range.[1]

Nevertheless, chronological age was not the sole reference for dividing children into developmental groups. Age is an assumed measure of expected maturation as a natural product of the process of aging or temporally being exposed to increased experiences. By this definition age is rendered quantitative. Developmental milestones, however, depend on evidence in input and also on the child's language system exposed to specific evidence. In other words, a system could be ready, but the stimulating experience does not occur, and vice versa. As such, other measurements are used to capture the qualitative changes in the child's grammar. These include elicited production tasks of

[1] Since all the experiments have to be administered, the age range below 3-6 was not included because some experiments were harder for younger children. However, during the age range, 3-6 to 4, some significant syntactic/cognitive maturations take place (e.g., Abdulkarim and Roeper, 1995, 1996).

embedded sentences and some linguistic-cognitive tasks which are described below under Language and Cognitive Measures.

As for the socio-economic level, children mostly come from middle and middle working socio-economic levels given the demographic characteristics of the area and the type of the sites.

The children were volunteered to participate in the study by their parents who chose to sign consent forms that were distributed at some preschools, elementary schools and summer camps in western Massachusetts areas. The selection criteria that each child participant met are listed below:

1. Each child was a monolingual standard American English speaker.
2. Each child demonstrated typical hearing, speech, language, and cognitive development. To meet this criterion, each child was administered the following procedures:
    a. Each child passed a hearing screening at 20dB for 1000 and 2000Hz and 25dB for 4000Hz. (Passing at 25dBfor 500Hz was dependent on noise environment since testing was done in natural settings, also Helfer, personal communication, February 29, 1999). Each child received a hearing screening as outlined in ASHA guidelines (1973).
    b. Each child passed a language screening using two subtests for language comprehension and production from two standardized tests. On the

Clinical Evaluation of Language Fundamentals-Preschool (CELF-P) (Wiig, Secord and Semel, 1992), the two subtests, Recalling Sentences in Context and Sentence Structure, were used. The age range for this test is from 3-0 to 6-11. For older children, two subtests were used from the *Test of Language Development-Primary* (TOLD-P:3) (1997). The subtests were IV. Grammatic Understanding and V. Sentence Imitation.

c. Each child was free of speech difficulties that are outside the typical developmental expectations as judged by the examiner and/or reported by others.

d. Each child received an age deviation score of 85 or above on the *Columbia Mental Maturity Scale* (CMMS) (Burgemeister, Blum, & Lorge, 1972). The *CMMS* is a general cognitive measure of non-verbal cognitive capacities, such as relational and analogy skills.

e. No history of atypical neurological, psycho-emotional or social developments was reported by parents, the care providers at day care centers, classroom teachers' and/or summer camp counselors.

<u>Procedures</u>

Data were obtained from three sources: language production and comprehension tasks, Theory of Mind tasks' and the four research experiments. A test protocol was developed so that language probes and experiments were spread over 4 sessions to be completed in no longer than two weeks. Each child received the same protocol. However, within each individual protocol, the four experiments were counterbalanced (see Appendix A for the protocol). Following are descriptions of the procedures of the different tasks.

Elicited Language Production and Comprehension Tasks

The language production and comprehension tasks included a comprehension task of verbs that take opaque complements and a production task of similar verbs. Since development of embedded sentences is dependent on mental and communication verbs (e.g., de Villiers, 1995a), these tasks were used as a measure of the development of complex sentences. As a supplement to age, they served as a developmental index.

The Comprehension Task

This task was developed by de Villiers (e.g., 1995a) to investigate when children acquire the feature of opacity of mental and communicative verbs. Communicative verbs, such as “say,” and verbs of mental state, such as “think,” take embedded propositions and do not allow referential substitutions (e.g., de Villiers, 1995a). Eight sentences were read, followed by a question. Each sentence was a statement about someone’s belief with two pictures depicting a situation where a protagonist of an event had a false belief of an object in the first picture and the true belief was shown to the child in the second picture. An example of a sentence and a question is “She thought the girl was reading a book, but she was really playing cards.” “What did she think?” The target answer is to provide the mental verb and/or the false object, that is “(She thought) it was a book.” A reality reading is when a child substitutes the real object for the one that was falsely believed. For the child to be ascribed the ability to formulate the dependency between such verbs and their complements, a child had to provide the false embedded proposition. This task is scored out of a total of 8. A passing score is 7/8 (>87%).

Since the age range of the participants started at 3-6 years old, results on this task did not differentiate between groups. Almost all children had high scores. Hence, results were not used towards the statistical analyses of the data.

The Elicited Production Task of Mental and Communicative Verbs

To elicit complements of mental or communicative verbs, each child was shown six videotaped events. In each event, a protagonist had a false belief of an object/person or desired an object. The video also showed the child the true belief. Following each video, the event in the video was presented to the child in a sequence of photos to control for memory. An example of an event is a man who puts his hat on top of a file cabinet. While he is reading a newspaper, a little boy puts a stuffed dog on the cabinet and takes away the man's hat. After finishing reading the newspaper, the man reached out for his hat, but he puts on the dog without realizing it. Then the child was prompted to provide descriptions of the event (e.g., Examiner: "So what happened?"). If the child did not provide an answer with the false complement, another prompt was introduced (e.g., "Why is he putting the dog on his head?").

Each response was coded for Semantic adequacy and Syntactic adequacy. A Semantically adequate response was when a child provided an adequate explanation of the event. A score of 1 was given to each correct response with a total of up to 6 points. As for the Syntactic adequacy codes, each response was coded accordingly:

Score	Descriptions of response
0	= no mental or desire verb
1	= bare mental or desire verb (e.g., "He's thinking.")
2	= mental or desire verb plus a nounphrase or prepositional phrase (e.g., "He thinks about hat.")

3 = mental or desire verb plus a complement but with the true object (e.g., "He thinks it's a dog on his head.")

4 = mental or desire verb with full false complement marked by "that" (e.g., "He thinks that it was his hat.")

Two Syntactic adequacy scores were derived in order to best reveal the child's ability. The two scores are under research. Syntactic adequacy 1 was the average score on all the items for Syntactic adequacy (N=6 with a possible subtotal of 2 per item). Syntactic adequacy 2 was the highest level achieved for Syntactic adequacy with 0 being the lowest and 4 the highest score.

Theory of Mind Tasks

Since Theory of Mind has been established in the literature to mark a cognitive development that correlates with different aspects of syntactic development and marks certain developmental stages (e.g., de Villiers, 1995a), Theory of Mind tasks were included as part of the language measures. In particular, it was of interest to compare the growth of Theory of Mind and the type of subordination a child showed in reference to embedded questions (e.g., Experiment 3).

Three tasks depicting Theory of Mind were used. Two tasks tested the ability to entertain a false belief, that is, a representation of a world situation that happened to contradict reality. This function involved, for example, blocking the attribution of knowledge of an object location to someone who had not seen it. Check questions were used for understanding the task and/or the story. The examiner acted out stories to the child and asked the child questions. Examples follow.

FALSE BELIEF:

1. Doll's House

John and Mary are playing a game in the bedroom. Mother calls to them from the kitchen, "Come have some juice and cookies." So Mary puts the game under the bed and goes to wash her hands in the bathroom. Then John says to himself, "Maybe the dog will chew the game under the bed. I better put the game away in the closet." So he puts the game in the closet and goes out to have some juice.

<u>Control Questions</u>:

Where did Mary put the game before she went to the bathroom?
Where is the game now?
Mary has finished her juice and cookies first. She comes back to play the game again.

<u>False Belief Questions</u>:

1. Does Mary know where the game is?
2. Where will Mary first look for the game?
3. Why will Mary look there?

(Scores: if 1 was correct=1; if both 2 and 3 were correct=1)

2. Prediction Task:

Here is a puppet, and he's really tired. Look, he's going to sleep under here while we play.
See this box? What's in here ... bandaids! I'm going to put them all over here in this box (plain).
Now where are the bandaids?
Here's the puppet waking up. He's crying because he's cut his finger. He needs a bandaid.

1. Where is he gonna look for the bandaid?
2. Why is he looking there?

(Scores: if both 1 and 2 were correct=1)

The third task was about representational change. The cognitive process involved is the modification of a mental representation for an object function, such as a candy box containing crayons. The examiner showed objects. An example illustrates:

3. Crayon Story
I've got a box to show you. [place on table]
What do you think is in the box?
So come over here so you can open it up and see.
Wow, look at that!
OK let's put it back and close it up again. (Examiner does that)
1. [Pointing at closed box] Now before when you were sitting over there, when I showed you the box, what did you think was in it?
2. Who is your friend in school, (may be John?) Suppose I brought ____ in here and showed her/him this box. What would ______ think is in the box?
(Scores: if 1 was correct=1; if 2 was correct=1)

In order to pass a child had to get a total of 5 points on these tasks.

The Experiments

Four experiments on the comprehension of the negative barriers in complex WH questions were designed. As for the procedures of the experimental tasks, the examiner read short stories accompanied by a sequence of pictures used to aid the child in understanding the story and to recall the events when questions were asked. The pictures did not exceed five per story and showed all main events. This was done to make it easier for the child to scan the set of pictures when asked a question and also to avoid being biased towards one reading over the other (Roeper and de Villiers, 1994). The child's responses were simultaneously videotaped and orthographically recorded.

The conditions of each experiment were counterbalanced. The experimental sets were also counterbalanced by children to minimize errors, and also to average the subject-independent variables interactions over such a design.

Experiments on the Negative Barriers in WH Questions

Four experiments were designed to test the predictions of the hypotheses. Each experiment is described according to its purpose in reference to the hypotheses, and the design of the experiment in terms of the conditions used, item types, counterbalancing procedures and examples, and procedures.

Experiment 1: The Negative Barriers "Not" and "N't"

Purpose: This experiment was designed to test the following hypotheses:

Hypothesis 1: Depending on the age of children, a negative "not" or "n't" is a barrier to long distance analysis.

Hypothesis 2: The negative "n't" emerges before "not" as head of the negative phrase.

If children were sensitive to these barriers, they should block long distance movement of adjunct WH words. Such an analysis would also yield further evidence regarding children's knowledge of negative barriers as part of a UG. Results combined with data on the WH barriers in Experiment 3 would also provide more evidence as to whether negation were a syntactic or a purely semantic phenomenon as has been argued. Unlike judgmental data, such data came from carefully designed and controlled contexts. The effect concerning the morphosyntactic distinction of the negatives "not" and the contracted "n't" on the development of negative barriers to long distance movement would also be tested. If children gave a similar analysis, that is short distance or long distance, to both, it would indicate that children are not making a distinction between the two.

Design and procedures. The experiment included the story context and the questions. All the questions contained the adjunct WH word "why." The three conditions included three negative questions with "not," three negative questions with the contracted negative "n't," and three affirmative questions as controls. For the negative questions, the context of the story contained two events as shown in the story examples. One event was provided for the embedded question while the other event was for the main negative question. After hearing the story and the question, a child could choose one of two possible answers. One was for the main clause WH question denoting a reason for not telling which was the short distance (SD) analysis; the other was for the embedded clause, the long distance (LD) analysis, denoting a reason for the embedded event. Each story was illustrated by no more than 4 pictures as is shown in Figure 3.1. Examples of the stories with pictures, the questions, and the possible answers follow:

A story for a negative WH question:

When this girl came home she did not tell her mom that she went to the zoo. Why didn't she tell her? Because her mom was watching her favorite TV show [Picture 2B in Figure 3.1]. The girl did not tell her mom why she went to the zoo that afternoon. She went there because she wanted to feed the animals [Picture 1 in Figure 3.1]. It's fun to go to the zoo.

(1) a. Why did the girl not tell her mom she went to the zoo?
b. Why didn't the girl tell her mom she went to the zoo?

Answers:

Main clause answer (SD analysis):
Because her mom was watching her favorite TV show.

Embedded clause answer (LD analysis):
Because she wanted to feed the animals.

The context for the affirmative control question had a similar design except that a reason for telling, instead of not telling, was provided for the main WH question (SD analysis) as shown below.

A story for an affirmative WH question:

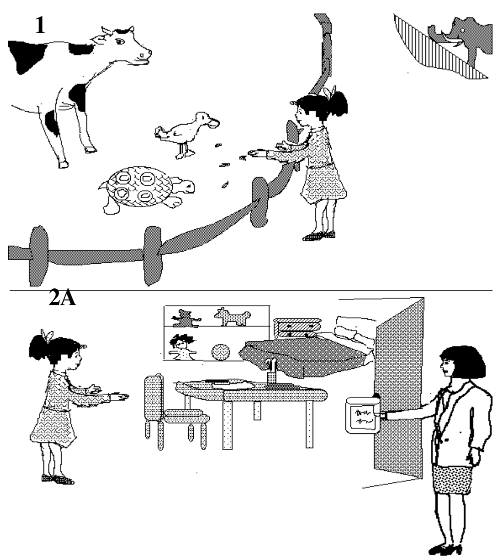
When this girl came home she told her mom that she went to the zoo. Why did she tell her? Because she wanted to show her mom the photographs [Picture 2A in Figure 3.1]. The girl told her mom why she went to the zoo that afternoon. She went there because she wanted to feed the animals [Picture 1 in Figure 3.1]. It's fun to go to the zoo.

(2) Why did the girl tell her mom she went to the zoo?

Answers:

Main clause answer (SD analysis):
Because she wanted to show her mom the photographs.

Embedded clause answer (LD analysis):
Because she wanted to feed the animals.



2B

Figure 3.1. A sequence of pictures of a negative and affirmative story for the experiment on “not” and “n’t.”

A total of 9 stories were counterbalanced according to the story context and the question type. Each story had two contexts, one for a negative question and one for an affirmative question, so that each participant would only hear one context of that story. The types of questions were also counterbalanced against the story contexts. All the stories had the embedded clause answer supplied towards the end of the story to bias the question construal to a long distance analysis. If negation blocks long distance analysis, it would provide strong evidence for a negative barrier in child grammar. A neutral sentence also ended each story so that the long distance analysis was not the last one heard. Three counterbalanced experimental sets were developed according to the question number and the condition of each question.

Each child listened to one story at a time with the pictures laid on the table in front of the child and then answered the question following the story. For this experiment, a child listened to 9 stories and answered 9 WH questions in one setting.

Experiment 2: The Negative Subject "Nobody"

Purpose: This experiment was designed to test the following hypotheses:

Hypothesis 1: A negative subject, "nobody," is a barrier to long distance analysis.

Hypothesis 2: A negative subject, "nobody," emerges before the negatives "not" and "n't."

The negative subject "nobody" is an overt specifier of NegP. Because it is a free lexical item, it should provide earlier evidence for a child to set a NegP with a specifier and a head with + Negative features. As such, it should be one of the earlier negative barriers a child develops. According to Hypothesis 2, "nobody" should block more LD analyses than "not" or "n't."

Design and procedures. In this experiment, all the questions contained the adjunct WH word "why." There were two conditions in the experiment: three negative questions with "nobody" and three affirmative questions with a regular NP substituting for "nobody" as a control. As in Experiment 1, each story contained two events. One event was for the embedded question and the other was for the main question as shown in the story examples. For the negative questions, two possible readings were available: one for the main clause WH question denoting a reason for not telling which was the short distance analysis, and the other was for the long distance WH question denoting a reason for the embedded event. Each story was illustrated by no more than 3 pictures as is shown in Figure 3.2. Examples of story contexts, the questions, the possible answers, and the pictures follow:

A story for the negative question:

These children were late to school. The bus broke down. When they came to school, none of the children told the teacher they were late. Why did nobody tell her? Because she was in the bathroom [2A in Figure 3.2]. None of them told her why they were late. They were late because the bus had broken down. Some schools are far from home.

(3) Why did nobody tell the teacher they were late?

Answers:

Main clause answer (SD analysis):
Because she was in the bathroom.

Embedded clause answer (LD analysis):
Because the school bus broke down.

A story for the affirmative question:

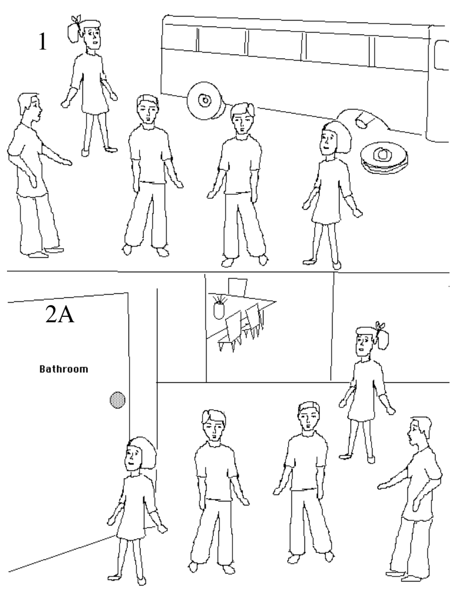
These children were late to school. The bus broke down. When they came to school, the children told the teacher they were late. Why did they tell her? Because she was worried about them [2B in Figure 3.2]. They told her why they were late. They were late because the bus had broken down. Some schools are far from home.

(4) Why did the children tell the teacher they were late?

Answers:

Main clause answer (SD analysis):
Because she was worried about them.

Embedded clause answer (LD analysis):
Because the school bus broke down.



2B

Figure 3.2. A sequence of pictures of a negative and affirmative story for the experiment on "nobody."

Six stories were counterbalanced according to the context of the story and the WH question. Each story had two contexts, one for a negative question and one for an affirmative question so that each participant would only hear one context of that story. The types of questions were also counterbalanced against the stories and their contexts. Two counterbalanced experimental sets were developed. The long distance reading was always supplied towards the end of the story to bias the question construal to a long distance analysis so that if negation blocked long distance analysis it would provide strong evidence for a negative barrier effect in child grammar. A neutral sentence ended the story so that the long distance reading was not the last one heard.

Each child listened to one story at a time with the pictures laid on the table in front of the child, and then she/he answered the question following the story. For this experiment, a child listened to 6 stories and answered 6 WH questions in one setting.

Experiment 3: The Negative Barrier "not" and Medial WH Answers

Hypothesis 1: The negative "not" is a barrier to medial WH answers (partial WH movement).

Hypothesis 2: The negative “not” induces more SD analyses in questions with medial WH words than the affirmative due to the cumulative effects of the negative barrier “not” and the WH barrier.

Purpose. This experiment was designed to test the negative barriers to medial WH answers in child English grammar. This experiment was designed to answer one general question in line with the previous questions about the development of negative barriers in WH questions. A specific question was whether negation blocks medial WH answers in child English grammar. Behind this question was a theoretical issue concerning the universality of the negative barrier on scope marking. If negation was a barrier to medial WH answers, then this result would support the idea that child medial WH answers follow a universal scope marking analysis. According to Hypothesis 2, negation would increase the barrierhood to analyses other than short distance analysis. The cumulative effect of both the negative “not” and the medial WH word in the question should accomplish that (e.g., Chomsky, 1986). If so, then such principles are features of UG that are available to the child.

Design and procedures. This experiment was formulated with multiple factors considered. The creation of a scope marking construction in English, a non-scope marking language, called for a complex design of multiple elements. One was the control of the WH words in the main clause and in the embedded clause of the experimental question. All the WH word pairs were adjunct WH words of the types “when,” “where,” and “how.” Argument WH words were not used to control for variability due to the argument-adjunct asymmetry. Arguments have the potential to move across a negative barrier. The idea was to represent a variety of adjunct WH words to be tested in child grammar. The WH word pairs in each question were counterbalanced. This control created 6 conditions for the WH word pairs as follows: “when-how,” “where-how,” “when-where,” “where-when,” “how-when” and “how-where.” For each WH pair condition, two sentences were used. Another condition was negation. Half of the WH questions had the negative “not” in the main clause. The other half had affirmative questions as the control.

Another factor controlled in this design was the context of the story. A contrastive set for the negative question was created when possible in the story. For example, a contrastive set for a “Where not telling *x*” question would be a place for “not telling *x* and another for telling *x*.” This pragmatic contrastive set was used to meet the negative questions.[2] Multiple readings were also provided to meet the pragmatic requirements of the main and embedded WH questions. Hence, most possible construals of the main or embedded question were included. Intermediate questions following each event were provided. One was to help the child to remember the events. Another was to avoid biasing the child towards one reading over the other. A total of 12 stories were developed following the design described above. Two counterbalanced experimental sets were used. Examples of story contexts, questions, possible answers, and pictures in Figure 3.3 follow:

A story for negation with medial WH words

This girl likes to ride her bike. Here she's at the park. She rode her bike fast down a steep hill at the park. It was getting dark. She ran into a big wall, but because it was dark she thought she hit a big tree. So she broke her bike by hitting a big wall.

Examiner: How did she break her bike?
Where did she break her bike?

---

[2] It could be argued that, for pragmatic requirements, negative questions need a contrastive set in the discourse context to be felicitous to ask. Further, if that requirement is met, then long distance movement of adjunct WH words could be permissible (Percus, personal communication, April 15, 1998). However, this does not seem to be the case since even when the pragmatic contrastive set is explicitly supplied, long distance movement is not permissibles rendering the sentences in (ia&b) ungrammatical.

(i) Scenario:

John's friend told the faculty that John left the faculty meeting early because he had to go to the airport to buy a ticket. But he didn't tell them that John had also a doctor's appointment. The next day John found everybody was upset with him. John thought that there was something wrong. Then John asked his friend:

a. John: *Why$_1$ didn't you say that I left t_1?

b. Friend: * Because you had a doctor appointment.

Since there is no available theory to account for that and the existence of counterexamples, this factor was not taken into consideration in developing the negative questions in general.

[For the negative question]

Here she's at home. She was afraid that her mom might get upset about that. So when she went home, she did not tell her mom about crashing her bike at the park.

Examiner: Where did she not tell her Mom?

Here she's at the store. She wanted her mom to buy her a new bike. So at the store she told her mom that she broke her bike at the park by hitting a big tree.

Examiner: Where did the girl tell her Mom?

How did she tell her Mom she broke her bike?

The experimental questions:

The negative question:

a. Where did the girl not tell her mom how she broke her bike?

The affirmative question (control):

b. Where did the girl tell her mom how she broke her bike?

For each experimental question following the example story, four readings were possible as follows:

1. Main clause answer (short distance analysis):

a. At home. (cf. "Where did the girl not tell her mom?")

b. At the store. (cf. "Where did the girl tell her mom?")

2. Embedded clause answer (long distance analysis):

At the park. (cf. "Where did (the girl say) she break her bike?")

3. Medial WH answer (partial WH movement):

a. Negative question: By running into the wall. (Reality) (cf. "How did the girl not tell her mom she broke her bike?")

b. Affirmative question: By hitting a tree. (False belief) (cf. "How did the girl tell her mom she broke her bike?")

4. Single clause answer (Reality):

By running into the wall. (cf. "How did she break her bike?")

Two answers to the negative question were not explicitly provided to reduce the complexity of the story. For answer (2), no embedded clause answer was provided in the story for the negative question (see footnote 2). The medial answer (3b) to the affirmative question was explicitly in the story where a character perceives a false manner, time, or place of an event by mistake, in contrast to reality reading. However, the reading for the negative question was shared with the reality reading for the control question. This was followed to avoid complication in the story. If children were not sensitive to negation, the reading would be available to them if they analyzed the negative question for a medial answer.

Each child listened to one story at a time with the pictures laid on the table in front of the child, and then answered the question following the story. For this experiment, a child listened to 12 stories and answered 12 WH questions in one session.

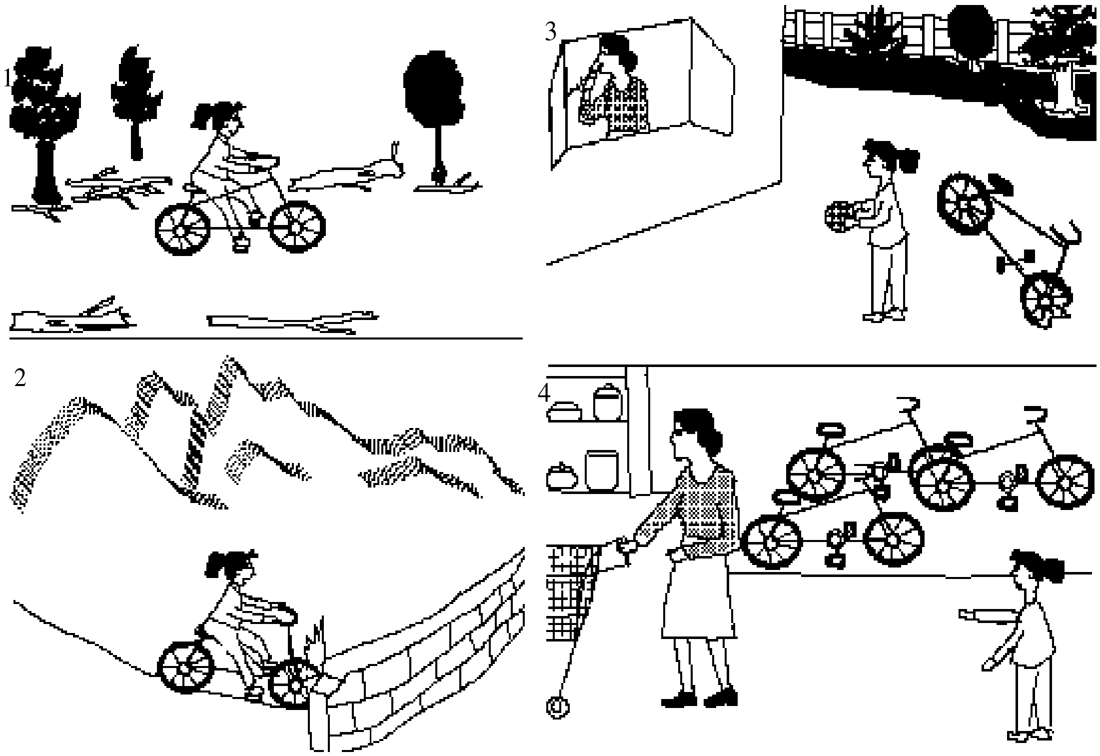


Figure 3.3. A sequence of pictures of a story for the experiment on the negative "not" and medial WH answers.

Experiment 4: Embedded Negative Phrases

Purpose. This experiment was designed to test the following hypotheses:

Hypothesis 1: A negative phrase with an operator preposed to the initial position of an embedded clause (or the middle of a two-clause sentence) is a barrier to WH word long distance analysis.

Hypothesis 2: A negative constituent preposed to the initial position of an embedded clause (or the middle of a two-clause sentence) is not a barrier to WH word long distance analysis.

Testing the two hypotheses would result in two-way comparisons. One was to compare an embedded phrase with a negative operator to a negative constituent. This would be new data on the development of embedded negative barriers. The other comparison was to contrast the effect of negative barriers in the main clause as in Experiments 1, 2, and 3 to negative barriers in the embedded clause. The predictions were that children would show similar barrier effects to both.

Design and procedures. This experiment contained two negative sets: the negative operator and the negative constituent. Phrases like "not often," "under no table," etc., were types of the first set. These negative phrases trigger subject-auxiliary inversion even in the embedded clause. Eight sentences contained negative phrases in the embedded clause of a WH question. Four of the sentences had a negative phrase of the operator kind, whereas the other four had a negative constituent which served as a control for the negative operator. Each set of sentences was counterbalanced according to the position of the negative phrase. Two sentences of a set had the negative phrase in question preposed to the initial position of the embedded clause, or the middle of the sentence, whereas the other two were in situ at the end of the embedded clause. This was another control.

Eight stories provided the contexts to the questions. The long distance reading was provided towards the end of the story to bias for a long distance reading. This was followed by a neutral sentence so that the long distance was not the last heard. Because the negative phrases had lexical content tied to the story context, unlike “not,” “n’t,” or “nobody,” the counterbalancing of the stories was restricted to two factors: the position of the negative phrase and the order of the stories. Two counterbalanced experimental sets were used. Examples are given first for the negative operator then the negative constituent with the pictures in Figures 3.4 and 3.5.

A story for the negative operator:

This morning, this girl found that her cat was up on the tree. She tried three ladders to reach the cat, but she could not reach the cat on the tree with any of the ladders in the morning. So none of the ladders were long enough. Then she thought her Dad could help her. The girl told her Dad at dinnertime that she could not reach her cat on the tree with any of the ladders in the morning. The Dad promised to help get the cat down.

The questions:

Preposed negative phrase:
a. When did the girl say that <u>with none of the ladders</u> could she reach the cat?

Non-preposed negative phrase:
b. When did the girl say that she could reach the cat <u>with none of the ladders</u>?

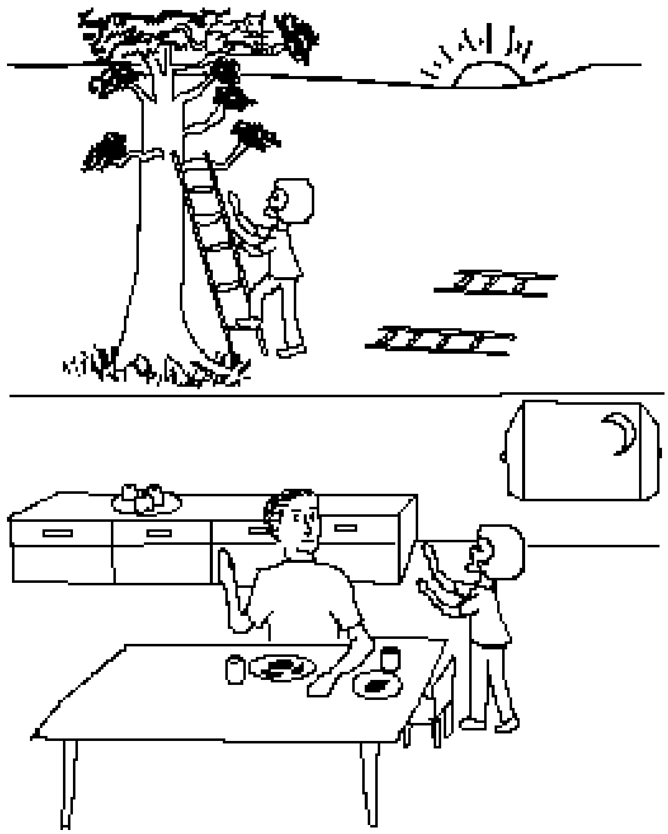


Figure 3.4. A sequence of pictures for the negative operator story.

A story for the negative constituent:

At lunchtime these boys were getting ready to go out fishing with their Dad. Their Dad saw that they had a fish. He asked where they had gotten it. They told him in the kitchen at home that they had caught it not long ago by the lake in the morning. Fish is fun to catch.

The questions:

Preposed negative phrase:
a. Where did the boys say that <u>not long ago</u> they caught the fish?

Non-preposed negative phrase:
b. Where did the boys say that they caught the fish <u>not long ago</u>?

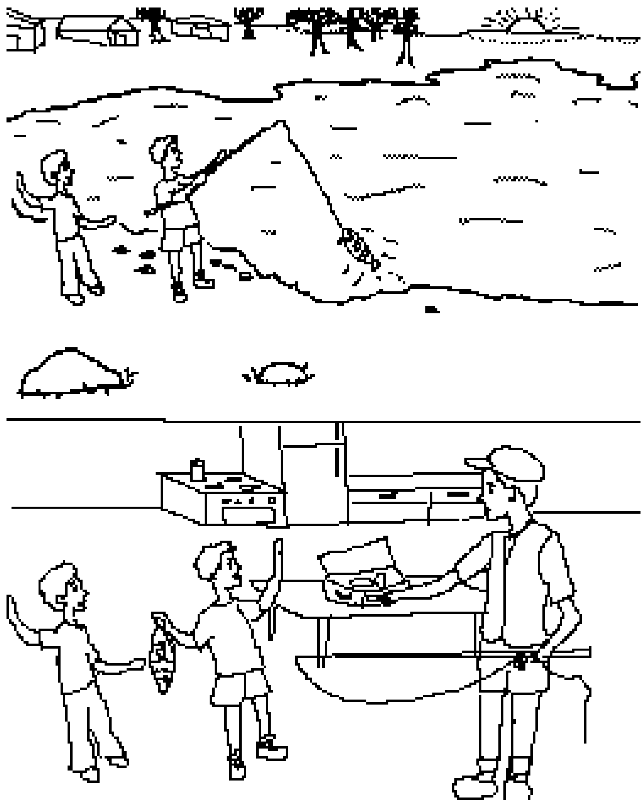


Figure 3.5. A sequence of pictures for the negative constituent story.

Each child listened to one story at a time with the pictures laid on the table in front of the child and then answered the question following the story. For this experiment, a child listened to 8 stories and answered 8 WH questions in one setting.

Data Analyses

Data analyses of the experiments took several stages. First data were carried out with a computerized relational database (4th Dimension) that allowed systematic entering, different searches by the different independent and dependent variables, and calculations of the data. The database consisted of fields for subject profiles (e.g., name, initials, gender, date of birth, date of test, etc.); screening profiles (e.g., CELF or TOLD scores, CMMS scores, Theory of Mind, etc.), and the experimental data. The data were first exported as a text file to StatView, a statistical software (Caldarola et. al., 1998) which helped to transpose the dependent variables into row formats and also run descriptive statistics. Each experiment was exported as a text file to SYSTAT, a statistical software program (Wilkinson et. al., 1992), to run statistical analyses.

The independent variables were age, counterbalanced experimental set, Semantic adequacy score, Syntactic adequacy 1 score, Syntactic adequacy 2 score and Theory of Mind score. The dependent variables were the scores on the experimental conditions. Effects of the experimental conditions were analyzed by a mixed within-subject design analysis of variance of age by question type by counterbalanced experimental set. This design is more powerful than a complete within- or between-subject designs because it has more error terms (Myers and Well, 1991). Planned contrasts, such as linear trends, were also run to answer specific questions. When patterns other than the ones predicted were observed, ad hoc contrasts were administered to find whether the patterns followed a developmental trend. Multiple regression and correlation analyses were run to test if any of the independent variables would predict the changes in the dependent variable scores.

Reliability

To ensure consistency in delivering the items and accuracy of recording children's responses, two judges transcribed 10% of the data either during testing or by viewing the videotaped sessions. Reliability was higher than 95%. One judge who had no prior knowledge of the subject matter also transcribed all the sessions on videotapes for further reliability of testing and scoring. For data coding, data were searched by different fields and subfields on 4^{th} Dimension for any entry errors or mis-codings. Also, on StatView, data were again checked for any discrepancies or entry errors. Tabulations of the data on 4^{th} Dimension, StatView and SYSTAT were all compared for consistency and reliable numbers.

CHAPTER 4

RESULTS

To determine how the data bear on the empirical hypotheses, descriptive and statistical analyses were run.

Results of Experiment 1: Does the Negative Barrier “not “and ”n’t” Block WH Word Long Distance Analysis?

Descriptions of Data Coding

Before reporting the data analyses, a description of how the children’s responses were coded is presented. The same procedure was followed for all the experiments. One of two answers could be selected for a negative or affirmative question. The example stories and questions below illustrate.[1] Story A provides context for the negative questions as follows:

[1] To illustrate the type of analysis children provided to each experimental question, an answer from a given story in each experiment is used as an example.

Story A:

When this girl came home she did not tell her mom that she went to the zoo. Why didn't she tell her? Because her mom was watching her favorite TV show. The girl did not tell her mom why she went to the zoo that afternoon. She went there because she wanted to feed the animals. It's fun to go to the zoo.

(1) a. Why did the girl <u>not</u> tell her mom she went to the zoo?
b. Why did<u>n't</u> the girl tell her mom she went to the zoo?

Answers:

Main clause answer (SD analysis):
Because her mom was watching her favorite TV show.

Complement clause answer (LD analysis):
Because she wanted to feed the animals.

When the WH word refers to the main clause, such as the "Because her mom was watching her favorite TV show" answer to questions (1a &b), it indicates a short distance analysis (SD) of the WH word. This analysis is obligatory for adults. However, when the WH word refers to the complement clause, such as "Because she wanted to feed the animals," a long distance analysis (LD) of the WH word is indicated.

Story B provides context for the control question as follows:

Story B:

When this girl came home she told her mom that she went to the zoo. Why did she tell her? Because she wanted to show her mom the photographs. The girl told her mom why she went to the zoo that afternoon. She went there because she wanted to feed the animals. It's fun to go to the zoo.

(2) Why did the girl tell her mom she went to the zoo?

Answers:

Main clause answer (SD analysis):
Because she wanted to show her mom the photographs.

Complement clause answer (LD analysis):
Because she wanted to feed the animals.

The two possible answers for the affirmative (control) question are either the main clause answer or the complement clause answer. When the WH word refers to the main clause, such as "Because she wanted to show her mom the photographs," it indicates a short distance analysis (SD) of the WH word. This analysis is an adult target. However, when the WH word refers to the complement clause, such as "Because she wanted to feed the animals," a long distance analysis (LD) of the WH word is indicated. The last analysis could be optional for adults though with a lesser degree than children.

Statistical Tests of the Predictions

Statistical analyses were run to test the predictions of the following empirical hypotheses:

Hypothesis 1: Depending on the age of children, a negative "not" or "n't" is a barrier to LD analysis.

Hypothesis 2: The negative "n't" emerges before "not" as heads of the negative phrase.

A 3 (question types) by 4 (age groups) by 3 (counterbalanced experimental sets) mixed design analysis of variance was run on the percentage of LD responses. The counterbalanced experimental set of the experiment was included as an independent variable to maximize the variance that could be accounted for and reduce the error term. The means of SD and LD responses and the standard deviations for the LD responses along with examples for the questions and the possible answers are shown in Table 4.1. The results of LD analyses are also presented graphically in Figure 4.1. Figure 4.1 shows a difference between the control and the two negative questions ("not" and "n't"), a very small difference between "not" and "n't," and a linear trend of age. The results are reported in the following subsections: Age Effect, Counterbalanced Experimental Set Effect, Question Type Effect and Regression Analyses of Background Variables.

Age Effect

Hypothesis 1 presupposed age differences. It was assumed at the outset that children would respond differently to the negative barrier depending on the age group (e.g., Abdulkarim and Roeper, 1997). A main effect for age emerged, F (3, 28) = 3.15, p= < .05. This result indicated differences due to age. As seen in Table 4.1, the negative questions received fewer complement clause answers (LD), such as "Because she wanted to feed the animals," than the affirmative control questions as children got older. The same decrease across age groups is graphically shown in Figure 4.1.

Table 4.1. Percentage of complement clause answers (LD) and main clause answers (SD) according to age and question types for experiment 1

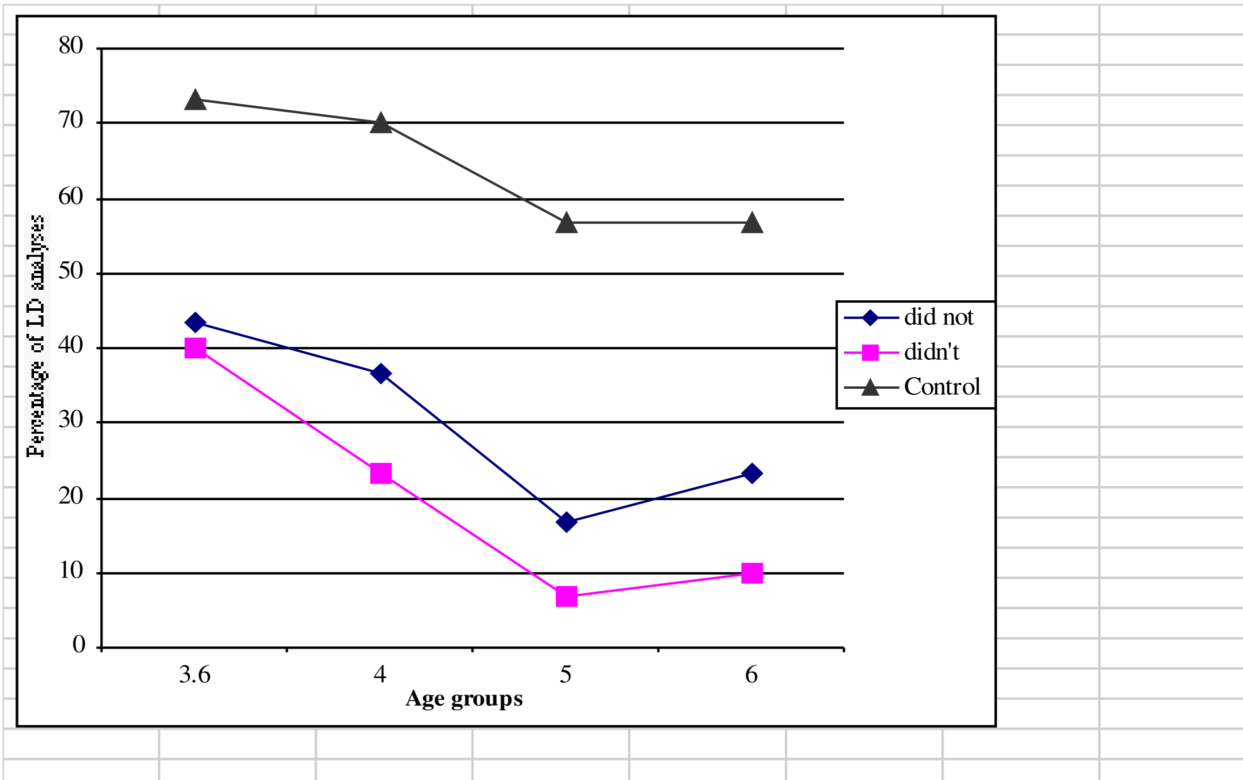


Figure 4.1. Line graph of the percentage of LD analyses, “Because she wanted to feed the animals,” according to age groups and question types.

To follow up on the age main effect, trend analyses were run on each question type to test whether children’s answers changed linearly as age increased. Figure 4.1 shows that as age increased, LD analyses decreased for the negative questions more than the control questions. A Test of Effects showed that LD analyses to both the “not” and “n’t” questions significantly decreased as age increased, $\underline{F}$ (1, 28) = 5.17, $\underline{p} < .05$, $\underline{F}$ (1,28) = 12.51, $\underline{p} < .01$ respectively; but not for the control, $\underline{F}$ (1, 28) = 0.94, $\underline{p} > .05$.

Although the means of the negatives for 5- and 6-year-olds were different in Figure 4.1, the difference was not significant. To test if those means were nonlinear, a quadratic trend contrast was run, but it was not significant, $\underline{F}$ (1, 36) = 1.95, $\underline{p} > 0.17$. Because the quadratic trend was not significant, the means seem to mainly follow a linear trend. Hence, the significant trends for age indicated that as children got older their sensitivity to the negative barrier increased, and therefore they did fewer LD analyses.

Comparisons of "not" and "n't" Between Age Groups

Hypothesis 2 was motivated by a specific syntactic issue concerning the morphosyntactic distinction between the negatives "not" and the contracted "n't." In particular, the question was whether the morphosyntactic difference between "not" and "n't" indicated differences in their position in the NegP. A consequence of that was whether they would be acquired differently because of their different positions or because of their different lexical forms. The position debate would predict that if one were a specifier, that is, "not" (e.g., Haegeman, 1995), it would emerge first. The lexical preference hypothesis related to learning grammar in lexical classes (e.g., Roeper, 1999) would predict that "n't" would emerge first since it attaches to an overt functional head, "do," in the grammar. Therefore, "don't" provides lexical evidence for "n't" to be set first as a negative operator.

Results of trend analysis showed that as age increased negative barrier effect increased as well. Planned contrasts, however, provide more specific information to answer the question as to at what age children become more sensitive to the negative barriers "not" and "n't." Hence, contrasts between age groups in an ascending fashion were analyzed.

Contrast of the Negative Barriers Between 3- and 4-Year-Olds:

The contrast of the negative questions combined between 3- and 4-year-olds showed a marginal difference, $F(1, 28) = 3.117$, $p = 0.09$. However, a contrast of the separate means of the two negative questions, "not" and "n't," for 3-and 4-year-olds yielded a significant difference for "n't," $F(1, 28) = 4.43$, $p < 0.05$, but not for "not", $F(1, 28) = 0.78$, $p = 0.39$. This result indicated that the effect of the negative "n't" appeared earlier than "not." In Table 4.1, 4 year olds did fewer LD responses for the negative "n't" (23.3%) than the 3-year-olds (40%).

Contrast of the Negative Barriers Between 4- and 5-Year -Olds:

A contrast between 4 and 5 year olds revealed a significant difference only when the negative questions were combined, $\underline{F}$ (1, 28) = 4.42, $\underline{p} < .05$. The contrast of the individual negative questions was nonsignificant.

Contrast of Negative Barriers Between 5- and 6-Year-Olds:

The contrast of the average of both negative questions between 5- and 6-year-olds was not significant, $\underline{F}$ (1, 28) = 0.24, $\underline{p}$ = 0.63. The contrast of the individual negative questions was also nonsignificant.

The contrasts of the negative questions among the age groups suggested that after age 4 children become more sensitive to the negative “n’t” than “not.” This particular result supported Hypothesis 2. However, both negatives develop more fully after age 5.

The Effect of the Counterbalanced Experimental Sets

There was no main effect for the counterbalanced experimental sets of the experiment, $\underline{F}$ (2, 28) = 0.312, $\underline{p}$ = 0.73.

Results showed two significant within-subject interactions. One was the interaction between the question type and counterbalanced experimental sets, $\underline{F}$ (4, 56) =

3.5, $p < .05$. The differences between the means of the control and negative questions were not as large in the counterbalanced experimental set 3 (means for the control: .47; for “not”: .31; for “n’t”: .31) as in sets 1 and 2 (means for the control: .71; for “not”: .33; for “n’t”: .17). However, the means still followed the predicted pattern where LD analyses, “Because she wanted to feed the animals,” decreased for the negative questions. One reason for creating more than one set of the experiment by counterbalancing the items was to average errors due to order of presentation, type of story, or question (see also design of Experiment 1 in Chapter 3).

The other significant interaction was among question type, counterbalanced experimental set, and age, $F(12, 56) = 2.07$, $p < .05$. This interaction was driven by 3 year olds who received counterbalanced experimental set 3. Unlike in all other conditions, they showed fewer LD analyses of the control question. However, the fact that the number was small (N=2) means this result is probably not statistically reliable.

Question Type Effect

Two predictions were stipulated in Hypotheses 1 and 2. In Hypothesis 1, it was predicted that negation would block LD analyses. Hypothesis 2 predicted that “n’t” would emerge earlier due to its lexical information. Under age effect, it was shown that children showed earlier sensitivity to “n’t” than “not.” Lack of an overall significant difference between "not" and "n't" would also be further evidence against the specifier/head distinction. Tests of those predictions are presented next.

The Control Versus the Negative Questions

As for within-subject effects, there was a significant main effect for question type, $\underline{F}$ (2, 56) = 33.118, $\underline{p} < 0.001$, indicating significant differences due to question types. (See the total means of LD analyses and their standard deviations in Table 4.1 for the three questions.)

Planned contrasts were further run between the average of LD analyses for the negative questions combined and control questions. Results of within-subject effects came out highly significant, $\underline{F}$ (1, 28) = 70.896, $\underline{p} < 0.001$. The means were 0.25 for the negative and 0.64 for the control.

The statistical results confirmed Hypothesis 1. The negatives "not" and "n't" appeared to be barriers to LD analyses. The significant within-subject effects indicated that the negative questions were different from the control questions.

"Not" Versus "N't"

It was assumed in this study that both “not” and “n’t” were heads of NegP. Therefore, it was predicted that overall there should be no significant difference between the two. To test this prediction, a planned contrast between the negatives “not” and “n’t” was run. Though marginal, the contrast between “not” and “n’t” was nonsignificant, $\underline{F}$ (1, 28) = 3.89, $\underline{p}$ = 0.07.[2] The negatives “not” and “n’t” were further contrasted within-subjects at each age group to find out if older children or younger children made the distinction, but no significant contrasts appeared. However, the difference between “not” and “n’t” was not as big as between the control and negative questions. Nevertheless, this result could indicate that they are of a similar categorial distribution, that is heads, in the NegP. A further support to this result comes from Experiment 2 on the negative subject, “nobody,” which is an overt specifier of NegP (see Experiment 2).

Summary of Results

Results of Experiment 1 supported Hypothesis 1. Negation was a barrier to WH word LD analyses. This effect was also dependent on age. After the age of 4, negative barriers seemed to be effective for “n’t,” but only after age 5 was the negative “not” ef-

[2] Age was included in this analysis to maximize the variance accounted for. As in the earlier analyses, age was significant, $\underline{F}$ (3, 28) = 5.08, $\underline{p}$ = 0.006, but it is not reported here. Interactions between age and question type and counterbalanced experimental set were not significant.

fective as a barrier. There was also no significant statistical difference between “n’t” and “not.” Such a result taken with other differences between “not” and the overt specifier “nobody” in Experiment 2 might indicate that “not” and “n’t” are heads of NegP.

Next are test analyses of some background independent variables that were part of the experimental protocol.

Regression Analyses of Complement Clause Production and Theory of Mind Scores on the Development of the Negative Barriers “Not” and “N’t”

The effects of the negative barriers on the linear decrease of the percentage of LD analyses were also tested against other independent background variables. These were the children’s scores on the tasks of Theory of Mind (ToM) and the elicitation of complement clauses. In addition to age as an independent variable, each child received a single score for ToM and three complement production scores, Syntactic adequacy 1 and 2 and Semantic adequacy. For a quick reference, these scores are outlined in Table 4.2. (For a full description of the tasks, see the Elicited Production Task of Mental and Communicative Verbs in Chapter 3: Methods.)

Table 4.2. A brief description of the ToM and complement production scores.

Score type	Range of points	Tasks
ToM	1 to 5	Two tested the ability to entertain a false belief, and the third

		was about representational change.
Syntactic adequacy 1	Average of 6 items; a score of 0 to 4 for each	Six videotaped events elicited complements to mental and communicative verbs. The score was based on the type of verb and/or complement.
Syntactic adequacy 2	Lowest 0 to highest score 4	Six videotaped events elicited complements to mental and communicative verbs. The score was based on the type of verb and/or complement.
Semantic adequacy	1 to 6	Six videotaped events elicited complements to mental and communicative verbs. The score was based on adequate explanations of the events.

One reason for including the ToM and complement production scores was to find out if factors other than age were related to the development of the negative barrier effect. Also, the more predictors entered into an equation model of multiple regression analyses, the more variance is accounted for and the error terms are minimized. In addition, these analyses reveal to what extent the variance of the predictors overlaps.

For each question type, three models (A, B and C) of multiple regression analyses were run with the independent variables age, ToM, and complement production scores. Model A contained the independent variables: age, ToM, and Syntactic adequacy 1. Model B had age, ToM, and Syntactic adequacy 2 as the independent variables. Model C included age, ToM, and Semantic adequacy.

For the negative question with "n't," age was a predictor for all the 3 models, $p < .01$. Syntactic adequacy 2 was a significant predictor in model B, $p < .05$. Semantic adequacy was a significant predictor in model C, $p < .05$.[3] (For specific values, see Table B. 4 in Appendix B.)

As for the negative question with "not," only age seemed a significant predictor across the regression models, A, B and C, $p < .05$. (For specific values, see Table B.1 in Appendix B.)

As for the control question, age was the only predictor in models A and C, $p < .05$. (See Table B.2 in Appendix B for specific values.) This question contained no barriers to LD analysis. Results on this question indicated that the decrease in LD analyses was more associated with age, a general index of development of syntax.

Summary of Regression Results

The results of the three types of questions showed that age was the common predictor of the decrease in LD analyses. However, the decrease in LD analyses for the negative question with "n't" was also predicted by Syntactic adequacy 2 and Semantic

[3] A model was run with Syntactic adequacy 2 and Semantic adequacy scores to test whether their individual significant effects in models B and C were independent from age or each other. However, neither was significant. Age was still the predictor.

adequacy indicating that the development of the negative barrier effect was related to the development of full tensed complements that enable children to handle negative barriers.[4]

Results of Experiment 2: Does the Negative Subject "Nobody" Block WH Word Long Distance Analysis?

Descriptions of Data Coding

The purpose of this experiment was to examine the effect of a different type of negative barrier, the negative subject. The children's responses were coded according to the type of analysis underlying each answer. Story A provides context for the negative question as follows:

Story A:

These children were late to school. The bus broke down. When they came to school, none of the children told the teacher they were late. Why did nobody tell her? Because she was in the bathroom. None of them told her why they were late. They were late because the bus had broken down. Some schools are far from home.

(3) Why did nobody tell the teacher they were late?

Answers:

a. Main clause answer (SD analysis):
Because she was in the bathroom.

---

[4] Interaction terms of the different independent variables were used but did not change the results. For a description of interaction terms, see regression analyses of Experiment 3.

b. Complement clause answer (LD analysis):
Because the school bus broke down.

For the question with a negative subject as in (3), one of two answers was possible. If the answer was "Because she was in the bathroom" as in (3a), then it indicated a SD analysis of the WH word, that is, the WH word was interpreted in relation to the main clause. This analysis is the target for adults. However, if the answer was "Because the school bus broke down" as in (3b), it indicated a LD analysis of the WH word, that is, the WH word was interpreted in relation to the complement clause.

As for the control, affirmative, question, story B was the context as follows:

Story B:

These children were late to school. The bus broke down. When they came to school, the children told the teacher they were late. Why did they tell her? Because she was worried about them. They told her why they were late. They were late because the bus had broken down. Some schools are far from home.

(4) Why did the children tell the teacher they were late?

Answers:

a. Main clause answer (SD analysis):
Because she was worried about them.

b. Complement clause answer (LD analysis):
Because the school bus broke down.

One of two answers was also possible for the control question. A SD analysis of the WH word was "Because she was worried about them" as in (4a) which could be the preferred analysis for adults. A LD analysis of the WH word was "Because the school bus broke down" as in (4b). Without barriers, children could prefer this analysis to the adult analysis.

Statistical Tests of the Predictions

Statistical analyses were run to test the predictions of the following empirical hypotheses:

Hypothesis 1: A negative subject, "nobody," is a barrier to LD analysis.

Hypothesis 2: A negative subject, "nobody," emerges before the negatives "not" and "n't."

A 2 (question type) by 4 (age group) by 2 (counterbalanced experimental set) mixed design analysis of variance was run on the percentage of LD responses. The means of SD and LD responses along with examples for the questions and the possible answers are shown in Table 4.3. The results on LD analyses are also presented graphically in Figure 4.2. Figure 4.2 shows a difference between the control and the negative question "nobody" but no linear trend of age. The results are reported in the following subsections: Age Effect, the Counterbalanced Experimental Set Effects, Question Type Effect, and Regression Analyses of Background Variables.

Table 4.3. Percentage of complement clause answers (LD analyses) and main clause answers (SD analyses) according to age and question types for experiment 2.

(N = number of subjects; standard deviations (sd) are shown for the LD analyses; adult targets, that is SD, are in bold face.)

		Negative subject "nobody" Sample question: Why did <u>nobody</u> tell the teacher they were late? LD: Because the bus broke down. **SD**: Because she was in the bathroom.			Control Sample question: Why did <u>the children</u> tell the teacher they were late? LD: Because the bus broke down. **SD:** Because she was worried about them.		
		Response type %			Response type %		
Age	**N**	LD	**SD**	Other	LD	**SD**	Other
3-6	10	20 (sd: .17)	**80**	0	80 (sd: .17)	**20**	0

4	10	30 (sd: .25)	**66.7**	3.3	63.3 (sd: .29)	**33.3**	3.4
5	10	6.7 (sd:.14)	**93.3**	0	60 (sd: .38)	**40**	0
6	10	20 (sd: .36)	**80**	0	66.7 (sd: .35)	**33.3**	0

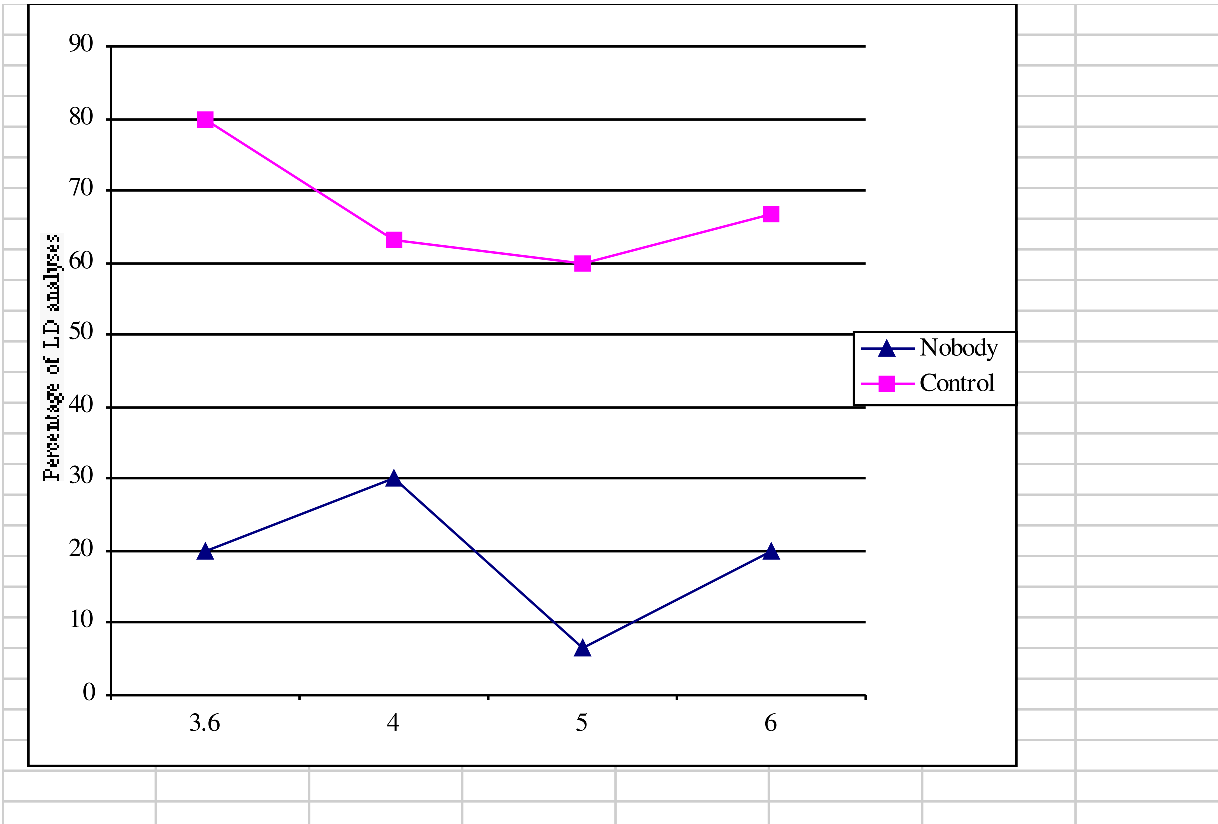


Figure 4.2. Line graph of the complement clause answers, LD analyses, according to age groups and question types for experiment 2.

Age Effect

A main effect for age did not emerge for experiment 2, F (3, 32) = 1.42, $p = 0.26$.

The observed lack of difference in the percentage of LD analyses in Table 4.3 and Figure 4.2 among the 6-year-olds and the younger groups on the negative question was contrasted. Results yielded no significant differences.

A follow up trend analysis for age was run which was not significant for both the negative question, $\underline{F}$ (1, 32) = 0.33, $\underline{p}$ = 0.57, and the control question, $\underline{F}$ (1, 32) = 2.27, $\underline{p}$ = 0.14 (see Figure 4.2).

Lack of age effect indicated that the development of the subject negative "nobody" seemed to emerge early.

The Effect of the Counterbalanced Experimental Sets

No main effect came out for the counterbalanced experimental sets, $\underline{F}$ (1, 32) = 2.92, $\underline{p}$ = 0.10. There was also no age by counterbalanced experimental set interaction, $\underline{F}$ (3, 32) = . 62, $\underline{p}$ = 0.61.

Two within-subject interactions were, however, significant. The question by the counterbalanced experimental sets interaction was significant, $\underline{F}$ (1, 32) = 4.33, $\underline{p} < .05$. The difference between the negative "nobody" question and the control question was smaller for those in counterbalanced experimental set 1 (means: .18; .55) than in 2 (means: .22; .76).

Some ad hoc contrasts were run for the means that seemed different following the question by counterbalanced experimental set interactions. First, there was a contrast between counterbalanced experimental sets 1 and 2. Only the control question was significant, $\underline{t}$ (26.5) = 2.24, $\underline{p} < 0.05$. However, both groups had significantly fewer LD analyses to the "nobody" questions than the control questions (for 1: $\underline{t} = -4.9$, $p < 0.001$; for 2: $\underline{t} = -9.2$, $p < 0.001$). Since the interest was in the negative question across age groups, this interaction did not qualify the main effect and seemed not to interfere with the interpretation of the overall results on the negative subject barrier.

The three-way interaction was among the question type by age by counterbalanced experimental sets, $\underline{F}$ (3, 32) = 4.48, $\underline{p} < .05$. One observation was that the mean of the negative question for 4-year-olds in the counterbalanced experimental set 2 (.42) was the highest across all age groups; however, the pattern of fewer LD analyses for the negative (.42) than for the control (.67) was still maintained. While the same pattern was also maintained for 5-year-olds, their mean for the control question (.25) in counterbalanced experimental set 1 was relatively lower than other age groups.

Question Type Effect

As for within-subjects effects, there was a highly significant difference between the negative "nobody" and the control, $\underline{F}$ (1, 32) = 111.51, $\underline{p} < 0.001$. The means were 0.19 for the negative subject "nobody" and 0.68 for the control. As the results showed, children provided fewer LD analyses, such as "Because the bus broke down," to the negative questions with “nobody” than to the control questions (see Table 4.3). This result supported the prediction of Hypothesis 1 that the negative subject “nobody” would block LD analyses.

Comparisons of “Nobody” With the Two Negatives “not” and “n’t”

Unlike for the negative “not” and “n’t” (see Table 4.1), the decrease in LD analyses for “nobody” showed early. To find out whether children treated “nobody” as different from the negative pair, “not” and “n’t,” first the negative subject “nobody” was contrasted to the average of the negative pair, “not” and “n’t.” The means were 0.25 for the negative pair “not” and “n’t,” and 0.19 for the negative subject “nobody.” The negative subject received fewer LD analyses than the negative pair. The difference was marginally significant, $F(1, 36) = 3.85$, $p = 0.057$. There was also a significant interaction between question type and age, $F(3, 36) = 3.49$, $p < .05$. The interaction effect indicates that the difference between the means is different at different age groups.

A closer look at the differences was necessary to answer the prediction raised by Hypothesis 2 concerning the development of “not” and “n’t,” heads of NegP, versus “nobody,” a specifier of NegP. When contrasted, the means of the 3-6-year-olds came out significant, $t(9) = -4.993$, $p < .01$, indicating that younger children were more sensitive to the negative subject than the sentential negatives. The contrasts for the remaining age groups were not significant. The next contrast was each negative head with “nobody.”

Contrast of “Nobody” with “Not”:

Since the contrast between groups average of the negative subject “nobody” and the negative pair “not” and “n’t” was marginally significant, “nobody” was further contrasted with each to find out how it compared with either of the two negatives. Results yielded a significant difference between “not” and “nobody”, $\underline{F}$ (1, 36) = 6.7, $\underline{p} <$ .05 (means 0.30 and 0.19, respectively). This first comparison showed that the negative subject “nobody,” which is a specifier of NegP, was significantly different from the sentential negative “not.” This result also supported the assumption that “not” is not a specifier of NegP.

Contrast of “Nobody” with “N’t”:

“Nobody” was compared to “n’t.” The means for “n’t” and “nobody” were 0.20 and 0.19 respectively. There was no significant difference between the two, $\underline{F}$ (1, 36) = 0.05, $\underline{p} >$ .05. There were, however, significant within-subject interactions between question type and age, $\underline{F}$ (3, 36) = 3.232, $\underline{p} <$. 05. A comparison of the means of the 3-6-

year-olds was significant, t (9) = 2.714, $p < .05$. However, comparisons of older age groups were not significant. The significant difference for the younger children was in clear support of Hypothesis 2.

Summary of Results

Results on Experiment 2 showed that the subject negative, “nobody,” was a barrier to LD analyses with a lack of differences due to age indicating an early effect. “Nobody” had a different effect from “not,” hence supporting the prediction of Hypothesis 2 that “nobody” should emerge earlier because the two negative forms belong to different categories. “Nobody” was different from “n’t” only at 3-6 years old. This result was compatible with the result on “n’t” where the 4-year-olds were different from the 3-6-year-olds indicating an early development of “n’t.” The lack of distinction between “nobody” and “n’t” for older age groups is assumed to be related to the extra evidence that “n’t” has from being merged with INFL by the Do-support rule.

Regression Analyses of Complement Clause Production and Theory of Mind Scores on the Development of the Negative Barrier "Nobody"

Although data showed no variance for age effect, other independent variables were tested in multiple regression analyses. None of the background variables (i.e. age, ToM, or complement production scores) was a predictor of the development of the negative subject "nobody." Results of multiple regression analyses were all insignificant.

Results of Experiment 3: Does the Negative Barrier "not" Block Medial WH Answers?

Descriptions of Data Coding

Children's answers were coded based on the type of analysis underlying each answer. To illustrate the coding system for the data analysis, a story is presented first followed by an experimental question with the possible answers and their underlying grammatical analyses as follows:

This girl likes to ride her bike. Here she's at the park. She rode her bike fast down a steep hill at the park. It was getting dark. She ran into a big wall, but because it was dark she thought she hit a big tree. So she broke her bike by hitting a big wall.
Examiner: How did she break her bike?
Where did she break her bike?

[For the negative question:]

Here she's at home. She was afraid that her mom might get upset about that. So when she went home, she did not tell her mom about crashing her bike at the park.

Examiner: Where did she not tell her Mom?

Here she's at the store. She wanted her mom to buy her a new bike. So at the store she told her mom that she broke her bike at the park by hitting a big tree.

Examiner: Where did the girl tell her Mom?
How did she tell her Mom she broke her bike?

(5) The experimental questions:

The negative question:
a. Where did the girl not tell her mom how she broke her bike?

The affirmative question (control):
b. Where did the girl tell her mom how she broke her bike?

Examples of the answers and their codings:

1. Main clause answer (SD analysis):
   a. At home. (cf.*Where did the girl not tell her mom?*)
   b. At the store. (cf. Where did the girl tell her mom?)

2. Complement clause answer (LD analysis):
   b. At the park. (cf. Where did (the girl say) she break her bike?)

[No LD answer was provided in the story for the negative question to reduce complicating the design (see the design of Experiment 3 in Chapter 3: Methods]

3. Medial WH answer (partial WH movement):
   a. By running into the wall. (cf. How did the girl not tell her mom she broke her bike?)
   b. By hitting a tree. (cf. How did the girl tell her mom she broke her bike?)

4. Single clause answer:
   a. & b. By running into the wall. (cf. How did she break her bike?)

The answer codes are explained in what follows. The main clause answers, which refer to the SD analyses, are the adult targets: (1a) for the negative question, "At home," or (1b) for the control question, "At the store." The remaining answers, most of which are not adult targets, were the complement clause (LD analysis), the medial WH answer (partial WH movement), and the single clause answer. The complement clause answer (LD analysis), a possible interpretation in adult grammar when no barriers apply, is when the initial WH word is interpreted with reference to the complement clause as in the answer (2a) for the control question, “At the park.”

Medial WH answers (partial WH movement) occur when the medial WH word is interpreted with reference to both the main verb and the complement clause as in the answer (3a) for the negative question, “By running into the wall,” or (3b) for the control, “By hitting a tree.” Single clause answers are when the medial WH word is interpreted with reference only to the complement clause as in the answers (4a&b), “By running into the wall.” The previous four answer types were predicted as possible interpretations of the experimental WH questions in the child grammar.

It was assumed at the outset that children correctly understand the differences among distinct WH words. However, that was not always the case. Some WH words received a “why” meaning rather than the target WH word meaning. For example, “when,” “where,” or “how” words which, respectively, have a temporal, spatial or a manner meaning that modifies a verb were answered as “why” words which have a causal meaning. These answers were classified as “broad WH words.” For this answer, children provided a broad meaning for the initial WH word. For example, the initial WH “when” in the experimental question gets two meanings, a temporal and a causal. For this reading, a “because” answer is reconstructed with reference to the main clause as in the answer (5).

5. Broad WH, main clause answer (Broad WH, SD analysis):
“Because she was at home,” or “Because she was afraid.”

Though the broad WH interpretation was not contained in the story design, the SD analysis part was similar to the target SD analysis. For this reason, it was analyzed as part of the SD analysis to examine the effect of negation. Broad WH interrogatives have also not been an uncommon interpretation among children. Therefore, it was analyzed for indications of the development of the WH words.

The other types of response, LD analyses and single clause analyses, are analyzed in Appendix B under Experiment 3 with a full description of the development of negation in complex WH questions.

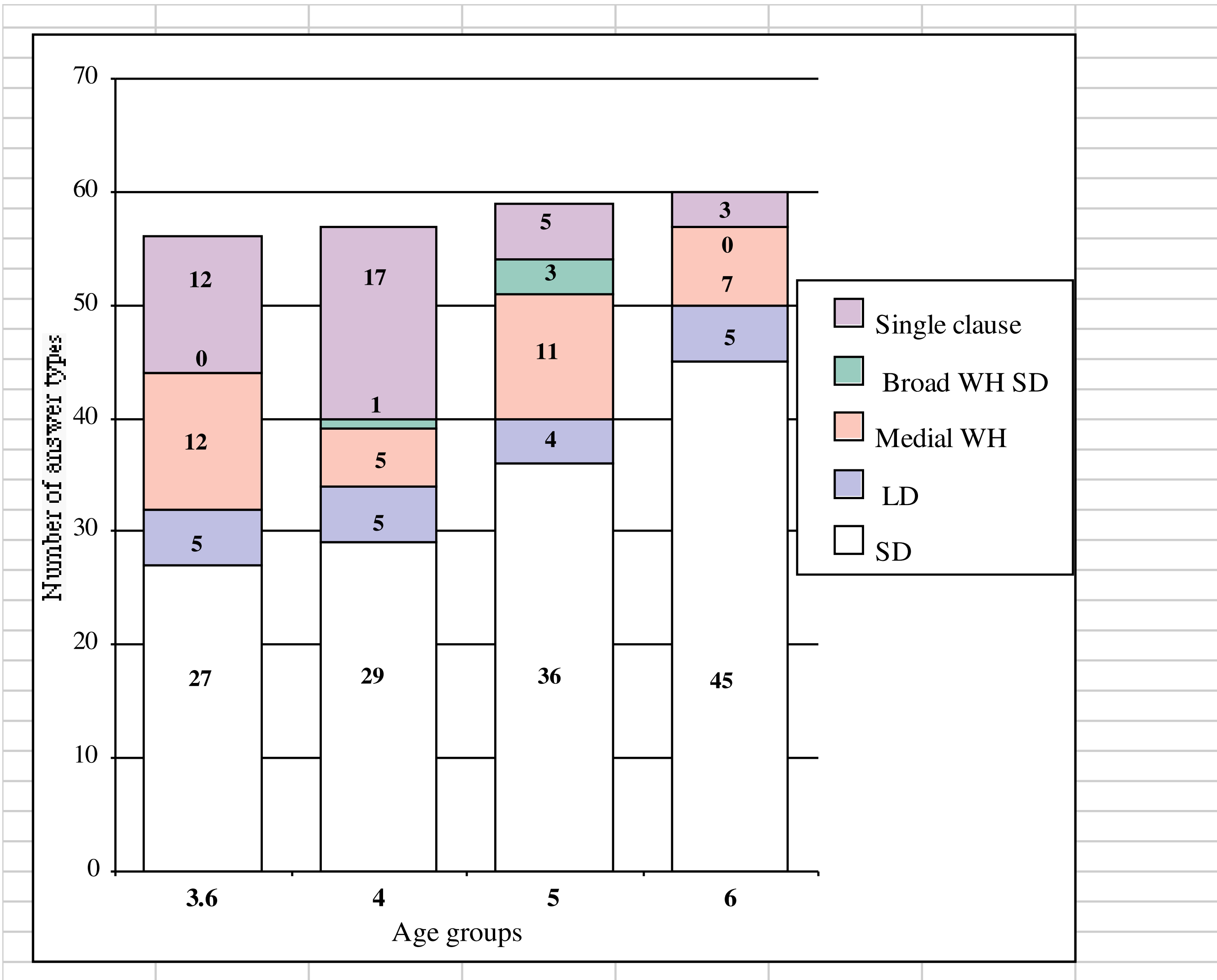
Statistical Tests of the Predictions

Statistical analyses were run to test the predictions of the following empirical hypotheses:

Hypothesis 1: The negative “not” is a barrier to medial WH answers (partial WH movement).

Hypothesis 2: As age increases, the negative “not” induces more SD analyses in questions with medial WH words than the affirmative due to the cumulative effects of the negative barrier “not” and the WH barrier.

A 2 (question type) by 4 (age group) by 2 (counterbalanced experimental set) mixed design analysis of variance was run on the medial WH answers and the SD responses. The number of SD, LD, medial WH, single clause and broad WH answers along with examples are shown in Figure 4.3 for the control question and Figure 4.4 for the negative question. Figure 4.3 shows that the SD analyses, “At the store,” answers predominate. Since SD analysis is the adult target, it seemed the most available analysis to children. However, when SD analyses were not available, a child selected alternative analyses, some of which might be compatible with grammars other than English. For example, the medial WH answers, “By hitting a tree” for the control as seen in Figure 4.3, exist in some grammars, such as German. Another type was the single clause answer, “By running into the wall.” However, those as well as the medial WH answers were



given less than the SD analyses. LD analyses, “At the park,” were few. A couple of answers were the broad WH, SD analyses.

Figure 4.3. The raw distribution of answer types to the control WH question (N= 6) according to age groups (N = 40). (Answers coded under other, i.e. not possibly interpretable under any category, were excluded.)

Legend: SD: “At the store;” LD: “At the park;” medial WH: “By hitting a tree;” Broad WH SD: “Because she was at the store;” Single clause: “By running into the wall.”

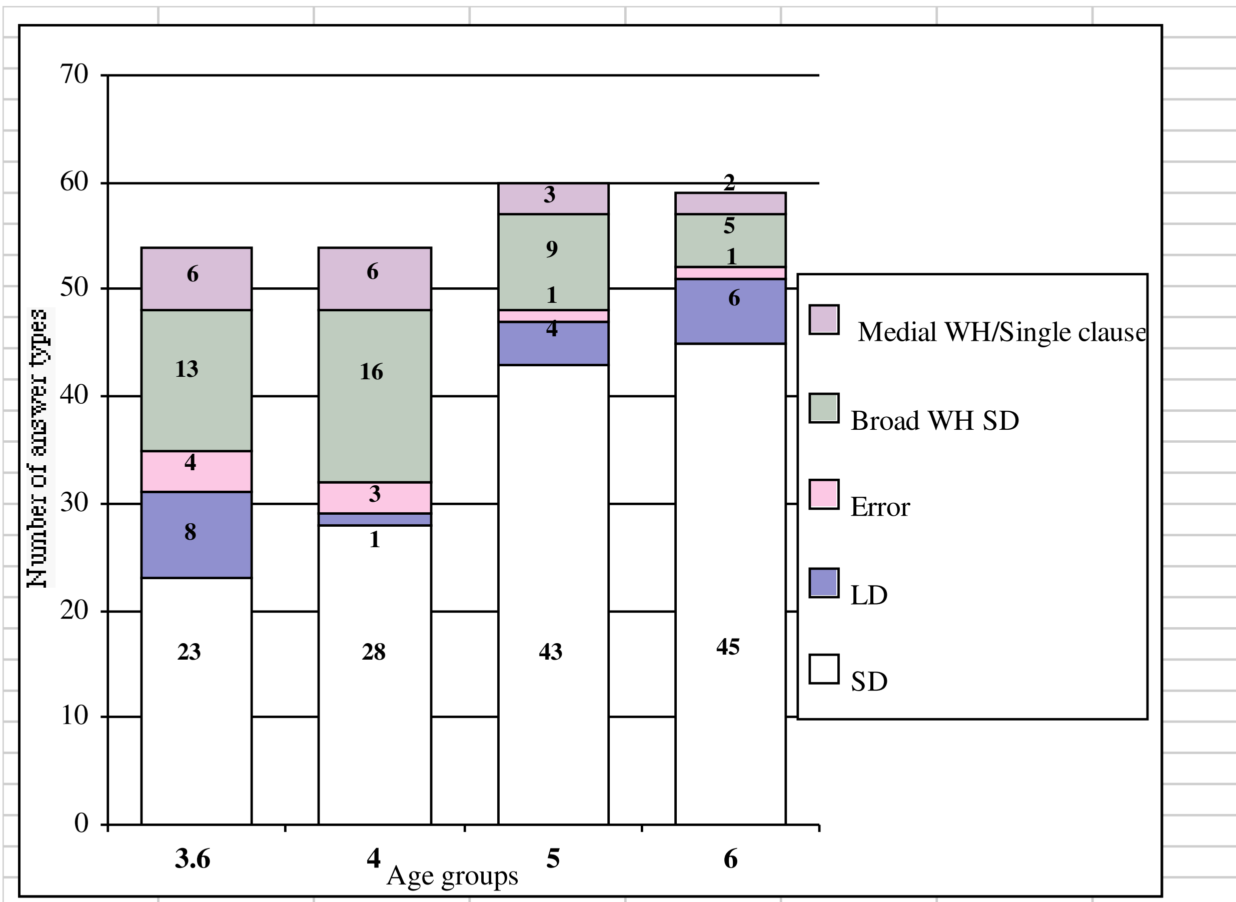


Figure 4.4. The raw distribution of answer types to the negative WH question (N= 6) according to age groups (N= 40). (Answers coded under other, i.e., not possibly interpretable under any category, were excluded.)

Legend: SD: "At home;" LD: "At the park;" Error: "By hitting a tree;" Broad WH SD: "Because she was at home;" Medial WH or single clause: "By running into the wall."

Figure 4.4 shows the same types of answers for the negative question. Similar to the SD analyses of the control question, the SD analyses that underlie "At home" answers were predominant. For both questions SD analyses seemed to increase linearly across age groups. "At the park" answers indicating LD analysis were few. "By hitting a tree" answers were also very few, and under this question they were pragmatically implausible answers to the negative question and, hence considered errors. An increase in the broad WH, SD analyses is shown for the negative question. For this question, the answer "By running into a wall" was less than that for the control question. This answer could be either the medial WH answers for the negative (cf. How did she not tell her mom she broke her bike?) or the single clause answers (cf. How did she break her bike?). It could also be both. A distinct medial answer for the negative question was not included in the design since it rendered the story taxing for children. (See the design of Experiment 3 in Chapter 3: Methods.) In either case, it was less than either the medial WH answer or the single clause answer for the control question.

The same answers are also presented in a line graph for any linear trends in Figures 4.5 and 4.6 for the control and negative questions. Figure 4.5 shows a difference between the SD analyses and the other responses, a linear trend for the SD analysis, and a possible interaction between the medial WH and the single clause answers.

Figure 4.6 also shows a difference between the SD analyses and the other response types. SD analyses seem to increase linearly. An interaction shows between the SD analyses and the broad WH, SD analyses. Broad WH, SD analyses show a linear decrease.

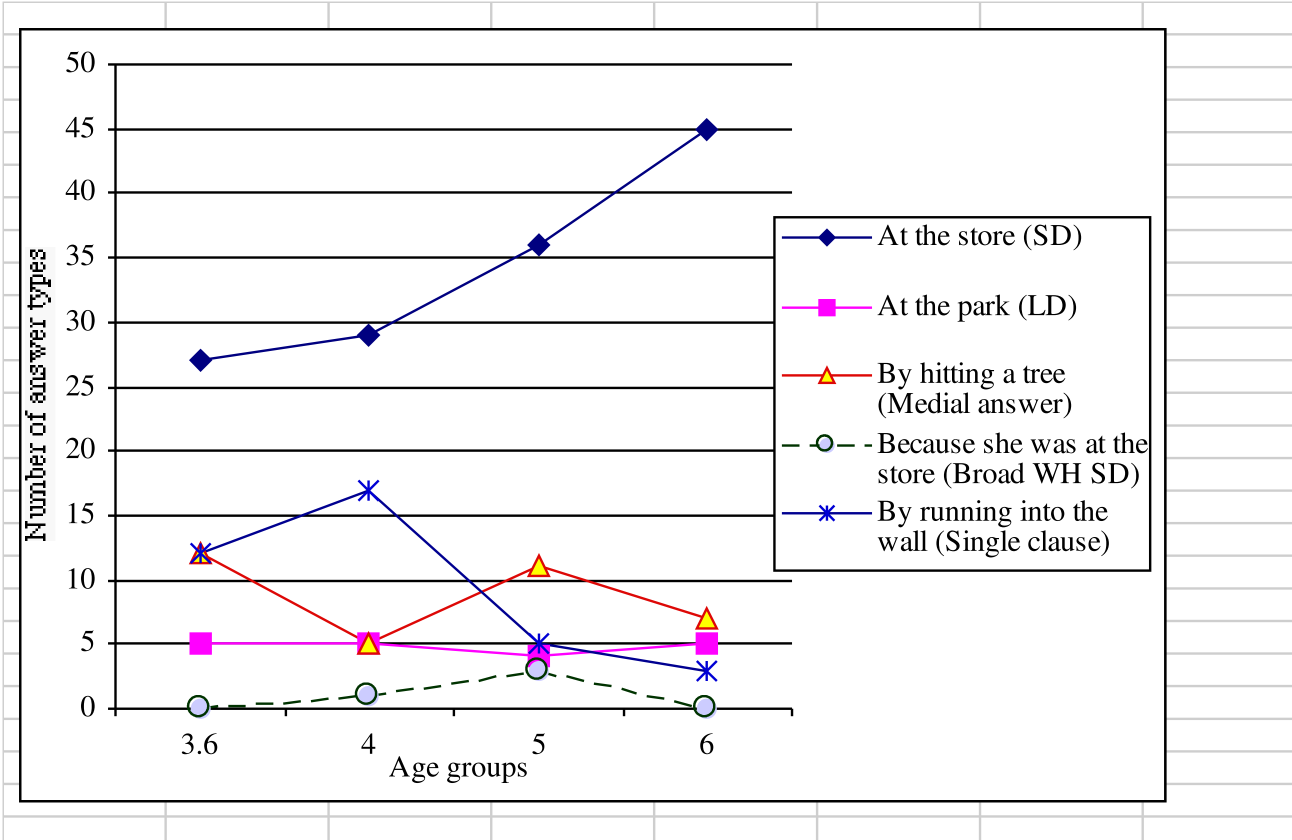


Figure 4.5. A line graph of the answer types for the control questions according to age groups.

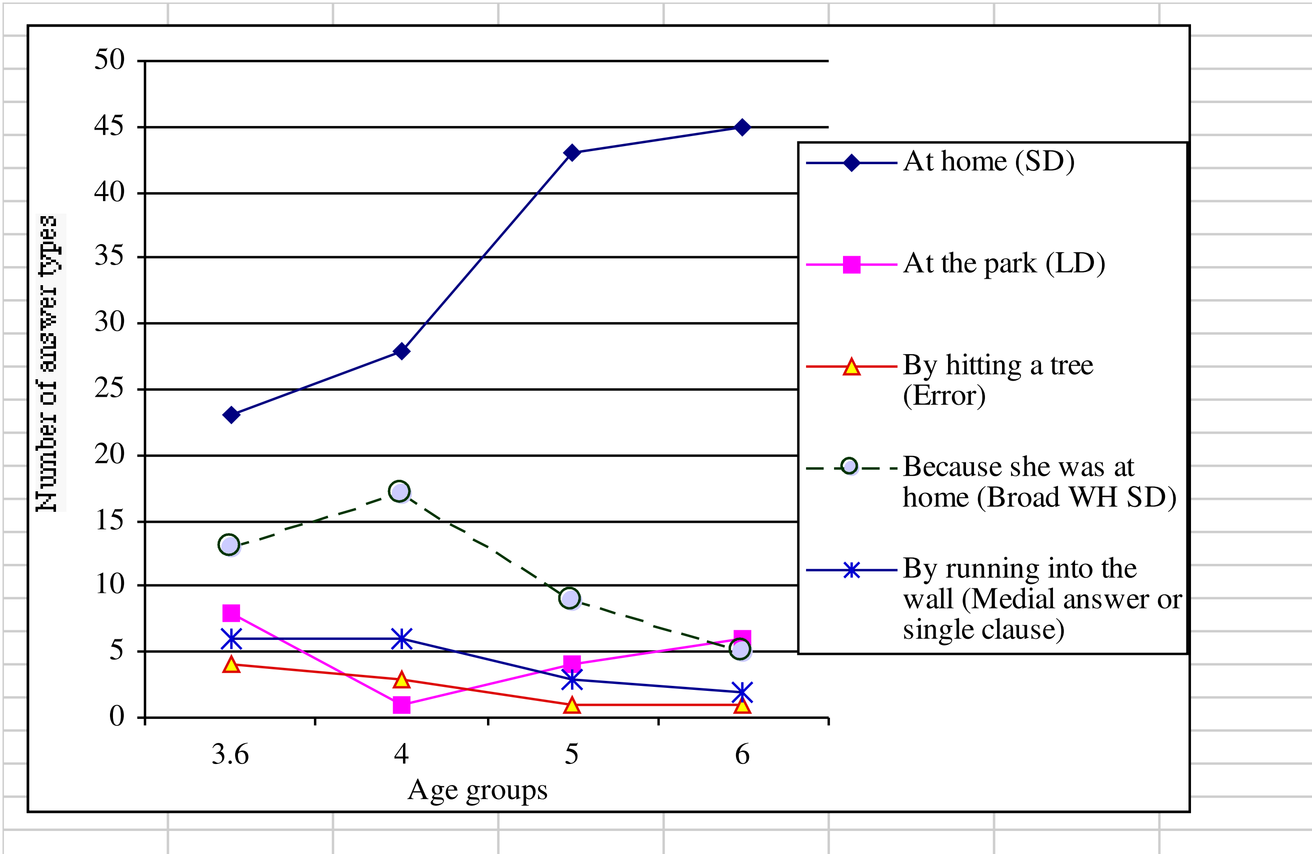


Figure 4.6. A line graph of the answer types for the negative questions according to age groups.

The results of the statistical analyses on the medial WH answers and the SD analyses are reported in the following subsections: Age Effect, Counterbalanced Experimental Set Effect, Question Type Effect, and Regression Analyses of Background Variables.

Hypothesis 1: The Negative "Not" Is a Barrier to Partial WH Movement (Medial WH Answers).

A medial WH answer, also referred to as partial WH movement, indicates that a medial WH word is assigned scope over the main verb even though its trace is in the complement clause, as in German. (See Partial WH Movement in Chapter 2 for an elaborate explanation of this analysis.) For this experiment, an indication of a medial WH answer is the answer "By hitting a tree" to the control question, or "By running into a wall" to the negative question.

When a medial WH word is present in the WH question, medial WH answers are predicted. However, when there is negation in the main clause, they should be less predicted according to both the theory of scope marking which describes the rules of partial WH movement analysis and the assumption that both medial WH answers and negative barriers are universal features.

Age Effect

There was no age main effect, $F(3, 32) = 0.75$, $p = 0.53$. No significant interactions were found.

The Effect of Counterbalanced Experimental Sets

There was no main effect for the counterbalanced experimental sets, $\underline{F}$ (1, 32) = 0.95, $\underline{p}$ = 0.34. There were also no significant interactions.

Question Type Effect

Results showed that children supplied more medial WH answers for the control questions than for the negative questions (see Figures 4.3 and 4.4). There was a significant within-subjects difference between the negative and the control questions, $\underline{F}$ (1, 32) = 6.57, $\underline{p} < .05$. The means for the two questions were 0.88 for the control and 0.43 for the negative.

The observed significant effect of the negative barrier is, nevertheless, underestimated. The "wall" answers for the negative question could be both medial WH answers and single clause answers. Yet their total number (N=17) was much smaller than those for the control question (N=72). Even if the "wall" answers were genuinely medial WH answers for the negative question, they were still significantly less than those for the control (N=35).

The "wall" answers to the negative questions were also contrasted to the "wall" answers to the control question, which were the single clause analyses. The question type had a significant within-subject effect, $F(1, 32) = 3.85$, $p = 0.05$. The means were 0.43 for the negative question and 0.93 for the control. The single clause analyses to the control question were significantly different from the ones to the negative question. This difference indicated that negation had an effect on the "wall" answers regardless of whether all the "wall" answers to the negative question were genuinely single clause or medial WH answers. Therefore, the evidence for the negative effect is undermined in this data.

Summary of Results

Results of Experiment 3 on medial WH answers supported Hypothesis 1. Negation was a barrier to medial WH answers as to LD analyses in Experiments 1 and 2. The results also implied that medial WH answers observed in child English grammar are a form of partial WH movement, as evidenced in German, that is subject to the negative barrier as described under the theory of scope marking.

Regression Analyses of Complement Clause Production and Theory of Mind Scores on the Development of the Negative Barrier “not” on Medial WH Answers

The background independent variables, ToM, and complement production scores, were tested for any effects on the development of the medial WH answers for the control and negative questions. For the control question, five models (A, B, C, D, and E) of multiple regression analyses were run with the independent variables age, ToM, and complement production scores and their interaction terms[5] (Lewis-Beck, 1980). (See Table 4.2 for a quick reference to these scores.) Model A contained the independent variables: age, ToM, and Syntactic adequacy 1. Model B had age, ToM, and Syntactic adequacy 2 as the independent variables. Model C included age, ToM and Semantic adequacy. Models D and E were used to determine if the significance of Semantic adequacy and ToM were independent from each other and from the Syntactic adequacy scores. Models D and E both had Semantic adequacy, age, and ToM, with Syntactic adequacy 1 for D and Syntactic adequacy 2 for E.

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[5] Interaction terms are included in a regression equation because the effect of one variable in the equation may depend upon another variable. Including them gives a more complete picture of how the different variables affect variance. Interaction terms are calculated by first centering the variables (subtracting the mean from each score, so that the mean is 0). This is a standard procedure for avoiding multicolinearity problems (Lewis-Beck, 1980). Then two or more variables, such as ToM, syntactic or Semantic adequacy scores, are multiplied together. The result is the interaction term(s) as the ones used in the regression equations in this study.

In models A to D, ToM seemed a predictor of medial WH answers, $p < .05$, but only marginally in model E, $p = .10$. Figure 4.7 shows that the passers of ToM produced more medial WH answers. In models C, D and E, the Semantic adequacy score was also a predictor of medial WH answers, $p < .05$ for C, $p < .01$ for D and E. The Syntactic adequacy score 2 for complement production was also another predictor of medial WH answers in model E, $p = .05$. Syntactic adequacy 1 was marginal in model D, $p = .07$; so was age in model B, $p = .08$. (For specific values see Table B.3 in Appendix B.)

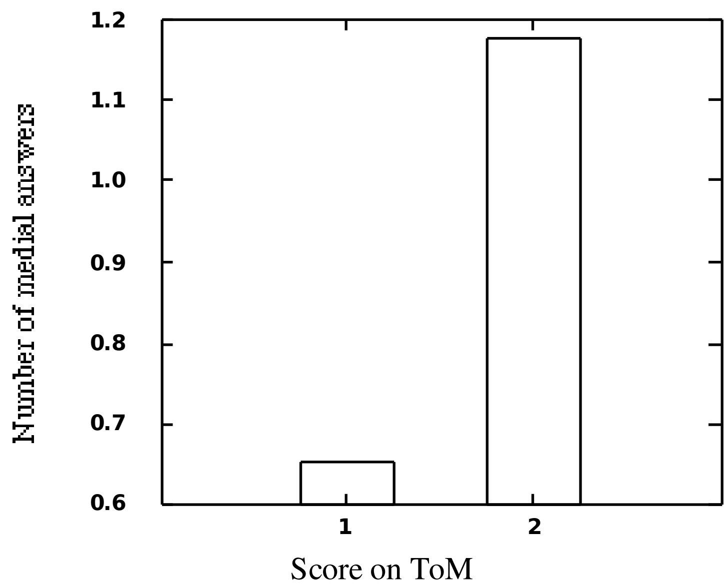


Figure 4.7. Raw distribution of medial WH answers for the control question according to ToM score. (1=failures; 2=passers)

Unlike the control question, only age was a predictor of medial WH answers for the negative question, $p < .05$. (For specific values see Table B.4 in Appendix B.) When syntactic adequacies 1 or 2 were entered in the equation with Semantic adequacy, age was still the only predictor. The medial WH answers for the negative question behaved differently from the medial WH answers to the control question. To clarify the question of whether or not they were genuine single clause answers, they were compared to the single clause answers of the control question.

Comparison of the Single Clause Answers to the Control and Negative Question:

Multiple regression analyses were run for single clause answers to both questions. Interaction terms of the independent variables, similar to the ones used in the analysis of variance, were included in the regression equations. Use of interaction terms was a statistical procedure to provide to the variance term information that used to be under the error term. This procedure was done to isolate the independent effect of each factor.

Age was the only predictor for single clause analyses of both the negative and control questions. (For a full comparison and specific values, see the Single Clause Analysis subsection under Regression Tables and Further Analyses of Experiment 3 in Appendix B.)

Summary of Regression Results

The results on the control questions showed that ToM, Semantic adequacy, and Syntactic adequacy 2 were the predictors of medial WH answers. The semantic and Syntactic adequacy measures are associated with the development of full tensed complements that enable children to handle embedded WH questions. The capacity for a ToM enables the children to also analyze false complements. In the stories the answer to the medial WH word was a falsely believed manner, place, or time depending on the type of the medial WH word (e.g., "how," "where," or "when"). However, medial WH answers are only an intermediate stage to the full tensed complement structure as in the target adult English complements.

As for the negative questions, age was the only predictor of the blocking effect of negation on medial WH answers. Similarly, age was a predictor of the effect of negation on LD analyses in Experiment 1. Age was also a predictor of single clause analyses for both the negative and control question indicating that the medial WH answers to the negative question could be merely single clause answers with few incidences for the negative question.

Hypothesis 2: As Age Increases, the Negative "Not" Induces More SD Analyses in Questions with Medial WH Words Than the Affirmative Due to the Cumulative Effects of the Negative Barrier "Not" and the WH Barrier

SD analysis, “At home” to the negative question or “At the store” to the control, was the most predicted analysis as in the adult grammar since there were two kinds of barriers. The medial WH word in the control question is a barrier to alternative analyses to SD analysis. The negative “not” as well as the medial WH word in the negative question are both barriers. Statistical analyses were used to examine how the two barriers could have cumulative effects and hence would force children to select more SD analyses compared to the control question with only one barrier. The results are reported in the following subsections.

Age Effect

There was a significant main effect for age, $\underline{F}$ (3, 32) = 4.45, $\underline{p} < .05$. There were no age by question interactions. As shown in Figures 4.3 and 4.4, SD analyses increased as age increased.

Since there was a main effect for age, the two questions were tested for a linear trend analysis. They came out significant, $\underline{F}$ (1, 32) = 13.6, $\underline{p} < .01$ for the negative question and $\underline{F}$ (1, 32) = 5.7, $\underline{p} < .05$ for the control question. The significant linear trend indicated that as children got older they increased SD analyses (see Figures 4.5 and 4.6).

However, specific contrasts were run to find when children became more sensitive to negation in medial WH structures and hence provided more SD analyses.

Contrasts revealed that 3-6-year-olds were not different from 4-year-olds on either question type. They were, however, different from 5-year-olds only on the negative question, F (1, 32) = 9.5, $p < .01$. They were different from 6 year olds on both questions, F (1, 32) = 10.7, $p < .01$ for the negative and F (1, 32) = 5.1, $p < .05$ for the control. There were marginal differences between the 4- and 5-year-olds on the negative question only, F (1, 32) = 3.4, $p = .07$. There were significant differences between 4- and 6-year-olds for the negative question, F (1, 32) = 4.1, $p = .05$, but marginal for the control, F (1, 32) = 3.8, $p = .059$. There were no differences between 5- and 6-year-olds.

When 3- and 4-year-olds were put into one group they were different from the 5- and 6-year-old group, t (37) = -3.8, p = .001 for the negative question and t (37.9) = -2.3, $p < .05$ for the control question.

Results on age differences revealed that the negative barrier effect showed after age 4, which was compatible with the negative effect in Experiment 1. The fact that 3-6-year-olds significantly differed and 4-year-olds marginally differed from the 5-year-olds only on the negative question suggested that the negative started to show barrier effects after age 4.

The Effect of Counterbalanced Experimental Sets

No main effect was found for experimental sets, $\underline{F}$ (1, 32) = 0.5, $\underline{p}$ = 0.48, their interaction with age, $\underline{F}$ (3, 32) = 0.41, $\underline{p}$ = 0.75, or their interaction with question types, $\underline{F}$ (1, 32) = 0.008, $\underline{p}$ = 0.93.

Question Type Effect

There were no significant within-subject effects for question types, $\underline{F}$ (1, 32) = 0.00, p = 0.98) or within-subject interactions.

However, some of the SD analyses of the negative question that were different from the target SD analyses were not included so far in the statistical tests. Such SD responses were labeled broad WH, SD analyses (Lyn Frazier, personal communication, March 10, 2000) as shown in the answer type (5, p. 174) (e.g., "Because she was at home."). They are explained next as a subsection to SD analyses and included in the statistical tests to examine the negative barrier effect.

The Broad WH, SD Analysis

One response which has been previously observed, but not analyzed, in children's interpretations of complex WH questions was the reconstruction of an answer containing a "because" clause (e.g., de Villiers, et. al., 1990), such as, the answers in (5, p. 174), "Because she was at home," or "Because she was afraid." Though unpredicted and not examined in previous studies, "broad WH, SD analyses" should be of equal interest to analyze and should be accounted for in the model of the development of barrier functions in complex WH questions. Before a statistical examination of the effect of the negative barrier on SD data including the broad WH, SD responses, an account of this response is presented first.

To account for the broad WH, SD analysis two descriptions are proposed. One describes how children might assign a WH word a broad meaning. The other describes how children perform a SD analysis as a result of learning the negative barrier.

Under the assumption that WH words consist of a lexical content and functional features (e.g., Chomsky, 1995), it is conceivable to propose that children learn and use the content and features of a WH word by lexical classes (e.g., Roeper, 1999) and dependent on structures. For example, some WH words are acquired before others. In the present data, when questions were analyzed by the initial WH word, "how" received the most "because" answers. The number of WH Broad readings each WH word received in the negative questions were: "when-not"= 8; "where-not"= 3; "how-not"= 33; and in the affirmative questions; "when-tell"= 0; "where-tell"= 0; and "how-tell"= 4. Until a WH word like “how” is obligatorily assigned its target lexical content, other meanings could be used, such as the broad WH word. In this case, WH words like “when” get a causal meaning equivalent to a “why” or “how come” WH word and a temporal meaning equivalent to a “when” WH word. This was suggested to be a default, or last resort analysis that children accessed when the target WH word meaning was not achieved (Roeper, personal communication, April 10, 2000).

It is also assumed that the availability of the lexical content of a WH word is not an all-or-none process. Some factors might make the target lexical content of a WH word less accessible. One example is complex structures. The presence of an adjunct WH word in a multiclausal sentence with negative and WH barriers in the negative question in this experiment is one form of complex structures (e.g., “Where did the girl not tell her mom how she broke her bike?”). Independently, it was observed that children had access to the target meaning of the same WH words in the negative question when used in simple one-clause questions at intervals of the story. (See the story of Experiment 3 above.)

The other description of the account relates to how children learn the WH operator feature of the same WH word by performing a SD analysis in the presence of the negative barrier. The prediction of Hypothesis 2 was that the negative “not” would induce more SD analyses than the control question. However, the negative question received SD responses that contained a broad WH meaning which were not included in the previous statistical analysis. The broad WH, SD analysis is accounted for as follows.

It was hypothesized that in the early stages of the development of complex syntax children either do simple analysis of the sentence, such as a single clause analysis, or disobey barriers by doing more LD analysis as shown in Figure 4.4 for 3-6-year-olds.

As children begin to learn about multiclausal sentences, they become more sensitive to a negative barrier. The predicted age would be around 4 years old as also motivated by the previous results on negation in Experiments 1 and 3. The negative barrier blocks the main WH word from having a trace in the complement clause; hence medial WH answers, LD, and single clause analyses should be excluded. In such a context, SD analysis should be the target analysis for the child. However, SD analysis of adjunct WH words, such as “when,” “where,” and “how,” seems to be less preferred by children due to a lack of semantic or pragmatic plausibility. Such WH words describe a time, place, or manner related to the communication verb, and, hence they are not in the center of discourse. This might make the time, place, or manner phrases that substitute for the WH words less available to children. Having to select the SD analysis, but with no preference for the lexical content of the main WH word, a child would shift the meaning of the target WH word to a default WH meaning of an adjunct type equivalent to a “why” WH word. Thus, a child reconstructs a SD analysis with a shifted broad WH meaning that contains a “because” clause (e.g., “Because she was at home.”).

When broad WH, SD analyses were seen as part of the SD analyses for the negative question, children appeared to do more SD analyses for the negative question than the control (compare Figures 4.3 and 4.4). Results of the statistical tests of the adult SD analyses grouped with the broad WH, SD analyses are described next under Age Effects and Question Type effect.

Age Effect

Age still had a significant main effect when the adult SD and the broad WH, SD analyses were tested as one group, $\underline{F}$ (3, 32) = 3.1, $\underline{p} < .05$.

As predicted by the account for the broad WH, SD analyses, the 3-6 to 4-year-old group was significantly different on the amount of broad WH, SD analyses from the 5- to 6-year-old group, $\underline{F}$ (1, 38) = 4.41, $\underline{p} < .05$. The younger group performed more broad WH, SD analyses (mean = 1.5) than the older group (mean = 0.7). This was compatible with the account that as children started learning negative barriers and multiclausal sentences, they performed more broad WH, SD analyses. However, as children got older the broad WH, SD analyses decreased and SD analyses increased as seen in Figure 4.6. This was reflected in the significant interactions between age and the two SD response types for the negative question, $\underline{F}$ (3, 36) = 4.254, $\underline{p} < .05$.

Negation also blocked all alternative analyses as children got older. All the other responses, broad WH, SD analyses, medial WH answers, LD, and single clause analyses, were separated from the SD analyses of both questions and contrasted between the younger and older age groups. The younger group, 3-6- to 4-year-olds (mean = 3.2), were significantly different from the older group, 5- to 6-year-olds (mean = 1.7), t (36.4) = 2.74, $p < .05$, on the negative question, but nonsignificant on the control, t (38) = 1.8, $p > .05$. This might suggest that as children got older, negation had an effect on selecting alternative analyses including the broad WH, SD analyses.

Question Type Effect

When the broad WH, SD analyses were added to the SD analyses, the negative and control questions were significantly different, F (1, 32) = 14.1, $p < .01$. The means were 4.58 for the negative and 3.53 for the control.

The negative question received more broad WH, SD analyses than the control (see Figures 4.3 and 4.4). There was a significant within-subject effect for question type, F (1, 32) = 21.69, $p < 0.001$. The dependent variable means of broad WH, SD analyses were 1.10 for the negative question and .10 for the control question.

When the negative questions were analyzed by the type of the initial WH word, “how” received the most broad, WH meaning shift (mean of “how”= .83; “where”= .08;

"when"= .2). The negative question with "how" was significantly different from "where" or "when", $F(64, 2) = 23.626$, $p < 0.001$. As also shown in Figure 4.6, the means of the three WH word questions decreased by age increase. However, "how" decreased the least. At 5 and 6 years old, there was 0 presence of broad, WH shift for "when" and "where" but .90 and .54 for "how" WH words respectively.

Summary of Results on the Broad WH, SD Analyses

The effect of the negative barrier appeared around age 4. Results indicated that negation was a barrier to analyses other than the SD analyses of the main WH words, which are the adult target. Children demonstrated a broad WH, SD analysis that technically was a form of SD analysis, but with a broad WH word meaning. An explanation for that was provided which was related to the effect of negation and the development of WH words. When both the adult SD analyses and the broad WH, SD analyses were taken into account, negation was a barrier that forced SD analyses even if sometimes the content of the main WH word did not match that of the adult.

Regression Analyses of Complement Clause Production and Theory of Mind Scores on the Development of the Effect of the Negative Barrier “not” on SD Analyses and Broad WH, SD Analyses

Trend analysis showed that age had a main effect on the increase in SD analysis. However, multiple regression analyses were run to determine whether other background variables contributed to the development of negation as a barrier that induces SD analysis.

For the control question, age was the only significant predictor ($p < .05$) in the three models A, B and C which were similar to the models used in previous multiple regression analyses. (See Table B.5 in Appendix B for specific values.) Since this analysis was the adult model, it was further examined to find whether the independent variables had independent effects. For this purpose, interaction terms of the different independent variables, similar to the ones used in previous analyses, were entered in each regression equation (A, B, and C). When interaction terms were entered in each model, age was still the predictor of the development of SD analysis.

For the negative question, age was a significant predictor in model A ($p < .01$). Age ($p < .01$) and Syntactic adequacy 1 ($p < .05$) were also significant predictors when interaction terms were used in the regression equation of model A. In model B, age was also a significant predictor of SD analysis ($p < .01$). When interaction terms were used, age was still a predictor ($p < .01$). Other significant predictors were Syntactic adequacy 2 ($p < .05$), age by Syntactic adequacy 2 interactions ($p < .01$) as well as the three way interactions of age by ToM by Syntactic adequacy 2 ($p < .05$). In model C, age was still the predictor of SD analysis ($p < .01$). When interaction terms for the Semantic adequacy score were used in Model C, only age was a predictor ($p = .05$). (For specific values, see Table B.6 in Appendix B.)

As for the broad WH, SD analyses, the same background variables were tested to find out if results would support the interaction between syntactic maturity and the development of negative barrier effects on analyses other than the SD analysis. The results are reported next.

Regression Analyses of Complement Clause Production and Theory of Mind Scores on the Development of the Negative Barrier "not" to Broad WH, SD Analyses

In the account for the broad WH, SD analyses, it was proposed that as children start to learn how to formulate and comprehend embedded multiclausal sentences, they also begin to understand the negative barrier "not." Such a change in syntactic ability was predicted to occur around the age of 4. This account was tested against the background variables of Syntactic adequacies which measure the production of multiclausal sentences. Theory of Mind was also included in the testing as a cognitive correlate of complex sentences.

Multiple regression analyses were run with the interaction terms of the independent variables of age, ToM, and syntactic scores as described in previous analyses of multiple regression. This was done to include as much information as possible since this aspect of the development of complex WH questions has not been examined before.

In model A, Syntactic adequacy 1 score ($p < .01$) and its interaction with age ($p < .01$) were significant predictors of the broad WH, SD responses to the negative question. In model B, however, the predictors were age ($p < .05$), ToM ($p = .05$), and the three-way interactions of age by Syntactic adequacy 2 by ToM ($p < .05$). No significant predictors were observed in model C where the Semantic adequacy score and its interactions with age and ToM were entered in the equation. (For specific values, see Table B.7 in Appendix B.)

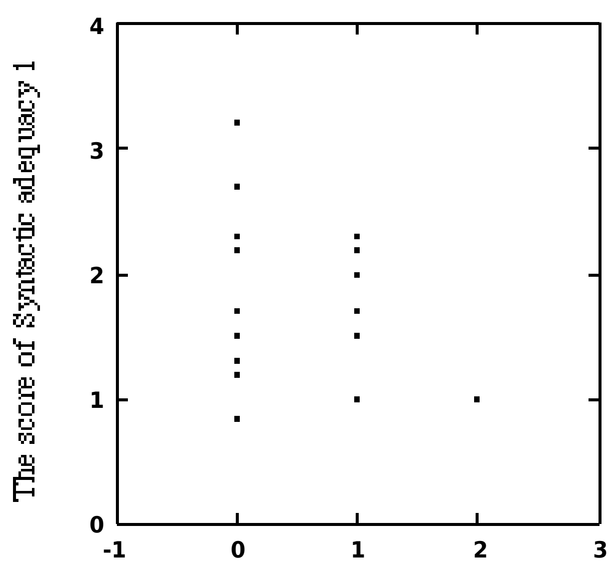
As for the control question, the small number of broad WH, SD responses (N = 4) was insufficient to run regression analysis.

Since significant effects of Syntactic adequacy 1 and its interaction with age emerged for the negative question, the means of the different age groups were examined to account for children's use of broad WH, SD analyses.

Under the account for broad WH, SD analysis, it was predicted that in the early stages of syntactic development of complex sentences and barriers to movement, more

LD analyses were performed which violated the negative barrier. To test that, the younger age groups were examined. Figure 4.8 shows a scatterplot of Syntactic adequacy 1 and LD analyses of the negative question for 3-6- and 4-year-olds. The Pearson Product Correlation, r = -0.27, p = 0.28, though nonsignificant, indicated that as the production syntax score increased, the LD analyses decreased as predicted.

To test whether 3-6-year-olds differed from the older age groups in the use of LD analyses, the scores of the 3-6-year-olds were contrasted to those of the rest of the age groups. For the negative question, the LD analyses provided by 3-6-year-olds were significantly different from the average of the older age groups, $F\ (1, 32) = 4.7, p < .05$. They were, however, not different on the control question, $F\ (1, 32) = .004$, $p = .95$.



Number of LD analyses of the negative question

Figure 4.8. The scatterplot of Syntactic adequacy 1 and the LD analyses of the negative question for 3-6- and 4-year-olds.

When children develop more of the grammar of complex syntax, they begin to respect the structure of complex WH questions. Hence, if the sentence contains barriers, such as a negative and medial WH word, children are structurally biased to select an SD analysis, and not LD analyses, reflecting development of grammatical structures and barriers. In the early stages, however, children assign a WH word a broad WH meaning indicating that they do not check the lexical content of the initial WH word. This analysis underlies the "because" answers. As older children set more rules in their grammar, they choose more grammatical analyses of the sentence, such as SD analysis as shown in Figure 4.4.

First the relationship between the development of complex syntax and structural barriers in sentences were tested in the younger 3-6- and 4-year-old age groups. Figure 4.9 displays the scatterplot of "because" answers to the negative question and Syntactic adequacy score 1, an indicator of accessibility of complex multiclausal sentences. A Pearson Product Correlation of the broad WH, SD responses with Syntactic adequacy 1 score was significant, $\underline{r} = 0.541$, $\underline{p} = 0.01$. To further confirm the results, 3-6-year-olds were selected, but the correlation was not significant, $\underline{r} = .31$, $\underline{p} = 0.39$. When the 4 year olds were selected the correlation between Syntactic adequacy 1 and the broad WH, SD responses was high and significant, r = .73, p = 0.018.

Similar analyses were run for the older age groups. The correlation was in the opposite direction but not significant, r = -0.241, p = .31. As expected, the older children decreased the use of "because" answers.

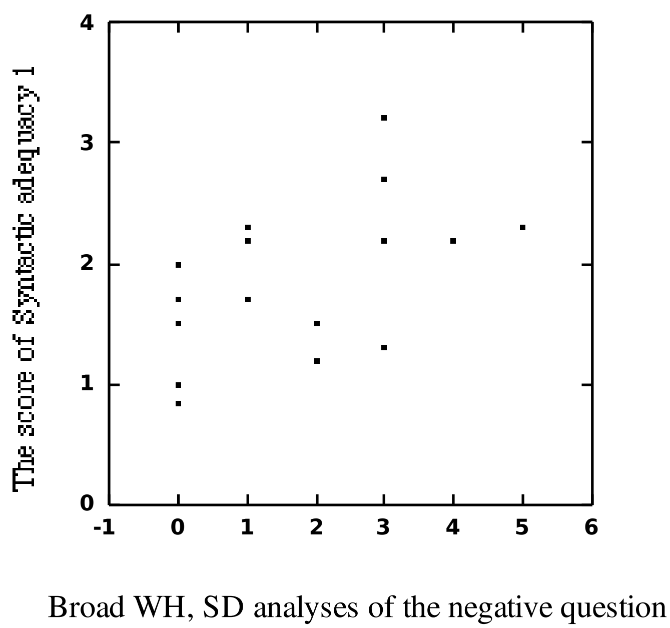


Figure 4.9. A scatterplot of the Syntactic adequacy 1 and the broad WH, SD analyses of the negative WH question for the 3-6- and 4-year-olds.

Summary of Regression Results

Results on the regression analyses supported previous results on age effect. For both questions age was a common predictor of the development of SD analysis. However, only negation was related to other language predictors. The development of full-tensed complements as indicated by the Syntactic adequacy scores seemed to be related to the development of the negative barrier effect on WH extractions from complement clauses. This effect was shown to induce more SD analyses even though some of these had a shifted WH word meaning.

Results on regression analyses also supported the account of the broad WH, SD analyses. As predicted, before children develop a full barrier effect of the negative, they performed more LD analyses. As the syntax of full-tensed complements develops, marked by the syntactic production scores, the barrier effect of negation develops and SD analyses increase, although the lexical content of the WH word is not yet fixed.

Results of Experiment 4: Does a Negative Phrase in the Initial Position of an Embedded Clause Block WH Word Long Distance Analysis?

Descriptions of Data Coding

To facilitate understanding of the data coding, examples of the stories, question types, and response types are given for the two kinds of negative phrases used in this experiment- the negative operator and the negative constituent.

First an example is presented of a story that preceded a question with a negative operator in the complement clause. A negative operator was assumed to be a barrier on WH word LD analysis.

A story for the negative operator:

This morning, this girl found that her cat was up on the tree. She tried three ladders to reach the cat, but she could not reach the cat on the tree with any of the ladders in the morning. So none of the ladders were long enough. Then she thought her Dad could help her. The girl told her Dad at dinnertime that she could not reach her cat on the tree with any of the ladders in the morning. The Dad promised to help get the cat down.

This story was followed by a WH question with a negative operator type of negative phrase in the complement clause: "with none of the ladders." In the experimental question, the negative phrase is preposed to the initial position of the complement clause as in (6a) with a subject-auxiliary inversion for the negative operator only. For clarity of reference, this position is referred to as the middle of a two-clause sentence. In the control question (6b), the negative phrase is in situ in the complement clause, or at the end of the sentence.

(6) a. When did the girl say that <u>with none of the ladders</u> could she reach the cat?

b. When did the girl say that she could reach the cat with none of the ladders?

Examples of answer types:

Main clause answer (SD analysis):
At dinnertime. (cf. “When did she say it?”)

Complement clause answer (LD analysis):
In the morning. (cf. “When did (she say) she couldn’t reach the cat?”)

As in Experiment 3, broad WH analyses were unpredicted response types but some children provided them. They were of two possible analyses in this experiment, that is, a broad WH word was reconstructed with reference either to the complement or main clause. Examples are:

Broad WH, SD analysis:
Because she couldn’t reach the cat. (cf. “Why did she say she could reach it with none of the ladders?”)

Broad WH, LD analysis:
Because it was too high. (cf. “Why did (the girl say) she couldn’t reach the cat?”)

Next is an example of a story that preceded a question with a negative constituent in the complement clause. It was assumed that a negative constituent does not block a WH word LD analysis.

A story for the negative constituent:

At lunchtime these boys were getting ready to go out fishing with their Dad. Their Dad saw that they had a fish. He asked where they had gotten it. They told him, in the kitchen at home, that they had caught it not long ago by the lake in the morning. Fish are fun to catch.

This story was followed by a WH question with a negative phrase of the negative constituent type in the complement clause: "not long ago." In the experimental question, the negative constituent phrase is preposed to the initial position of the complement clause as in (7a) but with no inversion for this kind of negative phrase. For clarity of reference, this position is referred to as the middle of a two-clause sentence. In the control question (7b), the negative constituent phrase is in situ in the complement clause, or at the end of the sentence.

(7) a. Where did the boys say that <u>not long ago</u> they caught the fish?

b. Where did the boys say that they caught the fish <u>not long ago</u>?

Examples of answer types:

Main clause answer (SD analysis):
In the kitchen, at home. (cf. "Where did they say it?")

Complement clause answer (LD analysis):
By the lake. (cf. "Where did (they say) they caught the fish?")

Broad WH, SD analysis:
Because they caught it. (cf. "Why did they say they caught the fish?")

Broad WH, LD analysis:
Because they wanted to eat one. (cf. "Why did (they say) they caught the fish?")

For both questions, SD analysis as described in previous experiments refers to the interpretation of the initial WH word in relation to the main clause as in (6) “At dinnertime” for the negative operator, and (7) “At home” for the negative constituent. The LD analysis is when the initial WH word is associated with the complement clause as in (6) “In the morning” for the negative operator, and (7) “By the lake” for the negative constituent.

The questions in this experiment also received broad WH analyses but with a fewer number than the negative questions in Experiment 3. The broad WH, SD analysis is similar to the one described for Experiment 3. Under this analysis, the WH word is structurally interpreted within the main clause, but semantically shifted to a causal meaning. With a similar meaning shift, the broad WH, LD analysis is, however, analyzed in relation to the complement clause.

Statistical Tests of the Predictions

Statistical analyses were run to test the predictions of the following empirical hypotheses:

Hypothesis 1: A negative phrase with an operator preposed to the initial position of an embedded clause (or the middle of a two-clause sentence) is a barrier to WH word long distance analysis.

Hypothesis 2: A negative constituent preposed to the initial position of an embedded clause (or the middle of a two-clause sentence) is not a barrier to WH word long distance analysis.

A 4 (question type) by 4 (age group) by 2 (counterbalanced experimental set) mixed design analysis of variance was run on the number of LD responses. Figures 4.10 and 4.11 show the response types of SD, LD, and broad WH, SD. LD responses are also shown with examples and according to age groups for the negative constituent and negative operator at the end of the sentence position, respectively. Figures 4.12 and 4.13 show the response types for the negative constituent and negative operator in the middle of the sentence position, respectively.

As shown in Figures 4.10 to 4.13, most of the answers were LD or SD analyses. A few responses were the broad WH, SD or LD analyses, and were mainly provided by the 3-6- and 4-year-olds. The 3-6-year-olds seemed to do similar LD analyses to those of the older groups, but their other answers were not all SD analyses. However, they did give more broad WH responses. In addition 3-6-year-olds provided answers that were considered irrelevant and were not included. As revealed in the Figures, all question types received more LD analyses- “by the lake” for the negative constituent and “in the morning” for the negative operator- than SD analyses- “at home” for the negative constituent and “at dinnertime” for the negative operator.

The LD analyses for the four question types are also represented in a line graph in Figure 4.14. Only the negative operator in the middle of the sentence position seems to have a linear pattern. As shown in Figure 4.14, the means of the 3-6- and 4-year-olds reflected the predicted pattern of having the fewest LD analyses for a question with a negative operator, such as “with none of the ladders,” in the middle of the sentence. However, the means of the older age groups did not.

Since LD analyses were predicted to be the analyses blocked by the negative operator barrier in the middle of the sentence position, LD analyses were statistically examined and compared among all the question types. Results are presented in the following subsections according to Age Effect, Counterbalanced Experimental Sets Effect, Question Type Effect and Regression Analyses of Background Variables.

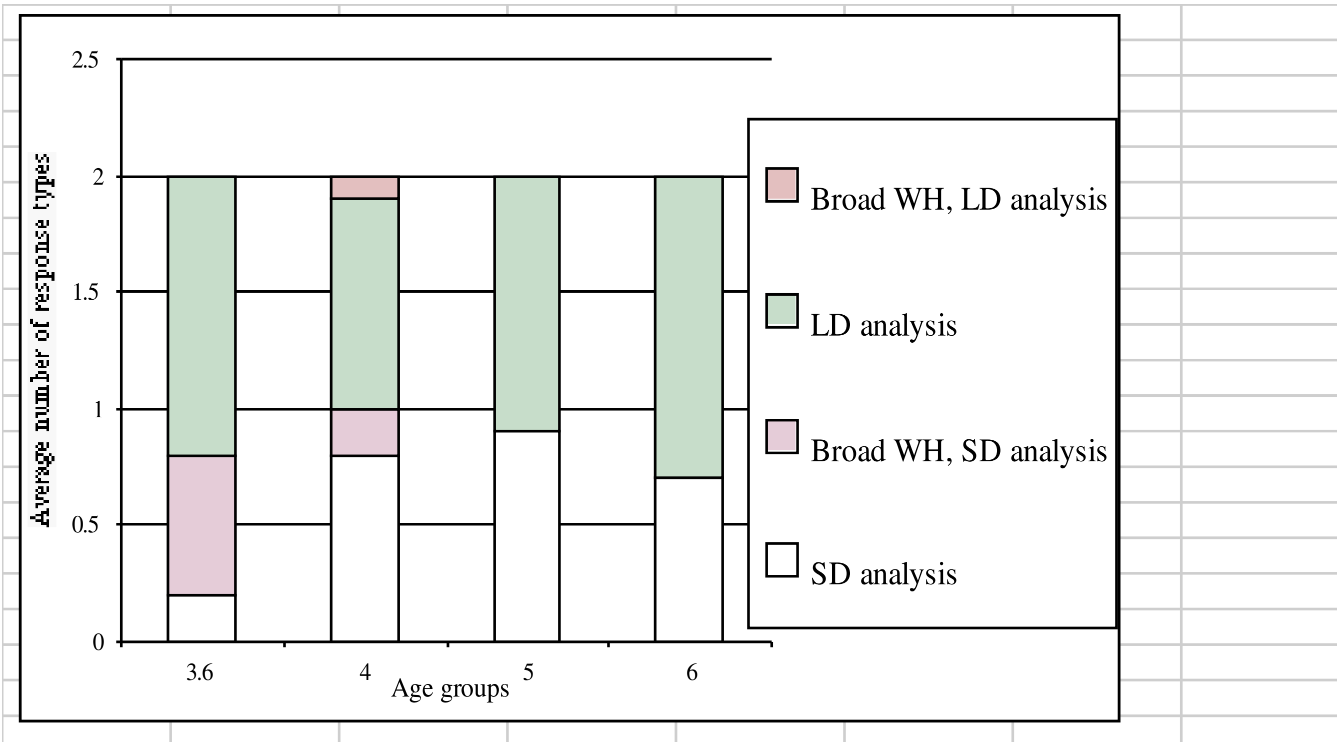
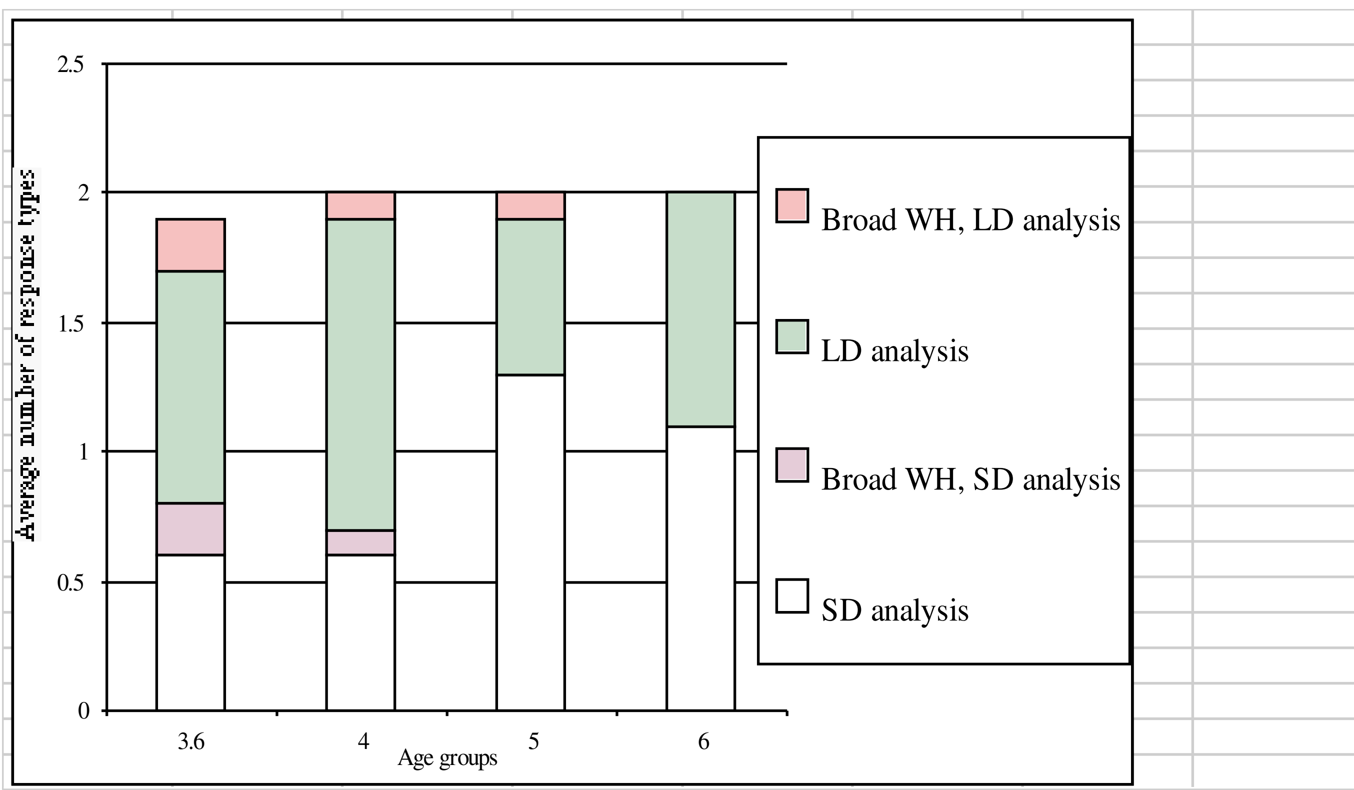


Figure 4.10. Distribution of average LD responses to the negative constituent at the end of the sentence.

Legend: SD: "At home;" Broad WH, SD: "Because they caught it;" LD: "By the lake;" Broad WH, LD: "Because they wanted to eat one."



2.5
2
1.5
1
0.5
0
Average number of response types
3.6
4
5
6
Age groups
Broad WH, LD analysis
LD analysis
Broad WH, SD analysis
SD analysis

Figure 4.11. Distribution of average LD responses to the negative operator at the end of the sentence.

Legend: SD: "At dinnertime;" Broad WH, SD: "Because she couldn't reach the cat;" LD: "In the morning;" Broad WH, LD: "Because it was too high."

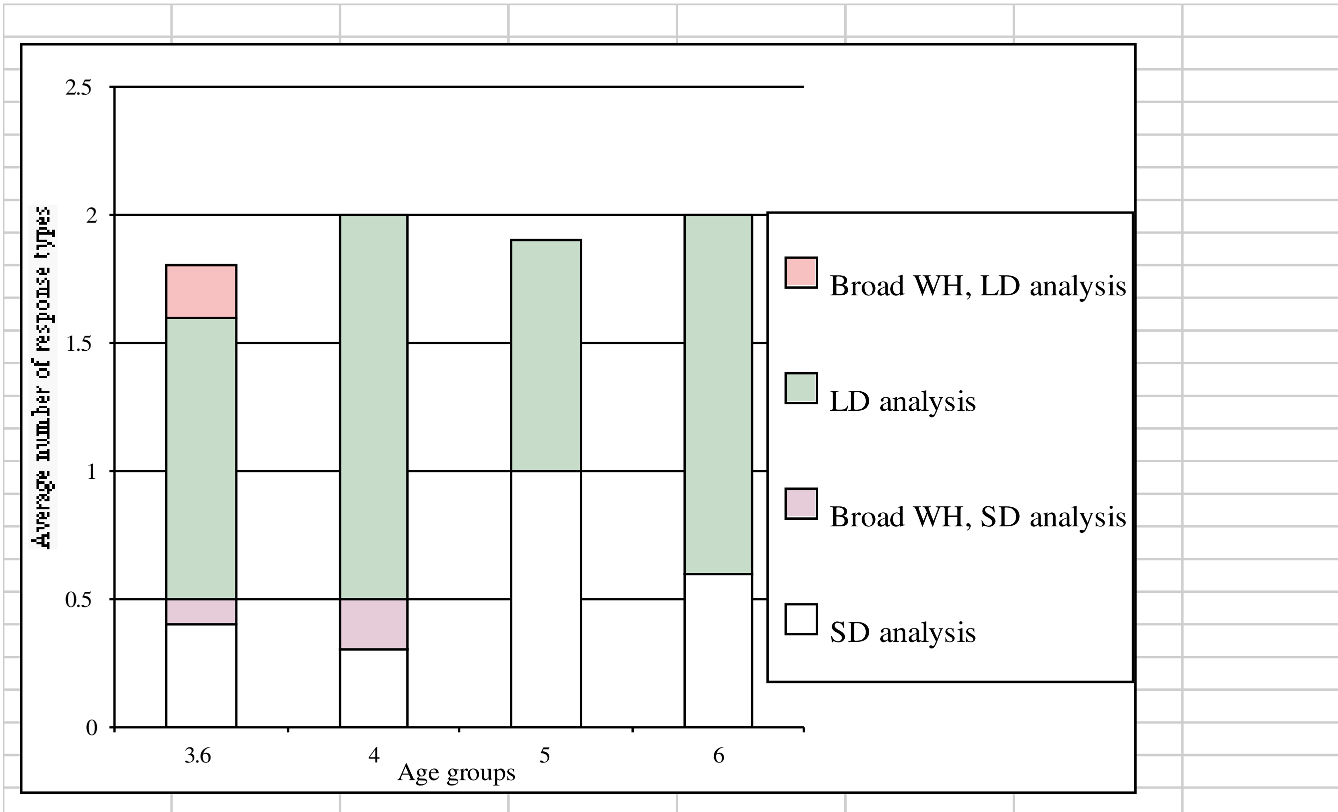


Figure 4.12. Distribution of average LD responses to the negative constituent in the middle of the sentence.

Legend: SD: “At home;” Broad WH, SD: “Because they caught it;” LD: “By the lake;” Broad WH, LD: “Because they wanted to eat one.”

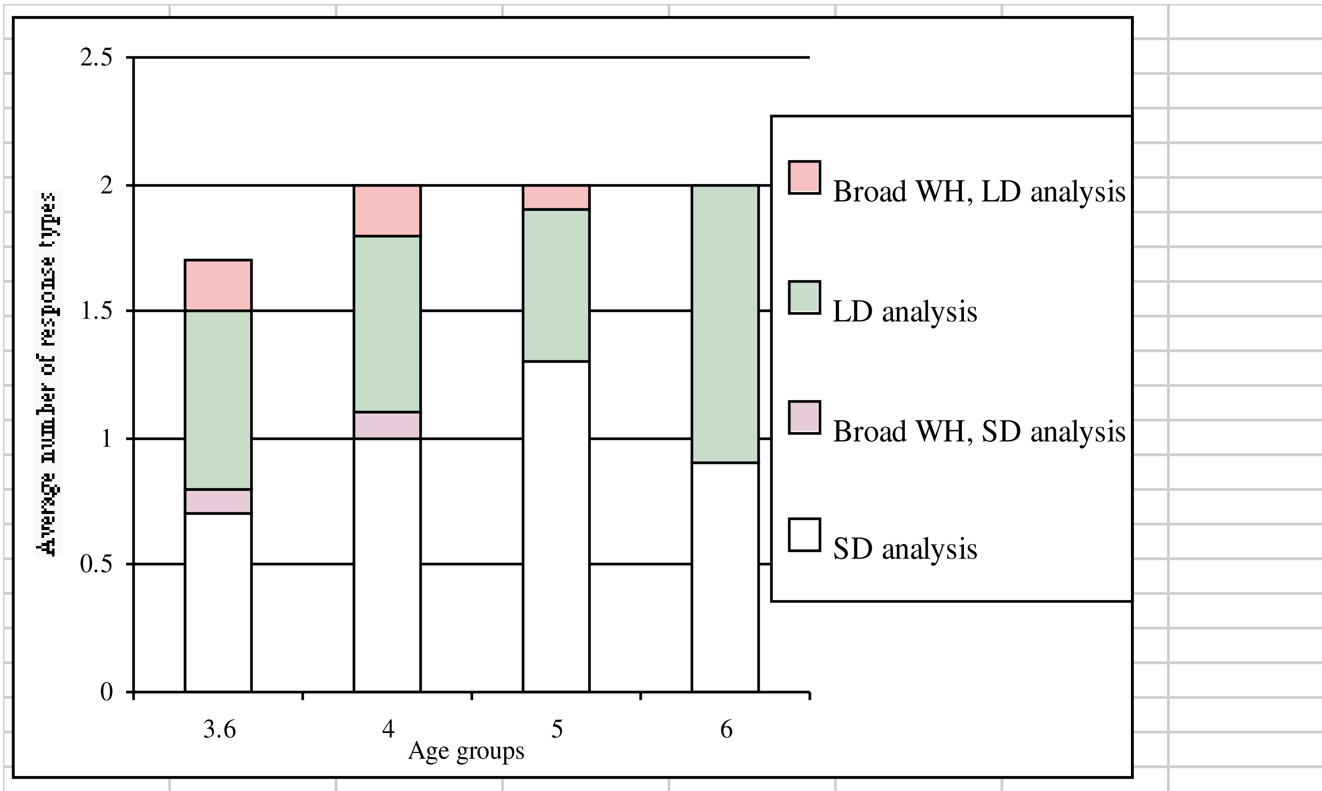


Figure 4.13. Distribution of average LD responses to the negative operator in the middle of the sentence.

Legend: SD: "At dinnertime;" Broad WH, SD: "Because she couldn't reach the cat;" LD: "In the morning;" Broad WH, LD: "Because it was too high."

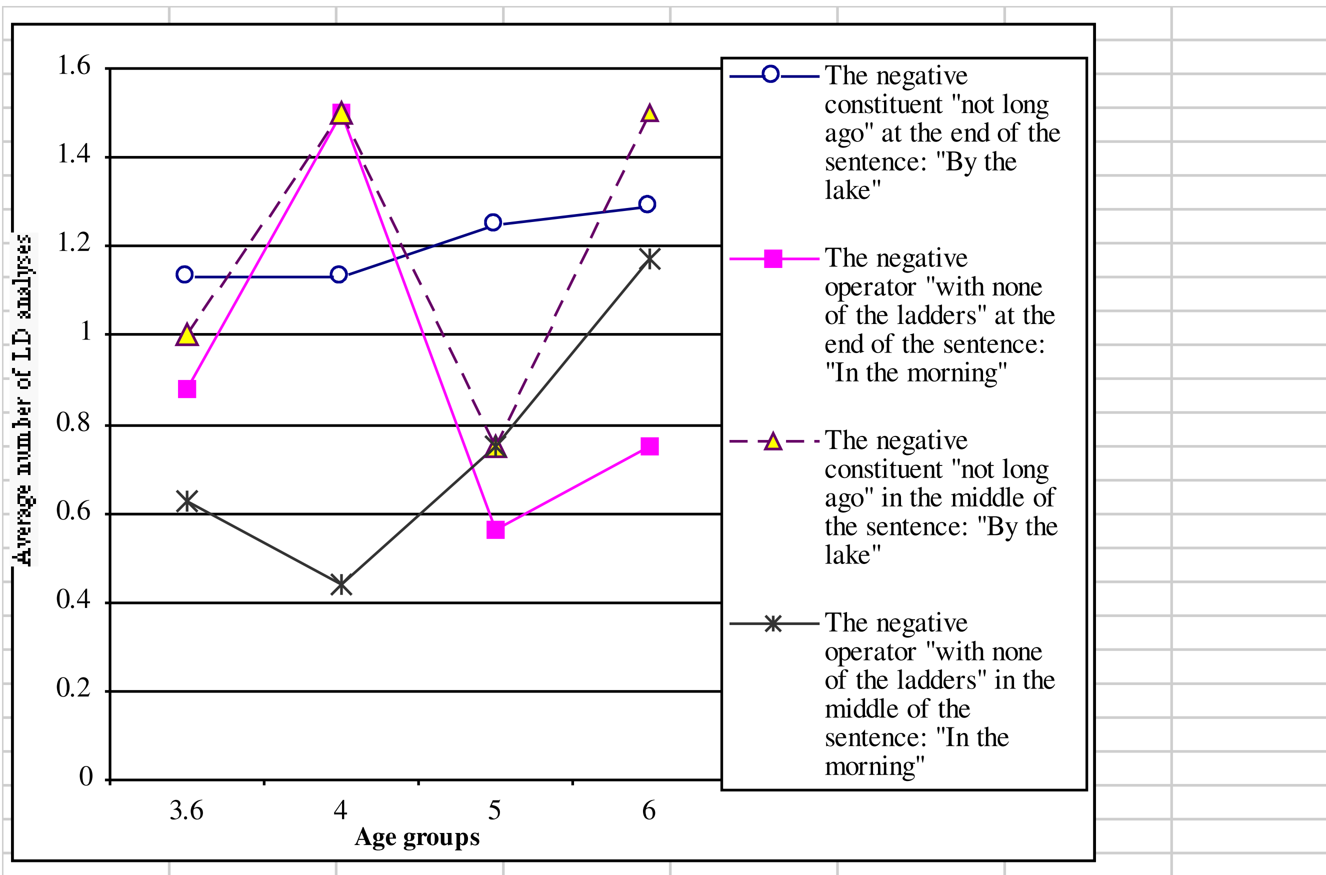


Figure 4.14. Distribution of average LD responses according to question type and age groups.

<u>Age Effect</u>

Results of the four question types revealed no main effects for age, F (3, 32) = 0.78, p = 0.51.

There was, however, a question type by age interaction, F (9, 96) = 2.32, p = 0.02. This interaction indicated that children responded to the questions differently at different age groups as seen in Figure 4.14.

Counterbalanced Experimental Set Effect

There was no significant main effect for the counterbalanced experimental set, F (1, 32) = 0.55, p = 0.46.

There was a question type by counterbalanced experimental set interaction, F (3, 96) = 7.8, $p < 0.01$, and a three way interaction among question type, age, and counterbalanced experimental set, F (9, 96) = 2.36, $p < .05$. The means for counterbalanced experimental set 1 were as follows: 1.25 for the negative constituent and 0 for the negative operator when they were at the end of the sentence; 2 for the negative constituent and 1.5 for the negative operator when they were in the middle of the sentence. As for counterbalanced experimental set 2, the means were 1.3 for the negative constituent and 1.5 for the negative operator when at the end of the sentence, and 1 for the negative constituent and .8 for the negative operator when in the middle of the sentence.

The means for the counterbalanced experimental set 1 seemed to have no interpretable pattern; however, the counterbalanced experimental set 2 appeared to yield the predicted pattern of means where the negative operator in the middle of the sentence showed the fewest LD analyses (.8). This is also presented graphically in Figure 4.15.

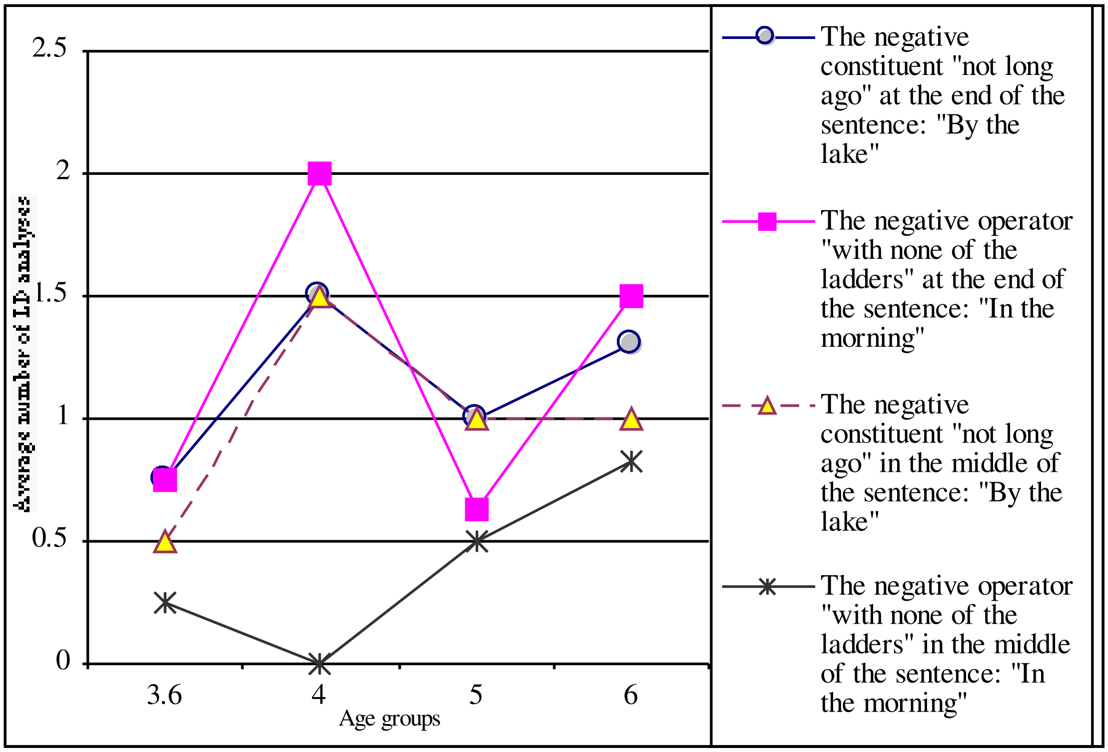


Figure 4.15. The average distribution of LD analyses according to question types and age groups for the counterbalanced experimental set 2.

To understand how the data would appear without the counterbalanced experimental set 1, counterbalanced experimental set 2 was selected and data was run separately. Results for counterbalanced experimental set 2 seemed a clearer outcome of the data.[6] Results on question type effect are reported in the next section.

[6] There was, however, no age main effect, F (3, 16) = 1.580, p =0.233. Results on the counterbalanced experimental set 1 also showed no age effect. There were within-subject significant effects for question type, F (3, 48) = 6.8, p = 0.001, and question by age interaction, F (9, 48) = 3.87, p < .01. However, the means did not reflect an interpretable pattern.

Question Type Effect

As for the within-subject effects, there was a significant effect for the question type, F (3, 96) = 4.97, $p < .01$. When the negative phrase was at the end of the sentence, the means for the LD analyses were 1.13 for the negative constituent and .9 for the negative operator. When the position was in the middle of the sentence, the means for the LD analyses were 1.23 for the negative constituent and .78 for the negative operator. To test the prediction of Hypotheses 1 and 2 different contrasts were run.

Contrasts between Question Types

To find significant differences among question types, contrasts between question types were run giving the following significant results:

A. With both in the middle of the sentence, the negative operator was different from the negative constituent, F (8, 32) = 2.489, $p < .05$.

B. The negative operator (the control) at the end of the sentence was different from the one in the middle of the sentence, F (8, 32) = 4.374, $p < .01$.

C. With both at the end of the sentence, the negative constituent was different from the negative operator, F (8, 32) = 2.541, $p < .05$.

D. The negative operator at the end of the sentence was different from the negative constituent in the middle of the sentence, $\underline{F}$ (8, 32) = 5.048, $\underline{p} < .01$.

E. The negative constituent in the middle of the sentence was different from that at the end of the sentence, $\underline{F}$ (8, 32) = 3.135, $\underline{p} < .05$.

The contrasts of interest are A and B. Contrast A reflects the effect of the negative operator as a barrier on LD analyses as compared to the negative constituent. Contrast B shows the effect of the negative operator in the middle sentence position as compared to the negative operator at the end position. As predicted by Hypothesis 1, fewer LD analyses occurred when the negative operator was in the middle of a two-clause sentence.

As for Hypothesis 2, contrast A showed that the negative constituent was not as much of a barrier to LD analyses as the negative operator. Although contrast E showed a significant difference between the two negative constituents, the means showed that the negative constituent in the middle of the sentence had slightly more LD analyses than the one at the end of the sentence. Thus this pattern was going in the opposite direction of the barrier effect indicating that it was not related to the position of the negative phrase.

Since all the contrasts came out significant, it was necessary to isolate how the negative operator in the middle of the sentence compared to all of the other conditions.

Contrast of the Negative Operator in the Middle of the Sentence to the Other Conditions:

A contrast of all three variables was run. The negative constituent at the end and in the middle of the sentence and the negative operator at the end of the sentence was run against the negative operator in the middle of the sentence. As predicted by Hypothesis 1, results showed that the negative operator in the middle of the sentence was significantly different from the other three, F (8, 32) = 2.54, $p < .05$.

Since counterbalanced experimental set 1 showed an unpredicted pattern of responses and counterbalanced experimental set 2 seemed to follow an interpretable pattern, LD responses were analyzed with counterbalanced experimental set 2.

As for within-subjects effects, there was a significant effect for question type, F (3, 48) = 6.05, $p < .01$, but no age by question type interactions, F (9, 48) = 1.24, $p = 0.30$.

Contrasts A to E that were run for both counterbalanced experimental sets were also run for the counterbalanced experimental set 2 but results were not significant.

However, when all three question types the negative constituent at the end of the sentence, the negative constituent in the middle of the sentence, and the negative operator at the end of the sentence- were also contrasted against the negative operator in the middle of the sentence position, results were significant, F (4, 16) = 3.63, $p < .05$.

The results of the contrasts strongly supported Hypothesis 1 and Hypothesis 2. Only the negative operator in the middle of the sentence was significantly different from all the other three conditions.

Repeated measures ANOVA was also run without counterbalanced experimental set 1. The effects of the position of the negative phrase (i.e. in the middle or at the end of the sentence) and the type of the negative phrase (i.e. a negative constituent or operator) were examined. Results showed a significant effect for position of the negative phrase, $F(1, 16) = 13.08$, $p < .01$. There were no significant interactions.

As for the type of the negative phrase, there was no significant main effect, $F(1, 16) = 1.67$, $p = 0.22$. However, the interaction of position by type of the negative phrase was significant, $F(1, 16) = 12.58$, $p < .01$, as well as the interaction of position by type by age, $F(3, 16) = 3.48$, $p < .05$.

Part of the children's answers, however, contained broad WH, SD and LD analyses as mentioned earlier under Descriptions of Data Coding. In this analysis, while a WH word is interpreted in relation to the complement clause or the main clause, the meaning of a "where" or "when" WH word is shifted from a spatial or temporal meaning to a "why" or causal meaning. This response type is described next.

Broad WH Analyses

In this experiment, there were 13 broad WH, LD analyses and 15 broad WH, SD analyses. Unlike Experiment 3 where the broad WH responses were distributed among 19 children with no more than 3 broad WH, SD responses per child, the broad WH responses from this experiment were mainly provided by 2 children. A 3-6-year-old (Subject: 22) gave 7 out of 8 broad WH responses, and a 4-year-old (Subject: 30) gave 8 out 8 broad WH responses. The remaining 6 responses were provided by 4 children of the age range 3.7 to 4.7 (Subjects: 8, 11, 21 and 28).

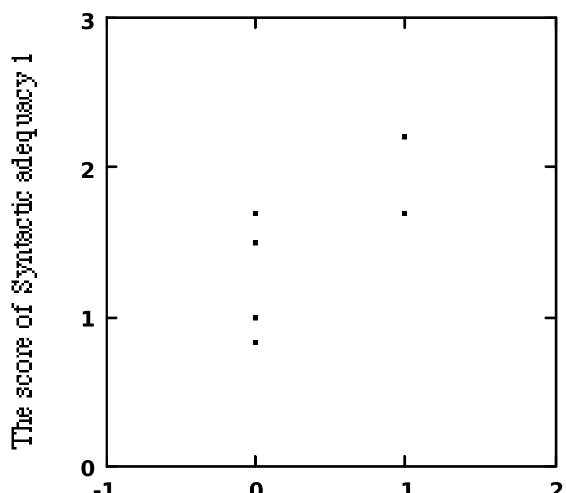
In Experiment 3, it was proposed under the account for broad WH, SD responses that there was dissociation between structural analysis of a WH word and its meaning. The SD analysis aspect of the broad WH analysis was forced by the negative barrier; however, children showed a non-preference for the target meaning of the main WH word by shifting it to a broad meaning. The same pattern did not occur in this experiment. Rather, the broad WH responses were confined to particular subjects. Two children showed the tendency to shift for a broad WH meaning. One explanation was that those children might not yet have developed the pragmatic and semantic plausibility for adjunct "when" and "where" WH words in such contexts as other children. Other children tend to show broad WH meaning when the sentence is structurally biased for a SD analysis, such as the negative questions in Experiment 4. Therefore, it is hard to generalize from few subjects.

Nevertheless, for the sake of exhaustive analysis, different analyses were run to find out if adding the broad WH, LD or SD analyses would change results. No differences were found which could be related to the subject profile nature of the data.

An account of the relationship between Syntactic adequacy 1 and the use of broad WH, SD analyses was provided under the broad WH, SD analysis for Experiment 3. To examine that account, the 6 subjects were selected to find out if question type forced broad WH, SD responses. Though marginal due to the small sample size, there were high correlations between Syntactic adequacy 1 and the use of broad WH, SD analyses only for the negative operator, $r\ (1) = .71$, $p = .11$, and the negative constituent, $r\ (1) = .78$, $p = .07$, in the middle of the sentence. Figures 4.16 and 4.17 reflect that correlation.

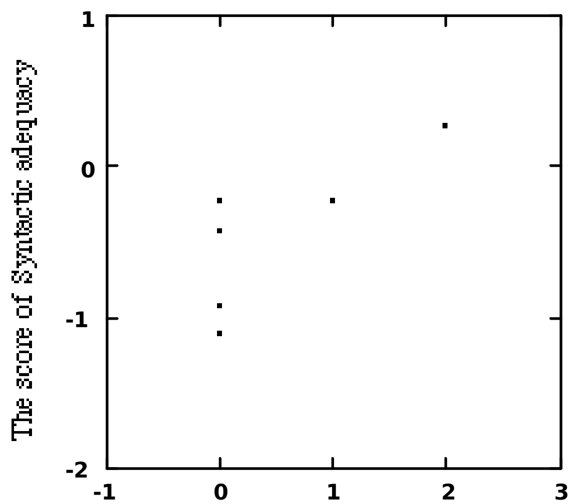
Though based on only a few subjects, such results are consistent with the previous account. That is, as children begin to learn about multiclausal sentences, they become more sensitive to a negative barrier even if it is weak, such as an embedded negative phrase. As shown in Experiments 1 and 3, the predicted age for this sensitivity to emerge was around 4 years old. The negative barrier biases towards a structural SD analysis by blocking the main WH word from having a trace in the complement clause; hence, LD analyses were excluded. However, a WH word undergoes a meaning shift because the adjuncts “where” and “when” are not preferred by a child when describing a communication verb.

This semantic shift of an adjunct WH word is shown to decrease with age. A significant trend analysis for age effect was shown for the negative phrases at the end of the sentence, $\underline{F}$ (1, 32) = 5.275, $\underline{p} < .05$. This condition is the control where no overt barriers exist.



Broad WH, SD analyses of the negative operator in the middle of the sentence

Figure 4.16. A scatterplot of broad WH, SD analyses of the negative operator in the middle of the sentence.



Broad WH, SD analyses of the negative constituent in the middle of the sentence

Figure 4.17. A scatterplot of broad WH, SD analyses of the negative constituent in the middle of the sentence.

Summary of Results

Results revealed that there was no age main effect for the barrier effect of the negative phrases in the complement clause to LD responses. However, when the four negative phrases were compared in terms of type and position, they were different. As predicted by Hypotheses 1 and 2, the negative operator in the middle of the sentence, but not the negative constituent, appeared significantly different from the other conditions and hence seemed to have a barrier effect on WH, LD responses. Moreover, repeated measure analysis of variance showed a significant interaction among age and the position and type of the negative phrase. This result supported the significant effect of the negative operator in the middle position of the sentence on decreasing LD analyses. The interaction also indicated that the effect was different at different age levels.

In this experiment, some children demonstrated broad WH responses. Though confined to only a few subjects, the results seemed to be consistent with the account in Experiment 3. Syntactic adequacy scores correlated with the emergence of a barrier effect of negative phrases in younger children who were forced to do SD analyses.

Regression Analyses of Complement Clause Production and Theory of Mind Scores on the Development of the Negative Barrier Effect of Negative Phrases in the Complement Clause

Multiple regression on LD analyses was interpreted with two considerations. One goal was to find the predictor of the decreased LD responses for the negative operator in the middle of the sentence condition, especially for the counterbalanced experimental set 2 (see Figures 4.14 and 4.15). The other was to find the predictor of the increase of LD analyses across age groups (see Figures 4.14 and 4.15). However, younger children gave more broad WH responses than SD analyses; therefore, they seemed to do fewer LD analyses.

Multiple regression analysis was run with the different independent variables- age, ToM, and complement production scores- to examine the predictor of the change in LD analyses. Separate analyses of LD responses per question were nonsignificant. Therefore, LD analyses were combined according to the end of the sentence conditions and the middle of the sentence conditions. Results were also nonsignificant.

The same regression models were used to test for SD analyses since they represent the adult target grammar. ToM and complement production score for Semantic adequacy were predictors only for the negative constituent at the end of the sentence (ToM: B = -0.39(-0.46), SE[7] = 0.17, t = -2.32, p < .05; Semantic adequacy: B = 0.23(0.09), SE = 0.41, p < .05). This negative phrase type had no negative operator, as assumed by the syntactic theory of negation (Haegeman, 1995), and no elements preposed to the middle of the sentence. These results seemed to be more related to the development of multiclausal sentences in general without other factors interfering.

The results of multiple regression did not reveal significant relations among the background variables and the question types.

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[7] SE: Standard error.

CHAPTER 5

DISCUSSION

This dissertation presents evidence for universal principles in English child language. Based on the review of the linguistic accounts of negative and WH barriers in Chapter 2, some acquisition hypotheses emerged concerning the universality and development of negative barriers to long distance WH movement and medial WH answers in embedded WH questions. In this chapter, predictions of each acquisition hypothesis listed in Chapter 2 are discussed relative to the experimental data.

Acquisition Hypotheses

Universal Grammar Hypothesis

The NegP is universal and variations are captured in the realization of heads or specifiers or both of the NegP. A negative operator which is a barrier to long distance WH movement occupies a specifier position whether in the main or embedded clause as shown in (1).

<u>Predictions</u>

If children had blocked or inhibited long distance WH movement and medial WH answers, then they would have treated NegP as an operator which is the adult form as illustrated in (1a). If children had not blocked long distance WH movement or medial WH answers, they would have analyzed NegP as an adjunct as in (1b).

(1) a.

CP
Operator$_1$
Why$_1$ C'
C IP
did t_1(e.g., Because she was asleep.)
the boy INFL'
INFL
<===========(scope of NegP)=============>
Operator$_2$ Neg'
Neg VP
not
V'
V NP CP
tell his mom
(*t_1) C'
C IP
(*t_1)
he took a bath?

(Because he was dirty.)

b. IP

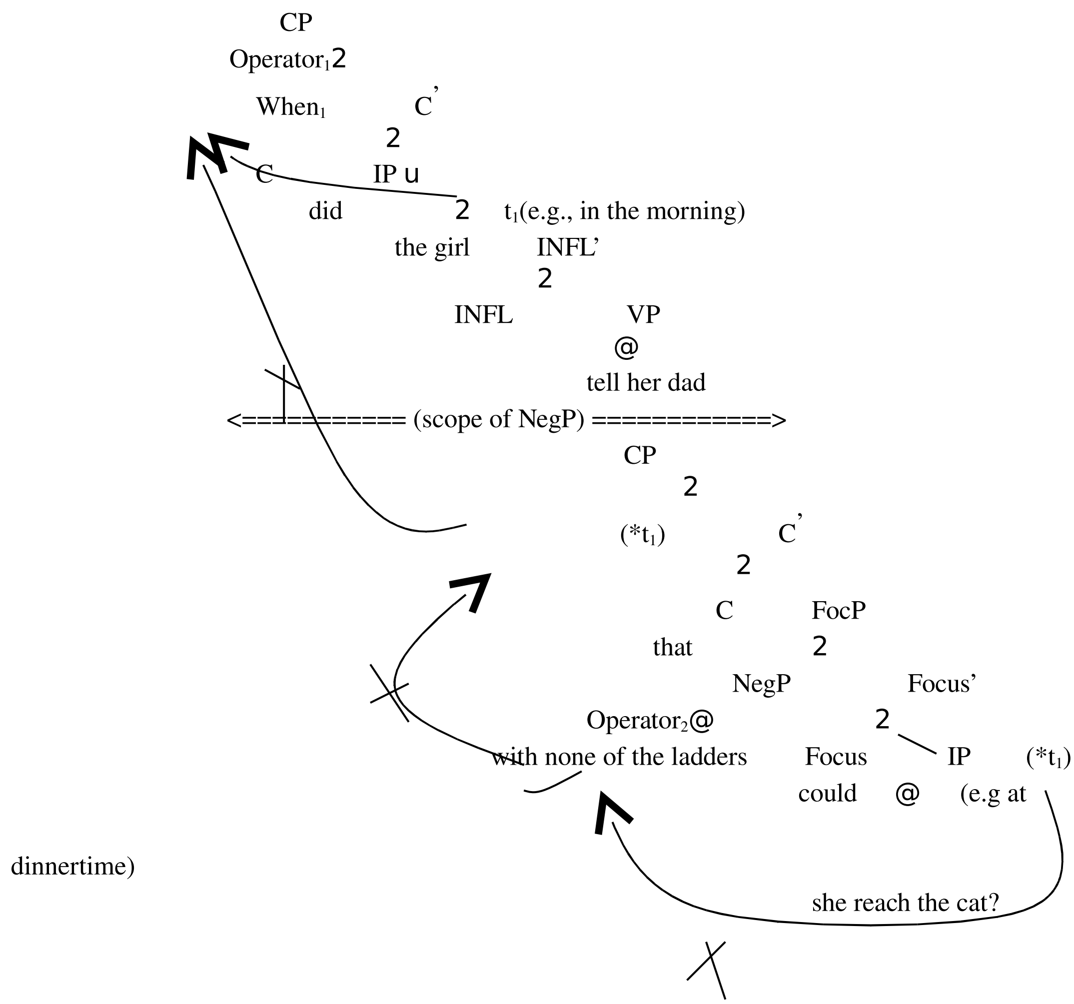
```
          2
      He            INFL'
                    2
            INFL          VP
             did          2
  (adjunct)=>NegP               VP
                    2           @
                          Neg   fix the car
                          not
```

Children blocked long distance WH movement and medial answers. Across all the four experiments, there were significant differences between the negative questions and the affirmative control questions. Such results support the proposal that negative phrases are universal (e.g., Haegeman, 1995; Ouhalla, 1991) and hence are part of the UG settings in child grammar. For negative barriers to appear, children must have analyzed NegP as in (1).

Negative Barrier Hypothesis

The NegP is a barrier to long distance WH movement and to the covert movement to the main clause in partial WH movement. For both movements, the negative barrier is structurally represented. A negative operator in the specifier of NegP as in (1), or FocP in the embedded clause as in (2), prevents an adjunct WH word, another operator, from moving through it since adjunct movement operates locally and cyclically through relevant specifier positions.

(2)



Prediction 1

In child grammar, NegP was a barrier to long distance WH movement.

In Experiment 1, Hypothesis 1 predicted that negation would be a barrier to long distance WH (LD) analyses in complex WH questions. Based on Rizzi's (1990) syntactic theory, Relativized Minimality is a principle that constrains the coexistence of two operators having wide scope over the sentence. The interaction of the initial WH word operator and the negative operator ("not" or "n't") in the main clause determines the fact that the negative operator would have the sentence scope. Hence, a WH word cannot have a trace in the embedded clause, or else a violation of the Empty Category Principle results (e.g., Aoun, 1993; Lasnik and Saito, 1984).

Experiment 1 showed that negation was a barrier to LD analyses as reflected by the significant differences between the negative and control questions. Negative barriers also developed as age increased. Specifically, negation emerged as a barrier after age 4. Regression results supported age as the primary effect on the development of the negative barrier. Therefore, Experiment 1 provided evidence consistent with empirical Hypothesis 1 and the negative barrier hypothesis.

In Experiment 2, empirical Hypothesis 1 predicted that the negative subject "nobody" should be a barrier to LD analyses. The prediction was based on assumptions about negative operators in general and the negative subject in particular. Children provided significantly fewer LD analyses to the negative question than the control question. Experiment 2 successfully demonstrated that the negative subject “nobody” was a barrier to LD analyses of WH words in embedded WH questions, thus supporting both empirical Hypothesis 1 and the negative barrier hypothesis.

In Experiment 4, empirical Hypothesis 1 predicted that an embedded NegP with an operator would be a barrier to LD analyses. The questions with operator NegP’s received fewer LD analyses. Thus NegP was a barrier even when in embedded clauses.

Prediction 2

NegP was a barrier to medial WH answers.

In Experiment 3, the question about the negative barriers extended to the medial WH answers phenomenon in English child grammar. Results from Experiment 3 provided clear support for empirical Hypothesis 1 and the acquisition hypothesis that the negative “not” would block medial WH answers. There was a significant within-subject difference between the negative and the control questions. The negative questions with medial WH words received significantly fewer medial WH answers than the control questions.

As further evidence of negative barriers, findings in Experiment 3 were consistent with the predictions of empirical Hypothesis 2. It was predicted that, as age increased, the negative “not” would induce more SD analyses in questions with medial WH words than the affirmative due to the cumulative effects of the negative barrier “not” and the WH barrier. A significant linear trend indicated that as children got older they increased SD analyses. When the negative and WH operators interact in a sentence, the negative operator determines the sentence scope and thus blocks long distance movement as in (1). In this way, the initial WH word cannot have a trace in the embedded clause.

Results on age differences revealed that SD analyses in the context of the negative barrier appeared after age 4, which was compatible with the development of the negative barriers in Experiment 1. Another evidence for the emergence of the negative barrier was that 3-6-year-olds significantly differed and 4-year-olds marginally differed from the 5-year-olds only on the negative questions. Significant differences were also found when two to two and a half year age intervals were compared (i.e., 3-6 to 5, 3-6 to 6 and 4 to 6). This suggested the time it takes for grammars to develop with respect to negative and WH barriers in embedded WH questions. When the broad WH, SD analyses were added to the SD analyses, the negative and control questions were significantly different. (See below as well as Chapter 4 for discussions on broad WH, SD analyses.) Therefore, results supported predictions of the negative barrier hypothesis as well as previous empirical data of negative barriers to LD analyses (e.g., Abdulkarim and Roeper, 1997).

<u>Prediction 3</u>

NegP was a barrier to discourse inference in complex WH questions, that is, fewer single clause answers were produced when NegP was present.

Single clause analyses are of interest because they can reveal the development of embedded questions (see Appendix B for an analysis of single clauses). They reflect the fact that early children's structures are transparent to events in discourse. (For illustration, see The Acquisition of Barriers in Complex WH Questions in Chapter 2.) In other words, children are biased towards the embedded event which is reality, but not the telling of the event.[1] Younger children showed some discourse inference in sentences like (3) which significantly decreased with age. Inference is an "unbounded" powerful cognitive operation that might compete with syntactic principles in younger children (e.g., de Villiers, et. al., 1990).

(3) Where did the girl tell her mom [$_{\text{reality}}$how she broke her bike]?

In the control questions of Experiment 3, it was expected that children would provide more medial answers. LD analyses were not expected because of the WH barrier. SD analyses were also expected from older children. Results, however, showed that younger children chose more single clause analyses than older children. As expected,

[1] For arguments refuting extra-grammatical processes, such as memory limitations, see de Villiers, Roeper and Vainikka, 1991.

they did not choose as many LD analyses because of the WH barrier, though the LD analyses, similar to the single clauses, represented real events.

SD analyses were not preferred. One possible reason for the few SD analyses was that the initial adjunct WH word, such as “where” or “when,” needed to be reconstructed in reference to a non-salient event. In the story context, “telling about something” is not salient as “doing something.” This being the case, children selected the embedded clause because it could be mapped onto a real event. Such children dispreferred false beliefs, and hence they did not choose as much medial WH answers as older children. In the stories, medial answers were based on false beliefs, though they were true from the point of view of the subject of the sentence. In fact, data showed that failures of ToM, a false belief task, gave more single clause analyses than passers of ToM as shown in Figure 5.1. However, passers of ToM did more medial WH answers, based on false events, as shown in Chapter 4 in Figure 4.7.

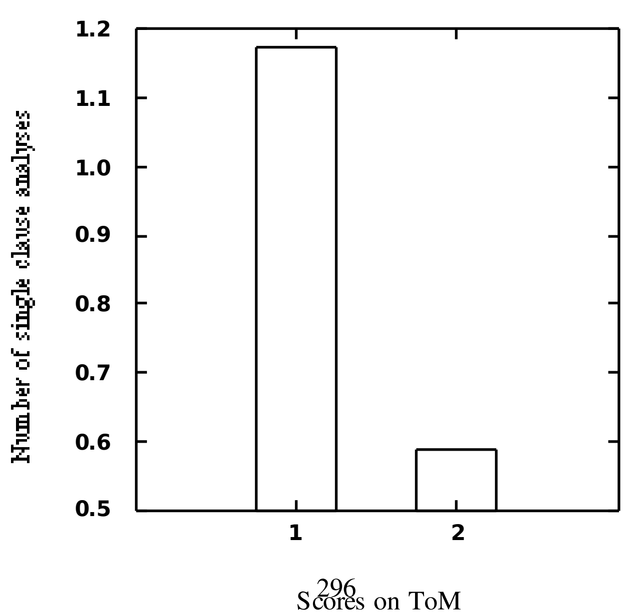


Figure 5.1. Number of single clause analyses for the control question according to the score on ToM. (1=failures; 2= passers)

A child's development of embedded structures indicates her computation of a proposition representing an event, the embedded clause, and a proposition that represents an abstract concept, such as telling or thinking. The proposition indicating telling or thinking is carried by the main clause. Until embedded structures are specified according to the adult grammar of the child's spoken language, a child could have access to default or unspecified representations. One default is reconstructing the medial WH words with the embedded event propositions, hence, doing single clause analyses. This type of response occurred with the affirmative questions in Experiment 3.

Syntactic barriers seem to provide evidence for more specified linguistic analyses even for younger children. When the grammar of negative questions did not match discourse analysis, a child had to reconstruct the initial WH words with the main propositions but shift the initial WH word meaning. Therefore, negation seemed to constrain the single clause analysis bias. Data in Experiment 3 showed that single clause answers to the negative questions were significantly fewer than those to the control questions. This result was a strong support for the negative barrier as a UG rule. Moreover, as grammar matured, single clause analyses decreased with age.

Negative barriers not only blocked discourse inference but also other non-adult response forms as the age of the children increased. In Experiment 3, the broad WH, SD analyses, medial WH answers, LD and single clause analyses, were separated from the SD analyses of the negative and control questions and contrasted between the younger and older age groups. The younger group, 3-6- and 4-year-olds, were significantly different from the older group, 5- and 6-year-olds, on the negative questions, but were insignificant on the control. These differences might suggest that as children got older, negation constrained selection of alternative analyses including the broad WH, SD analyses. These are discussed next.

Broad WH, SD Analyses

In Experiment 3, a different kind of response was provided by some children: the broad WH, SD analyses. Though they were grouped with the SD analyses, they were analyzed for their developmental patterns. The development of negative barriers accounted for the broad WH, SD analyses. With age increase, negative barriers blocked other analyses and induced more SD analyses as supported by results on regression analyses. In the early stages of syntactic development of complex sentences and before children develop a full negative barrier, 3-6-year-olds performed more LD analyses which violated the negative barrier. For the negative question, the LD analyses provided by 3-6-year-olds were significantly different from the average of the older age groups, 4, 5, and 6. As the syntax of full-tensed complements developed, marked by the syntactic production scores, the negative barrier developed and SD analyses increased although the lexical content of the WH word was not yet fixed.[2] The LD analyses also decreased as predicted.

The significant difference in broad WH, SD analyses between younger and older age groups is compatible with the account that as children started learning negative barriers and multiclausal sentences, they performed more broad WH, SD analyses. Having developed the structural representations, children attempted to analyze the complex WH questions. Thus, if the sentence contains both a negative and a medial WH word, children are structurally biased to select an SD analysis. They will, however, assign a WH word a broad WH meaning indicating that they do not check the lexical content of the initial WH word. This analysis underlies the "because" answers. The broad WH, SD account was supported by a significant correlation between Syntactic adequacy 1, a marker of developing full tensed complements, and broad WH, SD analyses, which only showed for the 4-year-olds.

When more reliance on syntactic-semantic grammars developed as reflected by significant regressions of age, Syntactic adequacy scores, and ToM, broad WH, SD analyses decreased. As older children set more rules in their grammar, they chose adult

[2] An alternative interpretation of broad WH, SD analyses offers a non-movement account in which the WH clause is base generated at an adjoined position. When the initial adjunct WH word in a complex WH question does not get linked to its trace, a "because" clause is high attached at the inflectional phrase (IP) level. For example, young children answer "how" questions as if they were "why" questions. de Villiers (1991) suggested this behavior to be the default reading of an adjunct question which lead to the proposal that adjunct questions are base-generated in an adjoined position at the IP level with no trace in the VP.

grammatical analyses of the sentence. Further evidence for the adult grammatical analyses was shown in a significant regression of age on SD analyses. This was also reflected in the significant interactions between age and the two SD response types, the adult SD and the broad WH, SD, for the negative questions which received significantly more broad WH, SD analyses than the control.

Moreover, data supported the hypothesis that grammar is learned by lexical classes (e.g., Roeper, 1999). "How" WH words seemed to be set later than others as evidenced by the fact that they received the most broad WH meaning shift, and were the only ones that continued to older ages. Lexical contents of WH words seem to be set by structural contexts. There were differences between how WH words were interpreted in the negative versus the affirmative questions. In the presence of the negative barriers, negative questions received the most broad WH meaning shifts. Another structural context is embedded versus simple structures. Children did not have a problem with the same WH words in the one-clause WH questions at story intervals. Single clauses represent events in discourse. Because children's early structures are transparent to discourse (e.g., Perez-Leroux, 1991), a WH word might be more accessible to the child when it has scope over an event. This indicates a strong reliance on a grammar of discourse as was discussed under the single clause analyses. However, when a WH word has scope over an abstract proposition, such as telling or thinking, its lexical content might be less accessible.

The Hypothesis of Functional-Lexical Differentiation of the Negative Elements

The four negative elements reviewed differ due to some functional and lexical features. These elements are the negatives "not," "n't," "nobody," and the embedded negative phrase, such as "with none of the ladders." Characteristics and predictions of each are addressed by using the results of Experiments 1, 2, 3, and 4.

<u>The Negative "Not"</u>

The negative "not" is a head of NegP. The whole NegP with "not" could be an adjunct to VP as in (4a) (e.g., Zanuttini, 1989) instead of a complement of IP as in (4b). In (4a), NegP does not have an operator, thus not a barrier. However, in (4b), the operator of NegP is a barrier.

```
(4)     a.              IP
                      2
                  He          INFL'
                              2
                        INFL          VP
                         did          2
                 (adjunct)=>NegP              VP
                              2               @
                                      Neg     fix the car
                                      not
```

```
b.                    IP
                    2
              He            INFL'
                            2
                    INFL          NegP <= (complement)
                     did          2
                (barrier)=>Operator      Neg'
                                         2
                                  Neg          VP
                                  not          @
                                               fix the car
```

Predictions

Long distance WH movement and late emergence of the negative “not” were possible.

The Negative “N’t”

The negative “n’t,” a head of NegP as shown in (5), undergoes contraction (5a) that operates on NegP and incorporation (5b) with C, the head of CP, where an auxiliary such as “do” applied by the Do-insertion rule. Incorporation also operates on Universal Grammar projections, such as NegP.

(5) CP

2

Why$_1$ C'

2

(b) Incorporation=> n't + C IP

didn't @ (t_1)

she NegP <= (complement)

2

(barrier)=>Operator Neg'

2

Neg VP

(a) Contraction=> not=> n't @

tell her mom CP

@ (*t_1)

she went to the zoo

<u>Predictions</u>

A child must assume NegP as in (4b) and (5) early in order to incorporate "n't." Incorporation of the negative "n't" with the auxiliary in C would show how a child used evidence in acquisition. Therefore, the negative "n't" would block long distance movement earlier than "not."

Experiment 1 directly compared the negatives "n't" and "not." As predicted by the empirical Hypothesis 2 which stated that the negative "n't" would emerge earlier than "not," data showed that "n't" emerged before "not." Results on the development of "n't" as a barrier after age 4 were consistent with previous findings that inversion got set after age 4, especially for adjunct WH questions which were also used in Experiment 1 (Deprez and Pierce, 1993).

The negative “not” is a free morpheme that could be analyzed as a VP adjunct or adverb (e.g., Zanutini, 1989), especially in the early stages. Contrastive evidence of minimal pairs like “He is <u>not</u> tired” versus “He is <u>really</u> tired,” and “That is <u>not</u> fast” versus “That is <u>really</u> fast,” where “not” and an adverb seem in complementary distribution, might not help a child to disambiguate “not” as the head of the NegP. Hence, a child would analyze “not” as an adjunct similar to an adverb till further evidence was available. On the other hand, the negative “n’t” behaves structurally differently from “not.” The negative “n’t” is contracted and incorporated into C as in (5).

According to the syntactic theory, operators have to agree with their heads (cf. Affective Operator Criterion: Lasnik and Saito, 1984; Rizzi, 1990; Haegeman, 1995). In a WH question, the initial WH word operator has to agree with its head C in the main clause, or CP. To accomplish that, an auxiliary, such as “am,” “is,” “was,” etc., has to move to C. In the case of a main verb in English, the Do-insertion rule applies and the auxiliary “do” is inserted. The negative “n’t” is cliticized onto the auxiliary or “do.” Since the auxiliary or “do” is a head of IP that carries tense and agreement features and also a head of CP that carries +WH features in a question, it could be additional evidence for the incorporation of “n’t” as a head that carries a negative feature. Such evidence indicates that “n’t,” like the WH operator, is a head of a functional projection NegP. Hence, the morphosyntactic distinctions of “n’t” could provide information that gives lexical preference to “n’t” as a NegP. Thus, the features and scope of the negative operator get set for “n’t,” and it becomes a barrier to LD analyses. Experiment 1, therefore, provided evidence in favor of the prediction of the acquisition hypothesis that the functional-lexical differences of “n’t” predict its early status as a NegP and a barrier.

The Negative “Nobody”

The negative subject “nobody” is the subject of a sentence and must be an overt specifier and operator of NegP as in (6) (e.g., Rizzi, 1990). Therefore, the negative “nobody” cannot be an adjunct. It is also a quantifier (Beck, 1996). If a quantifier phrase is a barrier, then a child should realize it immediately.

Predictions

If a child recognized “nobody” as a specifier, and hence an operator of NegP, then “nobody” should be an immediate barrier to long distance WH movement. However, if a child did not see the operator status of “nobody” and can adjoin it as an adverb, then it should not be a barrier.

Unlike “not” and “n’t,” “nobody” is predicted to emerge earlier and have a different barrier pattern.

(6) CP
2
Why$_1$ C'
2
C IP
did @ (t$_1$) (e.g., "Because she was in the bathroom.")
nobody NegP <= (complement)
2
(barrier)=>Operator Neg'
(nobody) 2
Neg VP
[+Neg] @
tell the teacher CP
@ (*t$_1$) (e.g., "Because the
bus broke down.")
they were late?

In Experiment 2, empirical Hypothesis 2 stated that the negative subject "nobody" emerges before the negatives "not" and "n't." Besides being overt operators, negative subjects like "nobody" are conjunction quantifiers that range over a set of individuals introduced in the context, whereas the negatives "not" and "n't" range over events indicated by propositions. This effect is reflected in the wide scope a negative has over a sentence. Like "not" and "n't," the scope of a negative quantifier intervenes with the movement of a WH word out of that scope; therefore, a negative barrier results. This evidence should help children to set "nobody" as a negative operator and barrier to LD analyses early.

Data showed no differences between age groups in their sensitivity to the negative subject barrier. The insignificant regression results of age, ToM, and complement production scores indicated that the variance of "nobody" was not affected by other language measurements. This result was further evidence for empirical Hypothesis 2 about the early development of a "nobody" barrier to LD analyses in embedded WH questions.

Furthermore, results of Experiments 1 and 2 were consistent with the prediction raised by empirical Hypothesis 2 in Experiment 2 concerning the development of "nobody" earlier than "not" and "n't." When "nobody" was contrasted with the negative pair "not" and "n't" within age groups, the younger children were significantly more sensitive to the negative subject than the sentential negatives. The negative subject "nobody" was significantly different from the sentential negative "not." This result supported the assumption that "not" emerges as an adjunct to VP. For "not" to block LD analyses, it should be represented as a complement of IP and an operator.

A significant difference between "nobody" and "n't" only for the 3-6-year-olds indicated that in the early stages of the development of the negative barrier, the specifier of NegP, "nobody," is set first. One reason is that since "nobody" is an overt specifier but not "n't," then the former should emerge earlier and younger children should reflect the distinction in their grammar. Significant within-subjects interactions between question type, "n't" and "nobody," and age also supported this claim. For older age groups, the lack of distinction between "nobody" and "n't" is related to the extra evidence that "n't" has from being merged with the head of CP and being cliticized onto an auxiliary that occupies C, the head of CP. This was also supported by the significant difference on "n't" between the 4-year-olds and the 3.6-year-olds in Experiment 1. Functional-lexical information from a negative element seems to provide evidence to the child. Therefore, results on age effects and the differences between the negative subject and the negative pair supported the acquisition hypothesis that specifiers of NegP emerge first.

The Embedded Negative Phrase

The embedded negative phrase, such as "not often" or "with none of the ladders," has a negative operator as indicated by inversion and negative polarity items. When it is preposed to the embedded clause, it must move to an operator position, such as the specifier of FocP, as in (7) and hence be a barrier to long distance WH movement as in (7a). In this case, the embedded NegP and WH operators compete for the specifier of FocP. Since embedded negative phrases are most of the time contained within PreP's, they could be analyzed as adjuncts if the negative operator is not realized as in (7b). Hence, they would not be barriers, especially in child grammar.

Predictions

If a child realized the operator status of embedded negatives as in (7a), then embedded phrases would be barriers to long distance WH movement. A child, moreover, would show an understanding of how embedded CP's are represented when operators co-exist.

If child analyzed embedded negatives as adjuncts as in (7b), then long distance WH movement was possible.

(7) CP
Operator$_1$ 2
When$_1$ C'
2
~~C~~ IP u
did 2 t_1(e.g., in the morning)
the girl INFL'
2
INFL VP
2
VP
@
tell her dad
<=========== (scope of NegP) ===========>
CP
2
(*t_1) C'
2
C ~~FocP~~
that Spec 2 (b) No barrier=>Adjunct

NegP Focus'

(a) Barrier => Operator$_2$@ 2

with none of the ladders Focus IP

could @ (*t_1)

she reach the cat?

In Experiment 4, empirical Hypotheses 1 and 2 stated that when a negative phrase with an operator or a negative constituent is preposed to the initial position of an embedded clause (or the middle of a two-clause sentence), only the negative operator is a barrier to WH word long distance analysis. If negative phrases are barriers, then embedded negative phrases with operators should be barriers too. The negative phrase determines the scope over the embedded clause. For long distance movement of the initial WH word to occur, the initial WH word has to have its trace in the embedded clause and has to move through the specifier position of the embedded Focus phrase. A negative phrase should prevent that from happening or else principles governing free (or ungoverned) traces, such as the Empty Category Principle (e.g., Lasnik and Saito, 1984), are violated. If children showed some sensitivity to the embedded negative barrier, then this should be evidence of UG settings that influence how both embedded operators and CP's are represented.

Significant differences between the preposed negative operator and other conditions might provide evidence that the preposed negative operator was a barrier to LD analyses. When the negative operator was preposed to the initial position of a complement clause, it was a barrier to LD analyses. In addition, the significant interactions of position by type of the negative phrases support the effect of the negative operator as a barrier. These results indicated that for a negative operator to interact with a WH operator and induce barrierhood, it must be in a specifier position in the embedded clause with a head that agrees with its features as is the case for structures in the main clause or CP. This position would be the Focus phrase, and children showed possible development of the use of such structures in the embedded clause.

Though there was no age main effect for the negative operator, the interaction of position by type by age suggested that negative operators were barriers to LD analyses that develop across age groups. One possible reason for the lack of age main effect could be the following: Preposed negatives have a +topicalization feature, like any other preposed noun phrases, and a negative feature. The negative operator phrase also induces inversion. Empirically it seems plausible to assume that the negative operator might be selected as a barrier since a negative operator, besides inducing inversion like a quantifier, also carries a negative feature. This multiple feature evidence might have contributed to the fact that there were no age differences on the negative operator.

Broad WH Analyses

The questions in Experiment 4 received broad WH analyses but in smaller numbers than the negative questions in Experiment 3. Under this analysis, the WH word is structurally interpreted within the main clause, but semantically shifted to a causal meaning. With a similar meaning shift, the broad WH, LD analysis is, however, analyzed in relation to the complement clause. The instance of broad WH analyses in this experiment was more related to individual variations among children. The broad WH responses were confined to particular subjects. Out of 6 children who did broad WH analyses, two children showed a greater tendency to shift for a broad WH meaning. One explanation was that these children might not yet have developed the pragmatic and semantic plausibility for adjunct “when” and “where” WH words in such contexts as other children.

A relationship, though marginal and similar to the one found in Experiment 3, appeared between Syntactic adequacy 1 and the use of broad WH, SD analyses only for the negative operator and the negative constituent in the middle of the sentence. Though based on only a few subjects, such results were consistent with the previous account. That is, as children begin to learn about multiclausal sentences, they become more sensitive to a negative barrier even if it is weak, such as an embedded negative phrase. As shown in Experiments 1 and 3, the predicted age was around four years old. The negative barrier biases towards a structural SD analysis by blocking the main WH word from having a trace in the complement clause; hence, LD analyses were excluded. However, a

WH word undergoes a meaning shift because the adjuncts “where” and “when” are not preferred by a child when adjuncts describe a communication verb.

In Experiment 3, it was proposed that negative barriers in a sentence constrain younger children, especially 4-year-olds, to use SD analyses even if they shift the WH word meaning by default. Without barriers, it seems that children could avoid the lexical shift of initial adjunct WH words by using alternative analyses, such as medial WH answers or LD analyses by default. However, this lexical shift of adjunct WH words disappeared as children got older. In Experiment 4, the lexical shift in the negative phrases at the end of the sentence decreased with age as indicated by a significant trend analysis for age. This condition was the control where no overt barriers existed.

The Hypothesis of the Parallelism of Negative and WH Barriers

According to syntactic theory, negative and WH barriers operate structurally. A negative or a WH operator in the specifier of NegP or CP prevents an adjunct WH word which is an operator from moving through it since adjunct movement operates locally and cyclically through relevant positions.

Predictions

WH barriers and negative barriers should both block long distance WH movement.

The assumption that the syntactic module is the core grammar predicts that if the negative barrier is a syntactic feature it should be learned relatively early just as the WH barrier is. This prompted the question as to whether or not negative barriers to WH movement were a syntactic phenomenon. Answering this question is crucial in determining the role of the negative barrier in language acquisition as part of the core grammar. Though WH barriers, as in the control questions in Experiment 3, are a syntactic feature, the nature of negation is debated between being a syntactic versus a purely semantic feature (e.g., Rizzi, 1990; Haegeman, 1995; Rullman, 1995). However, no controlled empirical data have been used to sustain such arguments. In acquisition theory, research has attempted to compare negative barriers to WH barriers across studies (e.g., Abdulkarim and Roeper, 1997). However, in this study a direct within-subjects comparison was made of the negative and WH barriers. The first evidence for the parallelism between WH and negative barriers came from testing whether or not the negative barriers followed the pattern of the WH barriers in the present data.

To determine if negative and WH barriers emerge around similar stages of development, the two barriers needed to be compared in the youngest age group tested in this study, that is, the 3-6-year-olds. Table 5.1 shows the percentage of LD analyses by the 3.6-year-olds to each negative barrier in the four experiments. In Experiment 3, LD responses were similar for both the negative and control questions. Both questions had medial WH words; however, the negative received fewer medial WH answers. As discussed in Chapter 4 under Experiment 3, the medial WH answers to the negative questions could be merely single clause answers. Hence, it would be possible that there were no medial WH answers. This result might indicate the early effect of the negative barrier in that it blocked medial answers.

Results also implied that medial WH answers in child English grammar are a form of partial WH movement, as in German, that is, both are subject to the negative barrier. Since in medial WH answers a medial WH word is covertly moved to the initial position of the sentence to have scope over the main clause, while its trace is in the embedded clause, medial WH answers could be assumed as a form of LD analyses. Medial WH answers have been suggested to be a default of LD analyses (e.g., Mahajan and Fanselow, 2000). When both LD and medial WH answers were combined for the negative and control questions, they behaved similarly. Results also showed that SD analyses significantly increased with the negative barrier. Moreover, the broad WH, SD analyses provided by children in Experiment 3 in the context of negation indicated that negation is a syntactic feature.

Table 5.1. Percentage of LD responses and medial WH answers by 3-6-year-olds across the negative barriers in Experiments 1 to 4.

Experiment 1		Experiment 2	Experiment 3				Experiment 4
“not” (N=3)	“n’t” (N=3)	“nobody” (N=3)	“not” (N=6)		Control (N=6)		Preposed negative operator
			LD	Medial	LD	Medial	
43.3%	40%	20%	13.3%	10%	8.3%	20%	35%
			Both 23.3%		Both 28.3%		

In Experiment 2, “nobody” showed the most effect on LD responses. The development of negative barriers seemed to reflect a pattern similar to the argument-adjunct asymmetry found in WH barriers. “Nobody,” which is an overt specifier, functions as the subject NP of a sentence as does an argument WH word. The negative barrier “not,” however, is assumed to be an adjunct. Therefore, “nobody” blocks more LD analyses. In Experiment 4, the preposed negative operator seemed to behave similarly to the WH barriers of the control questions in Experiment 3 when LD and medial WH answers were combined. The embedded negative operator condition was structurally the most similar to embedded WH barriers in the control question of Experiment 3 since both were in the specifier of the embedded clause.

In Experiment 1, “not” and “n’t” received slightly more LD responses than the other conditions. When the two negatives were compared with LD responses to the control question, a case of WH barrier, in Experiment 3, the youngest children seemed not to get a minimality effect (Rizzi, 1990) as early for the negative barriers “not” and “n’t” as for the WH barrier. Several possible factors could explain this result. During that stage of development, adjunction of the negative "not" instead of being a complement of the head INFL of IP might be the case. Instead of sentential negation, the negative "not" might be an instance of early anaphoric negation where the negative element negates a prior sentence (e.g., Mother: Didn't you see the car? Child: No I see car=> No, in fact, I did see the car) (Deprez and Pierce, 1993). If that is possible, then younger children might have interpreted the experimental sentences as affirmatives negating a sentence in the story, and hence performed LD analyses (e.g., Why did the girl not tell her mom she went to the zoo?=> No, in fact she told her mom why she went to the zoo=> because she wanted to feed the animals.) However, this explanation is more likely for children younger than the group tested.

The negative "n't" could also be a weak clitic associated with the development of the CP structure for subject-auxiliary inversion and, consequently, the application of the incorporation rule. As indicated by the present and previous empirical data, these features are set after age four, especially for adjunct WH questions where the auxiliary moves to C, the head of the specifier of CP, to realize the feature of a [+WH] operator (Deprez and Pierce, 1993). Adjunct WH questions were also used in this study. According to the agreement requirements of the Affective Operators (e.g., Rizzi, 1990, 1992; Haegemann, 1995), the head and the specifier of a WH operator or a negative operator must agree. The scope of the negative operator "n't," therefore, by evidence from incorporation with C, is set in the same way as the WH operator and hence becomes a barrier.

According to syntactic theory, negation parallels a WH operator. Setting the scopes of the WH and negative operators might cause them to interfere with each other. WH barriers have overt specifiers, but that is not always the case for negative barriers. Referential WH traces also help a child to map structural representations onto discourse contexts, but structural mapping seems not as transparent for negation. A child might also need to fix negative concord first (de Villiers, personal communication, June 21, 2000). Negation also has pragmatic requirements for a contrastive set of affirmative and negative propositions. Hence, negation might involve cross-modular features which make learning a parameter take time (e.g., Penner and Roeper, 1997). Also, variation of the NegP across languages might affect setting the NegP in child grammar, that is, whether her language allows overt negative specifiers or heads or both. For example, French allows an overt head and a specifier to be present simultaneously in the same sentence (e.g., Je ne mange pas), whereas English does not. These represent possible grammar types in UG. However, as soon as children learned the evidence for a specifier of NegP as shown in the case of "nobody," the negative barrier was similar to WH barriers. Additional evidence comes from the production data. The negative barriers were predicted by syntactic complement production scores. The negative barriers were honored in children's grammar as early as 3-6 to 4 year old which correlated with children's ability to produce complement clauses.

Thus, data showed that negative barriers are not purely semantic features. The present data, therefore, captured the syntactic aspect of negation. Negation at some levels is represented within the syntactic module and hence becomes part of the core grammars. Support was found in this study for the concept that negative and WH barriers follow a similar account, that is, a syntactic account. The findings also support previous comparisons which were done across studies (Abdulkarim and Roeper, 1997).

Universal Defaults and Intermediate State Grammars Hypothesis

Default grammars are shown to be present when a child exhibits analyses not directly found in her target grammar. Partial WH movement underlies medial WH answers which are possible UG default covert movement of overt long distance WH movement that a child uses before sufficient information is available to restrict it. Similar to long distance movement, covert movement is subject to negative barriers as in languages other than English.

Multiple grammars exist when two forms are present in child grammar for the same structure. Two NegP's exist, one is the adjunct "not," and the other is the complement NegP of IP, “n’t” or “nobody.” Two types of movements exist: long distance WH movement and partial WH movement.

Prediction 1

If medial WH answers in child English were default movements to long distance WH movement and if the child was aware of the covert movement which is cross-linguistically blocked by NegP, then NegP should be a barrier to child medial WH answers. However, if medial answers were not blocked, then the child did not understand negative barriers, and/or the covert movement analysis was not valid.

There were some rules used by default that could only be explainable within a model of default UG settings (e.g., Roeper, 1999). Children seemed to use default or unspecified UG rules when computations of different parameters[3] were not achieved in contexts of specific adult language, such as English. Medial WH answers are a phenomenon seen only in child, but not adult, English grammars.

Comparisons of child medial WH answers in English to partial WH movement in cross-linguistic grammars lead to the assumptions that medial WH answers were part of default UG settings. In syntactic theory, partial WH movement was described as a default

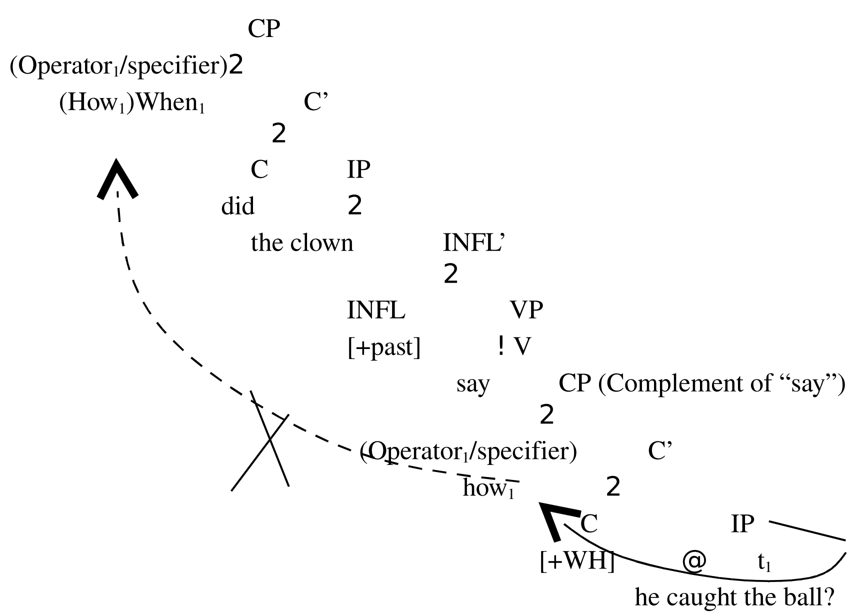
[3] Yang (2000) also referred to the concept of parameter intersections of which learning adult structures are a byproduct.

to LD, WH movement (e.g., Fanselow and Mahajan, 2000). The fact that age was not a significant predictor of medial WH answers indicated that they could be default to LD analyses which continued to exist in older children. Data in Experiment 3 of this study showed that some children used medial WH answers by default despite the requirement of WH barriers in English. They also gave single clause analyses, as governed by a discourse-linked rule, when failing to meet the requirement of the negative and WH barriers. Lexical default was shown when children projected a WH word with a broad meaning though they selected SD analyses as required by the negative barrier.

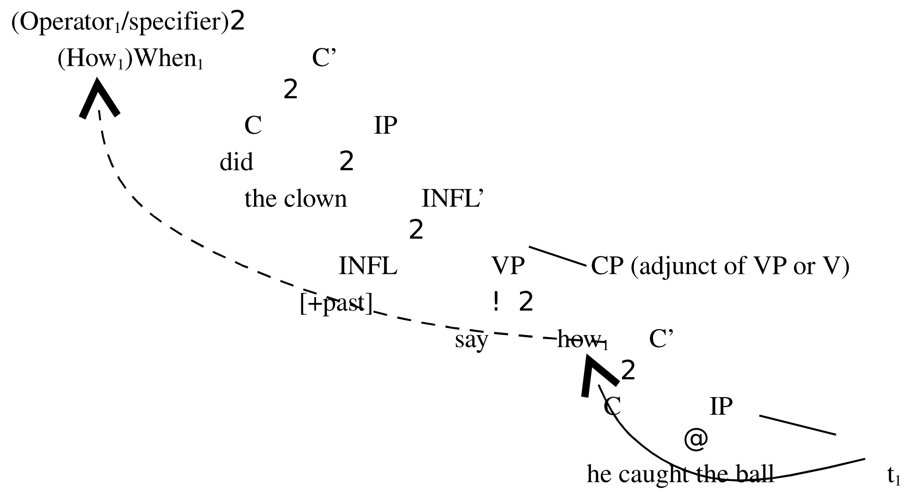
Cross-linguistically, negative barriers to partial WH movement were shown in previous research in adult language (e.g., Beck, 1996; Müller, 1996; Fanselow and Mahajan, 2000). In child grammar, if medial WH answers were default UG settings, they should also be blocked by negative barriers as was predicted by Hypothesis 1 in Experiment 3. Data showed that the negative barrier blocked medial WH answers in child grammars as it does in adult German. That is, similar to adults in German, children do not covertly move a medial WH word across the scope of negation. Results thus support the acquisition hypothesis that grammars for medial WH answers are universal default rules.

As discussed in Chapter 2 under the Acquisition of WH Barriers, medial WH answers could reflect two possible underspecified UG underlying representations and mechanisms during the intermediate stage to the development of full-tensed sentence complements. One representation concerns adjunction of complements. Adjunction has been proposed as the default representation (e.g., Roeper and de Villiers, 1994). Under the adjunction analysis, the second clause is adjoined at the VP level, or V, of the main verb as in (8b). In contrast, the second clause is a complement in the adult English structure as in (8a). Adjunction is the default operation since it meets the minimal requirement features of verbs (Penner and Roeper, 1997). Therefore, a medial WH word can move to the main clause. The other representation suggested is copying of the medial WH word to the left of the sentence. Copying is suggested to be another default UG operation that is found in some dialects of German since it is more general than a language-specific parameter (e.g., de Villiers, et. al., 1990). Copying would also be similar to (8b).

(8) a.



b. CP



As for mechanisms underlying default WH movement, in Chapter 2, concord was suggested as a default feature emerging relation before agreement relations and movement emerge (Roeper, personal communication, June 15, 2000). Movement rules include WH movement which is part of formulating WH questions. In the early stages of WH questions, multiple clauses or CP's could be produced by recursive rules, a concord operation (e.g., [CP +WH]=> [CP +WH[CP +WH]]). As such, a recursive CP structure is not subject to movement restrictions since it is not a complement of a main verb as in (8a).

However, there is a mismatch between child and, for example, adult German medial WH answers. For example, children used the initial lexical WH word as an expletive scope marker (e.g., "when" in 8b), whether they did movement by substitution of the scope marker or copying of the medial WH word onto the scope marker as is shown in (8b). Previous research has shown that, unlike in German, English speaking children allowed medial WH answers with infinitive complements (e.g., de Villiers, Roeper, and Vainikka, 1990). This mismatch is evidence that children have a basic UG rule that allows medial WH answers; however, to get the adult-specific scope marking structure in German, for example, computations of possible sets of UG rules are required.

Though movement operations underlie medial WH answers and long distance movement, computations of both different operations and structural-semantic representations result in different specific language structures. Such computations are subject to cross-linguistic as well as individual variations. For example, full-tensed sentence complements have different specific structures in English versus German. It is the same reason that, for example, dialects develop, languages change, and individual variations exist (e.g., Yang, 2000). Individual variations in the development of grammars were shown in the data. For example, in Experiment 4, it was shown that only few children performed the default broad WH analyses. Variations in bilingualism and similarities between adult second language and child first language (e.g., Hanania, 1974) indicate that language-specific grammars are not learned as a whole, but develop from sets of default to specific grammars.

Since there is not enough evidence of full scope marking structures in input sentences for the English speaking child, perfect scope marking and partial WH movement structures as in adult German seem unachieved. The idea of computation of the grammatical sets or parameters that children need to learn could in part explain why child structures often differ from target adult structures.

How Do Children Select the Target Grammar That Disallows Medial WH Answers in Their Grammars?

The answer to this question could explain the development of the specific grammar for WH movement in the English language. As reflected in the lack of a main effect for age, medial WH answers seemed to resist grammar change until later stages in language development that go beyond the age range tested in this study. One reason for this resistance might relate to partial WH movement as a default to LD analysis as discussed in Chapter 2. The main difference between LD analyses and medial WH answers is that in partial WH movement the medial WH word moves covertly to the initial position of the sentence. However, they both share an initial WH word with a scope over the main clause and a trace in the embedded clause. In this way, the analysis of medial WH answers seems compatible with data input of LD analysis. When an analysis is compatible with more than one grammar, it becomes ambiguous, and thus does not get penalized and eliminated early in development (e.g., Yang, 2000).

Different evidence might contribute to selecting a target grammar other than the grammar that allows medial WH answers. Input sentences with initial arguments could be evidence for English target grammar. Embedded questions with initial argument WH words, such as “what” or “who,” and medial WH words, would indicate that in English the initial WH word cannot be a scope marker. However, since sentences with initial arguments are not frequent in input, medial WH answers exist in later stages of development. Therefore, knowledge of the full features, WH and lexical, of WH words would eliminate medial WH answers.

Evidence from verb subcategorization features and semantic requirements of main verbs could play a role in selecting adult grammar. Once full subordination is specified, embedded WH questions would be selected and governed by the main verb, and hence, these embedded clauses have to agree with the verb subcategorization and semantic requirements. Thus, adjunction as default gets eliminated, and restrictions on long distance movement and medial WH answers apply (e.g., McDaniel, 1994; Weissenborn, Roeper, and de Villiers, 1991; Perez-Leroux, 1991). Moreover, this study presented negative barriers as another restriction on medial WH answers. As revealed in this study, negation showed that development of operator interactions might help to eliminate default settings.

Prediction 2

The NegP with “not” could remain as an adjunct as in (4a) if one assumed multiple grammars use. Medial WH answers could show in child grammar alongside long distance movement.

In Experiment 1, the negative “not” proved to be the least effective barrier to LD analyses, especially for children older than 3-6 years old. Results indicated that, though the negatives “nobody” and “n't” showed evidence of being analyzed as NegP, the negative “not” remained analyzed as an adjunct. Thus, two grammars appeared simultaneously in child grammar: a representation for a NegP as an operator and barrier, and a representation of NegP as a negative adjunct.

Experiments 1 and 3, for example, revealed that medial answers, short distance movements, and long distance movements could coexist in child grammar. The selection among these was determined by the presence or lack of syntactic constraints as apparent in this study.

The concept of default rules in child grammars still needs further evidence and explanation. One question concerns the factors that force a child to default to a specific rule. Another question is how the child learns what rules are not specific. Nevertheless, default rules represent the coexistence of different grammars in child language. These default rules represent stages in the development of child grammar till the adult target is specified by a process of elimination. The hypothesis of having intermediate states of grammars, therefore, seems to provide explanations for phenomena observed in English child grammars.

Production of Sentence Complements and Theory of Mind

In this study, the comprehension and production of sentence complements were tested. Elicited productions of embedded clauses to intentional verbs, such as “think” or “tell,” were used as an indication of the development of production of embedded sentence structures. Embedded sentence structures were the constructions used for the WH questions. Comparing the two within individual subjects and across experimental sentences would indicate how the development of embedded sentences in comprehension and production is related to syntactic principles involved in negative and WH barriers and WH movements. Any relationships found would suggest, for example, the major role syntax plays as the core grammar in the grammar of complex sentences.

Relationships between comprehension of the experimental sentences of embedded WH questions and production of sentence complements surfaced for some syntactic and semantic aspects of the WH questions. Some of these results were addressed above in relation to specific acquisition hypotheses. Though no cause- and- effect relationships were presumed, results indicated that the development of some aspects of embedded WH questions could be predicted by the development of some syntactic-semantic aspects of producing sentence complements.

More specifically, results suggested that the development of negative barriers was associated with developing complex sentences. In Experiment 1, development of negative barriers was predicted by the Syntactic adequacy and Semantic adequacy scores. Such scores represent the ability to form sentence complements. Though the control question was predicted by age, it was not predicted by the production syntactic measures. The control question represents a general case of embedded WH questions without overt barriers, such as negation. The association of the development of negative barriers and the production of complex sentences is an indication of the interaction of the principles involved in formulating embedded sentences. Besides providing evidence for UG principles, the experimental data on negative barriers and the syntactic production data indicated a degree of connection between some question derivation principles and structural subordination, both of which need to be honored in child grammar as early as possible. These include Relativized Minimality, Negative Operator Criterion (cf. Affective Operator Criterion, e.g., Haegeman, 1995), the Empty Category Principle, and verb subcategorization requirements.

Semantic adequacy and Syntactic adequacy 2 scores of sentence complement production were predictors of medial WH answers. The Semantic and Syntactic adequacy measures are associated with the development of full-tensed complements that enable children to handle embedded WH questions. However, medial WH answers are only an intermediate stage to the full-tensed complement structure as in the target adult English complements.

Syntactic adequacy scores were associated with the development of SD analyses of negative questions in Experiment 3. It was only age that predicted SD analyses for the affirmative questions. The development of full-tensed complements, as indicated by the Syntactic adequacy scores, seemed to be related to the development of the negative barriers to WH extractions from complement clauses. A full-tensed complement seemed to be subject to the requirements of the main verb which restricts movement of the medial WH word, especially in the presence of a negative barrier. An underlying theme could be that complements of heads of functional categories- NegP of INFL and CP of main verb- might correlate when present in a structure where both have to meet the head requirements, such as having operators and other features. This effect was shown to induce more SD analyses though some of those had a shifted WH word meaning.

ToM was related to some aspects of embedded questions, such as medial WH answers. In Experiment 3, the passers of ToM produced more medial WH answers. The capacity for ToM enables children to analyze false complements. In the stories, the answer to the medial WH word was a falsely believed manner, place, or time depending on the type of the medial WH word (e.g., “how,” “where,” or “when”). On the other hand, when children showed preference for discourse inference of embedded questions indicated by the single clause analyses in Experiment 3, they failed ToM. Results indicated children were more inclined to analyze embedded structures across sentence boundaries where real events mapped onto the true embedded clauses.

In addition to production and ToM scores, age was a developmental predictor of several experimental response types even when production syntax and ToM were not. Age is a scale of measuring the longitudinal frequency effect of experience or data input. That is, the older the children, the more they are exposed to data input and evidence. In addition, age reflects more use of grammar. Data input and use of grammar are, however, not independent. For language development to occur, children need to internally process data input by mapping them onto grammatical representations assumed to be pre-established as part of UG and make decisions about the compatibility of these representations with the data input.

Conclusion

In general, results supported the acquisition hypotheses that negation is a barrier to LD analyses and medial answers. Negative barriers seemed to show similar effects to WH barriers. Results, moreover, showed that children most of the time computed structural analyses as required by specific rules in the adult English grammar. The fact that children honored negative barriers, including embedded negative phrases, to LD analyses, medial WH answers, and single clause answers showed knowledge of some UG principles. More specifically, data on negative barriers showed realizations of Relativized Minimality, the Empty Category Principle, and LF (or covert) movement of medial WH words.[4]

Acquisition theory plays a role in describing what is crucial to the process of language development.[5] This role is to define what features in the data input might contribute to selecting adult English grammars. One feature in the data input is lexical sets which are resources of base derivations and operations (e.g., Marantz, 1994). Developing computations of more features of lexical items leads to developing complex sentence representations and derivations, such as WH movement. For example, developing verb subcategorization features helps to develop tensed complement clause structures (e.g., Roeper and de Villiers, 1994). Verbs that take interrogative complements, such as "ask" and "wonder," might be among the initial evidence in data input for the development of verb subcategorizations (e.g., Weissenborn, Roeper and de Villiers, 1991; Perez-Leroux, 1991).

However, developing verb subcategorizations comes in stages. For instance, until verb specific subcategorization features are mastered, LD analyses and medial WH an-

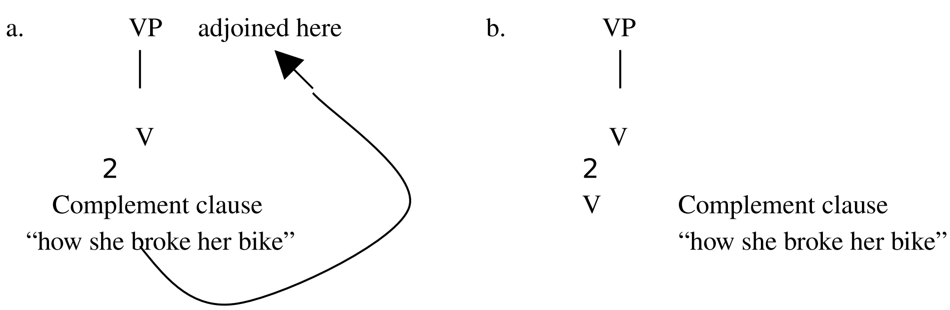
[4] Children also respected the Scope Principle that regulates interactions of operators (Aoun, 1993).

[5] This is important in the applied areas of language learning, such as a clinical setting.

swer derivations could be ambiguous and, hence competing in child grammar because they are computed similarly (e.g., Marantz, 1994; Fanselow and Mahajan, 2000). They are ambiguous because in both analyses the embedded WH word and the complement clause, such as “how she broke her bike” in (9), are adjoined at the VP level as in (10a) instead of being a full-tensed complement of the main verb which is the head V of the VP as in (10b) (e.g., Roeper and de Villiers, 1994).

(9) Where did the girl tell her mom how she broke her bike?

(10)



Hence, the complement in (10a) does not meet the requirements of the main verb which disallows medial WH answers. That is, a WH word could move out of the verb complement. However, under (10a) medial WH answers could be selected over LD analyses when a WH word is present in the middle of the sentence as “how” in (9). In this case, medial WH answers are the default of LD analyses (e.g., Fanselow and

Mahajan, 2000). The structure in (10a) is a possible structural representation in German for deriving medial WH answers or LD analyses, whereas in English only the representation in (10b) is allowed.

Similar to verb classes, classes of WH words and negative elements do not come as a whole. Syntactic or semantic features of a member of a class could be learned before others depending on salient evidence. For example, functional-lexical evidence helped to speed up setting the negative barrier rule of "n't" as a head of NegP. As for the WH word classes, children showed a difference in understanding "how" questions in single versus embedded WH questions. By analyzing the initial WH word as an expletive scope marker in performing medial WH answers, they also demonstrated the split of features of WH words. Empirical data, therefore, gives psychological reality to the feature composition of WH words, a +WH feature and a lexical content (e.g., Chomsky, 1995). Children also honored lexical class boundaries. For example, in previous research children showed argument-adjunct asymmetries (e.g., de Villiers and Roeper, 1991) and broad WH shift only for adjunct WH words.

In brief, new data on the acquisition of negative barriers in embedded WH questions were discussed within a framework of the acquisition hypotheses that predicted acquisition as a process of developing multiple UG grammars. A child is born with the ability to learn a language which is a logarithmic computation of abstract symbols (e.g., Chomsky, 1995). Results of this study fit the predictions of the hypotheses driven by assumptions from linguistic theory and acquisition theory. However, there still remains a large corpus of cross-linguistic phenomena in child grammar that need to be explained. Such data have implications for the theoretical integrity of the development of language as well as for applied clinical purposes.

Recommendations for Future Research

The interactions among WH words, negative barriers, and embedded clauses showed a need for full descriptions of the possible grammars, including structural and discourse grammars, which indicate children's language developmental stages. Therefore, further subtle aspects of the grammar of complex syntax need testing. Such aspects also need to be tested in younger as well as older age ranges than the range tested in this study. It would be interesting to discover at what age, for example, children decrease medial WH answers to 0% as in adult grammar. A specific question would be whether and when the two year gap across age groups in developing SD analyses for the WH questions in Experiment 3 decreases with older age groups.

The relationship observed between the tense/interrogative auxiliary "do" and the negative "n't" via incorporation rule to C and used to explain the early effect of "n't," might indicate a relationship between negation and tense. For example, it is assumed that concord and recursive rules, especially negative concord, are forms of feature relations that emerge earlier than agreement and movement operations to check features (e.g., Roeper, personal communication, June 15, 2000; Chomsky, 1995 for agreement as part of movement). Movement is also an operation for tense agreement. For example, verbs move to INFL to realize tense and agreement features, such as past tense, person, and number. English, though, has a covert or invisible verb movement. It would be a consistent account if concord were found to be an initial process in tense feature relations, such as those between the head of IP and a verb. In later stages, at 4 years old, the presence of "n't" on the head "do" blocks the embedded tensed complements. A test of the effect of "n't" on non-tensed complements would be a contrast as in the minimal pair in (11).

(11) Why did(n't) the girl like to swim in the pond?

Main clause answer:
(Negative) Because it was full of mud
(Affirmative) Because it was good for snorkeling

Complement clause:
Because it was a hot day.

Some more questions for future research might address negative barriers over argument WH words. Since negative barriers are sensitive to the argument-adjunct asymmetry similar to the WH barriers, it would be informative to test the effect of negation on medial arguments. Aoun (1993), for example, suggested that referential adjuncts, such as, "where" and "when," could parallel the behavior of arguments. Referential adjuncts were blocked in this study. Since partial WH movement with argument or adjunct is blocked (e.g., Beck and Berman, 1996), arguments are predicted to be blocked. This should provide another subtle test to the partial WH movement analysis for child English. Medial WH answers in child grammar could also be compared within the same subjects to other aspects of barriers to WH movement. For example, one aspect concerns WH feature movement. Developmental correlation might be tested between the partial movement phenomenon and the movement of WH words out of the determiner phrase (DP) since both involve feature movement and barriers.

APPENDIX A

Test Protocol for Data Collection

Session 1: Hearing and Language Screenings

Hearing screening: pure tone at 500Hz, 1000Hz, 2000Hz and 4000Hz according to ASHA guidelines (1973) (5 minutes)

Cognitive screening: CMMS (10 minutes)

Language screenings:

Age range 3-0 to 6-11: *Clinical Evaluation of Language Fundamentals-Preschool* (CELF-P) (Wiig, Secord, and Semel, 1992): subtests *Recalling Sentences in Context* and *Sentence Structure*.

Age range of 6-11 to 7-0: *Test of Language Development-Primary* (TOLD-P:3) (1997): subtests IV. *Grammatic Understanding* and V. *Sentence Imitation* (10 minutes)

Session 2: Production and Comprehension of Complements, Theory of Mind and Experiments 1 – 2

Video-taped task for complement production (5 minutes)

Comprehension of verb complements task (5 minutes)

Experiment 1: “Not” (7 minutes)

ToM task (Doll’s house) (5 minutes)

Experiment 2: “Nobody” (5 minutes)

Session 3: Experiment 3

ToM (Prediction task) (3 minutes)

Experiment 3: Medial WH questions (20 minutes)

Session 4: Experiment 4

ToM (Crayon box) (5 minutes)

Experiment 4: Preposed negatives (15 minutes)

APPENDIX B

Regression Tables and Further Analyses of Experiment 3

Tables for the regression analyses of complement clause production and Theory of Mind scores on the development of the negative barriers “not” and “n't “ in Experiment 1.

Table B.1. Multiple regression analyses of the relationships between the percentage of LD analyses to the question type “n't,” and age, ToM, and complement production scores. (Standardized Regression Coefficients in parentheses)

Dependent variable: Percentage of LD analyses to the negative question with “n't”

Predictor	B	SE	t	P
Model A				
N: 40 R^2: 0.30				
Age	0.121 (0.53)	0.041	2.961	0.005**
ToM	- 0.054 (-0.11)	0.081	- 0.664	0.511
Syntactic adequacy 1	0.077 (0.214)	0.056	1.380	0.176
Constant	0.200	0.034	-	-
Model B				
N: 40 R^2 : 0.35				
Age	0.117 (0.51)	0.037	3.192	0.003**
ToM	- 0.090 (-0.18)	0.076	- 1.179	0.246
Syntactic adequacy 2	0.185 (0.32)	0.083	2.223	0.033*
Constant	0.200	0.033	-	-
Model C				
N: 40 R^2: 36				
Age	0.136 (0.59)	0.039	3.500	0.001**
ToM	- 0.044 (-0.09)	0.077	- 0.579	0.566
Semantic adequacy	0.070 (0.35)	0.030	2.378	0.023*
Constant	0.200	0.033	-	-

* $p < .05$
** $p < .01$

Table B.2. Multiple regression analyses of the relationships between the percentage of LD analyses to the question type "not," and age, ToM, and complement production scores.
(Standardized Regression Coefficients in parentheses)

Dependent variable: Percentage of LD analyses to the negative question with "not"

Predictor	B	SE	t	P
Model A				
N : 40 R^2: 0.15				
Age	0.120 (0.44)	0.053	2.262	0.030*
ToM	0.182 (0.314)	0.104	1.748	0.089
Syntactic adequacy 1	0.013 (0.03)	0.072	0.180	0.858
Constant	0.300	0.044	-	-
Model B				
N: 40 R^2: 0.15				
Age	0.116 (0.43)	0.049	2.360	0.024*
ToM	0.178 (0.31)	0.102	1.739	0.091
Syntactic adequacy 2	0.004 (0.01)	0.112	0.040	0.969
Constant	0.300	0.044	-	-
Model C				
N: 40 R^2: 0.15				
Age	0.110 (0.41)	0.053	2.083	0.044*
ToM	0.173 (0.299)	0.104	1.675	0.103
Semantic adequacy	- 0.011 (-0.05)	0.040	- 0.266	0.792
Constant	0.300	0.044	-	-

* $p < .05$

Table B.3. Multiple regression analyses of the relationships between the percentage of LD analyses to the control question type and age, ToM, and complement production scores.
(Standardized Regression Coefficients in parentheses)

Dependent variable: Percentage of LD analyses to the control question

Predictor	B	SE	t	P
Model A				
N: 40 R^2: 0.12				
Age	0.118 (0.43)	0.055	2.155	0.038*
ToM	0.096 (0.16)	0.108	0.883	0.383
Syntactic adequacy 1	0.083 (0.19)	0.075	1.108	0.275
Constant	0.642	0.046	-	-
Model B				
N: 40 R^2: 0.09				
Age	0.095 (0.34)	0.052	1.827	0.076
ToM	0.069 (0.12)	0.108	0.639	0.527
Syntactic adequacy 2	0.026 (0.04)	0.118	0.225	0.824
Constant	0.642	0.047	-	-
Model C				

N: 40 R^2: 0.14

Age	0.125 (0.45)	0.054	2.316	0.026*
ToM	0.098 (0.17)	0.106	0.921	0.363
Semantic adequacy	0.059 (0.25)	0.041	1.444	0.157
Constant	0.642	0.045	-	-

* $p < .05$

Tables for the regression analyses of complement clause production and Theory of Mind scores on the development of the negative barriers "not" to medial WH answers in Experiment 3.

Table B.4. Regression analyses of the relationships between medial WH answers for the control question and age, ToM, and complement production scores.
(Standardized Regression Coefficients in parentheses)

Dependent variable: Medial WH answers to the control question: "Where did the girl tell her mom how she broke her bike?"

Predictor	B	SE	t	P
Model A				
N: 40 R^2: 0.14				
Age	- 0.244 (-0.26)	0.187	- 1.305	0.200
ToM	0.782 (0.39)	0.368	2.123	0.041*
Syntactic adequacy 1	- 0.099 (-0.07)	0.254	- 0.391	0.698
Constant	0.875	0.156		
Model B				
N: 40 R^2: 0.15				
Age	- 0.310 (-0.33)	0.172	- 1.798	0.081
ToM	0.789 (0.39)	0.359	2.196	0.035*
Syntactic adequacy 2	0.314 (0.13)	0.392	0.800	0.429
Constant	0.875	0.155		
Model C				
N: 40 R^2: 0.23				
Age	- 0.119 (-0.13)	0.176	- 0.675	0.504
ToM	0.684 (0.34)	0.346	1.973	0.056*
Semantic adequacy	0.280 (0.34)	0.134	2.094	0.043*
Constant	0.875	0.147		
Model D				
N: 40 R^2: 0.294				
Age	- 0.175 (-0.18)	0.173	- 1.010	0.320
ToM	0.753 (0.37)	0.338	2.230	0.032*
Syntactic adequacy 1	0.653 (0.44)	0.355	1.839	0.074
Semantic adequacy	0.554 (0.67)	0.198	2.806	0.008**
Constant	0.875	0.143		
Model E				
N: 40 R^2: 0.30				
Age	- 0.137 (-0.15)	0.169	- 0.812	0.422
ToM	0.571 (0.28)	0.338	1.691	0.100
Semantic adequacy	0.401 (0.49)	0.142	2.821	0.008**
Syntactic adequacy 2	0.791 (0.33)	0.397	1.993	0.054*
Constant	0.875	0.142		

*$p \leq .05$, ** $p < .01$

Table B. 5. Regression analysis of the relationships between medial WH answers for the negative question and age, ToM, and complement production scores.
(Standardized Regression Coefficients in parentheses)

Dependent variable: Medial WH answers to the negative question: “Where did the girl not tell her mom how she broke her bike?”

Predictor	B	SE	t	P
Model A				
N: 40 R^2: 0.12				
Age	-0.277 (-0.44)	0.125	- 2.212	0.033*
ToM	0.258 (0.19)	0.246	1.046	0.303
Syntactic adequacy 1	0.200 (0.21)	0.170	1.180	0.246
Constant	0.425	0.104		
Model B				
N: 40 R^2: 0.15				
Age	- 0.259 (-0.41)	0.114	- 2.269	0.029*
ToM	0.167 (0.124)	0.238	0.702	0.487
Syntactic adequacy 2	0.428 (0.27)	0.259	1.649	0.108
Constant	0.425	0.102		
Model C				
N: 40 R^2: 0.11				
Age	- 0.262 (-0.42)	0.125	- 2.097	0.043*
ToM	0.239 (0.18)	0.247	0.969	0.339
Semantic adequacy	-0.090 (-0.16)	0.095	- 0.944	0.352
Constant	0.425	0.105		

*$p < .05$

Tables of the regression analyses of complement production and Theory of Mind scores on the development of the effect of the negative barrier "not" to SD analyses and broad WH, SD analyses in Experiment 3.

Table B.6. Regression analysis of the relationships between SD analyses of the control question and age, ToM and complement production scores.
(Standardized Regression Coefficients in parentheses)

Dependent variable: SD analyses of the control question: "At the store" answers

Predictor	B	SE	t	P
Model A				
N: 40 R^2: 0.19				
Age	0.835 (0.495)	0.322	2.594	0.014*
ToM	- 0.377 (-0.104)	0.634	- 0.594	0.556
Syntactic adequacy 1	- 0.132 (-0.05)	0.438	- 0.301	0.765
Constant	3.425	0.268		
Model A with interaction terms for the Syntactic adequacy 1				
N: 40 R^2: 0.30				
Age	0.764 (0.45)	0.351	2.179	0.037*
ToM	- 0.435 (-0.12)	0.731	- 0.595	0.556
Syntactic adequacy 1	- 0.277 (-0.11)	0.782	- 0.354	0.726
Age*ToM	1.249 (0.34)	0.702	1.779	0.085
Age*Syntactic adequacy 1	- 0.412 (-0.139)	0.605	- 0.680	0.502
Age*ToM*Syntactic adequacy 1	- 0.288 (-0.05)	1.346	- 0.214	0.832
ToM*Syntactic adequacy 1	- 1.043 (-0.18)	1.428	- 0.730	0.471
Semantic adequacy	- 0.090 (-0.06)	0.403	- 0.223	0.825
Constant	3.231	0.365		
Model B				
N: 40 R^2: 0.233				
Age	0.899 (0.53)	0.291	3.091	0.004*
ToM	- 0.267 (-0.074)	0.606	- 0.440	0.662
Syntactic adequacy 2	- 0.971 (-0.23)	0.661	- 1.468	0.151

Constant	3.425	0.261		
Model B with interaction terms for the Syntactic adequacy 2				
N: 40 R^2: 0.36				
Age	0.822 (0.5)	0.398	2.064	0.047*
ToM	- 0.012 (-0.003)	0.686	- 0.018	0.986
Age*ToM	0.989 (0.3)	0.803	1.231	0.227
Semantic adequacy	- 0.343 (-0.2)	0.281	- 1.222	0.231
Syntactic adequacy 2	- 1.732 (-0.41)	0.990	- 1.749	0.090
Age*Syntactic adequacy 2	- 1.390 (-0.3)	1.315	- 1.057	0.299
Syntactic adequacy 2*ToM	1.683 (0.2)	2.153	0.782	0.440
Age*ToM*Syntactic adequacy	- 1.088 (-0.11)	2.887	- 0.377	0.709
Constant	3.314	0.328		
Model C				
N: 40 R^2: 0.19				
Age	0.765 (0.45)	0.320	2.388	0.022*
ToM	- 0.315 (-0.09)	0.631	- 0.499	0.621
Semantic adequacy	- 0.049 (-0.033)	0.244	- 0.201	0.842
Constant	3.425	0.268		
Model C with interaction terms of semantic score				
N: 40 R^2: 0.33				
Age	0.397 (0.24)	0.362	1.096	0.281
ToM	0.795 (0.22)	0.907	0.877	0.387
Age*ToM	0.613 (0.17)	0.741	0.827	0.414
Semantic adequacy	- 0.642 (-0.44)	0.464	- 1.383	0.176
Age* Semantic adequacy	0.301 (0.2)	0.351	0.857	0.398
Semantic adequacy*ToM	- 1.305 (-0.4)	1.063	- 1.227	0.229
Age*ToM* Semantic adequacy	1.391 (0.51)	0.768	1.811	0.080
Constant	3.522	0.420		

* $p < .05$

Table B. 7. Regression analysis of the relationships between SD analyses of the negative question and age, ToM, and complement production scores.
(Standardized Regression Coefficients in parentheses)

Dependent variable: SD analyses of the negative question: “At home” answers

Predictor	B	SE	t	P
Model A				
N: 40 R^2: 0.28				
Age	0.924 (0.56)	0.300	3.081	0.004**
ToM	0.069 (0.02)	0.591	0.116	0.908

Syntactic adequacy 1	- 0.432 (-0.17)	0.408	- 1.059	0.297
Constant	3.475	0.250		

<u>Model A with interaction terms for Syntactic adequacy 1</u>

N: 40 R^2: 0.39

Age	0.967 (0.6)	0.322	3.000	0.005*
ToM	- 0.097 (-0.03)	0.673	- 0.144	0.886
Syntactic adequacy 1	- 1.496 (-0.6)	0.719	- 2.081	0.046*
Age*ToM	- 0.796 (-0.2)	0.645	- 1.233	0.227
Age* Syntactic adequacy 1	0.815 (0.3)	0.557	1.463	0.153
Age*ToM* Syntactic adequacy 1	1.043 (0.2)	1.238	0.843	0.406
ToM* Syntactic adequacy 1	- 1.591 (-0.3)	1.314	- 1.211	0.235
Semantic adequacy	- 0.281(-0.2)	0.371	- 0.757	0.455
Constant	3.470	0.336		

<u>Model B</u>

N: 40 R^2: 0.27

Age	0.847 (0.51)	0.280	3.028	0.005**
ToM	0.238 (0.07)	0.583	0.409	0.685
Syntactic adequacy 2	- 0.566 (-0.13)	0.636	- 0.890	0.379
Constant	3.475	0.251		

<u>Model B with interaction terms for Syntactic adequacy 2</u>

N: 40 R^2: 0.48

Age	1.443 (0.9)	0.353	4.091	0.000**
ToM	0.883 (0.25)	0.607	1.454	0.156
Age*ToM	0.239 (0.07)	0.711	0.336	0.739
Semantic adequacy	- 0.134 (-0.09)	0.249	-0.539	0.594
Syntactic adequacy 2	- 1.897 (-0.5)	0.877	- 2.163	0.038*
Age* Syntactic adequacy 2	- 3.346 (-0.7)	1.165	- 2.873	0.007**
ToM* Syntactic adequacy 2	0.069 (0.01)	1.907	0.036	0.971
Age*ToM* Syntactic adequacy 2	- 5.261(-0.53)	2.558	- 2.057	0.048*
Constant	3.986	0.290		

Model C

N= 40 R^2= 0.26

Age	0.839 (0.51)	0.302	2.776	0.009**
ToM	0.154 (0.043)	0.595	0.258	0.798
Semantic adequacy	0.095 (0.07)	0.230	0.415	0.680
Constant	3.475	0.253		

Model C with interaction terms of semantic score

N= 40 R^2= 0.32

Age	0.724 (0.4)	0.355	2.039	0.050*
ToM	0.694 (0.2)	0.888	0.781	0.441
Age*ToM	- 0.905 (-0.25)	0.726	- 1.246	0.222

Semantic adequacy	- 0.192 (-0.13)	0.455	- 0.423	0.675
Age* Semantic adequacy	- 0.069 (-0.05)	0.344	- 0.200	0.843
ToM* Semantic adequacy	- 0.714 (-0.24)	1.041	- 0.686	0.498
Age*ToM* Semantic adequacy	0.622 (0.23)	0.753	0.827	0.415
Constant	3.710	0.411		

* p ≤ .05
** p < .01

Table B. 8. Regression analysis of the relationships between broad WH, SD analyses of the negative question and age, ToM, and complement production scores. (Standardized Regression Coefficients in parentheses)

Dependent variable: Broad WH, SD analyses of the negative question: “Because she was at home” answers

Predictor	B	SE	t	P
Model A				
N: 40 R^2: 0.44				
Age	- 0.291 (-0.25)	0.218	- 1.335	0.191
ToM	- 0.389 (-0.16)	0.455	- 0.854	0.399
Syntactic adequacy 1	1.436 (0.8)	0.486	2.953	0.006**
Age*ToM	0.255 (0.09)	0.437	0.583	0.564
Age* Syntactic adequacy 1	- 1.174 (-0.57)	0.377	- 3.117	0.004**
Age*ToM* Syntactic adequacy 1	- 0.403 (-0.1)	0.837	- 0.481	0.634
ToM* Syntactic adequacy 1	1.374 (0.35)	0.888	1.546	0.132
Semantic adequacy	0.240 (0.24)	0.251	0.955	0.347
Constant	1.354	0.227		
Model B				
N: 40 R^2: 0.36				

Age	- 0.623 (-0.53)	0.277	- 2.251	0.032*
ToM	- 0.955 (-0.38)	0.476	- 2.005	0.054*
Age*ToM	- 0.463 (-0.18)	0.558	- 0.830	0.413
Semantic adequacy	- 0.014 (-0.014)	0.195	- 0.073	0.942
Syntactic adequacy 2	0.395 (0.13)	0.688	0.574	0.570
Age* Syntactic adequacy 2	1.679 (0.47)	0.914	1.838	0.076
ToM* Syntactic adequacy 2	0.015 (0.002)	1.496	0.010	0.992
Age*ToM* Syntactic adequacy 2	5.094 (0.73)	2.006	2.539	0.016*
Constant	0.881	0.228		
Model C				
N: 40 R^2: 0.26				
Age	- 0.161 (-0.14)	0.262	- 0.615	0.543
ToM	- 0.808 (-0.32)	0.656	- 1.231	0.227
Age*ToM	0.192 (0.08)	0.537	0.358	0.723
Semantic adequacy	0.027 (0.03)	0.336	0.080	0.937
Age*Semantic adequacy	0.270 (0.26)	0.254	1.063	0.296
ToM*Semantic adequacy	0.265 (0.12)	0.769	0.345	0.732
Age*ToM*Semantic adequacy	- 0.661 (-0.35)	0.556	- 1.188	0.244
Constant	1.132	0.304		

* $p \leq .05$
** $p < .01$

Analysis of the Remaining Response Types of Experiment 3

The remaining response types, the LD and single clause analyses, were statistically tested for a full description of the development of complex WH questions. These are reported in this section as additional information.

Long Distance Analysis (LD). According to the syntactic theory of barriers to WH movement, a medial WH word or a negative "not" should block LD analysis. Though empirical data of English child language has been shown to support this hypothesis (e.g., de Villiers and Roeper, 1991), the LD analyses in this study are examined to test it further.

LD analyses or complement clause answers, "at the park," were also analyzed for significant effects (see Figures 4.3 and 4.4). The predicted outcome was that LD analyses should not be allowed in both the control and the negative questions due to the presence of the medial WH word in the former in addition to the negative "not" in the second. ANOVA as well as trend analysis results showed no significant effects. The means of the two questions for LD analyses were 0.475 for the negative and 0.475 for the control.

However, specific contrasts showed that on the negative question, the LD analyses provided by 3-6-year-olds were significantly different from the average of the older age groups, 4, 5, and 6, F (1, 32) = 4.7, $p < .05$. The same contrasts were, however, not different on the control question, F (1, 32) = .004, $p = .95$.

None of the background variables- age, ToM, or complement production scores- were predictors of a negative or medial WH barrier to LD analyses. Results of multiple regression analyses were insignificant.

Single Clause Analysis. Since single clause analysis is not an adult choice, syntactic theory has not articulated how a single clause analysis would be possible in a medial WH word structure- and even less possible with negation. Hence, single clause analyses, the "By hitting a wall" answer (see Figures 4.3 and 4.4), were analyzed to examine the development of WH and negative barriers.

The control question received more single clause analyses answers than the negative question, especially for the 3-6- and 4-year-olds as shown in Figures 4.3 and 4.4. First an ANOVA revealed a marginal age main effect, F (3, 32) = 2.3, p = 0.09, but no main effect for the counterbalanced experimental sets, F (1, 32) = 0.27, p = 0.61, or the interactions.

The marginal age main effect was further tested by linear trend analysis for each question. Results were significant for the control question, F (1, 32) = 4.56, $p < .05$, but marginal for the negative question, F (1, 32) = 2.87, p = .10.

As for within-subject effects, question type had a significant effect, F (1, 32) = 3.85, p = 0.05, but no interactions were significant. The single clause analyses to the control question were significantly different from the ones to the negative question. This indicated that negation had an effect on this analysis regardless of whether all the "By hitting a wall" answers to the negative question were genuinely single clause or medial

WH answers. The means for the dependent variables were 0.425 for the negative questions and 0.925 for the control.

Multiple regression analyses were run with all the possible interaction terms of the independent variables. This was done to include as much information as possible since, as with the broad WH answers, this type of analysis has not been looked at closely in terms of the development of complex WH questions. As shown in Table B.9, age was the only predictor for single clause analysis of the negative questions in models A and B. In Table B.10, age was also the only predictor for single clause analysis of the control questions in model A, but was marginal in model B.

Table B. 9. Regression analysis of the relationships between single clause analysis for the negative question and age, ToM, and complement production scores. (Standardized Regression Coefficients in parentheses)

Dependent variable: Single clause analyses of the negative question

Predictor	B	SE	t	P
Model A				
N= 40 R^2= 0.18				
Age	- 0.299 (-0.48)	0.142	- 2.107	0.043*
ToM	0.242 (0.18)	0.296	0.817	0.420
Syntactic adequacy 1	0.244 (0.25)	0.316	0.771	0.446
Age*ToM	0.367 (0.27)	0.284	1.295	0.205
Age* Syntactic adequacy 1	-0.086 (-0.08)	0.245	- 0.350	0.728
Age*ToM* Syntactic adequacy 1	- 0.063 (-0.03)	0.544	- 0.116	0.908
ToM* Syntactic adequacy 1	- 0.275 (-0.13)	0.578	- 0.475	0.638
Semantic adequacy	0.036 (0.07)	0.163	0.222	0.826
Constant	0.358	0.148		
Model B				
N= 40 R^2=21				

Age	- 0.353 (-0.6)	0.164	- 2.149	0.040*
ToM	0.046 (0.03)	0.283	0.163	0.871
Age*ToM	0.047 (0.03)	0.331	0.143	0.887
Semantic adequacy	0.002 (0.003)	0.116	0.015	0.988
Syntactic adequacy 2	0.466 (0.29)	0.409	1.140	0.263
Age* Syntactic adequacy 2	0.349 (0.18)	0.543	0.642	0.525
ToM* Syntactic adequacy 2	0.001 (0.0)	0.889	0.002	0.999
Age*ToM* Syntactic adequacy 2	1.152 (0.31)	1.192	0.966	0.341
Constant	0.341	0.135		
Model C				
N= 40 R^2= 0.20				
Age	- 0.210 (-0.33)	0.146	- 1.435	0.161
ToM	0.088 (0.07)	0.366	0.240	0.812
Age*ToM	0.434 (0.31)	0.299	1.452	0.156
Semantic a dequacy	0.025 (0.05)	0.187	0.135	0.894
Age* Semantic a dequacy	- 0.003 (-0.01)	0.142	- 0.024	0.981
ToM* Semantic a dequacy	0.450 (0.39)	0.429	1.050	0.302
Age*ToM* Semantic a dequacy	- 0.087 (-0.09)	0.310	- 0.282	0.780
Constant	0.318	0.169		

*p<.05

Table B.10. Regression analysis of the relationships between single clause analysis for the control question and age, ToM, and complement production scores. (Standardized Regression Coefficients in parentheses)

Dependent variable: Single clause analyses of the control question

Predictor	B	SE	t	P
Model A				
N= 40 R^2= 24				
Age	-0.531 (-0.45)	0.256	- 2.076	0.046*
ToM	0.043 (0.02)	0.534	0.081	0.936
Syntactic adequacy 1	0.014 (0.01)	0.571	0.024	0.981
Age*ToM	-0.447 (-0.17)	0.512	- 0.872	0.390
Age* Syntactic adequacy 1	0.105 (0.05)	0.442	0.237	0.814

Age*ToM* Syntactic adequacy 1	-0.105 (-0.03)	0.983	- 0.107	0.915
ToM* Syntactic adequacy 1	-0.143 (-0.04)	1.043	- 0.137	0.892
Semantic adequacy	0.227 (-0.2)	0.294	- 0.769	0.447
Constant	1.009	0.267		
Model B				
N= 40 R^2= 34				
Age	- 0.549 (-0.47)	0.282	- 1.949	0.060
ToM	- 0.341 (-0.13)	0.485	- 0.702	0.488
Age*ToM	- 0.698 (-0.27)	0.568	- 1.227	0.229
Semantic adequacy	- 0.079 (-0.08)	0.199	- 0.396	0.695
Syntactic adequacy 2	0.280 (0.09)	0.701	0.399	0.693
Age* Syntactic adequacy 2	0.376 (0.104)	0.931	0.404	0.689
ToM* Syntactic adequacy 2	- 0.818 (-0.13)	1.524	- 0.537	0.595
Age*ToM* Syntactic adequacy 2	2.395 (0.34)	2.044	1.172	0.250
Constant	1.040	0.232		
Model C				
N= 40 R^2= 27				
Age	- 0.376 (-0.32)	0.263	- 1.427	0.163
ToM	- 0.369 (-0.15)	0.659	- 0.561	0.579
Age*ToM	- 0.369 (-0.14)	0.539	- 0.686	0.498
Semantic adequacy	- 0.058 (-0.06)	0.337	- 0.172	0.865
Age* Semantic adequacy	0.031 (0.03)	0.255	0.122	0.904
ToM* Semantic adequacy	0.499 (0.23)	0.772	0.647	0.522
Age*ToM* Semantic adequacy	- 0.430 (-0.22)	0.558	- 0.771	0.446
Constant	1.008	0.305		

*p<.05

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