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The grammatical acquisition of wh-questions in early English multi-word speech

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"The weakest argument of all is the notion that if we cannot think of a way to teach something, it must not be learned or learnable"

Ervin-Tripp (1971)

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICIES

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Abstract

Recent studies of wh-question acquisition have tended to come from the nativist side of the language acquisition debate with little input from a constructivist perspective. The present work was designed to redress the balance, first by presenting a detailed description of young children's wh-question acquisition data, second, by providing detailed critiques of two nativist theories of wh-question acquisition, and third, by presenting a preliminary account of young children's wh-question development from a constructivist perspective. Analyses of the data from twelve 2 to 3 year old children collected over a year and of data from an older child (Adam from the Brown corpus, 1973) are described and three conclusions are drawn. First, it is argued that the data suggest that children's knowledge of how to form wh-questions builds up gradually as they learn how to combine lexical items such as wh-words and auxiliaries in specific ways. Second, it is concluded that two nativist theories of grammatical development (Radford, 1990, 1992, 1995, 1996, Valian, Lasser & Mandelbaum, 1992) fail to account successfully for the wh-question data produced by the children. Third, it is asserted that the lexically-specific nature of children's early wh-questions is compatible with a lexical constructivist view of development, which proposes that the language learning mechanism learns by picking up high frequency lexical patterns from the input. The implications of these conclusions for theories of language development and future research are discussed.

Section 1: Review

Chapter 1

Theories of Grammatical Development

1.1. Introduction

By the age of six years at the latest, normally developing children seem to have acquired most of the complex grammatical rules for combining words that take an adult second-language learner years of hard study to master. Attempts to explain this phenomenon range from descriptions of complex grammars through semantic-syntax linking rules to connectionist models but as yet there is no universally agreed upon solution. Current explanations of language acquisition can be divided broadly into two approaches based on very different assumptions. Nativist approaches argue on logical grounds (see Gold, 1967) that language is unlearnable unless children have access to innate grammatical principles (the learnability assumption; see Pinker 1984). Thus, the nativist approach stems from the assumption that innate language-specific knowledge that approximates to or is a subset of adult grammatical knowledge must be available to the language learning child. Modern constructivists, on the other hand, contend that there is no good evidence that the language cannot be learnt without such innate linguistic knowledge. Instead, they reason that general innate cognitive or semantic principles together with the information available in the child's input allow language to be learnt. These innate principles may be specially tuned towards linguistic input but are, importantly, not qualitatively different from the structures involved in other forms of cognitive activity.

Researchers from the two approaches also differ in their interpretation of Occam's razor. Nativists maintain that the most parsimonious explanation of acquisition is the one that posits the least amount of change from the child to the adult state. Thus, the simplest solution is one in which children have access to all the grammatical categories available to the adult from the beginning. Constructivist researchers, on the other hand, argue that the most parsimonious theory of language acquisition is one that posits the least amount of innate architecture necessary to learn a language. On this view, we should only adopt a theory positing more rather than less innate structure when the multi-word speech data convince us that this is the case.

These differences between nativist and constructivist approaches make it very difficult to find common ground on which to debate the two approaches. It is often argued that the first constructivist accounts were designed in response to early nativist work and that modern nativist theories such as those of Valian and Radford were constructed as a response to the failure of these constructivist theories to explain the early acquisition data. This is true to an extent. However, although modern nativists take account of the data presented by constructivist research, nativist theorists pay little attention to constructivist claims that language can, in fact, be learnt. Similarly, most constructivist researchers remain unconvinced by the learnability assumptions of nativism. As a result, comparing the two approaches on theoretical or logical grounds is unlikely to produce a consensus.

However, it is possible to compare the approaches on empirical grounds. Since the basis of scientific work is falsifiability, it must be possible to derive predictions that distinguish between theories from a consideration of the data. It is not possible, from a scientific perspective, to argue as Roeper (1992) tries to do, that:

> "the primary argument on behalf of an acquisition theory is its intrinsic logic and deductive power, not the claim that every predicted stage is overt and open to inspection by researchers" (Roeper, 1992, pg. 341).

Although it is important that theories have logical and theoretical consistency, they must also be testable against the multi-word speech data. As Popper (1966) argues, since

> "some social scientists are unable, and even unwilling, to speak a common language ... The only course open to the social sciences is to forget all about the verbal fireworks and to tackle the practical problems of our time with the help of the theoretical methods which are fundamentally the same in *all* sciences. I mean the methods of trial and error, of inventing hypotheses which can be practically tested, and of submitting them to practical tests" (Popper, 1966, pp. 221-222, italics in original).

This may be the only way to differentiate between sets of theories that are based on what are, in essence, contradictory theoretical assumptions.

The aim of the present work is to compare two current nativist and one constructivist approach to language acquisition by evaluating these theories on the basis of evidence from children's early wh-questions. In recent years, research on how children acquire wh-questions has stemmed mostly from the nativist side of the language acquisition debate and has been largely unchallenged by non-nativist researchers. There seem to be two reasons for this. First, the traditional non-nativist position has, for many years, focused on the role that semantic and/or cognitive categories play in the construction of grammatical categories. Since wh-question construction relies almost solely on the manipulation of grammatical rules that have no obvious semantic or cognitive basis, the acquisition of wh-questions does not seem to be explicable in these terms. Second, although alternative constructivist theories (e.g. semantic-distributional accounts) have been proposed, these have tended to concentrate on explaining the acquisition of very early multi-word speech, ignoring later developing constructions such as passives, embedded clauses and wh-questions.

The present thesis aims to begin to redress the balance by evaluating whether nativist theories can account for wh-question acquisition and by providing a possible explanation of wh-question acquisition from a constructivist perspective. To achieve this, the work will be divided into three sections. The first comprises chapters 1 and 2. Chapter 1 summarises the history of research into grammatical acquisition in order to place the theories discussed in chapter 2 in their wider context. Chapter 2 focuses more specifically on wh-question acquisition, detailing how wh-questions are said to be constructed, outlining some of the research that has already been conducted on this topic and considering the predictions made by certain models of grammatical development.

Section 2 comprises chapters 5 to 7 and incorporates the method and analysis chapters. Chapter 3 describes the data that will be used for the analyses. Chapter 4 provides a detailed outline of the sequence of acquisition of wh-questions, chapters 5 and 6 evaluate a maturational model (Radford, 1990, 1992, 1995, 1996) and a full competence account (Valian, Lasser & Mandelbaum, 1992) of wh-question acquisition and chapter 7 presents and tests an alternative constructivist theory of development. Section 3 consists of chapter 8, which summarises the findings and draws some overall conclusions.

1.2. Nativist theories

Nativist theorists of grammatical development start from the presupposition that it is impossible for grammar to be learnt simply from listening to speech (see Gold, 1967; Pinker, 1979). As well as logical arguments (e.g. Gold's theorem, 1967), three empirical justifications for this view have been proposed. First, it is suggested that not all language addressed to children consists of well-formed utterances. Children hear utterances that contain incomplete and ungrammatical sentences and have a limited exposure to the full range of structures present in the language. Without innate principles to guide them, it is argued, children would not be able to distinguish grammatical from ungrammatical utterances (the poverty of the stimulus argument, see Berwick & Weinberg, 1984; Lightfoot, 1982). Second, children come to use sentences that never occur in their language learning environment but they form very few ungrammatical utterances. The implication of this is that children are being guided by rules that govern the grammaticality of their production. Third, children are not given feedback as to the grammaticality of their utterances (the no negative evidence problem, see e.g. Bowerman, 1988) without which children cannot learn which utterances are ungrammatical simply from listening to input. To nativists, these findings suggest that the language learning task is impossible without the aid of certain innate language principles. The aim of nativist research is, therefore, to find the inherent properties and tendencies that are common to all languages and to specify how children identify the way in which these universal properties apply to their own language.

1.2.1. Transformational generative grammar

The first widely accepted model of grammar, transformational generative grammar (TGG or Standard Theory), was proposed by Chomsky (1957, 1965). In this model, Chomsky argued that grammar consisted of two types of rules - phrase structure rules and transformational rules - that together allow language users to generate all the possible sentence types in a given language. Phrase structure rules are used to generate basic sentence types (e.g. simple, active, affirmative declaratives). Transformational rules apply to the underlying deep structure (which corresponds to a simple, active declarative), and are used to derive the final spoken form - the surface structure. Thus, phrase-structure rules can be used to generate simple, basic, deep structure declaratives and transformational rules can be applied to these declaratives to generate surface form sentence types such as passives, relative clauses or questions.

Work on language acquisition from a TGG perspective (e.g. McNeill, 1970) followed the presentation of the linguistic theory and many of the early studies of wh-question acquisition were conducted within the framework of TGG. This work will be considered in more detail in chapter 2. However, TGG was criticised for a number of shortcomings, both theoretical and empirical. First, the theory seemed unnecessarily complex. A large number of transformational rules were necessary to capture the diversity of structures that grammars allow, some of which had rule-specific special conditions. In addition, there were few limits to how complex a transformational rule could be and, so, some were very complicated. When more than one rule had to be applied, the rules had to be ordered in particular ways and some transformations were obligatory while others were optional. The child had to learn how and when to apply these rules and how to manage the complex interactions between them. Attributing this vast task to the child seemed to complicate, rather than simplify, the language acquisition process (Atkinson, 1992).

Second, empirical studies of child language data failed to find any evidence that children were operating with adultlike, abstract grammatical knowledge. For example, Bowerman (1973b) and Braine (1976) reported that children's early utterances were much more restricted in their terms of reference than would be expected if they were working with adultlike grammatical categories. They argued that the structure of such utterances could be captured more accurately in terms of semantic or positional formulae (e.g. agent+action, hitter+hit). As a result, once Chomsky proposed an alternative theory - principles and parameters theory (also termed PPT or government and binding (GB) theory, Chomsky, 1981) - this soon replaced TGG as the linguistic framework for acquisition research.

1.2.2. Principles and parameters (PPT) or government and binding (GB) theory

PPT forms the framework for most modern nativist theories of grammatical acquisition, including that of Valian (1986, 1991) and Radford (1990, 1992, 1995, 1996) which will be discussed in chapters 5 and 6 of the present work. In PPT, the vast number of phrase-structure and transformational rules proposed in TGG have been streamlined into simpler phrase structure rules, that predict how all phrases of the language should be organised, and one transformational rule, move $\propto$ (alpha), which translates simply as 'move something'. Instead of a set of transformational rules, the theory posits limits on what can be moved and where it can be moved to. Movement of an element, for example, the wh-word from the object position to its landing site at the beginning of an object wh-question (e.g. from *John is eating what?* to *what is John eating?*) leaves an empty hole, a trace. In addition, lexical information about individual words stored in a mental lexicon, takes on the role that was previously played by phrase structure rules, specifying the kinds and positions of constituents that may combine in a sentence. Therefore, for example, the verb *to kick*, will have the information associated with it that the verb takes an obligatory subject NP (e.g. <u>*John*</u> *kicks*).

The advantage of PPT is that the large number of language- and construction-specific rules that were described by TGG have been replaced by a small number of powerful and universal innate principles: universal grammar (UG). UG restricts the number of possible hypotheses about the language that the child has to consider, making the learning task simpler. Language diversity is explained by positing that UG includes parameters, or switches, that learners must set in order to construct the grammar of their language. For example, some languages organise their phrases with phrase structure heads first (e.g. English) and others with heads last (e.g. Japanese). Children are able to set these parameters after a relatively brief exposure to their language.

Unfortunately, although the problem of over-complexity that faced TGG was overcome, the issue of explaining why young children's language was impoverished compared to that of the adult remained. For example, young children consistently omit grammatically obligatory constituents such as determiners, subjects, auxiliaries and morphology and do not produce complex structures such as passives and relative clauses until relatively late in development. In particular, nativist theorists could not explain why children make grammatical errors even after extensive exposure to their language. As Bowerman (1973a) pointed out, it is empirically unsound to attribute knowledge to children for which there is little or no evidence. Thus, the theory as presented could not explain the nature of the early multi-word speech data.

In response to this criticism, nativist researchers have begun to formulate theories that take account of the differences between adult and child speech, while remaining true to the assumptions of nativism that a complex structure such as grammar cannot be learnt without access to innate linguistic principles. In order to achieve this, theorists have begun to argue that children are somehow prevented from making use of their full knowledge, although such knowledge is available to them. What it is that prevents children using their knowledge is, however, hotly debated. Modern nativist theory can, thus, be broadly divided into two camps: those that suggest that children have access to adultlike grammatical knowledge but are prevented from utilising this knowledge in their production (continuity theories), and those that suggest that some aspects of linguistic knowledge only become available to the child at a later point in time (competence theories).

1.2.2.1. Continuity theories

Continuity theories are based on the idea that children have full access to universal grammar. Errors thus occur for reasons other than an impoverished knowledge base. One of the most influential continuity theories in the current literature is that proposed by Wexler and his associates (Schutze & Wexler, 1996; Wexler, 1994, 1996, 1998). Wexler's optional infinitive hypothesis states that by the time children start to produce multi-word speech they have already set all the basic parameters of their language. Children are hypothesised to make errors due to an initial stage in which they lack the knowledge that tense is obligatory in finite clauses. This knowledge only matures at a later stage of development.

Wexler claims to provide an explanation for a number of phenomena seen in the multi-word speech data including subject omission, pronoun case marking errors and the patterning of negative placement (see Schutze & Wexler, 1996; Wexler, 1994, 1996, 1998). However, the theory cannot account for the fact that children do not treat all verbs equally with regard to tense. Thus, some verbs occur almost always with tense and others almost always without tense (see Pine, Lieven, Rowland & Theakston, 1999). In addition, data from Dutch, German and English children suggest that verbs occurring in different positions in children's speech come from different populations with different distributional characteristics (Ingram & Thompson, 1996; Jordens, 1990; Pine et al, 1999). As it stands, the optional infinitive hypothesis cannot incorporate findings of this type. It also fails to make clear, detailed predictions about wh-question acquisition (though see Wexler, 1998, for preliminary ideas) so will not be considered in any detail in the present work.

An alternative idea is that proposed by performance limitation theory. Like Wexler, performance limitations theorists argue that children set all the basic parametric values of their language before they start to produce multi-word speech. Unlike Wexler, however, these theorists argue that errors occur as a result of the impact of extra-grammatical performance limitations. There are few who would dispute that performance limitations constrain speech in children and adults but where performance limitation theorists differ from other researchers is in their suggestion that performance limits are the main, or even sole, reason for children's grammatical errors. In other words, they argue that even young children are working with full, adultlike, grammatical competence.

One of the earliest performance limits accounts of early language development was that proposed by L. Bloom (1970). Bloom suggested that children's production was limited by a reduction transformation that systematically deleted certain constituents to reduce processing load. The probability that a certain item would be deleted was a function of factors such as the familiarity of the verb, the inclusion of a negative or the presence of certain discourse features. Unfortunately, although a well-specified model, the addition of a reduction transformation to be calculated during speech meant that the child's grammar would actually be more complex in its earlier stages than that of the adult (Brown, 1973). This would probably increase, rather than decrease, the processing load required in sentence formation.

An alternative solution has since been proposed. Working within the remit of PPT, Valian (1986, 1991) and P. Bloom (1990) have suggested that children have an adultlike phrase-structure grammar (Valian, 1986) but omit obligatory constituents from utterances due to a range of processing factors. These factors all restrict the scope of adult speech to an extent but have a greater impact on early speech due to children's lack of expertise at manipulating language. Valian's (1991) proposed performance-related limits on production include length, the content of the message the child wants to convey, syntactic and discourse requirements and pragmatic factors, and Valian provides a variety of examples of how these limits can impact on speech (e.g. Valian, 1991). In particular, her account (Valian, Lasser & Mandelbaum, 1992) provides a comprehensive explanation of wh-question acquisition.

As theoretical justification for the approach, performance limitation theorists have argued that theirs is the most parsimonious explanation of acquisition as it proposes no discontinuity between the state of grammatical knowledge in children and adults. However, the status of the empirical evidence in support of the approach is less clearly defined. Logically, it is hard to see how any data could contradict such an account. This is because a combination of different performance limits could, in theory, predict any pattern of acquisition. For example, auxiliary omission could be predicted if we argue that restrictions on utterance length lead children to omit items that carry the least semantic information. Conversely, subject omission could be explained by a performance limit that acts on the beginning of the sentence (c.f. Valian, 1991). It may be that the only way to test performance limitation accounts is to examine their claims about the status of the child's grammatical competence. Recently, many researchers (e.g. Pine, Lieven & Rowland, 1998) have done just this, arguing that such approaches attribute too much knowledge to the child and thus cannot explain the restricted nature of the early multi-word speech data. However, performance limitation theories have rarely been explicitly tested against the wh-question acquisition data. Thus, one of the aims of the present work is to evaluate a performance limitation account of wh-question acquisition. These issues will be discussed further in chapters 2 and 5.

1.2.2.2. Competence theories

Competence theories are also based on the assumption that the most parsimonious solution to the language acquisition problem is one that posits continuity between the mechanisms available to children learning language and those involved in adult processing. However, many competence theorists (e.g. Atkinson, 1996) argue additionally that the most extreme version of the continuity assumption is incompatible with the nature of early multi-word speech. In this view, the most parsimonious explanation of the differences between child and adult utterances is that there is a difference in the status of the grammatical competence attributable to children and adults. However, since, according to the learnability assumption, children must have innate grammatical knowledge, competence theorists suggest that some aspects of this knowledge are not accessible until later in development.

The simplest explanation of child language from a competence perspective is the idea that the parameters that learners must set in order to construct the grammar of their language are not set correctly until the child has gained considerable experience of the target grammar. Thus, the language-learning child makes errors because s/he is engaged in the process of determining the correct parametric values. The most widely cited of these parameter-setting accounts is the theory proposed by Hyams (1987) to explain the omission of subjects in early child language. According to Hyams (1987), children have to decide whether subjects are optional or obligatory in the particular language they are exposed to. This decision involves having to 'set' the pro-drop parameter. The initial setting of this parameter is assumed to be for optional subjects, so exposure to a language in which subjects are obligatory (e.g. English) is necessary to trigger the parameter to switch to the obligatory setting. Due to either processing limitations or to the maturation of grammatical capability, children go through a long period in which they are insensitive to the triggering data.

There are, however, problems with the parameter-setting theory, both on logical and empirical grounds. First, Valian (1990) argues that it is logically impossible for the child to reset her/his parameter. This is because a child interpreting data according to a grammar set at a null subject parameter will not be able to identify data that contradict her/his initial grammar (though see Kim, 1993, for an explanation designed to overcome this problem). In addition, the theory cannot explain how English learning children will learn that subjects are obligatory given that subjects are occasionally omitted in English speech (in imperatives, e.g. *get away from there*, or in ungrammatical but acceptable questions, e.g. *want a biscuit?*). In response, Hyams (1987) has suggested that hearing expletive pronouns (e.g. *it* in *it is raining*) would trigger the setting of the null subject parameter to the correct value. However, Hyams, importantly, fails to explain how children learn to distinguish between expletive and non-expletive pronoun use, knowledge which children would necessarily have to acquire before setting the pro-drop parameter.

Second, although Hyams argues that the data fitted the predictions of her account, further work has suggested that this is not the case. For example, although Hyams reports that her predictions about the timing of the production of subjects (including expletives), modals and *be* are supported by the acquisition data, this finding has not been replicated (Valian, 1991). In addition, subjects are not omitted uniformly as the approach would predict: lexical subjects are more likely to be omitted than pronominal subjects (P. Bloom, 1990; Valian, 1991) and children are more likely to omit articles from subject NPs than from object NPs (Gerken, 1991). Finally, Valian (1991) has found that Italian children aged 2 years old omit subjects almost twice as often as English 2 year olds despite the fact that, according to the theory, they are working with the same parameter setting as young English children. Thus, although more evidence needs to be acquired, I would argue that parameter setting accounts need to be expanded and elaborated before they can make serious proposals that explain how and why children produce and fail to produce certain grammatical structures in their early speech.

An alternative competence explanation proposes that, rather than incorrectly set parameters, the young language learning child has an immature or incomplete grammar, with other aspects of UG maturing later in development. There are various forms of these maturational accounts (see e.g. Roeper & Weiseenborn, 1990; Lebeaux, 1987; Guilfoyle & Noonan, 1992), all of which attribute different kinds of incomplete grammars to the child. However, the account that will be discussed in the present work is the one that makes the most specific claims about wh-question acquisition: Radford's small clause hypothesis (1990, 1992, 1995, 1996). According to this theory, certain universal principles may be genetically programmed to come on-line only at certain points in the child's linguistic maturation. This results in 3 distinct acquisition stages. During the first stage, children's speech is acategorical. Children seem to have little or no knowledge of how to access grammatical properties and rules. At about 1:8, children enter the categorical stage in which grammatical knowledge starts to mature, but only have access to the lexical-thematic structures of noun (N), verb (V), adjective (A) and preposition (P). The functional categories: determiner (D), inflection (I) and complementizer (C) do not mature until approximately age 2;0 (+/- 20%), the third stage in development.

The absence of functional categories in the child's linguistic system before age 2 means that the child cannot produce a whole range of related structures. Radford cites direct evidence from a large number of corpora that structures such as possessive *'s*, case-marked pronouns, modal auxiliaries, infinitival *to* and nominative case-marking do not appear in children's data until at least age 2. Unfortunately, evidence from other studies seemed to suggest that the data did not fit the predictions of the theory. In fact, it is now generally agreed that, contrary to the small clause hypothesis, items associated with the functional categories <u>are</u> present in the earliest multi-word speech and that children continue to make grammatical errors well after the functional categories are hypothesised to come on-line (see Valian, 1991). What is less well known is that Radford has modified his theory to account for these findings (Radford, 1992, 1995 1996). However, as will be argued in chapter 6, the modifications to the theory carry their own problems which stem from the issue of whether it is still possible, within the theory, to predict the impact maturational change will have on children's utterances.

1.3. Constructivist theory

In the early 1960s, several researchers (e.g. Braine, 1963; Brown & Fraser, 1963; Miller & Ervin, 1964) suggested that the learnability assumption carried an inherent logical contradiction. They argued that if basic grammatical relations are unlearnable because they are definable only in the abstract underlying representation of the utterance, all aspects of deep structure must be unlearnable for the same reason. However, within PPT, some aspects of deep structure are language-specific and therefore must be acquired by exposure to the language (e.g. the underlying order of constituents, see Bowerman, 1973b). If children command a learning process powerful enough to make these abstractions from the input, the same process may be able to deal with other, or even all, aspects of grammatical competence. To return to the poverty of the stimulus argument, language addressed to children may consist of badly formed utterances but children must be able to learn grammar from the language they hear if they are to learn language specific grammatical relations. In addition, although children do not receive direct positive feedback about the grammaticality of their utterances, they must receive feedback (for example, from their own learning mechanism) about what is grammatical, if only to retreat from errors such as *breaked*, *mans* and *I fell the dolly* (Bowerman, 1987).

Constructivist researchers have also argued that the speech that children hear may not be as impoverished as previously suggested. Many studies have shown that speech to children (Child-Directed Speech or C.D.S.) seems specially adapted to make the language learning task easier (Snow, 1977). Although the issue of whether C.D.S is necessary to language learning is hotly debated (see cross-linguistic studies such as that by Schieffelin & Ochs, 1986), the claim that speech to children is necessarily impoverished has lost some of its weight as a result. At the very least, it suggests that the role of input should be studied in more detail before it can be dismissed.

Finally, there is evidence that young children's grammatical knowledge is more restrictive in scope than nativist researchers have suggested. In fact, the nature of children's knowledge seems to be most accurately captured in terms of the semantic or situational role properties of particular words or even in terms of low-scope formulae organised around lexical items. In other words, children seem to treat words differently despite such words being united by a single grammatical category in the adult grammar. For example, Braine (1976) has suggested that the first productive structures produced by young children are limited scope positional formulae, produced in order to convey specific kinds of meanings. Braine (1976) has argued that early syntactic development consists of learning simple positional formulae, some of which may be lexically specific (e.g. *more* + X or X + *gone*, where X stands for a group of nouns) but others which are broader in range (e.g. agent + action).

1.3.3. Early constructivist theories

Given the arguments presented in the section above, constructivists have contended that it was premature to dismiss the idea that language could be learnt without access to UG. However, if constructivists were to argue that children did, in fact, learn language, they had to explain how it was learnt. The most obvious solution to this problem was to hypothesise that children accessed grammar through a more salient route. Early constructivist accounts of acquisition, therefore, argued that children could learn the grammatical categories underlying sentences by associating them with their semantic or cognitive equivalents. One proposal (see e.g. Bates, 1979; Bates, Bretherton & Snyder, 1988; Macnamara, 1972; Piaget, 1929, 1955) suggested that language development would follow on from the child's mastery of the relevant cognitive achievements. In other words, it was argued that language forms could only be acquired after the child had reached the relevant stage of conceptual development. For example, disappearance words such as *gone* would be acquired soon after the child masters object permanence (Gopnik & Meltzoff, 1987) and wh-words such as *when* and *why* would be mastered once the child has acquired the concept of temporal and causal conjunctions. Alternatively, it was suggested that the categories underlying early multi-word speech were based on underlying semantic, rather than syntactic, roles and relations. The child was said to learn language by mapping semantic roles such as agent, action, object and location, onto the corresponding syntactic categories (e.g. subject, predicate, verb and direct object). The linguistic underpinnings for this idea stemmed from Case Grammar (Filmore, 1968) which states that nouns can be semantically related to verbs in only a relatively small number of ways or 'cases' (e.g. agent, instrument, objective or locative). The child was said to acquire grammatical rules by determining the positioning of cases in utterances.

Unfortunately, the empirical evidence to support these approaches was not convincing. Cognitive theory had some success at explaining the content of early child language (e.g. the acquisition of *more* before *less*; see Clark, 1977; Carey, 1978) but experienced less success when called upon to explain the acquisition of grammatical structure (see Johnston, 1985, for a consideration of the acquisition of the passive). In addition, many such theories relied on correlating language achievements with Piagetian stages of development, which themselves are problematic (see e.g. Donaldson, 1978). Thus, although some cognitive prerequisites are inevitably necessary for language development, the nature of the link between cognitive and linguistic achievements is still very poorly defined. Similarly, the fit between the case grammar categories and those that the child seemed to be working with was far from perfect. Evidence suggested that children's semantic categories were more concrete than case grammar categories. The objective case, for example, contains a heterogeneous collection of semantic roles including objects of verbs, inanimate subjects of intransitive verbs, nouns of which adjectives are predicated and nouns for items possessed (Bowerman, 1973a). Case grammar provided no explanation of why children should assign these to a common category (Braine, 1976) nor of how some patterns (e.g. *more+X*) fit into the case categories.

Despite these problems, the idea that learning simple order rules for combining words that perform semantic functions could 'bootstrap' the child into syntax was a powerful one. Bowerman (1973b) showed that the words that correspond to syntactic subject, verb and direct object in young children's utterances were initially much more restrictive in terms of their semantic roles than nativist accounts would predict. For example, sentence subjects in very early multi-word speech tend to have an agentive relationship to the verb and early verbs tend to be action words. However, the question of what mechanism allows the child to progress from semantic to syntactic categories was not one easily answered as syntactic categories do not map directly onto their semantic correlates but are defined in terms of common distributional properties. Subjects are not always agents (e.g. *the key opened the door*) and verbs are not always action words (e.g. *Mary thinks about the problem*). How the child progressed from the earlier restrictive semantic categories to the more abstract general syntactic categories was a problem that needed to be addressed.

1.3.2. Schlesinger's semantic-assimilation hypothesis (1982, 1988)

A possible explanation was provided by Schlesinger (1982, 1988) who suggested that the child is acquiring rules that map conceptual categories and relations into certain utterance positions. In this model, early word classes could be built from semantic categories such as agent, action, and location by a process of semantic assimilation. For example, a child's initial verb category would consist only of action words. Words that are semantically similar to the action words already in the category would be incorporated into the prototypical verb/action category and the formal similarities between the words noted (e.g. 'takes progressing *ing*' or 'occurs after an agent'). Then, in order for the child to expand his action category to resemble that of the adult verb category, the child's learning mechanism would make use of the formal similarities between members of the action category. Thus, a child with a semantic agent-action rule who hears the sentence *Mary thinks about the problem* would note the formal similarities between the verb *think* and her/his class of action words. S/he would then expand her/his action category accordingly. In this way, the action category would come finally to resemble the syntactic verb category.

Although a coherent and plausible explanation of how children could 'bootstrap' into syntax, the theory's predictions are not borne out by the data. Children seem to be capable of acquiring distinctions that have no clear semantic correlate such as the mass/count noun distinction (Gathercole, 1985), linguistic gender (Levy, 1983a, 1983b) and noun/verb distinctions in Hebrew (Levy, 1988), and do so early and effortlessly. Similarly, young children are capable of acquiring non-concrete nouns such as *walk* (denoting action) and *minute* (denoting abstraction) as well as non-actional verbs such as *want* and *love*. In addition, actional adjectives such as *noisy* and *naughty* are never misclassified, as would be expected if children's syntactic categorisation was based on semantic correlates (Maratsos, 1982). Since pure semantic accounts could not explain the multi-word speech data, such accounts have largely been abandoned in favour of theories that incorporate an early role for distributional learning - semantic-distributional accounts.

1.3.3. Semantic-distributional accounts

The semantic-distributional approach includes a number of different accounts with one aspect in common: they posit that distributional or positional commonalties in the language guide children's learning of grammatical categories and rules. These theories posit that nativist and traditional semantic accounts attribute to children categories and rules that are more abstract than the data would indicate. They suggest instead that children learn language by picking up distributional patterns (as well as the semantic regularities and similarities common to certain word classes) and use these to form syntactic categories. For example, Maratsos (1982) argued that a build-up of knowledge of the similarities between the privileges of occurrence of particular lexical items allows children to group these lexical items into categories that approximate to adult formal word classes.

The problem, as Pinker (1979, 1984) has pointed out, is that such techniques allow for the possibility for serious word class error since children who construct word classes by paying attention to distributional similarities will be misled by the many words that belong to more than one word class. In addition, there are a large number of possible distributional regularities in even the most simple sentences. The task of sifting through all these possibilities to arrive at the right ones for a particular language would be a lengthy, if not impossible, task (Pinker, 1984). Most distributional accounts of language acquisition have, in response, concentrated on outlining ways to restrict the child's search space. For example, Braine (1987) has suggested that there is some evidence that children learn word classes by grouping words initially according to semantic and phonological similarities and then expanding these groups to include other words that share distributional properties. This idea is echoed in work by Maratsos (e.g. Maratsos 1988, 1990) who has suggested that both semantic and distributional information could be the key to children acquiring formal word classes. Bates & MacWhinney (1987) have also argued that the statistical properties of the input and a small number of cognitive principles allow the child to extract the relevant distributional semantic or phonological regularities from the input. Alternatively, Slobin (1985) has proposed that children are equipped with innate operating principles (OPs) that concentrate attention towards particular parts of the input. These allow children to pay attention to a certain set of linguistically relevant features, compare previously learnt sequences of information with newly acquired structures and, ultimately, develop grammatical rules. Finally, Tomasello (1992) has suggested that children build up knowledge of the combinatorial properties of words by paying attention specifically to verbs and other relational terms. According to his verb island hypothesis, children initially concentrate on learning how to organise their knowledge around verb specific patterns (e.g. hitter-hit-thing hit). Generalisation to grammatical categories and relations occurs as the commonalities between the functions of different words are abstracted.

These approaches have also attracted a number of criticisms. In particular, the argument has been put forward that the addition of cognitive, semantic, and phonological properties to the information the child must consider may actually increase the child's search space rather than restrict it (Pinker, 1984). For example, according to Slobin's (1985) theory, an unwieldy number of universal OPs would be necessary to capture the range of cross-linguistic differences (Rispoli, 1991). In addition, the specifics of many distributional theories do not fit the data. For example, Tomasello's (1992) idea that the child's attention focuses initially round verbs cannot account for certain aspects of the data. Pine, Lieven & Rowland (1998) have presented findings that seem to show that children's early knowledge is organised around high frequency markers (such as *a, the* and *I*) as well as verbs.

However, despite the problems with theories such as those presented above, modern semantic-distributional approaches are at least accordant with the evidence provided by studies of the acquisition data. In particular, they are compatible with a growing number of studies which suggest that children's early utterances pattern lexically as if children are picking up pockets of lexically specific information rather than working with knowledge of grammatical, cognitive or semantic categories (e.g. Akhtar & Tomasello, 1997; Pine & Martindale, 1996; Lieven, Pine & Baldwin 1997; Theakston, Lieven, Pine & Rowland, 1999; Tomasello, 1992). Evidence is accumulating that inherent similarities between words can provide clues to grammatical word classes and can be used to make syntactic decisions (see e.g. Brooks, Braine, Catalano & Brody, 1993) and connectionist implementations have shown that it is possible to mimic the course of language acquisition without building in innate grammatical knowledge (see e.g. Elman, 1990; MacWhinney & Leinbach, 1991; Plunkett & Marchman, 1991; Rumelhart, & McClelland, 1986; Elman, Bates, Johnson, Karmiloff-Smith, Parisi & Plunkett, 1996, Gobet & Pine, 1997). Although much of the modelling work tends to address certain areas of learning such as past tense verb learning and not the question of how children co-ordinate the whole language learning task (though see Gobet & Pine, 1997 for a preliminary attempt), these studies show that the learnability problem may not be such an obstacle as was once thought.

Constructivist approaches are thus proving a serious challenge to traditional nativist models. In particular, there is one idea that seems compatible with much of the evidence for lexical specificity presented in the literature. Pine et al (1998) have proposed a lexical constructivist account that suggests that children's initial grammar may consist of pockets of lexically specific knowledge patterning around frames that have occurred with high frequency in the input. Generalisation occurs as the children build up knowledge of the commonalties between different lexical frames and the items with which they occur. However, this and other semantic-distributional models of language acquisition have generally failed to address the issue of how later developing structures such as wh-questions are acquired. One aim of the present work, therefore, is to address whether distributional accounts, that of Pine et al (1998) in particular, can explain the pattern of wh-question acquisition data.

1.4. Summary

Nativist approaches to language acquisition start from the baseline provided by Chomsky (1957) and Gold (1967) that languages are essentially unlearnable unless the child has innate, linguistic principles that guide the language learning task. The task that confronts the nativist linguist is to explain how children map language universal principles onto the specific language they are learning and why children make errors in the process. Two types of solution to this problem have been proposed. Continuity theorists argue that children learn to set the parameters of their language very early on in the acquisition process and make errors in multi-word speech for other reasons, such as tense optionality or the impact of extra-grammatical performance limitations. Competence theorists argue either that the data are consistent with the idea that children are still setting the parameters of their language, or that some aspects of UG are not available until later points in development. The theoretical and logical arguments in favour of both approaches are hotly debated and, I would argue, there is little to choose between them. On empirical grounds, however, the evidence in support of these theories is less clear-cut, especially in relation to wh-question acquisition. One aim of the present work is, therefore, to evaluate one performance limitation and one maturational theory against the wh-question data in order to test the empirical validity of the two approaches.

Constructivist approaches to language acquisition have focussed on the question of how language could be learnt without access to innate, linguistically specified knowledge. Constructivists argue that semantic, distributional and/or phonological information in the input provides enough information for a language learning mechanism to learn grammar. The first theories based on this approach argued that semantic and/or cognitive categories could provide a route into grammatical competence. However, cognitive theories have problems explaining the acquisition of the structural properties of language and there is little evidence for the semantic idea that children's early knowledge is restricted to semantic prototypes or that semantics is necessary to 'bootstrap' into syntax. Semantic-distributional accounts have had more success in explaining the nature of early multi-word data. These rely on children paying attention to distributional, as well as semantic and/or cognitive, similarities between words in order to build up grammatical categories. These theories can be seen as providing a real challenge to nativist theories. However, none has, as yet, made specific predictions about the course of wh-question acquisition. Thus the second aim of the present study is to evaluate a semantic-distributional theory of wh-question acquisition. These accounts will be discussed further in the remaining chapters.

Chapter 2

A Review of Wh-Question Acquisition Literature

2.1. Introduction

The present chapter summarises some of the issues, theories and research that are relevant to the study of wh-question acquisition. The first section describes what wh-questions are and how they are structured in English. It also states the first aim of the present work. The second section reviews some of the major theories of wh-question acquisition and outlines the second aim of the work which is to test some of these ideas against data from young language learning children.

Three areas of wh-question acquisition will not be considered in detail in the present work. First, issues of how children come to comprehend wh-questions, how they come to understand the semantics and/or pragmatic intent of wh-questions and how they learn to distinguish between the meanings of different wh-questions will not be discussed. Instead, the production of grammatical wh-questions will be the focus of the analyses. Second, cross-linguistic studies will only be included when they illuminate our understanding of English wh-question acquisition. These restrictions were applied in the interests of providing a detailed picture of the acquisition of productive wh-structures in English rather than covering a broader range of issues in less depth.

Third, the present work follows most previous studies by concentrating on the question of how children acquire object and adjunct wh-questions and ignoring, to an extent, the issue of how other wh-questions are acquired. As the aim of the present work is to test current theories of wh-question acquisition, the focus of many of the analyses is of necessity restricted to the aspects of acquisition that are covered by former studies. Thus, other wh-structures will only be examined briefly in chapter 4.

2.2. What are wh-questions?

Wh-questions are information or open-class questions that require specific information in the answer, rather than just agreement or disagreement. The nature of the information required is determined by the particular wh-question word that fronts the question (e.g. *what, where, when, who, why, which, how, whatever* or *whose*). These wh-words do not belong to a specific word class but are sub-types of different word classes, all of which serve different functions. For example, *what, who* and *where* forms are wh-pronominals that stand for a missing constituent and require an answer that gives information about this constituent (e.g. *what are you doing?* requires the answer *I'm doing a picture*; *where are you going?* requires the answer *I'm going to Lauren's house*). Wh-sententials such as *why, how* and *when* do not stand for a missing constituent but ask for information about the semantic relations of the sentence (e.g. *why did you do that? - I did it because I wanted to*; *when are you going? - I'm going on Thursday)*. *Which* and *whose* are adjectival forms that specify something about a constituent (e.g. *which book do you want?* requires an answer such as *I want the green book; whose banana is it*? requires an answer such as *it is Amy's banana*).

Two types of wh-question occur in English, defined in terms of the syntactic status of the constituent of the corresponding declarative that is questioned by the wh-word. Argument wh-questions require information to be given about the argument of a sentence and can be either object wh-questions that require information about the grammatical object (e.g. *what is John doing*?) or subject wh-questions that question the grammatical subject (*who is taking you to the park?*). Adjunct wh-questions require information about adjuncts (for example, in the wh-question *how did Mary meet John?*, the wh-word *how* replaces the adjunct *at a party* in the corresponding declarative *Mary met John at a party*).

These different types of wh-question carry slightly different grammatical structures. Object and most adjunct wh-questions are formed by the application of three grammatical transformations. First, the object or adjunct of the corresponding declarative sentence (e.g. *John will read the book*) is replaced by the wh-word (e.g. *John will read what*?). Second, the object/adjunct wh-word is preposed to the beginning of the sentence (e.g. *what John will read?*). Third, the subject (*John*) and the auxiliary (*will*) are inverted to produce the correct grammatical wh-question (e.g. *what will John read*?). In a very few adjunct wh-questions (e.g. *why hack at it like that? how come you have got some sweets?*) this final subject-auxiliary inversion rule does not apply.

The formation of subject wh-questions only involves the first wh-fronting transformation. The subject (e.g. *Julie* in *Julie likes sweets*) is replaced by the wh-word (e.g. *who likes sweets?*). Some government and binding theorists argue that the wh-word is moved covertly to a different place in the phrase structure and these theories will be discussed in more detail below. However, all agree that subject auxiliary inversion does not take place.

Many studies have attempted to track the course of wh-question development and these will be discussed in detail in chapter 4. However, most of these studies have been based either on cross-sectional data from a large number of children or on longitudinal data from a small number of children. There has been no longitudinal study that also compares data from a relatively large number of children. The first aim of the present work is, therefore, to provide a detailed description and comparison of the data from 12 children who have been studied for a year between approximately 2 and 3 years of age.

2.3. Theories of wh-question acquisition

Theories of wh-question acquisition, like those of acquisition in other grammatical areas, can be broadly divided into two approaches: the nativist and the constructivist approaches.

2.3.1. Nativist theories

All influential nativist theories of wh-question acquisition have been based on transformational grammars. Early nativist theories of wh-question acquisition were based on transformational generative grammar, and later theories on principles and parameter theory. Both types of theory are discussed below.

2.3.1.1. Transformational generative grammar (TGG)

The assumption of TGG is that wh-questions are derived from a corresponding underlying declarative sentence according a series of strictly ordered transformational rules. First, the questioned element is replaced by the question word. For example, to form the question *where can John go?* the questioned element *to the park* (from the underlying declarative *John can go to the park*) is replaced with the question word *where* (to produce *John can go* *where?*). Second, the subject and the auxiliary invert (*John can go where?* becomes *can John go where?*). If no auxiliary is present in the corresponding declarative, a dummy auxiliary *do* must be inserted to carry tense (e.g. *John went where?* becomes *did John go where?*). Third, the question word is preposed to the beginning of the sentence (*where did John go?*).

According to TGG, the order in which these rules apply is critical. If the wh-word preposing rule were applied before the subject-auxiliary inversion rule, the auxiliary would have to move over the wh-word to the beginning of the sentence. This would produce ungrammatical questions such as **can where John go'*[1]. Thus, a strict order of transformations is essential for TGG to explain wh-question formation.

A full transformational grammar of interrogation from a TGG perspective was never completed (though see Chomsky, 1962; Katz & Postal, 1964; Lees, 1960, for preliminary ideas) but from work on acquisition it soon became clear that children were not using transformational rules to produce their very early questions. Bellugi and associates (Bellugi, 1965; Brown, 1968; Brown, Cazden & Bellugi, 1969; Brown & Hanlon, 1970) conducted detailed analyses of the questions of Adam, Eve and Sarah (Brown, 1973) and concluded that children's wh-questions could best be captured in terms of a four stage model in which wh-questions were formed by transformational rules only at the later stages of development. In the first stage, the children they studied produced only a few routines (e.g. *what's that?, where NP (go)?, what NP doing?*) and, otherwise, applied only the rising intonation operation to mark interrogation. By the second stage of development, the children had started to produce a

[1] Throughout the present work an asterix (*) indicates an ungrammatical utterance.

variety of questions with wh-words in sentence-initial position but omitted auxiliaries and/or subject-auxiliary inversion. At this stage, Bellugi (1965) argued, there was little evidence that the placement of the wh-word in sentence-initial position was the result of a transformation. Instead, she proposed that the wh-word functioned solely as a question introducer. This meant that there was no differentiation between subject and object/adjunct wh-questions at this stage[2]. However, by stage 3, children's question formation was more like that of an adult. Children seemed able to use the wh-fronting operation and to produce a range of auxiliaries. However, they often failed to invert the auxiliary with the subject, producing what are known as non-inversion or uninversion errors (e.g. **what John can do?* **where you will go?*). If no auxiliary was present, tense often remained on the verb (e.g. **what we saw?*).

Based on this evidence, Bellugi (1965) and Brown (1968) argued for a limit on the number of transformations that a young child could perform at any one time. They suggested that only one of the two transformations necessary for the formation of wh-questions (wh-fronting and subject-auxiliary inversion) could be applied at any one time. Thus, although children could produce correctly inverted yes-no questions (which only require one transformation) they could not produce correctly wh-fronted and inverted wh-questions. In other words, due to a limit on transformations, the children were producing uninverted wh-questions.

Bellugi's and Brown's analyses strongly contradicted transformational theories of children's early grammar that proposed that children were using

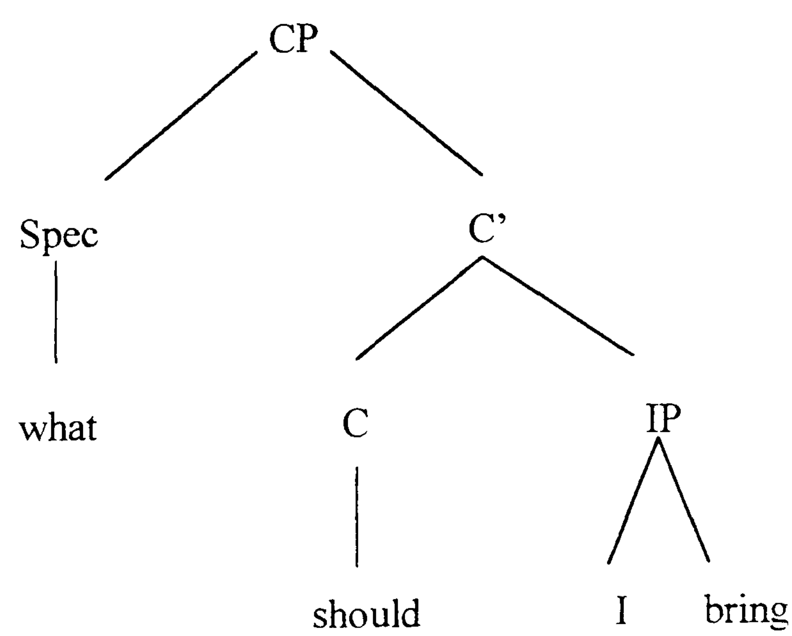
[2] Throughout the present work the term object/adjunct will be used to denote wh-questions in which the wh-word replaces the object or adjunct of the corresponding declarative.

innate transformational rules from the beginning of early multi-word speech. However, Bellugi's and Brown's suggestion that later questions were produced using transformational rules is not without problems. As will be detailed in chapter 4, others have failed to find an uninversion stage in development. Some researchers report that there is no evidence at all of such a stage and others have shown that even children who produce uninverted questions produce correct questions during the same period (e.g. Labov & Labov, 1978; Ingram and Tyack, 1979). In addition, Maratsos, Kuczaj, Fox & Chalkley (1979) have proposed logical flaws in the theory. They argued that if the only reason for uninversion errors is a limit on the number of transformations, wh-preposing errors should be equally as likely as uninversion errors (e.g. **John will do what?*), a prediction that was not borne out by the data. Another problem was that many uninverted wh-questions seemed to occur with negation, which involves an additional negation operation. Maratsos et al (1979) concluded that the child's difficulty seemed to lie more with analysing the properties of the auxiliary, rather than with a limit on the number of transformations s/he was capable of producing. As a result of these, and other problems (see chapter 1), TGG has largely been abandoned by acquisition researchers as a linguistic framework.

2.3.1.2. Principles and parameters (PPT) or government and binding (GB) theory

PPT is similar to TGG in its assumption that wh-questions are formed by the application of certain structural transformations from an underlying declarative sentence. However, rather than relying on a sequence of complex, ordered transformational rules, PPT proposes that children are applying a number of structure-dependent rules that determine which abstract syntactic elements can fill certain slots within a particular grammatical structure. According to current PPT (see deVilliers, 1995), object and adjunct wh-questions are complementizer phrases formed by two movement rules. First, the wh-word moves from its base position in the inflectional phrase, IP, (e.g. *I should bring what*) to the specifier position of the complementizer phrase ([Spec, CP] e.g. *what I should bring?*). Inflection (Infl), carried by an auxiliary, then raises to fill the head of C to produce the adultlike question (e.g. *what should I bring*). The resultant structure is shown in figure 2.1.

Figure 2.1. Surface structure template for the object wh-question *what should I bring?*



The rules governing the formation of subject wh-questions are more controversial. The problem stems from the fact that subject-auxiliary inversion does not seem to occur in such questions (e.g. *who likes Fred?* is grammatical, **who does like Fred?* is not) except for reasons of emphasis. For this reason, some (e.g. Gazdar, 1981) have suggested that the subject remains in [Spec, IP] so that auxiliary insertion is blocked. Others (e.g. Chomsky, 1986) have argued that the wh-subject moves to [Spec, CP] but that tense remains on the verb either because a question marker occupies the [head, CP] position (e.g. Valian 1992) or because the presence of a wh-trace between the verb and the [head, CP] position prevents movement of tense (e.g. Crain & Lilo-Martin, 1999). Research on this issue remains inconclusive. One study (Stromswold, 1988) claimed to resolve the issue in favour of the wh-word in [Spec, CP] analysis. Stromswold argued that if subject wh-questions were constructed without wh-movement, they should be easily and quickly acquired. She showed that this is not the case: subject wh-questions are not acquired before object wh-questions. However, Stromswold's analysis relied on the assumption that structures with movement rules will be acquired later than those without. This assumption is not borne out by the data; yes-no questions require movement, yet are acquired early (see Bellugi, 1965). The issue is, therefore, still very much unresolved.

Despite the controversy over subject wh-question formation, there is little argument over the linguistic rules governing correct object and adjunct question formation. The debate revolves, instead, around how to explain the acquisition of these structures. Theories of wh-question acquisition based on PPT have concentrated on explaining why children with innate linguistic knowledge make errors in wh-question production. These theories are divided into competence and performance theories.

2.3.1.3. Competence theories

Competence accounts of grammatical acquisition propose that young children's speech reflects the fact that they are not working with a full adultlike grammar. Within this approach are two types of theories: parameter setting and maturation theories. Parameter setting theories are based on the assumption that the process of learning language involves determining the correct value at which to set certain grammatical parameters. The most influential theory is that of Hyams (1987) which was proposed to illustrate how children set the null subject parameter and, therefore, does not consider wh-question acquisition. However, a parameter setting account designed to explain how children learn wh-questions has been proposed by Weinberg (1990).

Following government and binding theory (Chomsky, 1981), Weinberg exploits the cross-linguistic differences in the application of wh-question movement rules to explain the nature of early wh-questions. She suggests that there exists in UG a parameter that determines whether the language being learnt has CP positions available. In order for a child to use movement rules, this parameter must be set at the value which allows the existence of the CP - the marked (as opposed to unmarked) value. The parameter is initially set at the unmarked value, which means that children learning languages that require a marked setting (e.g. English) need to accumulate positive evidence that CP exists and switch their parameter value accordingly. Until they have accumulated a large amount of positive evidence that their language allows this transformation, children will not be able to apply wh-movement rules.

The theory predicts that before the parameter has been set correctly, children will mainly produce uninverted questions or questions with missing auxiliaries. Inverted questions will occur only with contracted auxiliaries which are pure cliticized forms not capable of movement. Unfortunately, however, the data do not support such an account. Uninversion seems to some extent to be wh-word specific (see Labov & Labov, 1978; Maratsos et al, 1979), a fact not explained by the parameter setting approach which would predict all wh-forms to be equally affected. In addition, uninverted and omitted auxiliaries do not occur earlier than inverted questions but co-occur with fully realised inverted forms both early and later on in the developmental process (see the data detailed by Labov & Labov, 1978). Thus, the pattern of early wh-question acquisition does not uphold a parameter setting approach.

A second type of competence account is based on a maturational approach and proposes that children make errors in acquisition because certain aspects of their innate grammar have not yet matured. Most maturational theories of wh-question acquisition are based on the assumption that some aspects of the complementizer phrases, or even the whole CP, are unavailable to the child at the early stages of development. For example, some suggest that the CP node may not be present in the child's grammar and that early questions are formed by adjunction to the IP (Vainikka, 1992). Others propose that the child's grammar may only have one position available to be filled, so once the wh-word has moved, auxiliaries must stay in base-generated position (e.g. Roeper, 1988). A third suggestion is that there is a distinction between argument questions that ask about the argument of a sentence (*who, what*, and some *where* and *how* questions) and adjunct questions that query the adjunct (all *why, when* and *how come* and most *where* and *how* questions). For example, Plunkett (1991) and deVilliers (1991) suggest that children invert argument questions (or produce them with abstract tense e.g. **what he do?)* but scramble the analysis for adjunct questions, placing the adjunct wh-word in [adjunct, IP], instead of [Spec, CP] position and producing uninversion or auxiliary omission errors.

All these theories have problems explaining the pattern of wh-question acquisition seen in the data, especially why wh-question errors in both argument and adjunct wh-questions co-occur with correct questions. They also cannot explain why some wh-words are more likely to occur with inversion than others (see chapter 4 and Labov & Labov, 1978; Maratsos, 1979; Valian et al, 1992). There is one maturational theory, however, that seems able to incorporate these effects - that of Radford (1990, 1992, 1995, 1996).

Radford's small clause hypothesis states that at the earliest stage of multi-word speech, children do not have access to the complementizer phrase, CP. Thus, although children can, and do, produce wh-questions at this stage, these questions are based on a misanalysis of the wh-questions they hear in the input and are not true object/adjunct wh-questions. Once knowledge of the CP matures at around 2 years of age, children can start to produce correct wh-questions. However, they have yet to master their new knowledge and may produce errors for a period until they acquire adultlike competence.

This theory can explain the co-occurrence of errors with correct production. However, it is a theory that has not yet been evaluated against a large, quantitative sample of wh-question data. One of the aims of the present study is, therefore, to evaluate Radford's theory in the light of such a sample of data (see chapter 5).

2.3.1.4. Performance limitation theories

In general, performance limitation theories are based on the assumption that children have available to them innate grammatical knowledge from the start of multi-word speech but fail to produce adultlike utterances due to performance limitations. These theories do not, however, deny that some language-specific aspects of grammar may only be acquired after a certain amount of exposure to a particular language. The ability to apply wh-movement rules may be part of innate competence but they are applied differently across languages. In English, movement rules are obligatory but in other languages they are optional (e.g. French) and in some languages they cannot be applied at all (e.g. Japanese). Thus, one of the tasks of the child is to learn exactly how to apply movement rules in their particular language.

Erreich (1984) and Valian, Lasser & Mandelbaum (1992) have suggested that children with access to innate grammatical categories may make errors while acquiring the language-specific aspects of grammar such as how to apply movement rules. One of these errors is to assume that subject-auxiliary inversion in English is optional, as it is in French. Children make this error because they are misled by the optional inversion rule of yes-no questions (e.g. *does he like chips*? and *he likes chips?* are equally acceptable) and the grammaticality of non-inversion in subject (especially *who*) wh-questions and *how come* questions. As a result, children assume that all questions with a similar underlying structure carry optional inversion. Valian et al (1992) additionally argue that each wh-word has its own properties which children have to learn individually. Therefore, some wh-words may occur only in inverted questions from the start and some may occur in inverted, uninverted and missing auxiliary forms.

This view of acquisition can explain why children seem to make uninversion and auxiliary omission errors concurrently with correctly formed wh-questions. However, it makes certain predictions about the data that have not yet been explicitly tested in an analysis of wh-question acquisition. Thus, one aim of the present work will be to test this theory. Chapter 6 will outline Valian et al's view of wh-question acquisition in greater detail and test the predictions of the theory.

2.3.2. Constructivist accounts

Constructivist theorists challenge the nativist assumption that language cannot be learnt without access to innate grammatical knowledge. Constructivist researchers have argued that since language-specific aspects of deep structure grammar must be learnt, there is no reason to assume that all aspects of such structure cannot be learnt. Constructivist proposals are based on the notion that children learn grammatical categories and rules by picking up sub-grammatical patterns from the input and expanding these slowly to incorporate grammatical distinctions. There are three main types of constructivist account but two of these have problems explaining wh-question acquisition. The final account may be able to incorporate an explanation of wh-question development.

2.3.2.1. Cognitive theory

Cognitive theory argues that cognitive developments are the precursors to linguistic developments and that language gains will only be achieved after certain cognitive skills have been mastered. It was suggested in Chapter 1 that these theories have been relatively successful at explaining the acquisition of the content of language (e.g. the acquisition order of specific words associated with different cognitive concepts such as *more* and *less*) but less successful at explaining the acquisition of certain structural aspects of language (see Johnston, 1985). This comment applies equally to wh-question acquisition.

For example, cognitive theories have been quite successful at explaining the order of acquisition of particular wh-words. Bloom, Merkin & Wootten (1982) have proposed that the cognitive and syntactic complexity of the concepts represented by wh-words determines the order in which they are acquired. Thus, *what, who* and *where* are early emerging as they are simple wh-pronominals asking for information about the major constituents of the sentence. *Why, how* and *when* occur later because they are wh-sententials requiring more complex information about semantic relations. Tyack & Ingram (1977) suggest a similar explanation. They argue that *what* and *where* questions are closely tied to the child's immediate environment and are thus learnt early. As the child develops an awareness of concepts such as causality, manner and time s/he will start to use relational wh-words such as *why, how* and *when*. In support, Clancy (1989) has reported similar sequences of acquisition in young Korean-learning children, although she qualifies her conclusion by indicating that the frequency of particular wh-words in the input has an equal if not greater impact on acquisition. She proposes that a child's cognitive understanding may have an indirect effect on language acquisition, mediated by the caregiver's sensitivity to their child's cognitive level, which then governs the frequency with which the caregiver uses a particular form.

Cognitive accounts, however, cannot easily explain why wh-questions carry specific structural properties. Since cognitive developments are generally assumed to be universal (by cognitive theorists at least; see Slobin, 1973), cognitive theories have problems explaining why movement rules are necessary to form interrogatives in English but not in other languages (e.g. French, Japanese). Similarly, the cognitive account cannot explain the types of error children produce when learning these structures. For example, no cognitive explanation has yet explained why some wh-questions are more likely to carry subject-auxiliary inversion than others. As Johnston (1985) has concluded, current cognitive theories have little to say about how the structural aspects of language are acquired.

2.3.2.2. Semantic accounts

Semantic approaches are mainly concerned with the early semantic-syntactic mapping of word classes, and as such most have very little to say about later acquired wh-questions. One account of interrogation formation based strictly on semantic categories has been formulated - that of Stemmer (1981) - and suggests that children's initial questions are based on the idea that words like *is* and *will* appear before actor expressions in questions. Grammatical rules would be built up as children generalised from actor expressions to other noun phrases. This account, however, is not supported by the data: young children seem to formulate and respond to all yes-no questions, not just those involving prototypical actor relations (Crain & Nakayama, 1987). At the present time, therefore, the acquisition of questions cannot be explained in terms of semantic categories.

<u>2.3.2.3. Semantic-distributional theories of wh-question acquisition</u>

Cognitive and semantic theories of development have been relatively unsuccessful at explaining the grammatical acquisition of wh-questions. However, semantic-distributional accounts of wh-question acquisition offer at least a possible explanation. Semantic-distributional accounts propose that positional (and sometimes semantic, phonological and cognitive) commonalities in the input allow children to learn the grammatical properties of their particular language. The accounts formulated by Kuczaj, Maratsos and colleagues (e.g. Kuczaj & Brannick, 1979; Kuczaj & Maratsos, 1983; Maratsos, 1979; Maratsos et al, 1979) and Labov and Labov (1978) have incorporated explanations of wh-question acquisition based on this assumption. They propose that children first acquire wh-questions by learning how individual wh-terms interact with the placement of specific auxiliaries. Early production is, therefore, lexically specific, with children learning how to apply wh-word and auxiliary movement rules on a word-by-word basis. Later in development, children start to generalise across auxiliaries and wh-words and produce overgeneralization errors (e.g. **how come are you going?*) which indicate that the initially specific rule has become generally productive over time.

Accounts such as these were heavily criticised as being too unconstrained (e.g. Pinker, 1979, 1984; see chapters 1 and 7) and more modern accounts (e.g. Slobin, 1985; Tomasello, 1992; Bates & MacWhinney, 1987) have concentrated on restricting the child's search space in prespecified ways in order to overcome this problem. However, none has attempted an explanation of wh-question acquisition despite the fact that the semantic-distributional approach is compatible with what we know about wh-question acquisition. A semantic-distributional learning mechanism that picks up specific patterns from the input could be expected to produce the types of lexically specific effects that studies such as those of Bellugi (1965) and Kuczaj and Brannick (1979) have reported. Such an account may also, for example, be able to explain the correlation between the order of acquisition of wh-words and their input frequency reported by Clancy (1989). One of the aims of the present work will be to provide a preliminary model of such an explanation - a lexical constructivist account - and test its predictions against the wh-question acquisition data. This model will be presented in chapter 7.

2.4. Overall summary

Wh-questions are relatively late acquired constructions that carry particular grammatical structures. Despite a large amount of research, no theory has successfully explained the acquisition sequence of these constructions. The present work aims to add to the body of literature on wh-questions in two ways. First, it will attempt to provide an in-depth analysis of the order of acquisition of wh-questions in twelve 2 to 3 year old children studied longitudinally for a year. This is believed to be the largest study of wh-questions in terms of number of children and length of observation yet attempted. Second, the work will provide a detailed critique of two current nativist accounts of wh-question acquisition before outlining an alternative constructivist account and testing the predictions that such an account would make. The final chapter of the thesis sums up the findings of the work and provides some suggestions as to the direction of future research.

Section 2: Method and Analyses

Chapter 3

Method

3.1. Dataset 1 - The Manchester corpus

Most of the analyses in the present work were conducted on data collected and transcribed as part of a longitudinal study on children's grammatical acquisition. Procedures for recruitment, data collection and transcription were all devised by the author in collaboration with Drs. Anna Theakston, Julian Pine and Elena Lieven. The corpus is termed the Manchester corpus (Theakston, Lieven, Pine & Rowland, 1999) and is available on the CHILDES database (MacWhinney, 1995; MacWhinney & Snow, 1985, 1990).

3.1.1 Participants

The corpus consisted of the data from twelve children who were audio-recorded in their homes in interaction with their mothers for a year between approximately 2 and 3 years of age. All were first born, monolingual English speakers who were cared for primarily by their mothers. The socio-economic status of the participants varied although most came from middle-class backgrounds. There were six girls and six boys. Elena Lieven and Anna Theakston recruited six of the children from Manchester, England (these were given the pseudonyms Aran, Carl, John, Liz, Ruth, Warren) while Julian Pine and myself recruited six from Nottingham, England (Anne, Becky, Dominic, Gail, Joel, Nicole).

Table 3.1 details the age and MLU ranges of each child at the beginning and end of the study (see appendix A for the MLUs of children at each datapoint). Ages ranged from 1;8.22 to 2;0.25 at the start and from 2;8.15 to 3;0.10 at the end of the study. MLUs ranged from 1.06 to 2.22 at the start of the study and 2.85 to 4.12 at the end.

Table 3.1. MLU and age of the 12 children at start and end of study

Child	Age at start	Age at end	MLU at start	MLU at end
Aran	1;11.12	2;10.18	1.41	3.84
Anne*	1;10.7	2;9.10	1.62	3.54
Becky*	2;0.7	2;11.15	1.55	3.31
Carl	1;8.22	2;8.15	2.12	3.92
Dominic*	1;10.24	2;10.16	1.25	2.88
Gail*	1;11.27	2;11.12	1.79	3.47
John	1;11.15	2;10.24	2.23	2.69
Joel*	1;11.1	2;10.11	1.39	3.38
Liz	1;11.9	2;10.18	1.38	4.11
Nicole*	2;0.25	3;0.10	1.06	3.29
Ruth	1;11.15	2;11.21	1.40	3.35
Warren	1;10.6	2;9.20	2.01	4.14

* data collected and transcribed by the author in Nottingham

3.1.2. Procedure

3.1.2.1. Recruitment (see appendix B for details of the screening forms used)

3.1.2.1.1. Initial screening procedure

A detailed screening procedure was put in place in order to recruit children who were just starting to use multi-word utterances. Possible participants were made aware of the study through advertisements in the local press, and posters and flyers at pre-schools, nurseries and doctors' surgeries in the local areas. Interested parents who contacted us were informed briefly about the nature of the study and asked a few screening questions. If the child seemed suitable, parents were asked whether they would like to receive further information. A detailed information pack was then sent out together with a vocabulary checklist. Parents were asked to read the information and to complete and return the checklist if they wanted to take part.

3.1.2.1.2. The checklist

The checklist was an Anglicised version of the MacArthur Communicative Development Inventory (Children). Since comprehension was not the focus of the study, parents were asked only to tick the words that their child actually produced. Once the checklist was returned a more detailed analysis of the child's developmental level was possible. The screening procedure continued only for children with a vocabulary of approximately 100 words and a developmental level of 1 (MLU = 1.34) as measured by the complexity section (E) of the checklist.

3.1.2.1.3. Initial visit screening procedure

Parents were contacted and any further questions they had were answered. The researcher then arranged an initial visit to be made to the child's home at a time at which both mother and child would be together. During the initial visit, mothers were also asked questions about daily and weekly routine. This was to determine whether the commitment to a year long, intensive study would suit their lifestyle. Mothers were also asked to sign a consent form.

The visit included a sample 15-minute recording of the child and mother in a play situation. This allowed us to familiarise both mother and child with the recording situation and the researcher's role, to record and analyse a sample of the child's speech to check for consistency with the data recorded on the checklist and to ascertain the quality of recording in the child's home.

3.1.2.1.4. Post-initial visit screening procedure

The sample tape recording was transcribed, and the number of spontaneous utterances and the MLU of the child from the transcript were calculated. If the child was considered suitable from the recording and from the initial visit, mothers were contacted and asked to make a final decision about whether to take part. If this decision was positive, the date and time of the first recording session were agreed.

At all times during the screening procedure and the study, mothers were made aware that their participation in the study was voluntary, that they could withdraw at any time and that all information gained would remain confidential. They were advised that the study would be lengthy and time-consuming and asked to think seriously about whether they were willing to give up the required amount of time. As a result of this and the rigorous screening procedures, drop-out rates during the screening process were high (about 50 to 60 parents originally contacted us) but drop-out rates during the study itself were relatively low and occurred at or near the beginning of the study (only 3 children failed to complete the study and these were replaced by new participants).

3.1.2.2. The data collection

The children were audio-recorded in their homes in interaction with their mothers for one year. The year was divided into seventeen datapoints that each consisted of three-week intervals. During each three-week interval, two hour-long recordings were made, either in consecutive weeks or in the same week. This produced a total of 34 hour-long tapes that corresponded to 17 datapoints with 2 hours of data at each datapoint.

The same researcher was present during all recordings (myself in Nottingham and Anna Theakston in Manchester) except for one two-month period during which half of the Nottingham sessions were conducted by a 3rd researcher, Rachel Edden.

3.1.2.2.1. The recording situation

Each hour-long recording session was divided into two separate sessions of 30 minutes in which mother and child interacted. The first 30-minute session consisted of free play in which the mother and child engaged in normal play activities. After this 30-minute session the tape was turned off. During one visit at each datapoint, tests for morphological productivity were conducted after the 30-minute free play session[3]. During the other visit, mothers could determine whether to continue with the second 30-minute session or pause for a break.

The second 30-minute session consisted of structured play activities in which mothers were asked to play with a set of toys provided by the researcher. The production of new toys was aimed at stimulating the children

[3] The results for these tests are not considered in the present work

to play for longer. The toys provided included a Duplo zoo and train, a toy car with a panda driver, toy animals, a shopping basket full of play food and rings on a pole. Some of these - the animals, the play food, the shopping basket and the train - were introduced a few months into study after it seemed to the investigator that the children were starting to tire of the toys that were being provided. Children were not restricted to the toys provided by the researcher but were encouraged to play with them.

During all recording sessions, mothers were asked to turn televisions and radios off. For some of the sessions, younger siblings were present. However, these children were all pre-verbal infants who did not interfere significantly with the dyadic nature of the interaction. During all sessions, the investigator attempted to remain in the background as far as possible to enable contextual notes to be taken.

There were some missed recording sessions: Aran, tape number 14, Carl, tape numbers 14 (structured play session only) and 24, John, tape numbers 15 and 16, Ruth, tape number 4 and Warren, tape number 3 (structured play session only).

3.1.2.3. Transcription

The investigator who had collected the data conducted all transcription. The Nottingham data that had been collected by a third researcher was transcribed by this researcher and checked by myself. The data was orthographically transcribed in CHAT format (MacWhinney, 1995; MacWhinney & Snow, 1985, 1990). Only child and adult child-directed speech was transcribed unless a child utterance was produced in response to non-child directed speech. Speech between adults was not transcribed. Transcripts were numbered 1-34 and labelled (a) for the free play and (b) for the structured play sessions.

3.1.2.3.1. Form of transcription

The investigators were not interested in the specific phonological forms used, so the target word, rather than an approximation of the child's phonological form, was transcribed. Unintelligible material was transcribed simply as *'xxx'*. Double commas were used to indicate tag questions and single commas to indicate vocatives. Otherwise, punctuation was only used to indicate the end of an utterance. On the main line, regular forms of plurals, possessives, progressive -ing, perfective *have*, past tense *-ed* and third person singular main verbs were marked for morphemisation according to the CHAT convention created for use with the CHILDES programs (e.g. *eat-ing, dog-s, clip-ed*). Contracted forms of auxiliaries and negatives were also morphemised (e.g. *I do-'nt like it, I-'ve got it*) and some were transcribed in full in order to distinguish between them (e.g. *he-'is/he-'has*).

Postcodes were used on the main line to mark utterances that were incomplete or non-spontaneous. The postcodes used were [+ I] for imitation, [+ SR] for self-repetition, [+ PI] for partially intelligible utterances, [+ IN] for incomplete utterances and [+ R] for routines. Utterances were considered repetitions or imitations if they were partial or complete repetitions or imitations of an utterance that had occurred 5 or fewer speaker utterances earlier, unless that utterance was over 10 seconds removed in time.

Incomplete utterances were those during which the speaker trailed off, was interrupted or interrupted her/himself. Partially intelligible utterances were utterances which had portions marked as unintelligible. Routines included nursery rhymes, counting and songs.

Errors were marked by a [*] on the main line and the correct form, if identifiable, detailed on a dependent tier. Errors of omission were marked with [*] and where the omitted material could be identified it was included on the main line but marked with 0 (e.g. he 0is going). Error codes were used only to mark the following types of errors:

Missing morphemes: e.g. *lots of horse-0s*

Missing auxiliaries: e.g. *where 0is he go-ing*

Word class errors: e.g. *a that one*

Case errors: e.g. *me do it*

Agreement errors e.g. *where does you go*

Overgeneralisations: e.g. *I run-ed away*

3.1.2.4. Morphological coding

A line of morphological coding was added to the transcripts using the MOR program created for use with the CHAT transcription system (MacWhinney, 1995; MacWhinney & Snow, 1985, 1990). MOR labelled the words according to syntactic categories without regard to context, providing alternative codes where appropriate. The coder then disambiguated the morphological coding line, selecting the correct form where more than one possible code was given. The MOR program generated many errors, some of which were not detectable during the disambiguation process. Therefore, the MOR line was not utilised for any of the present analyses.

3.1.2.5. Mean length of utterance (MLU) calculation

Mean length of utterance was calculated using the MLU program created for use with the CHAT transcription system. MLU was calculated per taping session (both free and structured play sessions together) from all complete child spontaneous utterances produced during that session (i.e. postcoded utterances were excluded). This gave us a total of 34 MLU scores for each child over the year and enabled us to divide transcripts into Brown's (1973) stages of development (see table 3.2).

Table 3.2. Number of tapes, age and MLU range for each child divided according to Brown's stages of development (Brown, 1973)[4]

Child	Stage I (MLU 1-2)	Stage II (MLU 2-2.5)	Stage III (MLU 2.5-3)	Stage IV-V (MLU 3+)
Aran (tape nos.) MLU range	1-3 1.41-1.83	4-8 2.18-2.37	9-16 2.49-2.98	17-34 3.08-4.22
Anne (tape nos.) MLU range	1-6 1.62-1.97	7-10 2.14-2.3	11-14 2.60-2.91	15-34 2.74-3.54
Becky (tape nos.) MLU range	1-8 1.46-1.99	9-11 2.05-2.44	12-17 2.53-2.94	18-34 2.95-3.51

[4] Children were considered to have moved into the next stage when the MLU on two consecutive tapes exceeded the boundary MLU.

Table 3.2. (cont.) Number of tapes, age and MLU range for each child divided according to Brown's stages of development (Brown, 1973)

Child	Stage I (MLU 1-2)	Stage II (MLU 2-2.5)	Stage III (MLU 2.5-3)	Stage IV-V (MLU 3+)
Carl (tape nos.) MLU range	N/A[5]	1-12 1.98-2.56	13-16 2.57-2.76	17-34 3.07-4.20
Dominic (tape nos.) MLU range	1-10 1.25-1.88	11-20 2.14-2.56	21-23 2.54-2.90	24-34 2.64-3.48
Gail (tape nos.) MLU range	1-3 1.71-1.91	4-8 2.07-2.46	9-21 2.56-3.11	22-34 2.82-3.67
John (tape nos.) MLU range	N/A (see footnote 5)	1-22 1.98-2.58	23-25 2.50-2.98	26-34 2.69-3.29
Joel (tape nos.) MLU range	1-8 1.39-1.92	9-14 2.06-2.33	15-23 2.53-3.07	24-34 2.81-3.38
Liz (tape nos.) MLU range	1-5 1.38-1.91	6-12 2.00-2.43	13-18 2.66-3.05	19-34 3.05-4.17
Nicole (tape nos.) MLU range	1-17 1.06-2.40	18-27 2.12-2.50	28-34 2.39-3.29	N/A (see footnote 5)
Ruth (tape nos.) MLU range	1-12 1.40-1.96	13-25 1.95-2.41	26-30 2.57-2.90	31-34 3.19-3.35
Warren (tape nos.) MLU range	1-2 1.98-2.01	3-6 2.33-2.40	7-11 2.53-2.87	12-34 3.12-4.34

[5] Carl and John produced no tapes in stage 1 and Nicole produced no tapes in stage 3.

3.1.2.6. Progress monitoring

The progress of each child's development was monitored throughout the year on record of visit forms completed during each visit and individual progress charts that were regularly updated by the investigators (see appendix C). Progress charts included a record of the date of individual tape recordings, the children's age and MLU at time of taping, the test period (i.e. datapoint) into which the tape recording fell and incidental information about the child's behaviour and language. The charts also allowed investigators to monitor the progress of transcription and coding and to record the scores for each child on the productive morphology tests that were administered once every datapoint.

3.2. Dataset 2 - Adam (Brown, 1973)

Three of the analyses in the present work investigated uninversion errors: errors in which the subject and auxiliary are not inverted in object/adjunct wh-questions as in the correct adult form (e.g. *where he is going?* instead of *where is he going?*). The children from the Manchester corpus were younger than the age at which uninversion errors are predicted to occur so Adam's data from the Brown corpus was included for these particular analyses.

3.2.1. The participant

The data from Adam were collected by Brown and his associates and detailed information about Adam is summarised in Brown (1973). Adam was from a middle class, well-educated family. There are 55 hours of data available for Adam, during which time his age ranged from 2;3.4 to 4;10.23. Mean length of utterance (MLU) ranged from 2.14 morphemes at the beginning to 4.54

morphemes at the end. Brown and associates selected Adam because at the start of the study he was just beginning to use multi-word utterances.

3.2.2. Procedure

3.2.2.1. The data collection

Data were collected by Brown and his associates (see Brown, 1973). At least two hours of data per month were collected during a visit every second week. Two investigators were present - one to transcribe and one to take contextual notes.

3.2.2.2. Transcription

The investigator present at the recording session carried out transcription. As with the data from the Manchester corpus, transcription was limited to the target word and no attempt was made to capture the child's phonological representation. The data have since been re-transcribed into minCHAT format by researchers at the CHILDES project and made available on the CHILDES database (MacWhinney, 1995; MacWhinney & Snow, 1985, 1990).

3.3. Wh-question coding

All the spontaneous, fully transcribed wh-questions produced by the children in both datasets were coded structurally according to the following criteria:

SINGLE - single word utterances (e.g. *what?*)

OBJECT/ADJUNCT - object/adjunct wh-question (e.g. *what are you doing? where did you go?*)

SUBJECT - subject wh-question (e.g. *who went to the park?*)

EMB - embedded wh-word (e.g. *do you know what to do?*)

NOAUX - a wh-question that requires neither auxiliary nor verb (e.g. *what about dinner?*)

ECHO - an echo question (e.g. *you what?*)

FRAG - a wh-question fragment (e.g. *what else?, what name?*)

3.4. Summary

Two datasets were used in the present work. The first dataset consisted of data from 12 children studied over a year from approximately age 2 to 3 years. The children were recruited on the basis of similar language abilities at the start of the study. They were taped for two hours every three weeks for a year and their data transcribed and coded morphologically. The second dataset consisted of data from Adam from the Brown corpus (Brown, 1973) which had been re-transcribed by researchers at the CHILDES project and made available on the CHILDES database (MacWhinney, 1995; MacWhinney & Snow, 1985, 1990). Data were collected for two hours every fortnight for two years and nine months. The wh-questions produced by the children in both datasets were coded according to their grammatical function.

Chapter 4

Describing the Data

4.1. Introduction

The aim of chapter 4 is to provide a detailed description of the types of wh-questions produced by the 12 children studied. The chapter is intended to be atheoretical, concentrating on previous and present findings rather than interpretations of the data. Theories of wh-question acquisition will be discussed in later chapters.

There are five major issues involved in describing the acquisition of wh-questions. The first issue concerns the relationship between the acquisition of the four different wh-structures: object/adjunct and subject wh-questions, embedded wh-phrases (including indirect wh-questions) and single wh-word structures. Second, is the issue of whether wh-words are acquired in a particular order. The third issue considers auxiliary acquisition, in particular, the question of whether children acquire different auxiliary forms in wh-questions at different periods of development. The fourth issue looks at the errors that children make and when they make them. Fifth, and finally, the question of whether there are individual differences in acquisition will be discussed.

4.1.1. The acquisition of different wh-structures

There are four wh-structures in which wh-words can occur: object/adjunct and subject wh-questions, embedded wh-phrases (including indirect questions) and single wh-word structures. Well-formed, adultlike object/adjunct wh-questions (e.g. *what are you doing?)* are questions in which the wh-word and tense (carried by an auxiliary) are preposed to the beginning of the sentence. Subject wh-questions (e.g. *who likes chips*?) and embedded wh-phrases (e.g. *I* *know what you like*) differ from object/adjunct wh-questions in that no movement is assumed to take place; the wh-word and tense remain in base-generated position[6]. Single wh-words (e.g. *what?*) are sentence fragments containing only the wh-word.

Very little work has been conducted on whether different wh-structures show similar developmental patterns, despite the fact that this issue is often pertinent to theories of acquisition (e.g. Radford's maturational theory, 1990, originally predicted that subject wh-questions would be acquired before object/adjunct wh-questions). One exception is a paper by Stromswold (1995) in which it was reported that the order of acquisition of subject and object wh-structures varied across the children studied. Five of the children in the study acquired object wh-questions before subject wh-questions, 3 acquired subject before object wh-questions and 4 acquired both types of question at the same age. These results suggest that there may be little interdependence between wh-structures. However, no work has yet reported a comparison of all four wh-structures. This will be the first aim of the present chapter.

4.1.2. The acquisition of wh-words

Studies on the order of acquisition of different wh-words seem to agree that *what* and *where* are the earliest acquired wh-words (e.g. Smith, 1933; Klima & Bellugi, 1966; Bloom, Merkin & Wootten, 1982). However, the order of the acquisition of other wh-words is less clear. Bloom et al (1982) have described two sequences of acquisition. They report that the sequence for the

[6] The linguistic status of subject wh-questions is, in fact, unclear. Some have suggested that subject wh-questions are constructed via covert movement of the wh-word (see Stromswold, 1995, and chapter 2). However, for the purposes of the present study, subject wh-questions will be assumed not to involve movement.

wh-questions that included verbs was *where* + *what* (at an average age of 26 months), then *who* (at 28 months), *how* (at 33 months) and *why* (at 35 months). *Which, whose* and *when* occurred rarely. The order of emergence for all wh-questions (with and without verbs) differed in that *how* emerged before *who* (e.g. *how about this?*).

Bloom et al (1982) noted that this sequence may be related to the differing complexities of wh-words. The early emerging *what, who* and *where* forms are wh-pronominals that ask for the major constituent they replace, whereas the later emerging *why, how* and *when* are wh-sententials that ask for information about the semantic relations of the sentence. *Which* and *whose* (that occur rarely) are adjectival forms that specify something about a constituent. Bloom et al (1982) concluded that the sequence of acquisition reflected the syntactic complexity of each wh-word. However, this interpretation relies on there being a universal sequence of acquisition across children and across different wh-structures. From the little work published on this issue this does not seem to be the case. Smith (1933) reports that *how, when* and *why*, not *who*, appear after *what* and *where*. Tyack and Ingram (1977) argued that, in their data, the order of acquisition was *what, where, why* and *how* with *who* and *when* questions occurring very rarely. Stromswold (1995) reported that, with *who*, children acquired subject and object wh-questions concurrently, but with *what* and *which*, object wh-questions were acquired first. The second aim of the present chapter is to describe the acquisition of different wh-words in different wh-structures to discover the frequency of use and sequence of acquisition of wh-words in different structures.

4.1.3. The acquisition of auxiliaries in object/adjunct wh-questions

Research on auxiliaries in English wh-questions has tended to focus on object/adjunct wh-questions. This is because auxiliaries must be present in object wh-questions and in the vast majority of adjunct wh-questions in order for tense to be realised, and they must undergo inversion with the subject position, moving from their base-generated position into the head of the CP. The acquisition of auxiliaries in these structures is thus expected to illuminate the issue of how and when children learn grammatical movement rules and categories.

At the earliest stages, however, auxiliary use in object/adjunct wh-questions seems to be limited to use with particular wh-words. Ingham (1993) and Fletcher (1985), in separate analyses of one child's data, both suggested that early auxiliary use was restricted to *do*, *are* and *-'s*, which were used exclusively with one wh-word only (*how*, *what* and *where* respectively). These results suggest that the first wh-questions with auxiliaries produced by children may be formulae (i.e. routines), rote-learned in full from adult utterances rather than constructed by an application of grammatical movement rules.

Another point of consensus among researchers is the finding that modals and negatives are very late occurring. For example, Klima & Bellugi (1966) reported that even by their Period B (MLU 2.75), no positive and only two negated modals *(can't* and *don't)* were produced. However, the nature of the acquisition of other auxiliary forms is less clear-cut. Some have argued that a wide range of auxiliaries start to occur in children's speech very quickly after children reach a certain stage of development. Thus, Bellugi (1971) has suggested that a wide variety of auxiliary verbs start to appear very quickly when MLU exceeds 3.50 and Ingham (1993) has reported that the proportion of auxiliaries in obligatory contexts increases dramatically from 25.2% to 89.8% of obligatory contexts between the ages of 2;10 and 3;0. On the other hand, Ingram & Tyack (1979) argued that in their data, auxiliary use showed a gradual, rather than rapid, increase across the age groups studied. The third aim of the present chapter is to investigate these issues by considering the following questions:

1. Are auxiliaries acquired gradually or at a certain point in development?
2. Are modals and negatives acquired late?
3. Is early auxiliary use in object/adjunct wh-questions restricted to a few rote-learned wh-question contexts?

4.1.4. Errors in object/adjunct wh-question acquisition

The literature on errors in wh-questions has also focused on object/adjunct wh-questions because errors in these structures are considered to illustrate the issues of how children learn to apply grammatical movement rules. Throughout the 1970s, the general consensus seemed to be that there was a universal sequence of acquisition for object/adjunct wh-questions. Early wh-questions were seen as routines (e.g. *what's that?*), which were gradually replaced by distributionally free wh-questions with omitted auxiliaries (**what he do?*), then by wh-questions with present but uninverted auxiliaries (e.g. **what he can do?)* and finally by correctly produced wh-questions (e.g. *what can he do?)*.

The most powerful evidence for this sequence of acquisition came from the work of Bellugi and Brown and their associates on three children - Adam, Eve and Sarah (e.g. Bellugi, 1965; Bellugi, 1971; Brown, 1968; Brown, 1973: Klima & Bellugi, 1966). At stage 1 (mean MLU 1.75), these researchers argued that only a few routines such as *where NP (go)* (e.g. **where kitty go/*where string)* and *what NP doing* (e.g. **what cowboy doing/*what you doing?)* occurred in children's utterances. At stage 2 (MLU 2.75), wh-words were included and placed in correct sentence initial position but auxiliaries were missing and there was no subject-verb inversion. At this point, it was very difficult to distinguish subject and object/adjunct wh-questions in children's speech (e.g. **who getting that/ *what getting?).* By stage 3 (MLU 3.5) auxiliaries started to appear but occurred in uninverted position (e.g. **what the words are doing?)*. At this stage, if the auxiliary was omitted, tense was often marked on the verb (e.g. **what we saw?/*where my spoon goed?*). Bellugi (1971) also reported some doubling of the auxiliary (e.g. **what shall we shall have?)* although these errors were much rarer.

Bellugi and Brown's conclusions have not gone unchallenged. The first controversy is over whether children go through an uninversion period at all. Erreich (1984) used elicited and spontaneous wh-questions to show that children did produce a quantity of uninverted wh-questions, though, unlike Bellugi and Brown, she found uninversion in yes-no questions at the same time. Labov and Labov (1978), in a study of the spontaneous data from one child, found evidence for an uninversion stage, although their results must be interpreted cautiously as they included in their uninversion category some questions with omitted auxiliaries. Others have failed to find evidence for an uninversion stage. Both Klee (1985) and Ingram & Tyack (1979) found only sporadic examples of uninversion errors in their data. As a result of the seemingly contradictory results, Maratsos (1979) proposed a developmental sequence of omission-misplacement (uninversion)-correct placement but argued that a child may, for long periods of time, display all three patterns at once.

The second controversy to arise as a result of Bellugi and Brown's findings concerned the issue of whether uninversion occurred more often with specific wh-words or with specific types of auxiliary. Some have reported that uninversion occurs more often with specific auxiliary forms. For example, Klee (1985) found that the auxiliaries *be, do, can* and *will* were all uninverted with low frequency and that copula *be* contained most instances of uninverted verbs. Bellugi (1971) has reported that uninversion was more likely and occurred for longer with negatives and modals.

Others, however, argue that uninversion is wh-word, not auxiliary, specific. Brown, Cazden and Bellugi (1969) have suggested that the wh-word *why* is most likely to carry uninversion. This is supported by the work of Kuczaj and Brannick (1979) who related that the correct placement of auxiliaries in *when, who, why* and *how* questions was delayed until after their correct placement in *what* and *where* questions. In fact, Maratsos, Kuczaj, Fox and Chalkley (1979) have argued that high levels of uninversion with negatives is an epiphenomenon of the fact that most negatives in children's speech occur with *why* - the wh-word that carries the lowest rate of inversion. Yet, although most are agreed that *what* is least likely and *why* is most likely to carry uninversion, the results for other wh-words differ from study to study.

Erreich (1985) found that children tend to invert with *who, what, where* and *which* but not with *why, when* and *how* and that inversion was not just restricted to one wh-term for any one child. Labov & Labov (1978) have argued for gradual acquisition of the inversion rule over one and a half years, with the wh-terms *how, which, who, where, what, when* and *why* contributing to the likelihood of inversion in descending order. DeVilliers (1991) has argued that adjunct wh-words (*why* and *how*) will occur more often with uninversion than argument wh-words (*who* and *what*) but Klee (1985) reported that uninversion occurred mainly with *where* and *why*. Thus, different studies seem to report contradictory results.

In the controversy over uninversion errors, other types of errors have been largely neglected in the literature. However, it has been recorded that, apart from uninversion and auxiliary omission errors, children produce double tensing errors (Bellugi, 1971), errors in which tense is marked on the main verb (Bellugi, 1971) and subject omission errors (Radford, 1990). The fourth aim of the present study is to record the types of error produced by the children and to address the following issues:

1. Is there a universal sequence of acquisition: routines → omission errors → misplacement/commission errors?
2. Is there a universal uninversion stage?
3. Do errors of uninversion tend to occur with specific wh-words and/or auxiliaries?

4.1.5. Individual differences

The lack of consensus between the studies outlined above could suggest that individual differences exist in the sequence of acquisition of wh-questions; in particular, in the acquisition of subject and object/adjunct wh-questions (Stromswold, 1995), in the order of acquisition of different wh-words and in the acquisition of inversion. The final aim of the present chapter is to compare the acquisition patterns of the 12 children, to isolate differences and similarities in their pattern of development and to answer the following questions:

1. Does the acquisition of different wh-structures vary from child to child?
2. Does the sequence of acquisition of different wh-words vary from child to child?
3. Does the sequence and speed of auxiliary acquisition vary from child to child?
4. Do different children produce different patterns of error at particular points in development?

4.2. Method

4.2.1. The Manchester corpus

The corpora for each child were divided according to 17 datapoints, each of which comprised two consecutive transcripts. Dividing by datapoint rather than MLU level allows a more fine-grained analysis of progression over seventeen points of observation rather than over 2 or 3 MLU levels. Many of the children remained in one stage for a long period of time (e.g. John remained in stage II (MLU 2-2.5) for 21 recordings and Nicole remained in stage I (MLU 1-2) for 16 recordings). Thus, dividing by MLU levels would have meant collapsing data collected over several weeks, or even months for some children. This would not have allowed us to investigate the nature of acquisition in detail (e.g. whether certain auxiliaries are acquired together at any one point in time). However, it must be noted that different children at the same datapoint may be at different points of development (e.g. the MLU range at datapoint 17 was 2.85 to 4.12 morphemes). The final analysis on individual differences provides more detail about variations across children.

Certain utterances were removed from the dataset. These included partially intelligible or incomplete (e.g. interrupted or trailing off) utterances, utterances with parts marked as unclear or questionable, quoted utterances, routines, and utterances where the structure of the question was unclear (e.g. if it was unclear whether the utterance was a matrix question or an embedded question fragment then the question was discarded). Full or partial repetitions or imitations of any of the 5 previous utterances were also excluded from the analyses.

All single wh-word structures, matrix object/adjunct wh-questions, matrix subject wh-questions and embedded wh-phrases were extracted from the transcripts. The analyses were conduced on wh-question types to reduce the impact of highly frequent but rote-learned phrases (e.g. *what's that*) on the results. Two tokens were defined as the same type if the wh-word, auxiliary, subject, verb and, if present, prepositional phrase were identical. For example, *what is he doing?* and *what is he doing in that car ?* were counted as two types, but *what is he doing?* and *what is he doing , Mummy ?* as one type. The results for the first four analyses on the Manchester corpus are presented as the results for the average child. The number of types produced by the average child was calculated using the following equation:

$$\frac{\text{Total number of types for all children}}{\text{Number of children (12)}}$$

Because analyses were conducted on types. not tokens. each single wh-word produced for each child was only counted once. For example, if Aran produced *what* in single word structure 12 times, this was counted as 1 type. Thus, if Aran was the only child who produced *what*, the average use of *what* in single wh-word structures would be 0.08 (1/12). If six of the children produced *what* in single wh-word structure, the figure produced would be 0.5, etc.

For order of acquisition analyses, a wh-word, auxiliary or wh-structure was considered 'acquired' after its first use. The use of more stringent criteria to ascertain point of acquisition was considered but was rejected on the basis that all productivity criteria carry certain theoretical assumptions about the role of rote-learned forms in development and about what constitutes productive use. Since the intention of this chapter was to consider acquisition in an atheoretical way, the application of a productivity criterion was considered inappropriate. However, in order to ensure that the results were representative of the child's consistent use, some analyses were repeated using a more stringent criterion to allow for comparison. According to this second criterion, an item was only considered acquired when produced in 3 or more different utterance types.

4.2.2. Adam (Brown, 1973)

The children in the Manchester corpus were younger than the age at which uninversion errors have been reported to occur so the uninversion analysis was repeated on later acquired data from Adam. All the matrix object/adjunct wh-questions that require inversion according to adult grammatical rules were extracted from the 55 one-hour transcripts recorded when Adam was between the ages of 2;3.4 and 4;10.23. Mean length of utterance (MLU) ranged from 2.14 morphemes at the beginning to 4.54 morphemes at the end. Six different wh-words were used by Adam - *how, what, why, which, where* and *who.*

All analyses were conducted on types, not tokens, to ensure that the presence of highly frequent but rote-learned phrases (e.g. *how do you do?*) would not influence the results. Two tokens were defined as the same type if the wh-word, auxiliary, subject, verb and, if present, prepositional phrase were identical.

Certain utterances were removed from the dataset, including partially intelligible and incomplete utterances, routines and quoted utterances. Full or partial repetitions or imitations of any of the 5 previous utterances were excluded, as were questions with double auxiliaries (e.g. **what can he can do?*), those with a missing subject (e.g. **what can do?*) and those in which the structure (e.g. matrix or embedded fragment) was unclear. Questions with the copula were also excluded from the dataset. All matrix object/adjunct questions were coded for inverted, uninverted or missing auxiliaries.

4.3. Results

4.3.1. The acquisition of different wh-structures

Table 4.1 indicates the mean number of single wh-word structures, matrix object/adjunct and subject wh-questions and embedded wh-phrases produced. Overall, object/adjunct wh-questions were the most frequently produced wh-structure by far (mean = 279.08 wh-types per child), followed by subject wh-questions (mean = 25.50 wh-types per child) and embedded wh-phrases (mean = 32.25 wh-types per child). In single wh-word content, the children produced a mean of 3.58 different wh-words with *what, where* (both used by 11 children) and *why* (used by 9 children) being the most frequent. The frequency with which the children used subject and object/adjunct wh-structures was significantly correlated ($r = 0.83$, $N = 12$, $p = 0.001$), but no other correlation reached significance.

Table 4.1. Mean number of wh-types in each wh-structure

Object/adjunct Wh-questions	Single wh-words	Subject wh-questions	Embedded wh-phrases
279.08	3.58	25.50	32.25

It is possible that the large differences between the number of object/adjunct and subject wh-questions produced could be due to a structural difference between subject and object/adjunct wh-questions. Object/adjunct wh-questions contain more obligatory constituents (wh-word, subject, verb, plus auxiliary for non-copula verbs) all of which can vary to produce different utterance types, whereas subject wh-questions contain only two obligatory constituents (wh-word and verb). To see if this affected the results, the number of tokens produced in object/adjunct and subject wh-question structures was calculated. Contrary to the above suggestion, the difference between subject and object/adjunct wh-question use increased - the children produced on average 446.25 object/adjunct wh-question tokens compared with only 39.92 subject wh-question tokens. Thus, the difference between the use of object/adjunct and subject wh-questions reflected a true difference in use rather than simply a structural distinction.

To determine whether different wh-structures were acquired concurrently, the number of different wh-structures produced by the average child at each datapoint was calculated.

Table 4.2 details the mean frequency of use of single wh-words, matrix object/adjunct and subject wh-questions and embedded wh-phrases over the year (see appendix D for results for individual children). From the table it is possible to see that each wh-structure showed slightly different patterns of progression. Object/adjunct wh-question production reached a peak at data point 15 and then tailed off. Subject wh-questions showed a less consistent picture but again, were most frequent at datapoint 15. Single wh-word structures showed an increase in frequency of production across the 17 datapoint, peaking at data points 15 and 17 with a mean of 2.17 single wh-word structures produced. Embedded wh-phrases, however, started to appear in the children's data much later than the other wh-structures (consistently occurring only after data point 8) and then rose more or less steadily until datapoint 16. This peak at data point 16 was due almost entirely to Ruth and Warren both of whom produced large numbers of embedded wh-phrases at this point.

Table 4.2. Mean number of utterances produced in each wh-structure (by datapoint)[7]

Datapoint	Object/adjunct wh-questions	Single wh-words	Subject wh-questions	Embedded wh-phrases
1	10.83	0.50	1.42	0.17
2	9.33	0.50	1.17	
3	15.92	0.58	0.92	0.17
4	13.25	0.58	0.92	
5	11.33	0.92	1.17	0.17
6	18.42	1.00	2.58	0.08
7	18.17	0.58	1.42	
8	20.92	1.00	1.75	1.25
9	23.67	0.83	2.00	0.67
10	24.00	1.08	1.67	1.50
11	24.17	1.42	1.58	2.58
12	24.92	1.08	2.08	2.08
13	25.83	1.50	2.92	2.67
14	26.50	1.67	2.25	4.17
15	26.67	2.17	3.08	4.00
16	23.83	1.67	2.17	7.92
17	23.25	2.17	2.42	5.42
Total	341.01	19.25	31.68	32.85

[7] Please note that the totals in this table do not correspond to those in table 4.1. In table 4.1, each wh-question type was only counted once, but in table 4.2 a wh-question type is counted

The results for individual children (see appendix D) are generally consistent with the claims made in the paragraph above, with a few exceptions. All children produced more wh-types in object/adjunct wh-question structure than any other type of wh-structure and except for subject and object/adjunct wh-questions, the amount of use in one structure seemed independent of the amount of use in another structure. Most of the children (except Carl and John, see appendix D) showed a steady increase in their use of object/adjunct wh-questions throughout the year, although these structures were produced in the greatest numbers before the end of the sample for all children except Nicole and Joel. Production seemed to tail off slightly after this point. Subject wh-question production was less frequent but again, for most of the children (except Warren, Gail and Carl) production peaked before the end of the sample. For single wh-word structures, most children (except for Anne, Becky and Carl) produced many more questions in the second half of the sample than in the first half. For embedded wh-phrases the mean results (see table 4.2) suggest that their presence increased steadily until datapoint 16, indicating that as children get older, they produce more of these wh-structures. The results for the individual children were more erratic, although, as concluded above, these structures were consistently produced by all children only at later datapoints. These results suggest that the frequency of use and order of acquisition of different wh-structures (with the possible exception of subject and object/adjunct wh-questions) may be independent.

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once for each datapoint at which it occurs. For example, if *where's he going* occurs at datapoint 1 and 2 it will be counted twice, once for datapoint 1 and once for datapoint 2.

4.3.2. The acquisition of wh-words

To ascertain whether the frequency of use of particular wh-words in different wh-structures was related, the frequency of use of each wh-word in each structure was calculated for the average child. Table 4.3 details the mean number of different wh-words used in each wh-structure.

Table 4.3. Mean number of different wh-words used in each wh-structure

Wh-structure	what	where	who	how	which	why	when	what-ever	whose	total
Object/adjunct wh-question	78.67	177.5	5.08	4.92	2.5	9	0.58	0.08	0.75	279.08
Single wh-word[8]	0.92	0.92	0.42	0.25	0.25	0.75	0.08			3.59
Subject wh-question[9]	13.25		11.92		0.25				0.08	25.58
Embedded wh-phrase	11.25	5.42	0.92	1	0.42	0.75	12.5			32.25

Nine wh-words were produced in total by the 12 children - *what, where, who, how, which, why, when, whatever, whose*. *What* and *where* were by far the most frequently used wh-words and were used predominantly in

[8] The analysis is a types analysis, so although each single wh-word may have been produced many time, each can only constitute one type. A score of one indicates the wh-word was used by all 12 children, a score of 0.05 indicates the word was used by 6 of the children etc.

object/adjunct wh-question structure (on average, *what* was produced 78.67 times and *where* 177.50 times in matrix object/adjunct wh-question structure). This was true for all 12 children individually as well. All other wh-words were used, on average, less than 20 times in each wh-structure and the structure in which each word was used most frequently differed from wh-word to wh-word . *What* was the only wh-word to be used consistently across all four wh-structures (this conclusion applied to all 12 children). *Where* was the most frequent wh-word type in object/adjunct wh-questions for the average data (see table 4.3) and for the data from all 12 children. *Who* was used most often in subject wh-questions (mean number of types = 11.92) but occurred far less often in any other wh-structure. Of the 11 children who used *who*, all used it in subject wh-questions more than in embedded wh-phrases, seven used it in subject wh-questions more than in object/adjunct wh-questions and two used it in equal amounts in subject and object/adjunct questions. *When* occurred very rarely in object/adjunct questions but was the most frequently used wh-word in embedded wh-phrases (mean number of types = 12.50). This conclusion also applied to the data from all 12 children individually. *How* and *why* occurred rarely in embedded wh-phrases (seven of the children used *how* and four used *why* in embedded phrases but both wh-words were used very infrequently). *Which, whatever* and *whose* occurred rarely in any structure, but most often in object/adjunct wh-questions. Nine children used *which* in object/adjunct wh-questions, three used it in single wh-structures, 3 in subject wh-questions and four in embedded phrases. *Whose* was used by 5 children in object/adjunct questions, by one child in subject questions and did not occur in

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[9] *How, where, when* and *why* cannot occur in subject wh-questions

the other structures. *Whatever* was used only once by one child in object/adjunct wh-structures and never in any other context.

In single word structure, *what* and *where* were used most often (each used by 11 of the 12 children). After *what* and *where*, *why* was the wh-word used by most children - 9 of the 12 children studied. *When* was used only by one child and *whatever* and *whose* were never used in single wh-structure.

To summarise, in general, although *what* seemed to be used in all wh-structures, *where* was the most frequently used wh-word in object/adjunct wh-questions and *who* occurred most often in subject wh-questions. *How, which, whatever* and *whose* were used rarely but most often in object/adjunct wh-questions. *Why* seemed to be preferred to all other wh-words except *what* and *where* in single wh-structure and *when* was used most often in embedded wh-phrases. Overall, the frequency of a particular wh-word in one wh-structure seemed relatively independent of its frequency in another.

Table 4.4. Summary of progression of wh-word acquisition

Object/adjunct wh-question	what/where => who => how => which => why => whose => when => whatever
Single word	what => where => why =>who => which => how => when
Subject wh-question	what => who => which => whose
Embedded wh-phrases	what => when => where => how => which/why => who

To establish whether the order of acquisition of a wh-word in one structure predicted the order of acquisition in another structure, the mean rank order of acquisition of wh-words in each wh-structure was calculated.

Only *what* appeared in a consistent position (first) in all wh-structures. For other wh-words, the order of acquisition, like the frequency of type use. seemed independent of wh-structure. There was also no evidence that the wh-adjectivals (*which* and *whose*) were consistently acquired after the wh-sententials (*why*, *when* and *how*) (see tables 4.10-4.13 and discussion in section 4.3.5.2. for details of how the results for some of the children differ from this pattern).

However, it was clear that the order of acquisition detailed above might have been affected by the lax acquisition criterion based on first use of a wh-word. Some of the wh-words included were used once at the early datapoints but did not reappear until later, if at all. As a result, the analysis was repeated for subject and object/adjunct wh-questions and embedded wh-phrases with a more stringent acquisition criterion, according to which a wh-word was considered acquired after it had occurred in three different utterance types (see appendix E for the data). According to this criterion, there was still no evidence for the order of acquisition suggested by Bloom et al (1982). For subject wh-questions and embedded wh-phrases there were few differences in the order of acquisition according to the two criteria. The only difference for subject wh-questions was that according to the more stringent criterion, *which* and *whose* were not acquired. The order of acquisition of *what* and *who* remained the same as for the 'first use' criterion. For embedded wh-phrases. *which* failed to meet the more stringent criterion but otherwise the order of acquisition was the same. In object/adjunct wh-questions, however, there were some minor differences. *Where* was acquired before *what* (not concurrently with it) and *when* and *whose* were acquired concurrently (not *whose* before *when*). *Whatever* production did not reach the 'third use' criterion. However, the most striking difference was that *why* was acquired before, not after, *how* and *which*. This would suggest that the early occurrences of *how* and *which* are restricted to a limited number of wh-types, with consistent production only occurring later in the sample.

To summarise, different wh-structures show different patterns of wh-word acquisition and frequency of type use. For object/adjunct wh-questions, *what* and *where* were used most frequently, and were produced from the start of data collection. In single word structure, *what*, *where* and *why* occurred most frequently and were acquired first. In subject wh-questions, *what* and *who* were produced most often and were acquired first. In embedded wh-structures, *what* was acquired first, (followed by *when*, *where* and *how)* and the most frequently used form was *when*. Only *what* occurred in a consistent position (first) in all four different wh-structures. Thus, with the exception of *what*, the frequency of type use and order of acquisition of a particular wh-word seemed to vary according to the wh-structure in which it is used.

4.3.3. Auxiliary acquisition in object/adjunct wh-questions

The aim of the first auxiliary analysis was to discover whether the acquisition of a range of auxiliaries occurred gradually over time or abruptly at a certain point in development. The analysis was conducted on matrix object/adjunct wh-questions only. Table 4.5 details the order of acquisition (determined by first use) of auxiliary categories by datapoint over the year for the 12 children.

Table 4.5. Order of acquisition of auxiliaries by datapoint

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nic-ole	Ruth	War-ren
1	cop be	cop be	Cop be	cop be/ aux be	cop be	cop be/do	cop be/ have		cop be			have/ cop be
2		do						cop be	have /aux be			
3		aux be/ have		have								
4						have				cop be		aux be
5	have		Aux be			aux be						
6			Do/ Have									
7		shall						aux be				
8								have	do	have		
9	can/ do		Can		have							
10												
11	aux be	can/ could						do/ can		do/ aux be		do
12			Shall					shall				
13					aux be				shall			
14				shall/ do					can		cop be	
15					can/do						aux be	
16	will	will				would						
17												

Contrary to Bellugi's (1971) suggestion, there was no one point in development at which a wide range of auxiliaries was acquired. Instead, auxiliaries seemed to be acquired gradually over the year. Copula *be* was produced earliest, followed by auxiliary *do*, auxiliary *have* and auxiliary *be*. As suggested by previous research, few modals were recorded - only *can, will, could, would* and *shall* - and they occurred in small numbers and relatively late in development. Moreover, only 2 negatives were recorded (both produced by Aran - *can't* and *don't,* see Table 4.14).

However, these results must be interpreted cautiously. The analysis above failed to differentiate between different auxiliary lexical forms (e.g. *is/has/are*). For example, the first use of copula *be* was always copula *is*; copula *are* often did not occur until much later in the year. As a result, this issue is picked up again in the individual difference analysis (section 4.3.5.3).

The second auxiliary analysis addressed the issue of whether the use of auxiliaries in early wh-questions was restricted to a few rote-learned questions based around particular wh-words. All wh-words used with auxiliaries at datapoint 1 were extracted (see Appendix F for a full list of wh-questions). Three of the children (Joel, Ruth and Nicole) produced no wh-questions with auxiliaries at datapoint 1 so their data are taken from the earliest datapoint at which they produced wh-questions with an auxiliary (datapoint 2 for Joel, 14 for Ruth and 4 for Nicole).

Early wh-questions were restricted to only a few (eight) wh-word+auxiliary combinations, all but one of which centred round the wh-words *what* and *where* (*what-'is, what is, where'is , where is, where-'has, who-'is, what-'re, what did).* Three of these (*what did, what-'re, who-'is*) only occurred once (Gail produced one instance of *what did*; Carl produced one instance each of *what-'re* and *who-'is*). No combination was produced by all children but *what-'is* was the most common, produced by nine of the 12. The average number of wh-word+auxiliary combinations was only 1.92 per child (range =1-5). Thus, the data suggest that the first auxiliaries used were acquired only in combination with a limited number of wh-words and may be simply rote-learned from adult utterances.

To summarise, as predicted, modal auxiliaries and negatives were acquired late and produced in very small numbers. Moreover, the earliest produced auxiliaries seemed to be acquired in rote-learned forms, all but one of which centred round the wh-words *what* and *where*. However, there is little evidence that different auxiliary types are acquired at any one particular point in development.

4.3.4. Errors in object/adjunct wh-question acquisition

To establish whether there was a universal sequence of routines before omission before misplacement, the mean number of correct wh-questions and error types produced at each datapoint was calculated. There were 10 types of question[10], classified as follows:

Correct wh-questions

Questions in which the main clause (wh-word, subject, verb and auxiliary) was grammatically correct according to the adult ideal. This category included questions with omitted determiners (e.g. *what is dog doing?)* and with inaccurate prepositional phrases (e.g. **why are you going for the park?* used instead of *why are you going to the park?).*

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[10] If a wh-question fell into more than one category it was included twice. For example, *where go* was included once as an omitted auxiliary error and once as an omitted subject error.

Errors of omission

Auxiliary omission; e.g. **where he going, *where that go?*

Subject omission; e.g. **where can go, *where's going?*

Main verb omission; e.g. **why did you in there?*

Errors of commission

Double auxiliary errors; e.g. **where does he does go?*

Agreement errors; e.g. **where's those?*

Uninversion errors; e.g. **where he can go?*

Tense on main verb errors; e.g. **where he goes/*where can he goes?*

Case errors; e.g. **where's him?*

Auxiliary misclassification: e.g. **where did he going?*

Other

Wh-question errors that were unclassifiable, including errors for which it was not possible to choose between two possible, mutually exclusive classifications. For example, **where are you go?* could either be an auxiliary misclassification error or an omitted progressive ending on the main verb.

Table 4.6 details the mean number of correct wh-questions and errors produced at each datapoint. Correct wh-question production increased over the year from 32.31% of the total number of wh-questions at datapoint 1 to 68.67% at datapoint 17. Thus, even by the end of the study, the children were still producing many wh-question errors. The most frequently produced error was omission of the auxiliary (e.g. **where he going, *where that go?*). Other errors occurred far less often.

Table 4.6. Mean number of wh-questions of each question type - correct use and errors

Data Point	corr-ect	omission error			error of commission						other	total
		omit. aux	omit. Sub-ject	omit main verb	double aux	agree-ment error	uninv	tense on main verb	case error	auxiliary mis-classif.		
1	3.5	6.92	0.25			0.08	0.08					10.83
2	3.58	5.67	0.25			0.25						9.75
3	4.75	10.5	0.83		0.25	0.42		0.17				16.92
4	5.58	7.5	1.17			0.17						14.42
5	6	4.67	0.5			0.67						11.84
6	9.92	7.5	0.67			0.75	0.17		0.08			19.09
7	11.42	5.25	0.25		0.08	1.25			0.25			18.5
8	11.83	6.42	0.83		0.17	1.75	0.17	0.08	0.25		0.08	21.58
9	12.42	8.08	0.83		0.5	1.58	0.58	0.08	0.33			24.4
10	13.75	9	0.42			1	0.08					24.25
11	15.17	6.83	0.42	0.08	0.17	1.58		0.17				24.42
12	15.67	7	0.67	0.08		1.33	0.25	0.25	0.33	0.08	0.17	25.83

Table 4.6. (cont.) Mean number of wh-questions of each question type - correct use and errors

Data Point	corr-ect	omission error			error of commission						other	total
		omit. aux	omit. Sub-ject	omit main verb	double aux	agree-ment error	uninv	tense on main verb	case error	auxiliary mis-classif.		
13	17.25	6.92	0.58			0.67	0.33	0.5	0.17		0.17	26.59
14	16.42	7.75	1		0.08	1.17	0.08	0.5	0.58		0.08	27.66
16	16.75	5.08	0.33		0.08	1.33	0.17	0.25				23.99
17	16.42	4.5	0.58		0.08	1.42	0.33	0.33	0.08		0.17	23.91
total	201.26	114.34	10.25	0.16	1.41	16.09	2.49	2.41	2.32	0.08	0.67	351.48

From Table 4.6 it is possible to see that there was little evidence for a sequence of omission → misplacement/commission. Omission errors, almost all of which were auxiliary omission, were the earliest produced error but were far more frequent at each datapoint, even the later datapoints, than errors of commission. The number of errors of commission did increase at later datapoints, but some errors of commission were present even at early datapoints (e.g. six of the children produced errors of commission before datapoint 4, see table 4.15). However, these results may have been confounded by the fact that the data was averaged across children who may be at different points of development. The issue is, thus, reconsidered in the light of the data from individual children in section 4.3.5.4.

In addition, there was no evidence for an uninversion stage. Uninversion errors were never very frequent. The most frequent error of commission was not uninversion but an agreement error (e.g. **what's them?*) which was also the earliest commission error produced and occurred mainly with contracted -*'s* and a plural subject. At no point did there seem to be an uninversion stage in which most of the errors produced were uninversion errors.

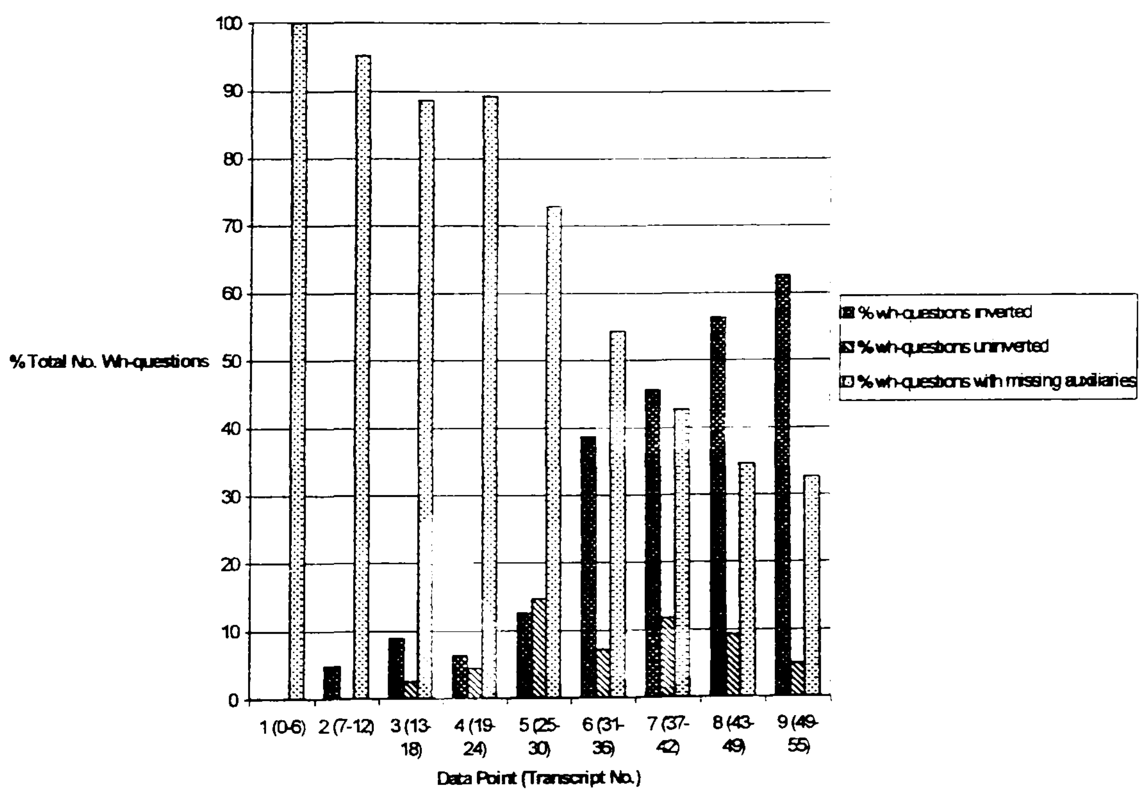
Finally, in order to determine whether uninversion was more likely with certain auxiliaries, the uninversion errors were extracted. There were 29 uninversion errors produced by 9 children, an average of 3.22 per child (range = 1-7, see Appendix G for full list). Uninversion was not restricted to a few wh-words but occurred with 7 wh-words (*where, who, how, what, why, which* and *when*) and was most frequent with *what* (14 instances) and *where* (9 instances). *What* and *where* each occurred in 6 children's data. *When, which, who* and *how* only occurred once each (Aran, Gail, Anne and Joel respectively) and *why* only occurred in 2 children (Aran and Liz). There were only 5 uninversion errors with modals (*can* occurred twice in Aran's data, *would* occurred once in Gail's data and *can* occurred once in Becky's and once in Aran's data) and one with a negative (*can't* was produced once by Aran). Eleven different lexical auxiliary forms occurred with uninversion. Therefore, uninversion did not seem to be restricted to either *why*, negatives or modals.

Uninversion errors, however, are alleged to occur after a child's MLU exceeds 3.0 morphemes (according to Klee's interpretation, 1985). Therefore, it could be the case that the children the Manchester corpus were too young to produce uninversion errors in large numbers or with the late occurring *why*, modals and negatives. As a result, the uninversion analyses were repeated on

Adam from the Brown corpus. The available dataset (55 one-hour transcripts) was divided into nine datapoints, the first eight consisting of six consecutive transcripts, the final data point consisting of seven consecutive transcripts. All matrix object/adjunct wh-questions were extracted.

Figure 4.1. details the percentage of wh-questions produced by Adam with inverted, uninverted and omitted auxiliaries at each of the 9 points between the ages of 2;3.4 and 4;10.23 (MLU 1.86-4.74).

Figure 4.1. Percentage of wh-questions with inverted, uninverted and missing auxiliaries as a proportion of the total number of wh-questions produced



From the graph it is possible to see that there was no uninversion period during which uninversion errors accounted for a large proportion of Adam's wh-questions. At no stage in development did the proportion of uninverted questions account for more than 14.6% of all wh-questions. At datapoint 5, Adam produced slightly more uninverted questions than inverted questions (12.6% of all wh-questions are inverted, 14.6% uninverted) but even at this peak, there were many fewer than questions with omitted auxiliaries (72.8% of all wh-questions). There was, thus, no evidence for an uninversion stage in development.

In order to determine whether uninversion was more frequent with *why*, modals and negatives, data from the period during which most uninversion errors occurred was used (data points 4-6, transcripts 19-36, MLU 3.24 - 4.10, child's age, 2;11.28 - 3;8.14).

Table 4.7 details the number of wh-questions produced inverted and uninverted with each wh-word and table 4.8 shows the number of wh-question produced inverted and uninverted with each auxiliary.

Table 4.7. Number of wh-question words that occurred with inverted and uninverted auxiliaries

Wh-word	Number inverted	Number uninverted	Total
What	55	15	70
Who	4	0	4
How	41	7	48
Why	3	33	36
Which	2	1	3
Where	11	4	15
Total	116	60	176

As with the Manchester corpus, uninversion was not restricted solely to questions with *why*. However, it was much more prominent with *why* (91.7% of *why* questions were uninverted) than with any other question. Uninversion was also more common with modals and negatives. Twelve of the 16 uninverted wh-questions occurred with either modals or negatives (three of these were with negated modals). Thus, for Adam's data, uninversion was more common with, but not restricted to, modals, *why* and negatives.

Table 4.8. Total number of auxiliaries that occur inverted and/or uninverted during the uninversion period

Auxiliary	No. inverted	No. uninverted	Total
am	1	0	1
are	15	0	15
-'re	3	0	3
can	2	14	16
can't	0	13	13
could	2	0	2
couldn't	0	1	1
did	8	1	9
didn't	0	2	2
do	52	0	52

Table 4.8. (cont.). Total number of auxiliaries that occur inverted and/or uninverted during the uninversion period

Auxiliary	No. inverted	No. uninverted	Total
don't	0	6	6
does	21	0	21
doesn't	0	3	3
had	1	0	1
-'has	1	1	2
have	1	0	1
is	5	1	6
-'is	2	4	6
may	0	1	1
might	0	1	1
shall	1	1	2
should	0	5	5
was	1	0	1
will	0	5	5
won't	0	1	1
Total	116	60	176

To summarise, although correct wh-question production increased throughout the year, the errors were still being produced in large numbers by the end of the study. The most frequently produced error at all datapoints for both corpora was auxiliary omission. Though most errors of commission were rare, especially at earlier datapoints, agreement errors were produced at all datapoints and were the third most frequently produced wh-question error for the Manchester corpus. The issue of the sequence of errors is returned to in section 5.3.5.4. Uninversion errors occurred with many wh-words and auxiliaries but were never produced in larger numbers than auxiliary omission errors. For Adam but not the younger children from the Manchester corpus, modals, negatives and *why* showed greater rates of uninversion than other wh-words and auxiliaries.

4.3.5. Individual differences

4.3.5.1. Differences in wh-structure

The first analysis addressed the question of whether the acquisition of different wh-structures varied between children. Table 4.9 details the number of utterances produced in each wh-structure by each child. All children produced object/adjunct wh-questions in greater numbers than in any other structure. However, eight of the children (Aran, Dominic, Gail, Joel, Liz, Nicole, Ruth and Warren) produced more embedded wh-phrases than subject wh-questions and three (Becky, Carl and John) showed the opposite pattern. One child, Anne, produced embedded wh-phrases and subject wh-questions in equal numbers. Furthermore, in single wh-word structures, some children used nearly the full range of possible wh-words (Aran and Becky used six wh-words in single wh-word structures) but others used many fewer (Dominic, Gail, John and Warren used only two). In short, individual differences existed between children in the amount they used each wh-structure.

Table 4.9. Total number of wh-structures produced by each child

	Object/adjunct Wh-questions	Single wh-words	Subject wh-questions	Embedded wh-phrases	Total
Aran	296	6	42	66	410
Anne	414	5	27	27	473
Becky	616	6	58	43	723
Carl	444	3	53	1	501
Dominic	94	2	3	26	125
Gail	273	2	15	34	324
John	131	2	21	6	160
Joel	240	4	33	37	314
Liz	265	3	8	25	301
Nicole	204	5	14	23	146
Ruth	139	3	7	32	181
Warren	233	2	25	67	327
Total	3349	43	306	387	3985

4.3.5.2. Differences in wh-word use

The order of acquisition of different wh-words in each of the 4 wh-structures was calculated using the 'first use' criterion (for all four wh-structures) and the 'third use' acquisition criterion (for object/adjunct, subject and embedded wh-structures, see section 4.3.2). Results for first and third use criteria were very similar (though acquisition was, predictably, consistently later for the third use criterion) so only the former will be reported below, and any differences indicated in parentheses. For all wh-structures, there were individual differences in the order of acquisition of wh-words. The orders of acquisition for each child in each wh-structure are illustrated in tables 4.10-4.13 (see appendix E for results using the 'third use' criterion).

Table 4.10. Order of acquisition of wh-words in object/adjunct wh-questions by datapoint

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
1	where /what	what/ where	what/ where	what/ where /who	what	what	what/ where		what/ where			where
2	why/ who	who	who			where		what	who	where		what
3			how					where		what		
4		how			where	who		who		who		
5				whose				how				
6			which		who				why			
7						how						how
8			why									
9									whose		where	who
10						which	how			why		
11	when		whose						how		what	
12	how	what-ever										
13				how				whose			why	
14	which	which /why					which			how		
15			when		which / how			which	which			
16		whose						when				
17				which		when						

For object/adjunct wh-questions (see table 4.10), *what* and *where* were the first acquired wh-words for all 12 children. Eight of the children (six for 'third use' criterion) then acquired *who*, two acquired *how*, one acquired *why* and one acquired *why* and *who* together. One child (Ruth) used neither *who* nor *how* in object/adjunct wh-questions. There was no evidence to support the suggestion of Bloom et al (1982) that *which* and *whose* (adjectival forms) would be consistently acquired after the wh-sententials, *why, how* and *when.* The number of different wh-words used ranged from 3-8 with a mean of 5.83 (for 'third use' criterion, range = 2-6, mean = 3.83).

Table 4.11. Order of acquisition of wh-words in single wh-word structures by datapoint

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
1	where /what	what	what	what	what							
2				where					where	where		
3		why	why									
4			where					what	what			
5		where			why					what/ why		where
6								where	why		what	
7												
8												
9							where				where	
10						where						
11		which				what						
12	why						how	why		which		
13	when/ who		how/ which								why	

Table 4.11 (cont.). Order of acquisition of wh-words in single wh-word structures by datapoint

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
14		who		why								
15	how		who					who		who		
16												
17												what

For single wh-word structures (see table 4.11), *what* was the first wh-word produced by six of the children, *where* was the first for five, and *what* and *where* were produced concurrently by one of the children (Adam). The number of different wh-words used ranged from 2 to 6 (mean = 3.59).

Table 4.12. Order of acquisition of wh-words in subject wh-questions by datapoint

Data Point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
1				what		what	what					
2			what									
3		what							what			
4												
5									who			
6		who	who					what				
7										who		
8												what
9	who							who				
10	what					who						who
11											what	
12										what		
13												
14	which	which / whose				which						
15					what							
16											who	
17												

For subject wh-questions (see table 4.12), *what* was the first acquired form for 10 of the children (9 for the 'third use' analysis), *who* for the other two (3 children according to the 'third use' analysis). Six of the children (9 for the 'third use' analysis) only produced *what* and *who* in subject wh-structures, three only produced *what*. The number of wh-words used ranged from 1 to 4 (mean = 2.08). The result of the more stringent 'third use' analysis revealed that only *what* and *who* reached the acquisition criterion, suggesting that the use of *whose* and *which* is limited to a restricted number of wh-question frames.

Table 4.13. Order of acquisition of wh-words in embedded wh-phrases by datapoint

Data Point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
1						how		what				
2												
3	what	what										
4												
5										when		
6												
7												
8		where	when			what		where /who				what
9			what/ where		when	which				what		
10	when/ why				where	why						where /who
11	where /how	when		what		when			where /how			when
12			which			where			what			
13								when	when	where		

Table 4.13. (cont.) Order of acquisition of wh-words in embedded wh-phrases by datapoint

Data Point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
14			why		which / what		what /how	how			when	
15	who		who								where /what	
16			how		how						why	
17							when		which			

For embedded wh-phrases there was even more variability in the order of acquisition (see table 4.13). The first acquired form was *what* for five of the children (six for third use analysis), *when* for four (two), and *how* for one child. The number of different wh-words used ranged from 1 to 7 (mean = 4.33, for third use analysis, mean = 2.92, range = 1-6).

4.3.5.3. Differences in auxiliary acquisition

The number of different auxiliaries (e.g. copula *be*, auxiliary *have*) used ranged from 2 to 8 (mean 4.83, see table 4.5 above for order of acquisition by child). All children produced copula *be*, eleven children produced auxiliary *have* and auxiliary *be* and 10 produced examples of auxiliary *do* (all children except John and Ruth). For all children, copula *is* was the first acquired auxiliary. Modal auxiliary acquisition was consistently late; eight children produced modals but no child produced a modal auxiliary until datapoint 7.

In the earlier section on auxiliary acquisition (section 4.3.3.) it was suggested that results showing a gradual pattern of acquisition may have been confounded by averaging across different auxiliary lexemes (e.g. *is/are/was*).

To address this problem, the order of acquisition of separate auxiliary lexical forms for all 12 children was calculated (see Table 4.14)[11].

Table 4.14. Order of acquisition of auxiliary lexemes

Data pt.	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nic-ole	Ruth	War-ren
1	cop is	cop is	cop is	cop is/aux is/aux are	cop is	cop is/did	cop is/has		cop is			has/ cop is
2		does						cop is	has/ aux is			
3		did/ aux is/has		has								
4			cop was /cop are			has/ do				cop is		aux are
5	has		aux are	cop are		does/ aux is						
6		cop are	do/ have/ aux is			cop were			cop are			
7		aux are/ shall/ have	has			aux are/ aux am		aux is				have
8			does					have/ cop was	did	has/ cop are		
9	can/ does	do	did/ can		has			has/ cop are/ aux are	aux are/ does	have		cop are
10	did					cop are	cop are					aux is
11	cop are/ aux is	can/ could								does/ aux are		does
12	aux was/ have		shall					does/ can		aux is		

[11] Again, the results of a 'third use' analysis showed a very similar pattern with a gradual progression of auxiliary acquisition and considerable variation in the orders of acquisition (see appendix H).

Table 4.14. (cont.) Order of acquisition of auxiliary lexemes

Data pt.	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nic-ole	Ruth	War-ren
13	do/ cop was/ can't				aux are			shall	shall			
14			aux was/ cop were	shall/ does				did	can	do	cop is	
15	don't		cop am/ cop be		can/ does	cop was			have/ do		aux is	
16	will/ aux are	will		aux am		would			cop was			
17				have				aux am				

From this table it is possible to see that the results reported previously were supported; there seemed to be no one point at which any child acquired a large number of different auxiliaries. Instead, acquisition seemed to proceed gradually. Order of acquisition varied according to child and the number of different lexical auxiliaries used ranged from 2 to 16 (Mean = 9.5).

4.3.5.4. Differences in errors

Table 4.15 illustrates the order of acquisition of correct wh-questions and different types of errors for all children. The first error to occur for all participants was auxiliary omission. Correct use also appeared very early. However, apart from correct use and auxiliary omission errors, the order in which the children started to produce errors was variable. Only correct wh-questions, questions with missing auxiliaries and questions with missing subjects were produced by all 12 children.

Table 4.15. Order of acquisition of correct wh-questions and errors[12]

Data point	Aran	Anne	Becky	Carl	Dominic	Gail
1	correct/ omit auxiliary	correct/ omit auxiliary/ omit subject	correct/ omit auxiliary	correct/ omit auxiliary/ omit subject	correct/ omit auxiliary	correct/ agreement error/ uninversion
2		agree-ment error				omit auxiliary
3		double auxiliary/ tense on main verb	omit subject/ double auxiliary	agree-ment error		
4						
5			agreement error			
6		uninver-sion			omit subject	
7		case error				omit subject
8	agreement error		uninversion/ tense on main verb			
9	uninversion					case error
10						
11				omitted main verb		
12	omit subject/ tense on main verb/case	omitted main verb	auxiliary misclassify/ other			
13						
14			case error	tense on main verb/case	agree-ment error	
15						
16						
17				uninver-sion		

[12] See section 4.3.4 for a description of the errors produced

Table 4.15. (cont.) Order of acquisition of correct wh-questions and errors

Data point	John	Joel	Liz	Nicole	Ruth	Warren
1	correct/omit auxiliary		correct/omit auxiliary			correct/ omit auxiliary
2		correct		omit auxiliary		
3		omit auxiliary/ agree	omit subject /double auxiliary/ agree			
4	omit subject			correct		
5		omit subject				agreement error
6			uninversion/ case	omit subject		
7						
8			other			
9		double auxiliary/ uninversion			omit auxiliary/ case	
10	agreement error					
11				agreement error/tense on main verb		
12				case		
13		other		uninversion	omit subject	omit subject/case
14					correct	other
15					uninversion	
16		Tense on main verb				
17				Double auxiliary		

Eleven children produced agreement errors (e.g. **what's them?*), 9 produced uninversion and case errors (**where's me?*), 6 produced tensing errors (e.g. **where('s) goes*), 5 produced double auxiliary errors (e.g. **where* *shall we shall go?)* and two omitted the main verb (e.g. **where can I?*)[13]. Furthermore, errors of omission did not always appear before errors of commission. Uninversion errors were produced by 9 of the 12 children and the first occurrence of uninversion varied from datapoint 1 to 17.

To summarise, despite some similarities, individual differences existed between the children in wh-question acquisition. First, the number of different wh-words produced in different structures varied from child to child. Second, the order of acquisition of different wh-words (with the exception of *what*) varied according to child and to wh-structure. Third, the order of auxiliary acquisition also differed from child to child with only two consistencies: copula *is* was the first auxiliary used by all children in their object/adjunct wh-questions and modals did not occur until the later datapoints for all children. Fourth, the order in which the children started to produce errors varied. Errors of omission did not always appear before errors of commission and uninversion errors were only produced by 9 of the 12 children and at different points of development. To conclude, there was little evidence for consistency in the sequence of acquisition of wh-structures, wh-words, and auxiliaries or in the types of errors produced across the 12 children studied.

4.4. Discussion

The aim of the present chapter was to describe the acquisition of wh-questions by concentrating on five major issues and the central questions that have been asked regarding each issue.

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[13] These were only considered as errors in contexts in which a main verb was required. This excluded contexts in which main verbs omission is allowable for discourse reasons (e.g.
MOT: you can go to the park at some point today.
CHI: when can I?)

The chapter looked first at the acquisition of four different wh-structures: single wh-word structures, subject and object/adjunct wh-questions and embedded wh-phrases. Little work has been conducted on this issue although there are theories that make predictions about the order of acquisition of each structure (e.g. Radford, 1990). The present study found that object/adjunct wh-questions were, for all children, by far the most frequently used wh-structure but that all structures showed a steady increase in use throughout the year. However, there was little evidence that the acquisition of different wh-structures was interdependent. For most of the children, matrix object/adjunct and subject wh-question production tailed off slightly at the end of the study, but production of single wh-words and embedded wh-phrases increased steadily. Subject and object/adjunct wh-questions and single wh-words were produced throughout the year but embedded wh-phrases did not start to appear until datapoint 8. There was great variability from child to child in the number of wh-types produced in each structure although the number produced in subject and object/adjunct wh-questions was significantly positively correlated. Therefore, it seems that the use of subject and object/adjunct wh-question structures may be related but single wh-words and embedded wh-phrases are acquired independently.

The second set of analyses investigated the acquisition of different wh-words in different structures. Previous studies have suggested different orders of acquisition (e.g. Smith, 1933, Bloom et al, 1982) but have failed to distinguish between the acquisition of wh-words in different wh-structures. The present study reported that different wh-structures show different patterns of acquisition and frequency of use. *What* was the only wh-word acquired in a consistent position (first) in all four structures. *Where* was the most frequently used wh-word in object/adjunct wh-questions and was acquired early in this structure, *who* was produced frequently and acquired early in subject questions, *why* occurred frequently and early in single wh-word structures and *when* occurred most and earliest in embedded wh-phrases. With the exception of *what*, the frequency of use and order of acquisition of a particular wh-word seemed to vary according to wh-structure.

There were differences between children within, as well as between, wh-structure. The only wh-words to be acquired first consistently by all 12 children were *what* and *where* in object/adjunct wh-questions. All other wh-words varied from child to child and from structure to structure. There was also variability in the number of different wh-words acquired by each child in each structure. There was no evidence that children consistently acquire wh-words in the order suggested by Bloom et al (1982) (wh-pronominals → wh-sententials → wh-adjectivals).

The third analysis investigated the acquisition of auxiliaries in object/adjunct wh-questions. The analysis supported the findings of previous researchers (e.g. Fletcher, 1985; Klima & Bellugi, 1966) that the earliest auxiliary forms are acquired in 'routines', restricted to use with one or two particular wh-words. The data also supported the notion that modals and negative auxiliaries are acquired late: the 12 children reported in the present study acquired only a few modals very late in the year and only 2 negative auxiliaries were reported: *can't* and *don't*. There was, however, very little evidence to support the suggestion that a number of auxiliary verbs are acquired rapidly after a certain point in development. Instead, the acquisition sequence showed a gradual increase, with different auxiliaries and, indeed, different lexical forms of the same auxiliary, produced at different stages of development. In addition, apart from copula *is* which was the first auxiliary form acquired by all 12 children, the order of production of auxiliary forms differed from child to child.

The fourth analysis concentrated on the acquisition of correct forms and errors in object/adjunct wh-questions. First, contrary to the suggestion of Bellugi and associates (e.g. Bellugi, 1965) the proposed sequence of omission followed by uninversion and/or other errors of commission followed finally by correct wh-question production did not appear. Although errors of commission were rare at earlier datapoints, they were present in the children's early utterances. Omission errors were the most frequent error produced by the children at all datapoints, not just at earlier datapoints, and correct wh-questions were produced by all children throughout the year, although in larger numbers at later datapoints. In addition, apart from auxiliary omission errors, which tended to be produced very early by all children, the order in which the children started to produce errors was variable. Only four of the 12 children showed the predicted pattern of omission errors occurring before commission errors.

Second, two analyses on different corpora were conducted to investigate whether uninversion errors occurred at a certain stage in development and with certain wh-words and auxiliaries. Both analyses found that there was no identifiable uninversion period (as predicted by Bellugi, 1965) in which uninversion errors were produced in very large numbers. Uninversion errors were present but were much rarer than correct wh-questions and omission errors.

From the Manchester corpus data, there was no evidence that uninversion was restricted to a few wh-words and/or auxiliaries, in particular *why*, negatives and modals. Uninversion occurred with 7 different wh-words and 12 different lexical auxiliaries. Only 9 of the 12 children produced uninversion errors during the sample, and first occurrence of uninversion varied from datapoint 1 to 17. However, it was noted that the children in the present study were younger than those studied by Bellugi and associates and, although they produced uninversion errors, they produced only a few *why* questions, negatives and modals in total. It was, therefore, considered possible that uninversion would occur more often with these forms at later stages. To test this, data from Adam (Brown, 1973) were analysed. This revealed that although uninversion was not restricted to *why*, negatives and modals, it occurred much more often with these items. However, since Adam was one of the children included in Bellugi's original study, this finding will have to be confirmed by data from other corpora before strong conclusions can be drawn.

The findings of the present chapter suggest two main conclusions. First, the acquisition of wh-questions varied considerably both between different children and between different wh-structures, and these results did not always replicate those of other studies. This could, of course, be a result of the application of a very lax acquisition criterion of first use. As the speech studied is only a sample of total speech, there is an element of chance governing which of the wh-words already acquired by the children is recorded first. Although the third use criterion provided similar results, it could be argued that this, too is a very lax acquisition criterion. However, as will be detailed in chapter 7, since the children produce a restricted range of wh-questions, most of which are infrequent or late-acquired, applying even a relatively lax acquisition criterion leaves very few data to be analysed. This problem argues for a need for very large samples of data . It also suggests a need for researchers to provide a strong rationale to justify their acquisition criteria in order to make salient the differences that could arise as a result of different criteria. This would enable decisions to be made as to whether individual differences exist between children over and above the differences that are an inevitable result of the use of different methodologies.

The second conclusion of the present chapter is that the acquisition process seemed to reflect a slow building up of knowledge rather than stage-like changes in competence. Neither wh-words nor auxiliaries were acquired during any one developmental period. Instead, the acquisition of wh-structures, wh-words and auxiliaries seemed to be gradual, and independent, to a certain extent, of the acquisition of other wh-structures, wh-words or auxiliaries. Errors, too, were gradually replaced by correct wh-questions throughout the year, although all children continued to make errors in object/adjunct wh-questions until the end of the study. There was no one developmental period at which all children started to produce a disproportionate amount of any one particular error.

Successful theories of wh-question acquisition will, thus, have to be able to explain these effects. The aim of the next three chapters is to investigate theoretical attempts to explain some of the patterns of acquisition that have been illustrated both in previous literature and in the present chapter. The next chapter considers Radford's maturational theory and, in particular, how well the notion of maturation fits the pattern of data in children's early wh-questions.

Chapter 5

Radford's Small Clause Hypothesis

5.1. Introduction

One of the most important tasks facing researchers who posit innate universal constraints on grammatical acquisition is to reconcile such a theory with the fact that most of young children's utterances seem to contradict nativist assumptions about what constituents are obligatory in the adult grammar (see chapters 1 and 2). One type of solution to this problem is to propose innate maturational constraints on grammatical knowledge. Unlike full competence theories (e.g. Valian, 1991) that credit young children with adult-like knowledge which is read through severe performance limitations, maturational theories are based on the proposition that some kinds of innate grammatical knowledge are not available to the young language-learning child until predetermined developmental stages (see e.g. Abney, 1987; Guilfoyle & Noonan, 1989; Kazman, 1988; Lebeaux, 1987; Platzack, 1989).

The theoretical motivation for a maturational as opposed to a continuity hypothesis is clear (see Atkinson, 1992; Borer & Wexler, 1987). Since there are many innate biological systems that mature (secondary sexual characteristics are the most commonly cited example of these), the assumption that certain grammatical properties may also mature is consistent with modern biological theory. Thus, from a biological viewpoint, there seems no reason to assume the continuity hypothesis *a priori*. In addition, maturational theorists avoid having to make assumptions (for example, markedness or intrinsic ordering) not grounded in linguistic motivations in order to explain why some grammatical constituents seem to appear before others. Non-maturational theorists often have to resort to such assumptions; for example, the justification for Hyams's (1983) hypothesis that the subject parameter is initially set at the unmarked value is empirical not theoretical. According to some maturational theorists, examples such as these suggest that there is no general argument from linguistic theory that favours the continuity assumption over a maturational one (see Borer & Wexler, 1987).

However, if we accept this conclusion, the issue of empirical validity becomes critical in order to distinguish between continuity and maturational approaches. Continuity theories must predict that all changes in the patterning of early multi-word speech can be explained by factors other than changes in grammatical competence - factors such as lexical learning, parameter setting or the lifting of performance limits. Maturational theories, on the other hand, must predict changes in the data that cannot be explained by such factors (Crain, 1991). At the very least, if the theory proposes interactions between maturational change and other influences, the expected pattern of data must be clearly articulated and distinguishable from patterns that could result solely from these other factors. This is the only prediction that distinguishes maturational theories, as a group, from full competence hypotheses. To suggest stages of maturational change that are hidden or so short that they are not observable (e.g. Roeper, 1992), immediately renders the notion of maturation untestable with regard to the data. If it is not possible to predict when and how the maturational shift will become evident, the data can neither support nor disconfirm the maturational hypothesis.

Unfortunately, many maturational theories fail to make clear predictions about precisely when maturation will occur and/or omit details about how maturation will affect the patterning of the data. For example, Schutze & Wexler (1996; see also Wexler, 1994, 1996, 1998) have suggested that although young children have set all the basic inflectional parameters of their language prior to the multi-word speech stage, they lack knowledge, initially, that tense and agreement are obligatory in finite clauses. Although Schutze and Wexler see themselves as continuity theorists, their theory relies on maturation in that the knowledge that tense is obligatory matures later in development (at about age 2;6). Although this theory does make predictions (for example, about the types of error children should and should not produce), these are, importantly, not maturational predictions. With regard to the nature of maturational change, the notion of tense optionality makes no quantitative predictions about how often tense will be present in the child's speech. Unfortunately, this means that there is no point in development at which the theory would predict changes in the patterning of data that could not also be predicted by a full competence account that states that tense is included more often as performance limitations on production are lifted. The evidence may not explicitly contradict the idea that young children are optionally including tense (and Schutze & Wexler present data to support their theory), but, within the confines of the theory, it is not possible from an examination of the multi-word speech data to test the idea that the knowledge that tense is obligatory matures.

There is one maturational theory, however, that appears to avoid this problem: Radford's small clause hypothesis (1990, 1992, 1995, 1996). This theory originally posited clear distinctions between grammatical stages, made very precise predictions about the exact sequence of acquisition and provided a comprehensive description of the types of utterances that should be produced at each stage. However, it quickly became apparent that the early multi-word speech data did not support such a clear distinction between stages of development. As a result, Radford has modified his theory to account for these data.

The aim of the present chapter is to provide a detailed critique of Radford's theory by paying particular attention to his explanation of wh-question acquisition. The argument will be made that although the modifications to the original theory resolve the discrepancies between the theory and the multi-word speech data, they have the effect of watering down the clear predictions of the original to the extent that the maturational distinctions are no longer clear. In the following sections the basic tenets of the theory and some of the problems with it are outlined, followed by a detailed consideration of the application of the theory to wh-question acquisition.

5.1.1. Radford's small clause hypothesis

Radford (1990) suggested that there are three stages in the development of grammar. At the first stage, acategorical one-word utterances lacking morphosyntactic properties are produced (typically between one and one and a half years of age). Then, at around 20 months of age, children enter the second stage - the first categorical stage of development - in which they are hypothesised to be working with only lexical categories (i.e. not functional categories). At this lexical stage of development, children's speech is characterised by the acquisition of the four primary lexical categories (noun, N; verb, V; preposition, P; and adjective, A), their phrasal projections (into N'/NP, V'/VP, P'/PP, A'/AP) and a set of lexical inflections such as the noun plural, and the progressive *-ing* verb ending. Children's speech also reveals evidence, according to Radford (1990), of cross-categorical symmetry in the internal structure of the N-system, V-system, P-system and A-system and a correct setting of word-order parameters at the head-/adjunct-/specifier-first values. These lexical structures are pure networks of thematic relations in the sense that every set of sister constituents is thematically interrelated. Child structures are, therefore, purely lexical-thematic structures as opposed to adult structures which are networks of both thematic and nonthematic sisterhood relations.

The absence of functional categories explains why children's early speech lacks the grammatical properties that are associated with the determiner (D), complementizer (C), and inflection (I) system. Lack of a D-system explains the systematic absence of referential determiners (*a, the*), the possessive determiner (*'s*), case-marked pronominal determiners (*I/me/my*) and the person/binding properties of (pro)nominals in early speech. Lack of a C-system accounts for the absence of complementizers, preposed auxiliaries and preposed wh-constituents and explains why young children seem unable to comprehend wh-questions involving preposed complements. Lack of an I system explains why young children show no evidence of having acquired a variety of inflectional systems including infinitival *to*, auxiliaries (modals, progressive *be*, perfective *have* and *do*-support), copula *be*, finite verb inflections (*es/ed*), nominative case marking and empty categories. These grammatical devices do not become available to the language learning child until the third stage - the functional stage of development (age 24 months, +/- 20%) - when the functional D, C and I systems come on-line.

5.1.2. Predictions of the theory

In a strong form, the theory could be seen to make three major predictions about the sequence of acquisition of grammatical categories in children's speech. First, it predicts the absence of any grammatical items associated with functional categories in the lexical stage. Second, it predicts that once functional categories come online, functional items should become apparent in children's speech very quickly:

> "for some children at least, a whole range of different nonthematic and functional properties do seem to be acquired within a remarkably short time of the child entering the functional-nonthematic stage of development" (Radford,1990, p. 277)

Third, it predicts developmental parallelism in the acquisition of the functional categories:

> "once children start to develop nonthematic structures ... a whole range of different functional and nonthematic properties will start to be acquired together, and thus will show broadly parallel development...we will never find any normal child at any stage of development who has (say) a fully developed I-system but no D-system or C-system. (1990, p. 284).

These three predictions are consistent with the idea that we should be able to identify a clear lexical-functional distinction in children's early multi-word speech. Unfortunately, however, such a distinction is not observable in the data. In the first place, items associated with the operation of functional categories do occur at the lexical stage. It is now widely agreed that young children's speech contains case-marked pronouns, modals, determiners, infinitival *to*, past tense, third person singular present and subordinate clauses (e.g. Valian, 1986, 1991). It is also clear that children's speech does not become adultlike very quickly after functional categories come on-line. Functional items start to appear only gradually and errors of omission are apparent well into the third and even fourth year (Valian, 1991). In addition, changes occur at the wrong time. For example, Valian (1991) has reported that infinitival *to* starts to appear in children's speech much earlier than third person singular *s*. Finally, functional systems do not develop in parallel. Elements of the determiner system start to appear before elements of the complementizer system and correct determiner case marking is apparent well before correct inflectional case-marking (Ingham, 1993).

5.1.3. Modifications to the predictions

It would seem that Radford's theory as presented above is not consistent with the early multi-word speech data. However, the theory can, in fact, account for these discrepancies. The first problem - that functional items occur in the lexical child's speech - is dealt with in the original (1990) version of the theory by the proposal that functional items may occur in lexical speech as long as their presence does not indicate productive use. In order to assess whether an utterance is productive, a criterion is established that states that a construction has only been 'acquired' when it is used productively with an appropriate category stem. Utterances in the child's data that fail to satisfy this criterion can be dismissed as non-productive or rote-learned forms. Consequently, sporadic examples of functional items do not constitute evidence that the lexical child has access to functional categories.

In response to the second criticism that children continue to omit functional items and produce errors after they have gained access to functional systems, Radford has modified the original theory. In a later paper (Radford, 1995), he has suggested that functional stage children must learn exactly how to manipulate the new grammatical knowledge. Errors will, therefore, occur until children have mastered the correct application of this new knowledge:

> "although we have suggested that functional category systems are acquired from around two years of age, this is not to say that two-year-olds have mastered all the complexities of the morphosyntax of functional categories" (1995, p. 499).

For example, children may omit auxiliaries because they are using null allomorphs for those functional heads which have adult contracted or clitic allomorphs (so *Daddy's working* surfaces as **Daddy working*) (Radford, 1995). Children may produce case-errors because they have not yet mastered the complex conditions under which a head licenses a specifier (a specifier-head mislicensing error, e.g. *me do it*) (Radford, 1995). Errors and omissions in later speech are thus compatible with the modified maturational account.

In response to the third criticism that functional categories do not, in fact, develop in parallel, the parallelism claim is abandoned (Radford, 1992, 1995). Instead of predicting that all functional systems should show developmental parallelism, Radford (1992) argues that external factors, such as the nature of the child's experience or the relative complexity of different functors, determine the order of acquisition. For example, the development of the child's tense (T) system[14] might depend on the frequency with which the child

[14] Radford (1990) refers to the I-system, which includes both Tense and Agreement. However, following modifications to linguistic theory (e.g. Pollock, 1989), Radford (1992)

hears inverted auxiliaries in C, because one of the criteria for establishing whether an item is positioned in T or V is whether or not it can undergo inversion to C. Thus, although in English there is reason to believe that T, AGR (agreement) and C should be acquired at more or less the same stage of development (Radford, 1992), evidence that this does not occur would not prove problematic for the theory. As long as lexical categories emerge in children's speech before functional categories, any other variation in emergence is consistent with the theory.

5.1.4. Problems with the modifications

All the above modifications seem reasonable on the face of it. Few would dispute that some early child utterances are rote-learned forms or that children will make errors while they are learning complex systems. However, although plausible assumptions in themselves, the application of the productivity criterion and the later modifications have the effect of greatly reducing the theory's testability (and perhaps even removing its clear predictions). This is the case for two reasons. First, the productivity criterion, necessary to explain why functional items are present in lexical speech, is applied neither rigorously nor consistently. For example, Radford (1990) classifies utterances as rote-learned for a number of different reasons. *What's that* is described as rote-learned because it has a variety of pronunciations (Radford, 1990, pg. 124) but *how are you* because it is repeated monotonously in the same transcript and is the only example of a correct wh-question. Other utterances are labelled formulaic for a number of different reasons: because

distinguished between the systems of T (tense) and AGR (agreement). This distinction does not, however, affect the basic principles of the theory.

they show highly-marked word order not found in other utterances, because the subject is never replaced by another nominal, because the verb form is invariant and because there is no independent evidence that the child has mastered tense/agreement at this point. More importantly, the criterion is applied more strictly to functional than to lexical items. Gathercole & Williams (1994) point out that Radford's (1990) evidence that lexical stage children know that nouns can take complements consists of what may be a few rote-learned forms with a missing unstressed function word (e.g. **cup tea, *drink water, *bottle juice*). The evidence provided for the productive use of adjectival complements consists of a single example and for prepositional and verbal adjuncts, a few sporadic instances. However, when examples of functional systems occur in the lexical child's speech, these are dismissed. For example, the presence of the functional possessive *'s* (e.g. *Daddy's*) is explained as an 'impostor', with a different syntactic status for the child. Possessive personal pronouns and the child's correct use of the case-marking function of prepositions are dismissed as 'sporadic' examples, and therefore not evidence of productivity. Thus, Radford's use of criteria for rejecting disconfirmatory data is somewhat inconsistent and even contradictory. This makes it impossible to determine exactly what would count as admissible evidence against the theory.

Second, the assumption that the functional child will make errors until s/he has mastered the complexities of functional systems effectively allows Radford to explain the same types of errors in different ways depending on whether they occur in the younger or older child's speech. For example, omission of progressive *be* in utterances such as **Daddy sleeping* (Claire, 24-

25 months, Radford 1990) at the lexical stage is cited as evidence that the child has no I system (Radford, 1990, pg. 159). However, omission of the same item at the functional stage in utterances such as **he sleeping* (Alistair, 30 months, Radford, 1995) suggests to Radford, instead, that the child uses null allomorphs of auxiliaries where adults use clitic allomorphs. Case-marking errors such as **me have biscuit* (Angharad, 22, Radford, 1990) provide evidence for lack of a case system in lexical speech, but errors such as **me haven't seen Spider* (Jem, 26 months, Radford 1995) at the functional stage are cited as evidence that the child has misanalysed the relationship between a specifier and a head (a specifier-head mislicensing error, Radford, 1995). What this means is that similar errors are explained in different ways, depending on whether the child is identified as being at the lexical or functional stage. The implication is that even if the child produced the same utterances at the lexical and functional stages, the data would still be consistent with the modified theory.

5.1.5. Wh-question acquisition

In a strong form, the theory makes two predictions about wh-question acquisition. First, it predicts that the lack of the complementizer system at the lexical stage means that the lexical child will not be able to produce wh-questions with preposed wh-words and auxiliaries (i.e. correct adultlike object/adjunct wh-questions). This is because the lexical child has no CP head and specifier position into which to place the wh-word and auxiliary. As evidence, Radford (1990) reports that young children can neither produce nor comprehend adult wh-questions, producing phrases such as **Daddy go?*

(instead of *where does Daddy go?*, Daniel, 23 months) or **you got?* (instead of *what have you got?*, Harriet, 18 months; from Radford, 1990). In addition, young children's imitations of adult wh-words often leave wh-word in base-generated position; for example:

Adult: *what are they doing there?*

Child: *doing what there?* (Claire, 23 months) (Radford, 1990).

These examples suggest that young children do not have access to the functional categories necessary to create or parse adult wh-questions.

Second, Radford's original theory predicts that after about 24 months of age, all aspects of the complementizer (CP) system come on-line (Radford, 1990). As a result, children can produce correct wh-questions. Wh-words can be preposed into the specifier position of the CP, and auxiliaries, modals and the copula into the head position of the CP. In support of this prediction, he presents evidence that shows that children very rapidly acquire many different C-system structures after about 24 months (see e.g. the analysis of the data from Heather, Radford, 1990, pg. 282).

Thus, in a strong form, the theory predicts that there should be a clear lexical-functional distinction: lexical children should produce no correct wh-questions (i.e. no wh-questions with preposed wh-words and/or auxiliaries) and functional children should produce only correct wh-questions. However, once again, the data do not fit such a clear pattern. As Radford (1990, 1995) himself notes, lexical children do produce correct wh-questions and functional children continue to make errors long after the functional categories are hypothesised to have come on-line. Therefore, the modifications are essential in order to explain the data.

5.1.6. Modifications to the predictions

The appearance of functional constructions in the lexical period is dealt with in the original (1990) theory. First, a criterion of productivity is applied that states that a construction has only been 'acquired' when it is used productively with an appropriate category stem. Radford argues (1990), that correct wh-questions (e.g. *what's that*) and wh-questions with preposed wh-words (e.g. **where milk go? *where doggie go?*, Radford, 1990, pg. 133) are not used productively but are unanalysed formulaic or semi-formulaic utterances (e.g. *where X go)*. As unanalysed structures, these questions are produced in the absence of categorical knowledge so their presence does not indicate productive functional category use.

Second, it is proposed (1990) that some wh-questions produced at the lexical stage may be misanalyses of adult wh-questions, reinterpreted by the child in lexical terms. This explanation covers a variety of different wh-question types. Wh-questions with preposed wh-words and missing auxiliaries (**what you doing?)* are explained as clausal adjuncts produced in the absence of functional knowledge by adjoining the wh-word to the left of the overall verbal small clause (VP) structure. The presence of wh-word plus cliticized/missing copula sequences (*what's that*?, Dewi, 18 months; *what's this?*, Stefan, 19 months; **where Mummy?*; Daniel 19 months; from Radford, 1990) and questions in which the copula agrees with the wh-word (e.g. **where's them*, Jonathan, 28 months, Radford, 1990) is explained by the proposal that the child has misanalysed the wh-word as occupying a superficial subject position within the clause. Since subject wh-questions do not rely on the CP for their correct expression, the lexical child can produce them. This analysis could also apply to the occurrence of these errors with non-copulas (e.g. **what's you doing?)* as Radford (1990, pg. 131) suggests that lexical children seem to parse adult utterances with sentence-initial wh-words and auxiliaries as subject wh-questions. In this way, by applying a productivity criterion to sporadic utterances and reinterpreting anomalous data in lexical terms, the theory's predictions are matched to the data produced in the lexical stage.

The presence of errors in the functional child's speech is not explained by the original theory (Radford, 1990). However, later papers (Radford, 1992, 1995) include the proposal that errors occur because children have failed to master the complexities of functional categories, and misanalyse certain functional system properties as a result. First, Radford (1992) suggests that wh-questions with missing auxiliaries may occur in later speech because the child is producing null (i.e. covert instead of overt) auxiliaries. The child knows the auxiliary should be present but believes that it is possible to use null allomorphs instead of clitic allomorphs (e.g. so *where're you going* surfaces as **where you going?*). Second, to explain uninversion errors with modals (e.g. **what he can ride in*?, Bellugi, 1965; Klima & Bellugi, 1966) he argues that the child has misanalysed the relationship between the specifier and head of the CP. The child mistakenly restricts wh-word preposing to utterances licensed by an AGR constituent. Wh-words that occur with modals (modals do not carry agreement) will not be licensed to occur in the specifier of the CP but will, instead, be analysed as adjuncts to the TP. Thus the modal auxiliary will remain in base-generated, post-subject (i.e. uninverted) position.

Third, to explain uninversion errors that occur with non-modals (e.g. **what he's doing?*), children are said to be over-generalising specifier-head agreement (Radford, 1995). There are two possible ways in which this could cause uninversion. The C-feature, which is directly discharged onto an inverted auxiliary in C in adult English, could, instead, be indirectly discharged onto the interrogative wh-phrase in CP-specifier position. This would leave the auxiliary in post-subject position. Alternatively, C could inherit the categorical properties of its specifier. Since the wh-specifier is always nonverbal, this would mean that head C inherits the relevant nonverbal feature. This would block auxiliary inversion, since an inverted auxiliary is by nature verbal and cannot be positioned in a nonverbal C.

Fourth, Radford (1992) suggests that overgeneralization of head-specifier agreement means that the preposed auxiliary (head) agrees with its CP specifier. This results in errors in which the auxiliary/copula agrees with the wh-word, not the underlying subject (e.g. **where's they going*, **what's those*, Radford, 1990) and those in which the subject is assigned accusative not nominative case (e.g. **what's them*, **where's me*, Radford, 1990).

5.1.7. Problems with the modifications

Overall, the effect of invoking the productivity criterion and of explaining anomalous data in terms of certain misanalyses is to make the maturational theory compatible with the data. Unfortunately, however, these modifications make it hard to determine what specific predictions are made by the theory. First, once again, the application of the criterion for productivity is not even-handed. Correct wh-questions at the lexical stage are dismissed on the basis that they are sporadic, and questions such as **where Daddy go?* are defined as semi-formulaic, for example, on the basis that they 'have an unmistakably semi-formulaic character about them' (Radford, 1990, pg. 132). However, the acknowledged 'sporadic' appearance of questions compatible with a lexical analysis, such as *'know what'*, is considered evidence that children cannot prepose wh-words despite the possibility that such utterances are likely to have been rote-learnt from adult echo questions (Gathercole & Williams, 1994). In sum, sporadic examples compatible with the theory are accepted, but examples that do not fit the theory are dismissed. Without a strict operational criterion of productivity, it is possible simply to 'explain away' on an ad hoc basis much of the data that does not fit the theory.

Second, when we look in detail at the errors accounted for by the misanalysis explanations at the functional stage, we find that most of these are actually identical to the wh-structures produced at the lexical stage (see Table 5.1 for a summary). Wh-questions with omitted auxiliaries *(*what Daddy doing?)* are regarded as examples of null auxiliary use at the functional stage but clausal adjuncts or semi-formulaic utterances at the lexical stage. Uninverted wh-questions *(*what you are doing?)* are explained as some kind of misanalysis of the relation between specifier and head at the functional stage but are also compatible with a lexical clausal adjunct analysis in which the wh-word is adjoined to the left of the VP or IP[15]. Finally, wh-questions in which the auxiliary/copula agrees with the wh-word *(*what's these?)* and wh-questions in which the true subject is assigned accusative case *(*where's him?)* are seen as examples of specifier-head agreement errors at the functional stage. However, once again these errors occur at the lexical stage but are explained in terms of a misanalysis of the wh-word as the subject of the wh-question.

Table 5.1. Types of wh-questions and their lexical and functional explanations

Wh-question Type	Lexical Explanation	Functional Explanation
Missing/in situ wh-word (e.g. *that?, he's doing what?)*	Functional categories have not matured	No functional explanation
Correct wh-question with auxiliary or modal (e.g. *what are you doing?*	Unanalysed formulaic/semi-formulaic (applies only if occur in small numbers)	Functional categories have matured
Correct wh-question with cliticized/omitted copula (e.g. *where's Daddy?)*	Child misanalysed wh-word as subject	Functional categories have matured
Omitted auxiliary (e.g. *what you doing?*)	Clausal adjuncts or semi-formulaic utterance	Child uses a null instead of overt auxiliary
Uninverted wh-questions with modals (e.g. *what you can do?)*	Clausal adjunct	Specifer-head misanalysis - wh-word analysed as adjunct to TP
Uninverted wh-question with non-modals (e.g. *what you are doing*?)	Clausal adjunct	Overgeneralisation of specifier-head agreement
Copula/auxiliary agrees with wh-word (e.g. *what's those*)	Child misanalysed wh-word as subject	Overgeneralisation of specifier-head agreement
True subject assigned accusative case (e.g. *what's them?)*	Child misanalysed wh-word as subject	Overgeneralisation of specifier-head agreement

[15] The presence of auxiliaries at the lexical stage does not provide evidence that the child has a CP, only that the child is using IP structures. Uninverted wh-questions are, thus, compatible with a CP-less analysis.

In other words, the errors identified by Radford are produced at both stages of development and are compatible with the criteria for both the lexical and functional stages. If all the errors produced by children can be explained in both functional and lexical terms, there is no pattern of data that could disconfirm Radford's hypothesis and none that can unambiguously support it.

5.1.8. Aims of the present study

The first aim of the present analysis is to evaluate whether, given the modifications made to Radford's original theory, it is possible to distinguish between the lexical and functional stages of development in the data of twelve 20-36 month old children. Analyses will be conducted to determine whether the modifications included are necessary to explain the acquisition data. If the strong version of the theory cannot explain the data, the present study will test whether Radford's modified theory has any predictive power by investigating the errors produced at both stages of development and how well the lexical and functional criteria fit each stage. If data from both stages can be equally explained by either set of criteria, it will be concluded that there is no evidence for a maturational shift in child data, and that the data fit the theory only because it no longer makes genuinely testable maturational predictions.

The second aim of the present study is to test the theory further by investigating data from a later period of development. In order to conclude that there is evidence in the data for a maturational change, it must be possible to distinguish maturational change from changes due to other factors such as learning or the lifting of performance limitations. Thus, an observed distinction between lexical and functional stage data can only support a maturational theory if the distinction is unique to these two stages. If the same distinction can be observed between two later 'functional' periods of acquisition, the pattern of acquisition data can only be safely attributed to the child becoming a more competent speaker, not to a qualitative, maturation-driven shift in the nature of the child's grammar.

5.2. Method

All wh-questions were extracted from the 34 one-hour transcripts recorded for each of the twelve children in the Manchester corpus. Certain utterances were then removed. These included partially intelligible or incomplete (e.g. interrupted or trailing off) utterances, utterances with parts marked as unclear or questionable, quoted utterances and routines. Full or partial repetitions of the five previous utterances were then removed. Subject wh-questions were also excluded as they do not rely on the complementizer system for their correct expression. The analysis was conducted on wh-question types to ensure that the results were not affected by highly frequent rote-learned routines.

5.2.1. Criteria for distinguishing lexical and functional stages.

Radford distinguished between the lexical and functional stages of development in terms of age; his functional categories come on-line at about age 2 years (+/-20%). However, since age is a relatively poor measure of linguistic development during the early stages, the present study will use mean length of utterance as a measure of developmental level. Radford's lexical stage of development is designed to explain Brown's (1973) 'telegraphic' stage

I, in which children's speech is described as restricted to the primary lexical categories of noun, verb, adjective and preposition. Other grammatical devices start to appear at Brown's stage II (MLU = 2-2.5), which maps onto the functional stage of development. In the present study, the functional stage will, therefore, be taken as beginning at about MLU 2 (see Discussion section for a consideration of possible criticisms of this decision). The data from the twelve children were divided into three stages: stage 1: pre MLU 2. stage 2: MLU 2-3 and stage 3: MLU 3 and above (see table 3.2; stage 2 here incorporates stages 2 and 3 in table 3.2). A child was regarded as moving to the next stage of development when two transcripts had MLUs over the MLU boundary. Two children (John and Carl) produced no stage 1 data and one (Ruth) produced no wh-questions in stage 1. These three children's data were not included.

5.2.2. Lexical stage criteria

All wh-questions produced at each stage were coded according to lexical criteria as follows:[16]

Original lexical categories:

Missing wh-word + auxiliary	wh-questions in which the wh-word and auxiliary are absent. (e.g. **Daddy doing?)*. Context and intonation were used to discriminate between

[16] If an utterance fell into two categories it was counted twice, once in each category.

	declaratives, yes-no and wh-questions. Any examples in which the child's meaning was unclear were discarded.
Wh-word in situ	wh-questions in which the wh-word is in base-generated position, (e.g. **Daddy did what?*).

Modified lexical categories:

All of the above plus:

Wh-word misanalysed as subject	a copula wh-question with a cliticized/absent copula *be* (e.g. *what's that?*, **where Mummy?*); a wh-question in which the copula/auxiliary agreed with wh-word (**what's you doing?*) or in which the true subject was assigned accusative case (**what's them?*); wh-questions with omitted subject (**where's eating*?); wh-questions in which the tense was carried on the main verb (e.g. **what he does*)[17].
Clausal adjuncts	wh-questions with preposed wh-words but no auxiliary present (e.g. **what Daddy doing?*) and uninverted wh-

[17] See section 5.1.6 for a full rationale for why these structures can occur in the lexical stage. Wh-questions in which the tense is carried on the main verb are not considered by Radford but are compatible with the idea that the wh-word has been misanalysed as the subject because tense in subject wh-questions remains on the main verb.

questions (e.g. **what you are doing?*). for a full rationale for why these structures can occur in the lexical stage see section 5.1.7.

<u>Questions that do not fit lexical stage criteria:</u>

Correct wh-questions	questions with preposed wh-words and auxiliaries.
Tense on main verb and auxiliary	questions with double marked tense (e.g. **what does he does*?). These are not CP errors but IP errors. However, they are not explicable in terms of Radford's theory of wh-question acquisition.
Other	utterances that could not be classified. These were not included in the analysis.

In an attempt to apply the criterion for productivity across the three stages of development, it became an impossible task to integrate the various definitions of 'formulaic/semi-formulaic' into a workable operational definition. For example, at stage 2, some of the most frequent wh-questions were of the type *where('s) X gone*. According to Radford utterances such as these 'have an unmistakably semi-formulaic character about them' (1990, pg. 132). However, such questions do satisfy other criteria for productivity; for example, they are not sporadic, they are produced with a variety of subjects and they occur at the same time as other utterances that seem to show that the child has mastered tense and agreement. As a consequence, the formulaic/semi-formulaic category was not included in the analysis.

5.2.3. Functional stage criteria

All wh-questions produced at each stage were also coded according to functional stage criteria as follows:

Original functional criteria:

Correct wh-questions	wh-questions with correctly preposed wh-word and auxiliary/copula.

Modified functional criteria:

The above plus:

Spec-head misanalysis	questions with uninverted modals (e.g. **what he can do?*) and with double marked tense with modals (e.g. *where can he go-es?)*[18]
Overgeneralisation of spec-head agreement	Questions with uninverted non-modals (e.g. **what he did want?)*, with double marked tense with non-modals (e.g. *where does he goes*? See footnote 18), with auxiliaries that agreed with the wh-word (e.g. **what's those*) and with

[18] Radford does not consider an explanation for double tensing errors but he does state that they may constitute evidence for the maturation of the CP (Radford, 1996). Thus, they are not included in table 5.1, which indicates only the structures that are explained by Radford's modifications, but they are included here as they are compatible with Radford's theory.

	accusatively marked true subjects (e.g. **what does her want?).*
Null auxiliaries	wh-questions with missing auxiliaries.

Questions that do not fit the functional stage criteria:

Wh-word missing/in situ	wh-questions in which the wh-word is missing or in base-generated position (e.g. **Daddy did what?).*
Omitted subject	wh-questions with omitted subjects (e.g. **where's going?*). These are not considered by Radford but are not explicable in his terms.
Tense on main verb	these are tensing errors and not directly related to the child's grasp of the complementizer system. However, Radford's theory cannot explain their occurrence.
Other	utterances that could not be classified. These were not included in the analysis.

5.3. Results

5.3.1. Description of the data

Table 5.2 details the number of correct wh-questions and errors produced at each stage of development by all the children (see Appendix I for details of results for individual children). Table 5.2 includes all wh-question errors, rather than just those discussed by Radford which are indicated in table 5.1 (see method section for a rationale of why some of the errors not considered by Radford are, in fact, compatible with his theory).

Table 5.2. Total number of correct wh-questions and different types of errors at stages 1 (lexical stage), 2 and 3 (functional stages). A star (*) indicates an error that is not compatible with the lexical stage and a hash (#) indicates an error that is not compatible with the functional stage

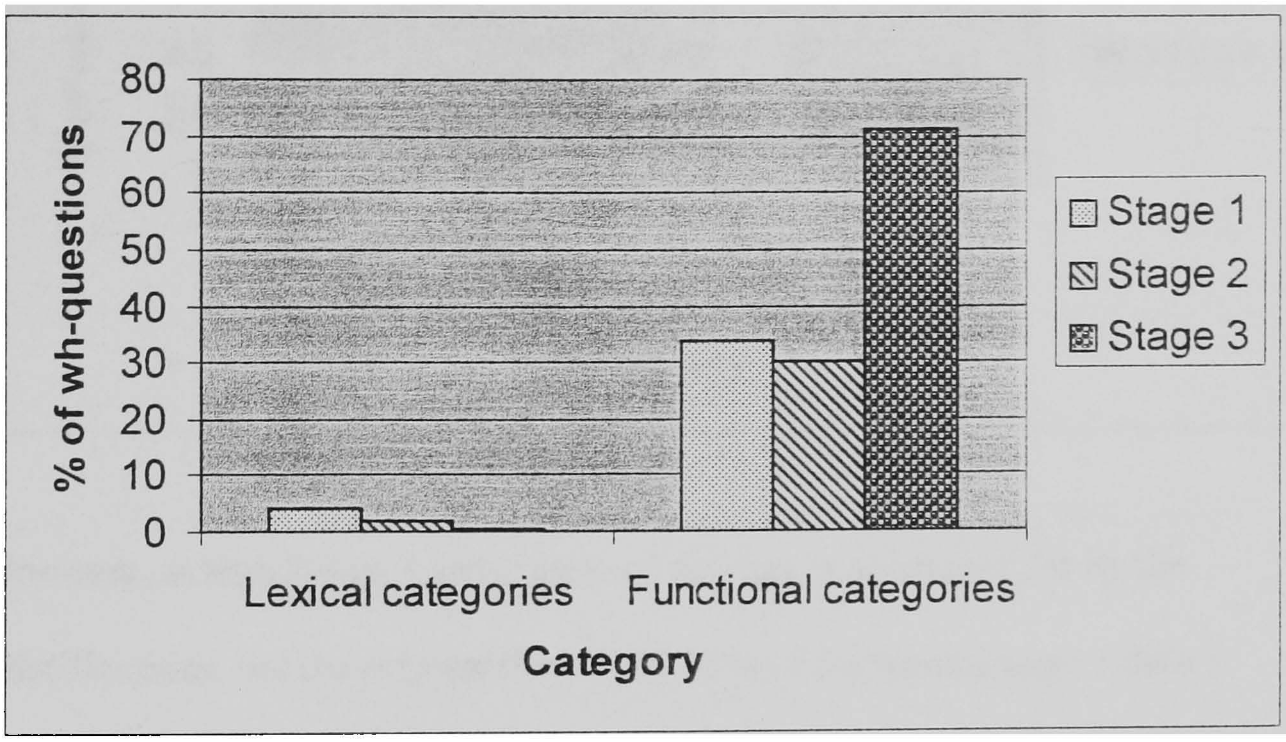
Type of wh-question	Stage 1 (MLU 1-2)	Stage 2 (MLU 2-3)	Stage 3 (MLU 3+)
*Correct question (with auxiliary or fully realised copula)	28	182	600
Agreement error	5	60	100
Omitted auxiliary	47	197	165
Case error	0	10	6
Correct question with cliticized copula	42	299	539
Omitted copula	63	231	125
#Omitted subject	12	38	34
#Tense on main verb (no auxiliary)	0	1	5
*Double tensing errors	0	12	8
Uninversion	1	13	15
#Omitted wh-word and auxiliary	0	18	4
#Wh-word in situ	9	1	0
Total	207	1062	1601

The number of correct wh-questions produced increased through the developmental stages, as predicted by the maturational theory. However, nearly all types of wh-question were produced at all stages of development. Overall, there is no evidence that the errors produced at stage 1 (the lexical stage) are qualitatively different from those produced at the functional stages (stages 2 and 3).

5.3.2. Testing the theory

In order to test whether Radford's categories could account for all the data without modifications, the number of wh-questions that fitted into his original lexical and functional criteria at each stage was calculated. Figure 5.1 shows the percentage of wh-questions produced overall that fit into the original criteria – the lexical criteria include only wh-questions with wh-words in situ or missing; the functional criteria include only correct wh-questions (including those with a cliticized copula that are presented separately in table 5.2 above). From the figure it is possible to see that the original lexical criteria account for very few of the wh-questions produced: even at stage 1 they explain only 4.34% of the data produced. The original functional criteria account for more of the data but less than half at stage 2 (30.02%) and only 71.14% of the data even at the latest stage – stage 3. In addition, the original functional criteria explain the lexical stage (stage 1) data much better than the lexical criteria (33.82% of the stage one data fits into the original functional criteria but only 4.34% fits into the original lexical criteria). The functional criteria also explain the stage 1 data slightly better than they do the stage 2 data (33.82% of the stage 1 data fit the functional criteria compared to 30.02% of the stage 2 data).

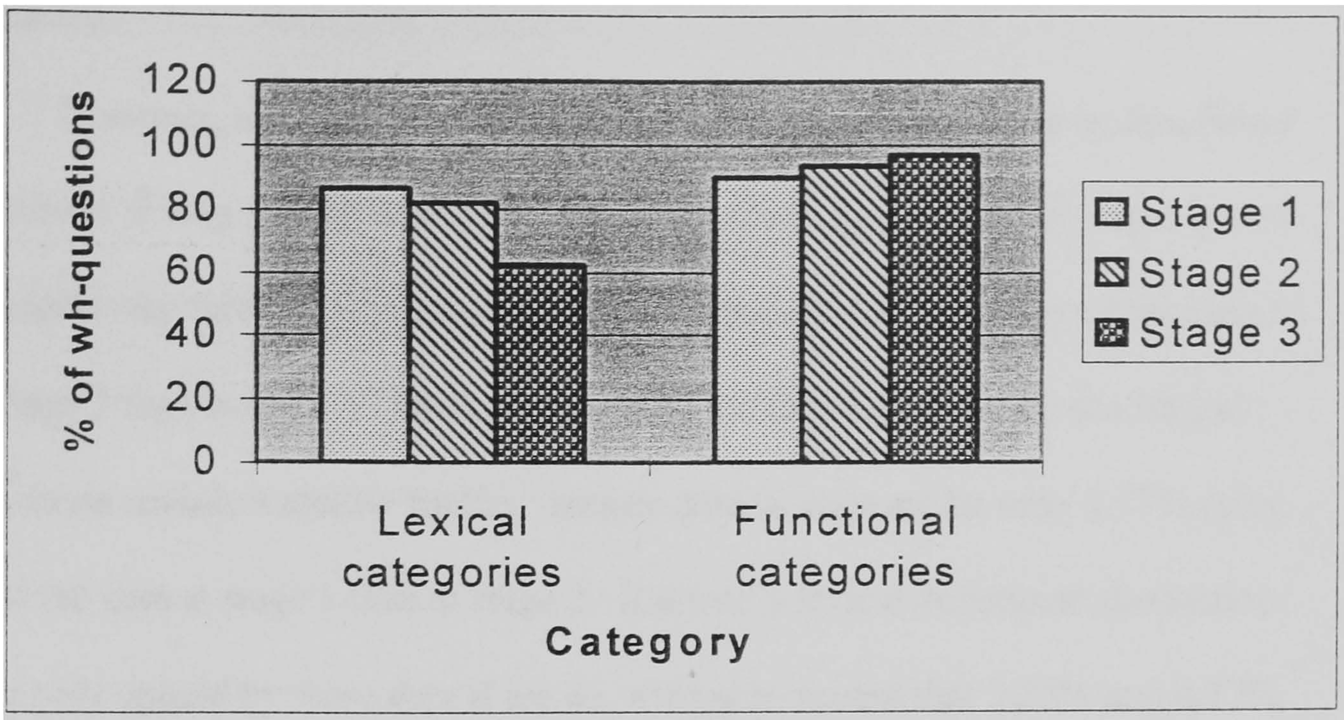
Figure 5.1 Percentage of wh-questions that fit into original lexical and functional categories at stages 1, 2 and 3.



Thus, the modifications are essential if the theory is to explain the wh-question acquisition data. However, even with the modifications, the theory does not explain all the data produced. Figure 5.2 shows the mean percent of wh-question types that fit into the modified lexical and functional criteria at each of the 3 stages.

The figure shows that at stage 1 (the lexical stage), 86.47% of the wh-questions produced by the children fit into the modified lexical stage criteria. Therefore, even with modifications, the lexical criteria do not account for all the lexical stage data. The functional stage criteria produce a better fit to the data - at stage 2 (the first functional stage), 94.63% of the wh-questions produced fit into the modified functional categories, a figure that increases to 97.31% by stage 3.

Figure 5.2. Percentage of wh-questions that fit into modified lexical and functional categories at stages 1, 2 and 3



However, at both stages 1 and 2 most of the data is accounted for by the modifications, not the original theory: 82.13% of the lexical stage 1 data is accounted for by the lexical stage modifications; 64.61% of the functional stage 2 data is accounted for by the functional stage modifications.

To ascertain whether the lexical criteria explain the lexical stage better than they do the functional stage and whether the functional criteria explain the functional stage better than the lexical stage, the difference between the proportion of wh-questions that could be accounted for by the criteria at each stage was calculated. Consistent with the theory the number of wh-questions that fit into the lexical criteria decreased from 86.47% at stage 1, to 81.73% at the stage 2 to 62.02% at stage 3. This decrease is predicted and is due to the fact that the children produce more correct wh-questions at stages 2 and 3 than at stage 1. In addition, the number of wh-questions that can be accounted for by the functional criteria increases as the child gets older – from 89.86% at stage 1, to 94.63% at stage 2 to 97.31% at stage 3. This increase is due to the fact that the children produce fewer wh-questions with wh-words missing or in situ (e.g. *Daddy does what?*) at the later stages. This is also predicted by the theory.

However, although more wh-questions can be accounted for by functional criteria at stage 2 than at stage 1, the difference between the two stages is very small – the functional criteria account for a mean of 3.55% more of the data at stage 2 than at stage 1. An examination of the data explained by the lexical criteria reveals a similar finding: lexical criteria account for only 4.77% more of the data at stage 1 than at stage 2. Radford's lexical-functional distinction is only upheld by these data if we are willing to accept that 3.55% and 4.77% differences constitute adequate grounds for a qualitative shift in the child's grammar.

In addition, even at stage 1, the functional criteria fit the data better than the lexical criteria (86.47% of wh-questions at stage 1 fit into lexical criteria, but 89.86% fit into the functional criteria). This means that on average, at the lexical stage, the children produce more correct wh-questions (that do not fit lexical criteria) than they do wh-questions with wh-words missing or in situ (that do not fit functional criteria). At both stages, the functional criteria explain the data better than the lexical criteria. The data, therefore, do not support the claim that children in stage 1 are at the lexical stage, and children in stage 2 the functional stage of grammatical development[19].

Finally, the question of whether the differences that were observed between stages 1 and 2 were reflected between the functional stage 2 and 3 or whether they were specific to the lexical-functional distinction was addressed.

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[19] The criticism could be forwarded that these results are due to a misplacement of the cut-off between the lexical and functional stages. See section 5.4 for a consideration of this issue.

Contrary to the predictions of Radford's theory, there were differences between the two functional stages– stages 2 and 3. The lexical criteria accounted for, on average, 19.71% more of the data at stage 2 than stage 3. The functional criteria accounted on average for 2.68% more of the data at stage 3 than at stage 2. If we want to argue that the distinction between stage 1 and 2 data is evidence for a qualitative shift between a lexical and a functional grammar, we must also argue for a qualitative shift between stages 2 and 3. Radford's theory does not predict such a shift.

5.4. Discussion

The present study tested for evidence for the lexical-functional distinction proposed by Radford (1990, 1992, 1995, 1996). It was found that the acquisition pattern was broadly consistent with the hypothesis that children will produce more correct wh-questions as they get older. However, this evidence is not enough to support a maturational hypothesis over any other. In order to test the maturational theory the data must show evidence of a qualitative shift from a lexical to a functional grammar. No evidence for such a shift was found in the data.

Without modifications, the theory only accounts for a small amount of the data produced by the children. With modifications, the criteria account for the majority of the data produced but the difference between the composition of the stage 1 and stage 2 data is very small. Functional and lexical criteria fit over 80% of the data in both stages 1 and 2 and the functional criteria actually produce a better fit to the stage one data than the lexical criteria. In addition, the differences observed between stage 1 and stage 2 are mirrored by differences found between the two functional stages 2 and 3. Although the data may seem superficially to support Radford's claim, the results merely reflect the fact that the children studied are producing more correct wh-questions, and making fewer errors in their production, as they get older.

In effect, Radford's theory has superficial plausibility only and this is for two reasons. The first is Radford's lax application of the productivity criterion to examples rather than to large amounts of data. For example, in the present study, there were 70 correct wh-questions produced at stage 1 (mean = 7.78 correct questions per child). The 70 correct questions produced at stage 1 are highly unlikely to pass Radford's criterion for productivity and could easily be categorised as rote-learned forms. At stage 2, the children produce a total of 481 correct wh-questions (mean = 42.89 correct questions per child), which suggests that the children, by stage 2, are using such questions productively. However, quantitative analysis of the data shows that the differences between the stage 1 and 2 data are much smaller than they seem. This is because fewer questions in total were produced at stage 1 than at stage 2 (207 in total at stage 1, 1062 at stage 2), so the 70 correct questions produced make up a significant proportion of the stage 1 data (33.81%). In fact, at stage 1 correct wh-questions constitute more of the data than any other category of question except questions with missing auxiliaries (see Table 5.2). By failing to take account of differences in the total number of questions produced, Radford mistakes a gradual increase in the amount of correct wh-questions with qualitative differences in the type of questions produced. Only by analysing quantitative data from both lexical and functional stages even-handedly is it possible to state conclusively that the data support or disconfirm the hypothesis. Once such an analysis is applied, the evidence does not support the maturational hypothesis over any other theory of wh-question acquisition.

The second reason for the theory's plausibility is that the later modifications (Radford, 1992, 1995, 1996) make it very difficult to ascertain what would constitute evidence for a lexical-functional distinction. The children studied produced many different wh-questions but nearly all of these are compatible with both lexical and functional criteria. As a result, the lexical data fit the lexical criteria and the functional data fit the functional criteria despite the fact that the children studied produced the same types of error at all stages of development (see Table 5.2). The only wh-question errors incompatible with the functional criteria but consistent with the lexical criteria are wh-questions with base-generated or missing wh-words, with an omitted auxiliary and tense marked on the main verb and those with omitted subjects and, in fact, the results for these structures actually disconfirm the prediction as all types of structure occur at the functional stage. Similarly, the only wh-questions incompatible with the lexical stage but not the functional stage are correct wh-questions and double tensing errors (e.g. *where does he goes*?). Only the latter (present in small numbers) confirm the prediction and occur only at the functional stage. With regard to correct wh-questions, although they occur at all stages (contrary to the theory) without applying rigorous productivity criteria to quantitative data, it is easy to dismiss such forms prematurely as rote-learned forms. Thus, it may be that all disconfirmatory examples can be discarded as unanalysed, and therefore non-productive, utterances simply as a result of the thinness of the data that is produced at stage 1.

Once these facts are taken into account, the only prediction that the theory makes that is supported by the data is that children at the functional stage of development should produce more correct wh-questions than children at the lexical stage. Because this prediction fits the observed acquisition pattern the theory gains superficial plausibility but it is a result that no one would dispute: all theories would predict that the oldest children make fewer errors. This effectively means that Radford's theory makes no predictions over and above those of other theories since few would disagree that the oldest children will produce more correct wh-questions than the younger children. Radford himself acknowledges the importance of prediction, dismissing a cognitive complexity theory of development because of its 'lack of predictive power' (1990, p. 269) and the parameterisation theory because 'it would seem to make no predictions beyond this [the prediction that all lexical categories will be acquired before any functional categories]' (1990, p. 973). These arguments apply in equal measure to Radford's own theory. The data studied here argue strongly for the idea that there is, in fact, no evidence for a lexical-functional distinction in the nature of the children's grammar.

Finally, although the present study has concentrated on one maturational theory it must be noted that the same problems may well apply to others. Although maturational theories do make other predictions about the nature of early multi-word speech, it is only in the notion of maturational change that such theories are distinguishable from full competence or constructivist accounts. Given that maturational theories do not deny the influence of factors such as lexical learning or the lifting of performance limits, proposed maturational changes in grammatical competence can only be supported by data that cannot be explained solely by these other factors. Unfortunately, the data do not support this view; evidence presented in the present paper and elsewhere (e.g. Valian, 1986, 1991) suggest that older and younger children do not construct utterances with qualitatively different grammatical knowledge. Thus, Radford can only explain the data by abandoning his original maturational predictions. Other maturational theories, too, may derive their plausibility from a failure to predict the nature of the maturational change. If this is the case, what is required is a theory that can explain the patterning of early multi-word speech without having to match proposed developmental stages to data that so clearly demonstrate no such qualitative change.

Chapter 6

Valian's performance limitation theory

6.1. Introduction

The conclusion of the previous chapter that there are no observable stages in early wh-question development would seem to provide support for the performance limitation account of language acquisition. Performance limitation theories are based on the premise that young children have adult-like grammatical knowledge in place but operate under severe performance limitations that restrict production. One of the most influential theories within this approach is that proposed by Valian and her associates (Valian, 1986, 1991, 1992; Valian, Lasser & Mandelbaum, 1992; Valian, Hoeffner & Aubry 1996; Valian & Eisenberg, 1996). Valian's theory is presented as an alternative to the idea that certain types of innate grammatical knowledge mature over the course of development and the arguments in her papers are designed to highlight the failure of such maturational explanations. As a critique of maturation, the papers are very successful. They show that the gradual emergence of different grammatical constituents in early multi-word speech is incompatible with maturational predictions. However, the extent to which the evidence they present supports the performance limitation theory itself is doubtful. In particular, the theory cannot explain the extent of lexical specificity in early child speech. The aim of the present chapter is to evaluate the evidence presented in support of the performance limitation theory and to devise additional analyses that test the success of the account at explaining wh-question acquisition.

6.1.1. Valian's performance limitation theory

Although it is presented as an alternative to a maturational account, Valian's theory is also based on the nativist assumption that some aspects of grammar are universal, and therefore innate, and that others are language-specific and develop after exposure to a language. However, where Valian and her associates (Valian, 1986, 1991, 1992; Valian, Lasser & Mandelbaum, 1992; Valian et al, 1996; Valian & Eisenberg, 1996) differ from maturational theorists is in their proposal that all the universal aspects of grammar are available to the young language-learning child at the start of the multi-word stage. According to this view, children who are producing multi-word utterances (i.e. children who have moved beyond producing only single words or a few rote-learned phrases, MLU 1.5 +/-.3, Valian, 1992) are doing so with full knowledge of all grammatical categories (both lexical and functional). In other words, an adult-like phrase structure grammar is already in place.

The theory presents two arguments to explain why children produce ungrammatical speech. The first and most well known of these arguments is the idea that errors occur when the cognitive demands of producing speech are too high. Speech production for the adult, like any other well practised cognitive task, is automatic and relatively effortless in terms of processing load (see Chi, 1978; Case, Kurland & Goldberg, 1982). Speech production for the 'novice' young child, though, is deliberate, requiring cognitively demanding processes and operations. Young children, as a result, employ strategies to reduce the cognitive load involved in speech production: for example, they may fail to lexicalise a particular node or minimise iteration in production. It is this attempt to reduce the effort involved in production.

which, according to the theory, causes many of the types of error we see in early multi-word speech.

In support of the theory, Valian has reported that the speech of young children is compatible with the suggestion that they already have an adult-like phrase structure grammar in place. She has argued that by age 2;6 (MLU 3), children use examples of all the syntactic categories (including determiner, adjective, noun, noun phrase, preposition and prepositional phrase, Valian, 1986) and show early, though sometimes infrequent, correct use of modals, infinitival *to*, tense and subordinate clauses (Valian, 1991). Children produce very few word class and pronoun case marking errors, which suggests that they already have knowledge of how to use the syntactic categories of their language (Valian, 1991). In addition, at least after MLU 2, American children learning English seem to know that subjects are obligatory (Valian, 1991).

Valian has also concluded that, consistent with the theory, children seem to be restricted in the types of utterance they produce in a way that suggests they are using certain strategies to reduce production costs. For example, there is evidence that children may omit subjects in long utterances (Valian, 1991). Similarly, pronominal subjects are more likely to be combined with longer verb phrases than lexical subjects, and subject noun phrases containing determiner, adjective and noun are infrequent before MLU 3.5. When the subject is present, another constituent (verb, object or adverbial phrase) is more likely to be omitted (L. Bloom, 1970). Alternatively, some children seem to know that a subject is required but cannot enunciate it, reducing the subject to a schwa instead of omitting it (P. Bloom, 1990).

Cognitive load is also a factor in subject omission according to the theory. The fact that subjects are omitted more than objects (P. Bloom, 1990; Valian, 1991) is consistent with evidence that suggests there is a high processing load associated with the beginning of a sentence (e.g. Pinker, 1984; Mazuka, Lust, Wakayama & Synder, 1986). In addition, the intransitive verb frame, less costly in terms of cognitive load, is used significantly more often than the transitive frame in early speech samples (Valian, 1991), although young children show evidence of being able to use both frames. Children are also more likely to include copula *be* than auxiliary *be* in their early utterances because the auxiliary's more complex phrase structure (which includes two verbal elements instead of one) imposes a greater cognitive load than the copula. (Valian, 1992; see Figures 6.1-6.3 for a comparison of the phrase structures of auxiliary and copula *be*).

Finally, there is confirmation from other fields. For example, children are reported to have a smaller working memory than adults, a memory span that is correlated with their MLU (Blake, Quartaro, Austin & Vingilis, 1989). Olsen (1973) has suggested that this inferior memory may be due to the children's lack of experience of manipulating language. This, according to Valian (1991), makes it highly likely that the child will only be able to produce short utterances although, like the adult, s/he has the whole grammatical system available to her.

Figure 6.1. Deep structure template for the sentence *she is a girl*

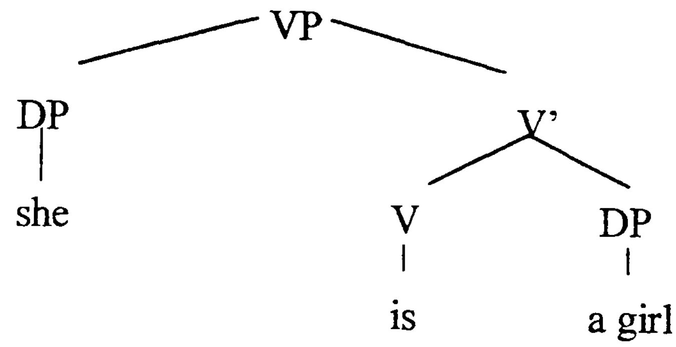


Figure 6.2. Deep structure template for the sentence *she be swimming*

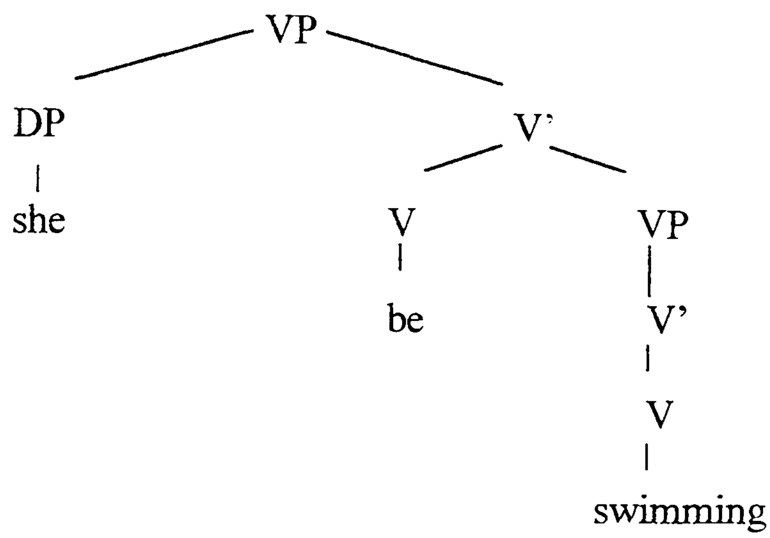
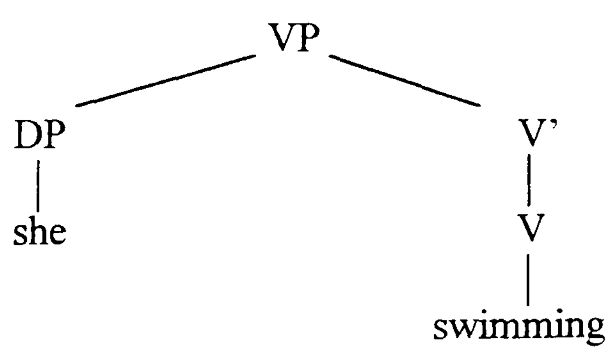


Figure 6.3. Deep structure template for the sentence *she swimming*



The second less well known performance limitation explanation for grammatical errors in early speech suggests that the child may still have to learn which lexical items fill which categories as well as how language-specific rules govern the placement of certain subcategories and operators (e.g. modals) and the movement of elements into different landing sites (e.g. tense and agreement lower from INFL to the verb in English, but the verb raises into INFL in Italian). It is this explanation that is used in Valian, Lasser & Mandelbaum's (1992) account of wh-question acquisition. They have suggested that errors in wh-question acquisition result because children have not yet mastered exactly how the principles of UG extend to English. First, children lack knowledge that tense must be lexicalised in English and second, they lack knowledge of the range of modals (e.g. a child may say **he do it* or **what he do* because s/he has not learnt the modal *can).* Neither of these mistakes is confined to wh-questions, children produce untensed forms and omit modals in declaratives as well as questions (e.g. **he go*). The third reason for errors, however, is specific to wh-questions. Valian et al suggest that children are mistakenly applying an 'optional' inversion rule to wh-questions, a rule that allows them to construct both inverted and uninverted wh-questions.

Valian et al (1992) suggest three reasons why a child may make the mistake of assuming inversion is optional in English wh-questions. First. optional inversion in matrix object/adjunct wh-questions is correct in some languages (e.g. French) and therefore optional inversion must be a possible grammatical principle that the child has to consider[20]. Second. the child has

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[20] The possibility of an optional inversion rule must be available in UG for the following linguistic reasons. Following linguistic theory (e.g. Plunkett, 1991, Chomsky, 1989. Katz & Postal, 1964 and Halle & Marantz, 1993) Valian, Lasser and Mandelbaum (1992) postulate that questions in all languages are headed by the abstract marker Q. However, they also suggest this abstract marker heads a maximal projection QuesP (for Question Phrase). In English , abstract Q is spelled out as a null morpheme but in other languages (e.g. Chinese. Sesotho) it may become an overt morpheme.

QuesP is a complement of CP and takes IP as a complement. The presence of QuesP across languages has two consequences - inversion and the characteristic question intonation evidence from yes-no questions in her/his input that optional inversion is possible in English. Third, the child hears some wh-words with uninverted or no auxiliaries in subject (especially *who*) wh-questions and *how come* questions. S/he has to learn from exposure to inverted questions in her/his input, that inversion is obligatory in matrix object/adjunct wh-questions. In addition, each wh-word has its own properties which children have to learn individually. The fact that inversion is obligatory in object and most adjunct wh-questions is one of these properties. For some wh-words, the child will learn this very quickly so there will be little or no optional inversion. For other wh-words, the process takes longer and the period of optional inversion will be extended.

Together, these factors explain the three types of error that Valian et al have identified in young children's speech. Questions with omitted auxiliaries and no tense (e.g. **what he do, *what he doing?)* are explained by the fact that children are producing uninverted wh-questions in which tense is not lexicalised (e.g. **what he do?)*[21]. To explain the presence of errors in which

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pattern. In English, the presence of QuesP in the syntactic structure allows but does not force movement of Infl (plus *have* or *be*) to C, resulting in inversion of subject and auxiliary. When Infl does not rise to C in questions (noninverted) it attaches to the verb (assuming Halle and Marantz's 1993 analysis). Therefore in English yes-no questions, both inverted and noninverted forms are allowed. In inverted questions, INFL raises to C (eg; did he buy it?) but in noninverted yes-no questions , INFL attaches to the verb (eg: *he bought it?)*

In English wh-questions (WH), however, only inverted forms are allowed. Valian et al argue that this must be the case given Plunkett's Specifier Licensing Condition (SLC) that states that if [Spec, CP] is filled in a root clause the head must also be filled. Since [Spec, CP] is occupied in wh-questions by the wh-word, something must rise to occupy C. In French , Q can raise to fill C resulting in noninversion as Q is a head and cannot be substituted for by I or I+V. However, in English, INFL raises to fill C: resulting in inversion (with the exception of *be* and *have*, verbs in English do not leave the VP in derived structure). To summarise, C must be filled in wh-questions but languages differ in what can occupy C. In French, Q can occupy C whether [Spec, CP] is filled or empty (i.e. in yes-no and wh-questions). In English, Q can only occupy C if [Spec, CP] is empty (i.e. only in yes-no questions). Valian et al argue that some young children mistakenly choose the French, not the English, setting of their grammar. This means that English children have an 'Optional Inversion Rule'.

[21] Valian et al argue that, in cases where *do* support is omitted, Q has raised to C and abstract tense has raised and attached to Q. Insertion of the head *do* support cannot occur because C is

tense is present on the main verb (e.g. **what he does?),* Valian et al suggest that children are producing uninverted wh-questions in which the tense is left on the main verb either because the insertion of the auxiliary is unnecessary or because the child lacks lexical knowledge of the range of modals[22]. The presence of noninversion errors (e.g. **what he can do?)* is explained simply by the fact that the child is applying the optional inversion rule, and has failed to invert the auxiliary[23].

6.1.2. Problems with the theory

At first sight, then, the performance limitation theory would seem to provide a coherent theory of acquisition, compatible with the multi-word speech data. The idea that children have near-adultlike grammatical knowledge but make errors due to cognitive restrictions on production or because they have as yet failed to master some of the more complex language-specific structures is consistent with both the continuity assumption of nativism and the multi-word speech data. On close inspection, however, the evidence from the data is less clear-cut. One major problem with Valian's theory, as well as performance limitation theories in general (see P. Bloom, 1990; Gerken, 1991) is the fact that it is very hard to distinguish whether the proposed performance limits are acting on the production, rather than the acquisition mechanism. In other words, the evidence presented in support of the performance limitation account is equally compatible with the idea that the child is a performance limited learner (e.g. Pine, Lieven & Rowland, 1998), who has been unable to

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already occupied by Q. To explain the absence of auxiliary *be* and *have* Valian et al suggest that Q raises into C, preventing the insertion of a verbal carrier for Tense+Aspect.

22 In such cases, Q raises to C and I lowers to V.

23 Q raises to C, blocking the movement of the auxiliary into C.

learn the missing element. For example, a child with a limited short-term memory may only have been able to learn *want a biscuit* from the adult input *do you want a biscuit* or, alternatively, *want biscuit* when the adult input is *I want that lovely biscuit*. Valian, et al (1996), in fact, make this point themselves in order to explain why the length of the sentences children hear affects whether a subject will be included when children imitate adult utterances:

> "in the elicited imitation paradigm a great deal of the processing load is experienced during comprehension ... the processing limitations begin their influence in the comprehension phrase of the task" (Valian et al, 1996, p. 162).

If, as Valian et al fail to do, we extend this point to spontaneous speech, it suggests that the processing load in spontaneous speech may fall in the same place - on the comprehension task rather than, or as well as, the production task.

In fact, the subject omission data could be explained more simply in terms of the patterning of subject placement in the child's input utterances. For example, subjects are omitted more than objects (Valian, 1991; P. Bloom, 1990) and occur, in the main, with untensed, non-finite verbs (*want biscuit* but not *wants biscuit*) (Wexler, 1994, 1996). Pine, Lieven, Rowland & Theakston (1999) point out that although tensed forms tend to occur with a subject immediately preceding or following them in adult speech (*she eats the biscuit, she wants the biscuit*), untensed forms frequently occur separated from the subject of the sentence, usually by a tensed auxiliary or matrix verb (e.g. *she is eating the biscuit, she likes to eat the biscuit*). Assuming performance limits on learning, if subjects occur separated from the verb more frequently than objects in children's input data, the difference in the rate of subject and object omission could be explained in terms of the likelihood of the child picking up subjectless lexical formulae with untensed verbs (*eating the biscuit, eat the biscuit*). Bearing this in mind, the data discussed so far do not favour a performance limit on production account over a performance limit on learning account. This possibility must be investigated before the conclusion can be made that the difference between the rate of subject and object omission provides support for the performance limitation account of early multi-word speech.

Thus, as it stands the evidence for performance limitations on production is far from convincing. It is, perhaps, impossible to test whether performance limitations act on production until such theories produce well-specified predictions that detail exactly how particular performance limits would impact on production and allow us to distinguish between this and the effect of such limits on the child's acquisition mechanism. Given this problem, it may only be possible to test performance limitation accounts by examining their claims that language-acquiring children are working with adultlike grammatical categories. The implication of this aspect of the theory is that children have knowledge of, and produce examples of, all the syntactic categories at an early age and Valian (1986) provides some evidence that this may be the case. However, critics have argued that Valian overestimates the syntactic knowledge that would be needed to produce these results because her analyses ignore the possibility that the data can be explained in more limited scope terms (e.g. Pine & Martindale, 1996). Pine & Martindale (1996) have argued that Valian's (1986) criteria for knowledge of a grammatical category are too generous and can be passed by children with a relatively small amount of limited scope knowledge. In a re-analysis of the data on determiner use, they concluded that, in the early stages, (ages 1;10-2;6; MLU 2.20-3.40), a child's knowledge about the behaviour of determiners is specific to the predicate frames in which the determiner appeared.

In fact, there is very little evidence that a child's knowledge of how to use one lexical item in a construction generalises readily to other members of the same category or even to other constructions. In a study of auxiliary acquisition, Kuczaj and Maratsos (1983) reported that a child's knowledge about a particular lexical auxiliary failed to generalise from one sentence structure to another. Pine et al (1998) found that, in the data from 12 children, there was no overlap in the verbs with which different auxiliaries were used and the auxiliaries *can, do, be* and *have* accounted for an average of 90.3% of all the children's different uses of auxiliaries.

The results for tense inclusion show similar effects. Bloom, Lifter and Hafitz (1980; see also Clark, 1996; Pine, et al, 1998) show that different morphological markers are initially applied to different populations of verbs, suggesting that rather than abstract tense, children's knowledge is limited to how to combine certain morphological markers with certain verbs. Akhtar & Tomasello (1997), in a study of novel verb forms, have reported that the present progressive inflection is used productively before the regular past tense marker, and before the children could use or comprehend word order correctly with these verbs, suggesting that productivity with word order may be independent of developments in verb morphology. In fact, Tomasello

(1992) has reported that the best predictor of the complexity of the use of a particular verb (i.e. how many arguments are used with a verb) is not the general complexity of the structures the child is capable of using, as would be predicted by a performance limitation theory, but the complexity of the structures the child has already mastered with that particular lexical item. These results count against attributing syntactic knowledge of tense and inflection to young children.

The evidence for lexical specificity also throws doubt on the assertion that low word class and pronoun case marking error rates support the performance limitation hypothesis. As Rubino and Pine (1998) have indicated (see also Pine & Martindale, 1996), since the opportunity for error is dependent on the pattern of lexical specificity in the data, it is difficult to calculate what the expected error rate would be. For example, Pine, et al (1998) report that high rates of correct nominative case-marking can be explained in terms of knowledge about the privileges of occurrence of particular lexical items, especially the first person singular nominative pronoun, *I*, which accounts for an average of 84.3% of the children's nominative pronouns (see also Lieven, Pine & Baldwin, 1997; Rispoli, 1994). The children's use of the accusative pronoun *me* in correct accusative and incorrect nominative positions was, in fact, not significantly different from chance. It is difficult to justify attributing adult-like knowledge of case marking to young children merely on the basis that children have some productive knowledge of the privileges of occurrence of the lexical item, *I*.

Taken together, the results outlined above indicate that children's initial multi-word utterances reflect knowledge that is much more limited in scope than the performance limitation account would predict. Valian's commitment to the assumptions of modern transformational grammar (Chomsky, 1981), means that she effectively overlooks the possibility that young children's knowledge may be restricted to the way lexical items, not grammatical categories, behave in sentences. This is an important failure given that the evidence presented above does not support the view that children's utterances are being produced on the basis of general underlying syntactic categories.

6.1.3. Testing the theory: wh-question acquisition

Valian et al's (1992) theory of wh-question acquisition seems on the face of it to avoid the problem detailed above. This is because the theory predicts a certain degree of lexical specificity in the children's data, with errors occurring more or less often depending on the identity of particular wh-words or even of the auxiliary form (e.g. Valian, 1992, suggests that copula *be* will be easier for the child to learn than other auxiliaries such as auxiliary *be* because it carries a simpler syntactic structure; see section 6.1.1.). Thus, the criticism that Valian's theory does not explain why children's speech is distributionally limited cannot be applied to Valian et al's explanation of wh-question acquisition.

However, while this is the case, the theory lacks predictive power. As suggested above, since performance limitation accounts are underspecified about the way in which performance limits will interact with each other and with errors stemming from mistakenly set parameters, the only way to evaluate such theories is by examining their prediction that children's speech will reflect category-general not lexically specific knowledge. If a role for lexical specificity is incorporated within the theory, the theory effectively predicts all conceivable acquisition sequences. This is because it predicts that the child operating with the wrong rule will produce inverted as well as uninverted/omitted auxiliaries. A child who produces correct and incorrect questions with all wh-words can be said to have an optional rule with all wh-words. A child who produces only correct questions has 'hit upon' the correct rule. A child who produces errors with only a few wh-words has a mixture of optional and obligatory rules applied to different wh-words. Thus, all possible combinations of use would seem to be compatible with the theory.

Given these facts, the only way to test the theory is to exploit the fact that Valian et al have only considered a role for limited lexical learning. More widely distributed effects cannot be explained by the theory. In particular, it cannot account for a role for low-scope rote-learned or semi-formulaic utterances that are not constructed by the application of movement rules (e.g. *what's* + X, *what did* + Y). The widespread presence of such lexical effects would pose problems for the assumption that children can only start to produce correct wh-questions in large numbers by using the principles set down in universal grammar.

Work on wh-questions at this lexical level is not as extensive as that for other grammatical systems. Thus, the aim of the present chapter is to test Valian et al's theory by investigating whether lexically specific effects not explained by the theory are present in children's early wh-question data. The section below details how this will be achieved.

6.1.4. Aims of the present chapter

6.1.4.1. Auxiliary omission

Valian et al posit lexical specificity with regard to the wh-word being used. In addition, different rates of auxiliary omission at the categorical level are compatible with the theory because Valian (1992) has suggested that less syntactically complex auxiliaries, for example, copula *be*, will be acquired before more complex auxiliaries such as auxiliary *be* and *have*. Given this point, it is reasonable to expect omission rates to follow the same pattern, with children avoiding the more complex syntactic structures by omitting the auxiliary. However, within the theory, if children are working with an auxiliary category, there is no reason to expect one lexical auxiliary to be omitted more often than others. Valian et al (1992, also Valian, 1992) cannot explain differences between a child's use of different forms of the same auxiliary (for example, if third person singular copula form *is/was* was present more often that second person singular or plural copula *are/were)*.

In order to examine this hypothesis we would have to be able to identify the missing constituent. This is only possible for copula *be*, auxiliary *be* and auxiliary *have* which have an observable effect on other grammatical items in the utterance so long as the subject of the sentence is present (e.g. *where the ball?* has an omitted copula *is*; *why you throwing the ball?* has an omitted auxiliary *are*; *where the ball gone?* has an omitted auxiliary *has).* The first aim of the present study will be to test whether certain forms of copula *be*, auxiliary *have* and auxiliary *be* are omitted more often than others. If this is the case, it will be concluded that it may be the identity of the lexical item, not an optional inversion rule, that predicts whether an item is included or omitted from a child's utterance.

6.1.4.2. Auxiliary uninversion

A similar analysis can be applied to auxiliary non-inversion. Valian et al suggest lexical specificity in the rate of inversion with regard to the wh-word being used but not the auxiliary. Auxiliary inversion should only be affected by the wh-word, not by the auxiliary item itself. For example, a child with an optional inversion rule for *what* should produce inversion optionally with all members of the auxiliary category. When the child combines *are* with *what*, *are* should be equally likely to occur in pre- as post-subject position (i.e. the child should be equally likely to produce *what are+subject+verb* as **what+subject+are+verb?*). In other words, there should be overlap in the wh-word+auxiliary combinations that occur in inverted and uninverted questions. The second aim of the present study is to test whether there is evidence for Valian et al's proposal that auxiliary inversion is predicted only by the identity of the wh-word, not the identity of the lexical auxiliary. Only if this is the case, can we conclude that there is evidence that the child is even-handedly applying an optional inversion rule to all members of the auxiliary category.

6.2. Method and Results

6.2.1. Analysis 1: Auxiliary omission

6.2.1.1. Method

The data from the Manchester corpus were used. Certain utterances were removed. These included partially intelligible or incomplete (e.g. interrupted or trailing off) utterances, utterances with parts marked as unclear or questionable, quoted utterances and routines. Full or partial repetitions of the five previous utterances were then removed. Subject wh-questions were also excluded as they do not require an auxiliary for their correct expression, as were wh-questions without subjects. All analyses were conducted on types, not tokens, to ensure that the presence of highly frequent but rote-learned phrases (e.g. *how do you do?*) would not influence the results. Two tokens were defined as the same type if the wh-word, auxiliary, subject, verb and, if present, prepositional phrase were identical.

Wh-questions were extracted from the transcripts recorded only after each child had produced the specific lexical auxiliary under consideration at least twice in any utterance type (e.g. wh-question, yes-no question or declarative) in order to pre-empt the criticism that certain auxiliaries may be omitted because the child has not yet learnt the lexical form of the auxiliary. For the auxiliary category analysis, wh-questions were extracted from transcripts produced after the child had produced at least 2 examples of any form of the auxiliary (e.g. for copula *be*, one example of copula *is* and one of copula *am*). Auxiliaries that had not occurred in two lexical contexts by the end of the taping period were excluded. Table 6.1 details the first transcript used for each auxiliary category and each lexical auxiliary.

Table 6.1. First transcript used for the auxiliary omission analysis[24]

Child	Auxiliary Category			Lexical Auxiliary forms					
	copula be	have	aux. be	copula is	copula are	has	have	aux. is	Aux. are
Aran	3	6	9	3	4	11	6	19	26
Anne	2	7	4	2	2	7	14	4	14
Becky	2	7	10	2	8	7	12	14	15
Carl	2	6	2	2	2	6	28	3	6
Dominic	5	19	10	5	16	19	23	15	22
Gail	2	5	6	2	9	5	18	6	15
Jack	2	2	9	2	4	2		9	
Joel	3	14	2	3	4	17	16	5	13
Liz	4	5	5	4	11	5	20	5	12
Nicole	5	16	8	6	17	16	21	16	17
Ruth	2		34	21	14				
Warren	2	2	6	2	14	2	26	6	33

6.2.1.2. Results

The first analysis investigated the children's use of the copula and auxiliary categories. The implication of the theory presented in Valian (1992) is that copula *be* will be acquired earlier than auxiliary *be* and *have* in all utterance

[24] Empty cells indicate that the child did not produce the auxiliary form in two different lexical contexts. These forms are not included in the analysis. Note that the first transcript of use for one of the lexical auxiliary forms does not always coincide with the first transcript for the auxiliary category because all forms of the auxiliary (e.g. *am, was, were, is*) were considered for the auxiliary category but only one form (e.g. *is* or *are*) for the lexical auxiliary forms.

types as it has a simpler syntactic structure and is easier to construct. This idea suggests that, according to performance limitation theory, omission rates may be similarly affected. The first analysis investigated whether omission occurred more often with one auxiliary or copula *be* type than another. All wh-questions with omitted or present copula *be*, auxiliary *have* and auxiliary *be* were extracted and the percentage presence in obligatory context calculated (see Table 6.2 for percentage presence and appendix J for the raw data).

Table 6.2. Percentage presence in obligatory context of copula *be*, auxiliary *have* and auxiliary *be*

Child	Copula be	Auxiliary have	Auxiliary be
Aran	65.66	55.88	59.26
Anne	78.28	70.91	65.38
Becky	83.22	83.61	83.56
Carl	56.03	62.07	55.26
Dominic	35.82	57.14	50.00
Gail	95.12	76.19	70.83
John	64.71	75.00	0.00
Joel	88.05	75.00	66.67
Liz	74.83	73.81	54.05
Nicole	37.31	23.81	35.29
Ruth	4.71		
Warren	67.52	48.78	58.82
Mean	62.61	63.84	54.47

First, as predicted, copula *be* was significantly more likely to be present in obligatory contexts than auxiliary *be* (median (copula *be)* = 66.59 versus median (auxiliary *be)* = 58.82, Wilcoxon z = 2.22, N = 11, p = 0.03). This was the case for all children except Becky and Dominic. Second, as predicted, there was no significant difference between the presence in obligatory context of auxiliary *have* and auxiliary *be*, (median (auxiliary *have*) = 70.91 versus median (auxiliary *be*) = 58.82, Wilcoxon z = -1.25, N = 11, p = n.s.). However, copula *be* was less likely to be present in obligatory context than auxiliary *have* (median (auxiliary *have*) = 70.91 versus median (copula *be*) = 66.59), although this difference failed to reach significance (Wilcoxon z = 1.07, N = 11, p = n.s). Thus, the results support the prediction of Valian (1992) that auxiliary *be* will be omitted more frequently than copula *be* but not the prediction that auxiliary *have* will be omitted at significantly higher rates than copula *be*.

However, Valian's theory (Valian et al, 1992) also predicts that there will be no difference between a child's use of different forms of the same auxiliary. To test this, an analysis was conducted to test whether certain forms of copula *be*, auxiliary *have* and auxiliary *be* were present in obligatory contexts more often than others. Wh-questions with present copula and auxiliary *is* and *are* and auxiliary *have* and *has* were extracted, together with wh-questions in which the omitted auxiliary could be identified as copula or auxiliary *is/are, have/has*. There were not enough examples of copula or auxiliary *am* to include in the analysis. The number of times each lexical auxiliary form was present expressed as a proportion of the total number of obligatory contexts for each auxiliary form was calculated. The results are shown in Table 6.3 (see appendix J for the raw data).

Table 6.3. Percentage presence in obligatory contexts of copula *is/are*, auxiliary *have/has* and auxiliary *is/are*

Child	Copula is	Copula are	Auxiliary has	Auxiliary have	Auxiliary is	Auxiliary are
Aran	70.29	30.43	80.96	16.67	86.67	50.00
Anne	80.83	53.85	74.47	50.00	73.68	14.00
Becky	86.84	42.31	87.80	72.22	100.00	76.92
Carl	59.24	15.79	68.63	100.00	72.73	28.57
Dominic	42.11	0.00	61.54	0.00	0.00	100.00
Gail	95.45	66.67	82.05	0.00	76.47	75.00
John	68.09	28.57	90.00			
Joel	90.00	66.67	95.45	37.50	100.00	62.50
Liz	75.69	60.00	85.71	33.33	66.67	22.22
Nicole	40.51	11.76	23.53	0.00	30.00	42.86
Ruth	6.15	0.00				
Warren	69.13	42.86	48.72		69.23	
Mean	71.22	38.61	73.35	34.41	67.36	52.45

The results show that copula *is* was significantly more likely to be present in obligatory contexts than copula *are* (median (copula *is*) = 69.71 versus median (copula *are*) =36.37, Wilcoxon z = 3.06, N = 12, p =0.002) and auxiliary *has* was significantly more likely to be present in obligatory contexts than auxiliary *have* (median (*has*) = 80.96 versus median (*have*) = 33.33, Wilcoxon z = 2.19, n = 9, p = 0.03). Auxiliary *is* was more likely to be present in obligatory contexts than auxiliary *are* though this difference failed to reach significance due to the small number of subjects (median (*is*) =73.21 versus median (*are*) =50.00, Wilcoxon z = 1.36, N = 9, p = 0.17). The results suggest that, contrary to the prediction of Valian et al, some lexical forms of the auxiliary, in particular the second person singular and plural, are more likely to be omitted than others. It seems to be the identity of the lexical auxiliary, not an optional inversion rule that predicts whether children will omit auxiliaries in their early wh-questions.

6.2.2. Analysis 2 - Auxiliary uninversion

6.2.2.1. Method

The twelve children in the Manchester corpus did not produce enough uninverted wh-questions for the uninversion analysis to be conducted. This may be because the children were taped at an earlier age than has been reported for uninversion errors. As a result, the analyses were performed on the longitudinal data from one child - Adam from the Brown corpus (Brown, 1973) made available on the CHILDES database (MacWhinney & Snow 1985, 1990).

All matrix object and adjunct wh-questions that require inversion according to adult grammatical rules were extracted from the 17 one hour transcripts recorded when Adam was between the ages of 3;0 and 3:8 (MLU 3-4, measured by two consecutive tapes with a MLU over the morpheme boundary). This was the period during which most uninversion errors occurred.

All analyses were conducted on types, not tokens, to ensure that the presence of highly frequent but rote-learned phrases would not influence the results. Types were defined as in the previous analysis. Certain utterances were removed from the dataset. These included partially intelligible or incomplete (e.g. interrupted or trailing off) utterances, quotations and routines. Full or partial repetitions or imitations of the 5 previous utterances were excluded, as were questions with double auxiliaries (e.g. **what can he can do?*) and those with a missing subject (e.g. **what can do?*). In order to replicate the types of wh-questions used in Valian et al's (1992) uninversion analysis, questions with the copula were also removed from the dataset. All matrix object/adjunct questions were coded for inverted or uninverted auxiliaries.

6.2.2.2. Results

The first analysis in this section investigated whether some wh-words were more likely to occur with inversion than others, as predicted by Valian et al (1992). All wh-questions with either inverted or uninverted auxiliaries were extracted and the number of wh-questions that occurred inverted and uninverted with each wh-word calculated (see Table 6.4). The inversion rates varied from wh-word to wh-word. The percentage inversion ranged from 100% for *who* to 8.3% for *why*. As Valian et al suggest, different wh-words show different levels of inversion.

The second analysis investigated the prediction that for each wh-word that shows optional inversion, there will be overlap in the auxiliaries that are used inverted and uninverted. For each of the five wh-word that showed optional inversion (*what, why, how, which* and *where*), the number of times each lexical auxiliary was used in inverted and uninverted form was calculated.

Table 6.4 Number of wh-words that occur with inverted and uninverted auxiliaries and percent proportion of the total number of times each wh-word occurred with either form

Wh-word	No. inverted	No. uninverted	% inverted	% uninverted	Total
What	55	15	78.6	21.4	70
Who	4	0	100	0	4
How	41	7	85.4	14.6	48
Why	3	33	8.3	91.7	36
Which	2	1	66.7	33.3	3
Where	11	4	73.3	26.7	15
Total	116	60	65.9	34.1	176

A lexical auxiliary was defined as any different form of a particular auxiliary (for example, *is, are* and contracted *'s* were counted as 3 lexical auxiliaries) in order to distinguish between overlap caused by the application of an optional inversion rule and overlap due to the child using one form of an auxiliary (e.g. *is)* in inverted questions and another (e.g. *are*) in uninverted questions.

Table 6.5 details the wh-words that were produced by the child, the auxiliaries that occurred with each wh-word and whether each auxiliary occurred in inverted or uninverted form. There were 46 different wh-word+auxiliary (wh+aux) combinations and 172 different question types, 112 in inverted and 60 in uninverted form. Contrary to the predictions of Valian et al's theory, only three of the 46 combinations occurred in both inverted and uninverted form; *how+can, what+'is, why+is* (marked in bold in table 6.5). These 3 overlapping combinations only accounted for 10 (5.8%) of the 172 different question types. If the 19 combinations that only occurred once and could not, thus, show any overlap are removed the three combinations still only account for 6.5% of the 153 different question types. Although the lack of overlap could be due to sampling constraints, this seems unlikely given the number of questions included in the sample (172 different wh-question types, 46 different wh-word+auxiliary combinations).

Table 6.5. Total number of wh-word+lexical auxiliary combinations *what, where, how, why, which*) that occur inverted and/or uninverted[25]

Wh+aux combination	No. inv.	No. uninv.	Total	Wh+aux combination	No. inv.	No. uninv.	Total
how can	**2**	**4**	**6**	where did	1	0	1
how can't	0	3	3	where do	3	0	3
how could	1	0	1	where does	3	0	3
how did	5	0	5	where had	1	0	1

[25] Wh+aux that occur both inverted and uninverted are marked in bold

TABLE 6.5 (cont.) Total number of wh-word+lexical auxiliary combinations

what, where, how, why, which) that occur inverted and/or uninverted

Wh+aux combination	No. inv.	No. uninv.	Total	Wh+aux combination	No. inv.	No. uninv.	Total
how do	19	0	19	where shall	1	0	1
how does	14	0	14	where should	0	2	2
what am	1	0	1	where will	0	2	2
what are	14	0	14	which does	2	0	2
what're	1	0	1	which should	0	1	1
what is	4	0	4	**why is**	**1**	**1**	**2**
what'is	**1**	**1**	**2**	why'is	0	3	3
what was	1	0	1	why can	0	3	3
what can	0	7	7	why can't	0	10	10
what did	2	0	2	why couldn't	0	1	1
what do	27	0	27	why did	0	1	1
what does	2	0	2	why didn't	0	2	2
what have	1	0	1	why do	2	0	2
what'has	1	0	1	why don't	0	6	6
what may	0	1	1	why doesn't	0	3	3
what shall	0	1	1	why 'has	0	1	1
what should	0	2	2	why might	0	1	1
what will	0	3	3	why won't	0	1	1
where'is	1	0	1	total	112	60	172
where could	1	0	1				

In addition, if this was the case, one might expect that the combinations that occur most often in Adam's speech would be the ones most likely to show overlap. However, not one of the six combinations that occurred 7 or more times showed any overlap (*what do* occurred 27 times, *how do* occurred 19 times, *what are* and *how does* occurred 14 times, *why can't* occurred 10 times and *what can* occurred 7 times in inverted or uninverted forms but never in the opposite form). The results do not support the prediction of Valian et al's theory.

6.3. Discussion

The results of the present study fail to uphold the predictions made by Valian et al's (1992) performance limitation account of wh-question acquisition. First, auxiliary omission rates are consistent neither with the predictions from an optional inversion rule nor with the idea that the complexity of syntactic structure influences omission rates. Although, as predicted, auxiliary *be* is significantly more likely to be omitted than copula *be*; auxiliary *have*, which should show similar rates of omission as auxiliary *be*, is omitted at a slightly higher rate than copula *be*. In addition, the children do not omit different lexical forms of the same auxiliary at similar rates, as predicted by the theory. Instead, the results suggest that the omission rates differ according to the lexical form of the auxiliary. Thus, the third person singular forms *is* and *has* were more likely to be present in obligatory context than second person/plural *are* and *have*.

Second, although different wh-words showed different rates of uninversion, as predicted by the theory, there was very little evidence that children's uninverted wh-questions were produced as a result of an optional inversion rule applied evenly to all members of the auxiliary category. Of the 46 wh-word+auxiliary combinations produced, 23 occurred in inverted form, 20 in uninverted form but only three occurred in both inverted and uninverted forms. None of the most frequent combinations occurred in both forms. Inversion seemed dependent not only on the identity of the wh-word as expected, but also on the identity of the individual lexical auxiliary.

These results have two implications. First, they indicate that the errors we find in children's early wh-questions may not be attributable to an optional inversion rule as suggested by Valian et al. According to the optional inversion rule, at any one point in development, children will have a variety of rules, applied to different wh-words. With some wh-words, children behave as if inversion is obligatory. With others, children behave as if inversion was optional, choosing to include or omit, invert or fail to invert auxiliaries on a moment-by-moment basis. However, this notion of optionality assumes that inclusion/exclusion of inversion or the auxiliary will be determined only by the identity of the wh-word that heads the sentence not by the identity of the auxiliary. In other words, there is no reason, within the theory, to suggest that certain lexical auxiliary forms will be more or less likely to occur with inversion than others. Thus, the theory cannot explain why inversion and omission are differentially affected by the identity of the lexical auxiliary involved.

Second, the results are consistent with previous research that shows that the distribution of early multi-word speech may best be captured by descriptions that are couched in terms of lexically-specific rather than category-general patterns. In this view, the difference between inverted, omitted and uninverted wh-questions may lie at the lexical level, with inversion and omission applying only to a restricted number of specific wh-words, auxiliaries and/or wh-word+auxiliary combinations only (see Chapter 7 for further discussion of this point). These findings pose a problem for all current performance-limitation accounts which, while often acknowledging the existence of lexically specific effects at the earliest stages of multi-word speech, usually attribute these to extra-grammatical factors associated with the young child's immature cognitive system or restricted vocabulary. On this assumption, the existence of such effects in the much later acquisition of more complex grammatical relations, such as wh-questions, is problematic. Thus, at present, performance limitation theories, such as that of Valian et al, cannot explain the presence of such late-occurring lexically specific effects.

Lexical specificity in the data is, of course, not necessarily a problem for future performance limitation accounts. There are many potential explanations that could incorporate a role for category-general knowledge within the child's learning mechanism and still remain compatible with the data. For example, lexical specificity in auxiliary omission could be due to performance factors that apply to a greater or lesser extent depending on the auxiliary. Thus, for example, auxiliaries that refer to plural subjects (*are/have*) could impose a greater cognitive load than those that refer to first and third person singular subjects (*is/has*). Alternatively, the forms *is* and *has* could be used more frequently and, therefore, retrieved more easily.

However, post hoc performance limitations could be invoked to explain any pattern of data. For example, let us suppose that the results suggested that *are* and *have* were, in fact, less likely to be omitted than *is* and *has*. If this were the case, we could formulate a performance limitation argument that explained these data by attributing extra cognitive load or pragmatic force to certain auxiliary forms and not others. We could, for example, argue that the high frequency of *you* contexts in mother's speech (as opposed to *I/he/she* contexts) could explain such findings or that second person singular verb forms such as *have* are easier to construct because their phonological form is usually identical to that of the infinitive in English. Although all are plausible explanations, performance limitation theories that are able to incorporate such arguments are left wide open to the criticism of unfalsifiability. In order to avoid this criticism, such theories must avoid making post-hoc modifications to the performance limits and, instead, make strong, falsifiable statements about how particular performance limitations will impact on the data.

In fact, what is needed is a process model that details exactly when and how performance limits could be expected to impact on the course of sentence production and acquisition. The model would have to include information on how such limits would interact - with each other, with the innate grammatical knowledge and with the accompanying language-specific lexical learning - in order to make strong claims about the predicted acquisition sequence. Such an account would allow us to distinguish between performance limits on production and on learning as well as generating testable predictions about the nature of the acquisition data. Until the production of such a model, however, the conclusion must be drawn that there is very little evidence from early child data that children possess adultlike grammatical knowledge but are restricted in production by severe performance limits. Given this conclusion, the possibility must be considered that the nature of child speech is not a result of maturational or performance limits on production but simply reflects the nature of their grammatical knowledge. In other words, children's speech may pattern lexically at first simply because their knowledge is restricted to how particular lexical items behave in different lexical constructions. The next chapter considers this idea in more detail.

Chapter 7

Lexical Constructivism

7.1. Introduction

The theories of Radford and Valian, although very different in their specific claims about the acquisition process, both come from the nativist or formalist side of the debate about how children acquire language. They share the assumption that the task facing the child is not strictly one of learning but of adapting universal, innate knowledge according to the particular language they are exposed to. In contrast, the constructivist approach posits the view that children are learning language - that they are constructing, on-line, a grammar out of the input they hear. This is not to say that there is no role for innate constraints. However, constructivist researchers argue that knowledge of language emerges during the course of learning as a result of the interaction between innate cognitive, not specifically linguistic, abilities and the structure of the language environment.

One constructivist idea that has received much attention in recent years is the proposal that young children learn grammar by building up knowledge of how words and sub-grammatical formulae behave in sentence structures. The aim of this final analysis chapter is to test this idea as an explanation of the phenomena reported in this thesis. In the following sections, the history and main ideas behind the approach will be considered first, before discussing how one particular lexical constructivist account could explain the results reported in the present work and the predictions this account would be expected to make.

7.1.1. Lexical constructivism

The lexical-constructivist approach stems from early work that focused on providing a detailed description of the nature of early child speech. One of the first to attempt this was Braine (e.g. Braine, 1963, 1976) who concluded from an analysis of the corpora of 11 children (Braine, 1976) that children's early multi-word speech consisted of limited scope formulae produced in order to realise specific kinds of meanings. Braine (1976) demonstrated that many of children's early utterances seemed to be produced using 'constant + variable' patterns, in which individual words or sub-syntactic categories were used in a single position and combined with a variety of other words. In this way, the children's early phrases seemed to reflect knowledge of semantic-distributional patterns that were realised at differing levels of abstraction. Some seemed to be general semantic patterns (e.g. action+patient - *eat dinner, get ball*), but others centred on more specific semantic classifications (e.g. ingest+thing ingested - *drink water, eat chocolate*). Still others were lexical, based around a particular pivot lexeme (e.g. X + *gone, big* + X). Importantly, however, there was no evidence of knowledge of broad syntactic categories (e.g. subject, object, noun and verb) in children's early multi-word utterances. On the contrary, Braine (1976) argued that the data actually contradicted claims for syntactic categories such as noun and verb phrases in early speech. For example, according to formal grammars, both locatives and actor-action patterns should be constructed using the subject-predicate construction rule $S \rightarrow NP_{subj}\ VP$. However, in Braine's (1976) corpus, two children produced groping (i.e. non-ordered) locative patterns concurrently with productive actor-action patterns, a fact inconsistent with a grammar containing a syntactic NP_{subj} VP rule.

Work conducted on a variety of syntactic devices produced support for Braine's analysis (see e.g. Bloom, Lifter & Hafitz, 1980; Clark, 1996; Kuczaj & Maratsos, 1983). In particular, some researchers have suggested that a wide range of grammatical structures - verbs, determiners, auxiliaries, argument structure, morphology and nominative case-marking - are acquired in low-scope, lexically specific formulae (e.g. Akhtar & Tomasello, 1997; Pine & Martindale, 1996; Lieven, Pine & Baldwin 1997; Theakston, Lieven, Pine & Rowland, 1999; Tomasello, 1992). For example, early determiner use seems to be restricted to patterns of the type *that's a* X, *where's the* Y (where X and Y represent initially mutually exclusive groups of nouns or noun phrases (Pine & Lieven, 1997). Similarly, a high proportion of early subject-verb sequences can be explained in terms of a relatively small set of lexical subject + verb patterns (Pine et al, 1998). There is, thus, an increasing body of evidence to suggest that children's early multi-word utterances may well reflect grammatical knowledge that is restricted to how limited scope formulae combine to realise specific kinds of meaning.

However, explanations of how adultlike grammatical knowledge could emerge from such limited formulae are as yet ill defined. One influential solution was proposed by Braine (1987) who argued that as long as we accept the notions of predicate and argument as cognitive primitives available at the outset of language acquisition, children can learn word classes by paying attention to semantic and phonological similarities between words. The word classes so learnt can then be expanded to include other words that share distributional properties. Therefore, the sentence *the smell grossed out the boy* is parsed by the rule initially formulated on the basis of sentences such as *the man kissed the baby* in which the objects and action are easily understood in semantic terms.

This idea is echoed in the work of Maratsos (e.g. Maratsos & Chalkley, 1980, Maratsos, 1988, Maratsos, 1990). Like Braine, Maratsos has suggested that the major form class categories have semantic cores that are important for initial acquisition but that, in the end, acquisition relies on the child picking up distributional regularities between lexemes. However, unlike Braine, Maratsos (1990) argued that noun and verb acquisition follows different paths. Thus, a child's entry to the noun category could be attained by grouping together concrete-reference terms. Structural similarities could be used to expand the noun class to nouns without concrete-reference terms. For non-nouns, however, the semantic cores are less accessible. Children cannot assume that action, stative and locative properties form the basis of other form classes because such categories are not universal cross-linguistically. Instead, children were hypothesised to combine non-nouns according to structural properties, especially small-scale combinatorial properties such as tense and aspect markers. Thus, Maratsos's theory, like Braine's, relied on distributional, phonological and/or semantic similarities between members of the same form class.

Evidence in support of these theories comes from research on both natural and artificial language learning. For example, in the laboratory, adults and children find it virtually impossible to learn arbitrary word classes in an artificial grammar but relatively easy once semantic or phonological similarities between some of the members of each category are introduced (e.g. Braine, 1987; Brooks, Braine, Catalano, Brody & Sudhalter, 1993). There is also evidence that such phonological and/or semantic similarities may form the basis of grammatical word class categories in natural languages too, for example, in Hebrew (e.g. Levy, 1983a) and French (e.g. Karmiloff-Smith, 1979) gender distinctions. In addition, early implementations of distributional theories as computer simulations have met with some success. For example, Klein and Kuppin (1970) created a program which used distributional heuristics to combine words and phrases into classes and eventually devise rules that could generate sequences of such classes. Another program devised by Kelley (1967) learnt word order heuristics based on the 'pivot grammar' suggested by Braine (1963) and the assumption that word classes can be associated with an absolute or relative position in the sentence.

However, serious flaws in both verbal and implemented distributional theories were noted by Pinker (1979, 1984). First, a reliance on distributional analysis would lead the child into serious error because many words belong to more than one word class. In a much quoted example, Pinker (1979) has illustrated that the analyser that hears the sentences:

Hottentots must survive

Hottentots must fish

Hottentots eat fish

Hottentots eat rabbits

is likely to merge the combinatorial properties of *must* and *eat* into a single class and produce nonsensical sentences such as *Hottentots eat survive*. Word class errors such as these are extremely rare in child's speech (Maratsos, 1983). Second, there are a vast number of distributional regularities and combinatorial possibilities even in the most simple sentences. A pure distributional analyser would be faced with the lengthy, if not impossible, task of deciding which, out of a large number of possible combinatorial properties to pay attention to. Adding phonological and semantic constraints would have the effect of increasing, not reducing, the number of possibilities to be considered. Only by restricting the generalisation mechanism would we reduce the possible properties to be considered. However, such an analyser would then require an inordinately large number of overlapping sentences to make any generalisations at all.

In order to overcome these problems, many theories focus on a detailed consideration of the data with the aim of discovering whether there is evidence that children restrict the focus of their attention in order to make the initial stages of language learning easier and more accurate. One solution to this problem has been proposed by Tomasello (the verb island hypothesis, Tomasello, 1992). Tomasello's theory pays less attention to linguistic classifications such as formal word class categories (e.g. noun and verb) and syntactic relationships (e.g. subject and object) on the basis that constructivist research attempts to explain acquisition without recourse to linguistic distinctions. According to Tomasello's (1992) theory, neither knowledge of formal word class categories and syntactic relations nor knowledge of semantic-role categories is necessary for children to learn language.

Tomasello (1992) has argued that children build up knowledge of the combinatorial properties of words based around their knowledge of particular verbs and relational terms. According to this view, the initial learning of argument structure and morphology occurs on a verb-by-verb basis (Akhtar & Tomasello, 1997; Tomasello, 1992). Thus, children initially learn verb-specific patterns such as *pusher-push-thing pushed* or *hitter-hit-thing hit*. Generalisation from specific verb patterns to grammatical categories will occur as the commonalties between the communicative functions of particular words are abstracted.

Tomasello's theory, unlike the models of Maratsos and Braine, does not specify the mechanism by which language acquisition will take place. However, it avoids the problem of how to restrict the analyser's frame of reference by detailing more precisely the distributional properties of the language to which children will pay attention. According to Tomasello, children will restrict the focus of their attention at first to verbs and other predicates. This is because children are not merely listening passively to input but are actively trying to deconstruct adult actions and intentions. Central to this process is an understanding of the verb: in *John kissed Mary*, it is the verb *kissed* that gives us a clue as to the activity that is being discussed. Therefore, verbs and other predicates are the pivot around which children will construct their utterances.

Unfortunately the strength of Tomasello's theory - that it provides a specific pivot around which children's structural analysis can centre - has also turned out to be one of its biggest problems. The frames around which children seem to construct their utterances do not seem to be restricted to the kinds of verbs and predicates that Tomasello suggests. Pine et al (1998) have recently argued that children's knowledge is organised not around verbs but around high-frequency markers that can include auxiliaries (e.g. *can, do*), pronouns (e.g. *I, me*) and even some nouns (e.g. *Mummy*, child's name). Such findings pose particular problems for Tomasello's verb island hypothesis as the idea that verbs, as well as nouns, can form 'mental objects to be analysed and categorised' (Olguin & Tomasello, 1993, p. 269), at least until verbs are themselves the arguments of predicates, is specifically rejected under the verb island hypothesis (see Olguin & Tomasello, 1993, p. 269)[26].

Recently, however, a new way in which to restrict the focus of the child's attention has been proposed. Pine et al (1998) have suggested a lexical constructivist account in which the pattern of lexical specificity in young children's data could be explained if the child's breadth of focus was constrained, not by verbs, but by frequency. According to this idea, the frequency with which a lexically specific frame occurred in the input would determine whether or not it was learnt. The development of syntagmatic categories would subsequently involve a gradual broadening of scope as the child built up knowledge of the number of, and overlap between, the lexically-specific frames in which particular items can appear; a process that would ultimately result in adult-like, abstract generalisations across different frames and lexical items. In this account, it is the frequency with which items and combinations of items occur in the input that restricts the scope of focus for the distributional analyser.

Like Tomasello's verb island hypothesis, this account is not a process model of the acquisition mechanism but a description of how the early multi-word speech data can be explained in constructivist terms. However, it makes firm predictions about the nature of child speech and its relationship with the

[26] Though see Tomasello & Lieven (in prep.) for a usage, rather than verb, based approach to early syntactic development

input and has implications for the types of mechanism that would be expected to underlie acquisition (see Chapter 8; Croker, Pine & Gobet, 2000; Gobet & Pine, 1997; Jones, Gobet & Pine, 2000). In particular, its claims about wh-question acquisition seem to fit the data presented in previous chapters. It is this account that will be considered in the remainder of the present chapter.

7.1.2. Wh-question acquisition

Very little work has been conducted specifically on wh-questions from a constructivist viewpoint. This is the case for two reasons. First, constructivist researchers have tended to focus their attention on very early multi-word acquisition in which the restricted nature of children's knowledge can be most clearly observed. Since wh-questions are present only in small numbers in early data their acquisition has largely been neglected. Second, the rarely disputed assertion that object and adjunct wh-questions can only be produced with reference to certain grammatical movement rules excludes the notion that wh-questions acquisition can be explained in lexical-constructivist terms. On this assumption, once children start to produce these structures in large numbers, they must be doing so with near-adultlike grammatical knowledge. In other words, although lexical constructivists generally accept that early multi-word speech may be restricted to sub-grammatical categories, the assumption that later acquired, more complex structures are constructed according to general grammatical principles has rarely been challenged.

However, this assumption is based on the premise that children must be generalising from knowledge that has been learned in relation to early acquired grammatical constructions in order to construct later acquired structures. This idea seems antipathetic to the assumption behind many constructivist accounts that the knowledge gained about the behaviour of one structure transfers very slowly to the production of another. In addition, there is very little evidence that children's knowledge of how to use one construction generalises quickly either to other members of the same grammatical category or to other constructions (see e.g. Braine, 1976; Kuczaj & Brannick, 1979; Kuczaj & Maratsos, 1983; Ninio, 1988; Tomasello, 1992; Lieven, Pine & Baldwin, 1997; Pine, Lieven & Rowland, 1998).

It would seem plausible to suggest, therefore, that at the same moment in time, children may be much more productive with one structure than with another. Early wh-questions could be explained, not in terms of grammatical movement rules, but with reference to a small number of lexically specific frames incorporating a constant or 'marker' combined with a variety of different lexical items or phrases. Errors could be seen as examples of 'groping patterns' (Braine, 1976) in which the child is attempting to produce a question before s/he has acquired the knowledge necessary for its correct expression. These would only occur when the child has not learnt the relevant lexically specific frame and/or marker with which to produce a correct question. Over time, errors would disappear gradually as the child learns more correct frames and as the initially lexically specific knowledge slowly generalises across all members of the relevant grammatical categories.

In order to test this hypothesis, however, we need to define the nature of the child's lexically specific knowledge. This is difficult to do *a priori* as, unlike rule-based theorists, constructivists cannot rely on descriptions of the adult grammar to motivate predictions about the child's knowledge. It could be argued that the auxiliary, wh-word and subject of the question should be examined since these are the elements involved in the movement rule. However, since the account predicts that the child is producing wh-questions without knowledge of movement rules, there is no reason to anticipate that the relation between the subject and the auxiliary is the important one from the child's point of view. In addition, there are three reasons to predict that the child's lexically-specific knowledge is likely to centre round wh-word+auxiliary combinations rather than auxiliary+subject combinations or, indeed, individual vocabulary items (e.g. wh-words) as has been suggested for other grammatical systems (e.g. Pine & Lieven. 1997; Pine et al, 1998). First, there is evidence that the earliest wh-questions produced with an auxiliary can be explained with reference to three formulaic patterns that begin with a limited range of wh-word+auxiliary combinations. For example, Klima & Bellugi (1966) have suggested that the early wh-questions of Adam, Eve and Sarah (Brown, 1973) could be identified as stemming from only two low-scope formulae: *what + NounPhrase (+ doing)* and *where + NounPhrase (+ going)*. In a similar analysis, Fletcher (1985) noted that the earliest wh-questions with auxiliaries produced by one subject, Sophie, could be explained almost exclusively with reference to three formulaic wh-word+auxiliary combinations: *how+do, what+are* and *where+'s*. If later wh-questions are constructed in much the same way as these early formulae, the wh-word+auxiliary combinations would be predicted to serve the same function. Second, the range of possible wh-words and auxiliaries is more limited than the range of potential subjects and verb phrases, so the most likely constant in wh-questions is the wh-word+auxiliary combination. Third, wh-word+auxiliary patterns can be seen as particularly salient in semantic terms, serving as a consistent indicator that a wh-question is being produced. For the purpose of the present analysis, therefore, children's early inverted wh-questions will be defined as formulaic wh-word+auxiliary combinations, combined with a variety of different noun phrase and/or verb phrase sequences. Consequently, the account predicts that children's early wh-questions will be produced according to sub-categorical structures based around lexically specific wh-word+auxiliary frames.

The lexical constructivist approach also incorporates an explanation of how children learn such wh-word+auxiliary combinations. It has been suggested that the lexically specific nature of early wh-question use is consistent with the idea that children's early grammatical constructions reflect a process of 'functionally-based distributional analysis' of their input (Tomasello, 1992, p. 28). Thus, an information-processing system that is constrained by the limits which apply to human distributional learning (Braine, 1987, 1988) could reproduce the lexically-specific effects that have been reported in early multi-word speech data by learning how high frequency markers interact with the groups of lexical items with which they occur in the input. In other words, the pattern of wh-question acquisition should reflect the pattern of high and low frequency wh-word+auxiliary combinations in the child's input. Some evidence for this process in wh-question acquisition has been provided by Clancy (1989) who reported that the acquisition order of Korean's children's wh-questions centred around specific wh-word+verb patterns and depended to an extent on input frequencies. This idea has not until now been tested on English speaking children. The following section details exactly how such an account could explain the pattern of data reported in the present work and outlines the predictions from this account that will be tested in the present chapter.

7.1.3. Explaining the previous findings

The first finding of the present work was that children's knowledge of the behaviour of wh-questions and their component parts builds up gradually over time (see chapter 4). The children's first wh-questions were restricted to a few wh-words (typically *what* and *where*) combined with a limited number of auxiliaries (typically *be*, usually contracted *'s*). Over the year recorded, the children seemed to add new wh-words and auxiliaries one by one until by the end of the study, the mean number of object/adjunct wh-words produced was 5.83 (range 3-8) and the mean number of auxiliaries 9.5 (range 2-16). These findings seem to be consistent with the lexical constructivist account which would predict that the acquisition of wh-words and auxiliaries in wh-questions would be gradual as the child slowly builds up a vocabulary of individual wh-word+auxiliary frames from those that are used frequently by the mother.

Two further predictions were derived to test this explanation. First, it was predicted that a small number of wh-word+auxiliary combinations should account for a large proportion of each child's wh-question data. Second, it was predicted that if children pick up high frequency items more successfully than low frequency ones the order of acquisition of particular wh-word+auxiliary combinations in the child and the relative frequency of these combinations in the mother should correlate. The first two analyses of the present chapter test these predictions.

The second conclusion of previous chapters was that the types of error produced did not seem to differ from one stage of development to another (see chapter 5). Instead, children produced the same errors at all the stages of development under consideration and the number of errors produced showed a gradual decline throughout the year (see chapter 4). The two types of errors that were most frequent - auxiliary omission and auxiliary uninversion - were discussed in detail (see chapter 6). Auxiliary uninversion seemed to be restricted to particular wh-word+auxiliary frames and omission rates differed across different auxiliary lexemes. Again, both findings are compatible with the lexical constructivist approach. However, the explanation for uninversion is the most straightforward and will be discussed first.

The lexical constructivist account incorporates an explanation of the pre-subject positioning of the auxiliary in the child's correctly inverted wh-questions which does not rely on crediting the child with a subject-auxiliary inversion rule. According to the theory, correctly inverted wh-questions will be produced when the child has learnt a relevant wh-word+auxiliary marker around which to base her/his question frame. Uninversion errors will only occur when the child has not learnt the particular wh-word+auxiliary marker around which to base the question s/he wishes to ask. Based on this suggestion, the lexical constructivist theory would predict, first, that correctly inverted wh-questions will be produced when the child has learnt the appropriate lexically specific wh-word+auxiliary combination from the input. For this to occur, the combination will have to be present in the mother's speech with sufficient frequency for the child to learn it. Second, if uninverted wh-questions are produced when the child has no appropriate model available, the theory predicts that uninversion will only occur with wh-word+auxiliary combinations that are not of sufficiently high frequency in the input for the child to learn them. The present work has already established that, compatible with the lexical approach, inverted and uninverted wh-questions occur with different populations of wh-words and auxiliaries (see chapter 6). It has not, however, established whether this separation is due to the differential frequency of wh-word+auxiliary combinations in the child's input. The present chapter will investigate the prediction that the wh-word+auxiliary combinations that the child uses in inverted wh-questions will be of significantly higher frequency in the child's input than the wh-word+auxiliary combinations that the child fails to use.

Explaining auxiliary omission is less straightforward. The present work has reported that the lexical auxiliaries *is* and *has* are less likely to be omitted from the child's wh-questions than the lexical auxiliaries *are* and *have*. However, all four of these forms would be expected to be present in the mother's input. The child will never, presumably, hear *what you got* as mothers tend not to omit auxiliaries from wh-questions[27]. Thus, the most simple lexical constructivist explanation would be that the auxiliaries that are present most often in obligatory context would be of higher frequency in the input than those that are omitted more than they are produced. Thus we could compare the input frequency of auxiliaries present over half the time in obligatory contexts with those omitted over 50% of the time. Unfortunately, this is not possible with naturalistic data research. This is because, according to the lexical constructivist account, contracted and uncontracted forms must

[27] Although it may be that adults contract the auxiliary to such an extent that it becomes inaudible.

be treated as separate forms, rather than two variants of the same lexical auxiliary. There is no reason, within the theory, to expect children to equate the two forms. However, when a form is omitted from a child's utterance, it is impossible to ascertain whether that form would have been contracted or uncontracted. Thus, it is not possible to construct an omission analysis of this type that distinguishes between contracted and uncontracted forms and it is not consistent with the lexical constructivist account to do otherwise. This prediction may only be testable using computational modelling or experimentation.

For the purpose of the present work, then, a slightly different analysis will be conducted: one that tests auxiliary omission less explicitly but which allows us, importantly, to distinguish between contracted and uncontracted forms. I suggest that the lexical constructivist account would predict that the auxiliary is only included when wh-word+auxiliary pattern occurs with sufficiently high frequency in the mother's data. If the combination occurs with low frequency, children may do one of two things. They may fail to use the wh-structure completely or they may only pick up the high frequency wh-word but not in combination with a particular low frequency auxiliary. In the latter case, children may combine the wh-word with variable subject and verb phrases but omit the auxiliary. The present chapter, therefore, will test the prediction that the wh-word+auxiliary combinations that the children use correctly will be of higher frequency in the mother's input than those the child fails to use.

To summarise, the present chapter offers an alternative explanation of wh-question acquisition to that proposed by nativist researchers. It is proposed that children are learning wh-questions initially as low-scope lexical structures that pivot around high frequency wh-word+auxiliary or wh-word frames. From this proposal, four predictions about the nature of children's early wh-questions can be made. First, it is predicted that the children's wh-questions will be explicable in terms of a few lexically specific wh-word+auxiliary frames combined with a variety of subjects and verb phrases. Second, the order of acquisition of such frames should closely mirror their frequency in the child's input. Third, the auxiliaries that the child tends to include should be of higher frequency in the input than those the child omits. Finally, the wh-word+auxiliary combinations that occur in correctly inverted child wh-questions should be of significantly higher frequency in the child's input than those that occur in uninverted wh-questions.

7.2. Method

All analyses except the uninversion analysis were conducted on the children from the Manchester corpus. The uninversion analysis was conducted on Adam from the Brown corpus (1973) for the reasons stated in Chapter 6. For the Manchester corpus, all fully transcribed object/adjunct wh-questions produced by the children were extracted from the 34 one-hour transcripts. For the Adam data, all fully transcribed object/adjunct wh-questions were extracted from the 17 one hour transcripts recorded when Adam was between the ages of 3;0 and 3;8.

Three different sets of data were extracted from the mothers' data. For the lexical specificity analysis, the same number of wh-questions were extracted from each of the 12 mothers' data as were produced by the child. This was in order to compare the nature of the child and adult speech and to test the possibility that any lexical specificity in the child's data could result solely from sampling constraints. For example, Aran produced 176 different wh-question types so the first 176 of Aran's mother's wh-questions were used. For the input correlations and auxiliary omission analysis, mother data was extracted from the first four transcripts recorded for each of the 12 mothers. For the uninversion analysis, Adam's mother's data was extracted from the ten transcripts of tapes recorded immediately prior to those used for child data (transcripts 9-18).

For both corpora and for both mother and child data, only fully transcribed object/adjunct wh-questions were extracted. Certain utterances were excluded: these included partially intelligible or incomplete (interrupted or trailing off) utterances, utterances with parts marked as unclear, quoted utterances and routines. Full or partial repetitions or imitations of the five previous utterances were also excluded. Subject wh-questions were not considered in the present analysis.

The analyses were all conducted on wh-question types, not tokens. This was to minimise the effect of rote-learned forms that had been learnt from high token but low type-frequency mother utterances on the analysis. Two utterances were defined as two types if one or more item differed (including items such as prepositions and prepositional phrases but excluding vocatives and fillers). Therefore, for example, *what's he doing* and *what's he doing, Mummy* and *now what's he doing* counted as one type but *what's he doing in there* and *what's he doing* as two types. This decision was taken on the basis that the similarities between two wh-questions with different (or present or absent) prepositional phrases are less salient than the similarities between two questions that differ only in the presence or absence of a vocative. Thus, in the latter case, children are more likely to treat both questions as the same question type.

Analyses distinguished between forms on the basis of surface structure, not grammatical category membership. Therefore, contracted and uncontracted forms of auxiliary were treated as different lexical forms. In addition, and perhaps more controversially, contracted *is* and contracted *has* were treated as one form - *'s*. This decision was taken on the rationale that a child working with only lexical categories will have no reason either to posit a relationship between contracted and uncontracted forms or to assume that one form (*'s*) represents two different auxiliaries.

7.3. Results

Analyses 1, 2 and 3 are conducted on data from the Manchester corpus. Analysis 4 was performed on data from Adam from the Brown corpus (Brown, 1973).

7.3.1. Analysis 1 - Lexical specificity

Analysis 1 tested whether a small number of wh-word+auxiliary combinations could account for a large proportion of the children's correctly inverted wh-question data. Only wh-questions with the wh-word and auxiliary present and correctly inverted were included in this analysis (this included errors that did not affect the wh-word or auxiliary, for example, subject omission errors). For each child, the number of different wh-question types produced with each wh-word+auxiliary combination was calculated. Combinations were only included if they were considered productive according to the criterion that they occurred in 3 or more question types. This criterion was adopted because (as noted in chapter 4, page 85) utterances produced only once or twice could be rote-learned forms learnt from one or two utterances with high token but low type-frequency. For example, a child whose mother produces *how are you?* with high frequency but who produces no other *how+are* combinations could not be expected to pick up a *how+are* pattern, only *how are you?* as a rote learned form. This utterance would not be reflective of a wh-word+auxiliary pattern picked up from wh+aux combinations in the input produced with high type frequency, which is what the lexical constructivist account predicts.

Table 7.1 details the number of productive wh-word+auxiliary combinations produced by each child, the number of question types these combinations accounted for and the percentage of the total number of questions produced that are accounted for by these productive combinations (see Appendix K for a full list of the productive combinations used by each child). One child, Ruth, produced only three wh-questions overall - two with *what's* and one with *where's* - so none of her wh-questions reached criterion. Her data are not included in the table.

All children except Becky produced fewer than 13 productive combinations (mean = 7.73, range = 2 - 29). Becky produced many more combinations that any of the other children (29 combinations). Without her, the mean number of combinations produced is 5.6 (range = 2 - 12). Seven of the children have five or fewer productive combinations.

Table 7.1. Number of productive combinations produced by each child and number and % of the total number of wh-question types that these combinations account for

Child	Number of productive combinations	Number of question types accounted for	% of total number of question types accounted for
Aran	12	153	86.93
Anne	8	251	86.85
Becky	29	461	92.76
Carl	4	206	94.93
Dominic	2	31	81.58
Gail	5	211	93.78
John	3	73	94.81
Joel	9	169	88.95
Liz	4	166	90.22
Nicole	4	51	86.44
Warren	5	136	95.77
Mean	7.73	173.45	90.27

Although the children produce few productive combinations, these combinations account for over 80% of the wh-questions they produce in all cases (mean = 90.27%, range = 81.58% - 95.77%). This means that, as predicted, a small number of lexically specific wh-word+auxiliary combinations account for the majority of the children's wh-questions. An even more startling result is, however, the fact that most of the children's data could, in fact, be accounted for by only two combinations - *what's* and *where's*.

Table 7.2 details the number and percent of the total number of wh-question types accounted for by the combinations *what's* and *where's*. All twelve of the children were included in this analysis.

Table 7.2 Number of wh-question types produced with *what's* and *where's* and percent of the total number of wh-question types accounted for by *what's* and *where's*

Child	Number of wh+aux produced with *what's* and *where's*	% of the total number of types accounted for by *what's* and *where's*
Aran	150	59.66
Anne	225	77.86
Becky	229	46.08
Carl	195	89.86
Dominic	31	81.58
Gail	200	88.89
John	70	90.91
Joel	139	73.15
Liz	160	86.96
Nicole	36	61.01
Ruth	3	100
Warren	127	89.44
Mean	130.42	78.78

For all children but Becky, over half their wh-question types over the year were produced with *what's* or *where's* (mean for 12 children = 78.78, range - 46.08% - 100%). Even for Becky, the child with the most variability in her productive wh-question types, 46.08% of her 497 wh-questions were produced with either *what's* or *where's*. Thus, despite the fact that these data were collected over a whole year (approximately age 2-3 years), there is still great lexical specificity in the children's data as predicted. A very few combinations - as few as two in most cases - account for the majority of the children's wh-question data.

There is, however, the possibility that the fact that the data is sampled and not a complete record of the children's speech could confound the results. It may be that with a richer sample of data, the children would produce a much wider variety of wh-questions. For example, Becky was the child with the most number of productive wh-word+auxiliary combinations and was also the child with by far the most number of wh-questions recorded (497). With a richer sample of data for the other children, the lexically specific effects may disappear.

In order to test this hypothesis, the children's data were compared with data from identical samples of maternal data. If the lexically specific effects are simply due to sampling, similar effects in a similar sized sample of maternal data should also be found. The total number of correct wh-question types was calculated for each child and an identical number of wh-question types were extracted from the first few transcripts for that particular child's mother's data. In some cases (Ruth) this involved using less than one transcript's worth of maternal data, in others (Becky) it involved extracting over 13 transcripts' worth of data. In all cases, the mother's sample had been collected over a smaller time period than that of the child and was, therefore, more likely to be context-sensitive than the child's data. However, this difference is likely to make the maternal sample more, not less, lexically specific than it would have been if it had been collected over a longer period. Therefore, any differences between maternal and child data that show that children's speech is more lexically specific than that of their mother are actually likely to be under- rather than over-estimates of the differences between mother and child speech.

Table 7.3. The number of combinations, the number of productive combinations and the percentage of total wh-question data accounted for by the productive combinations - mothers and children

Child	Number of combinations in total		Number of productive combinations		% total wh-question data accounted for	
	Child	Mother	Child	Mother	Child	Mother
Aran	30	44	12	14	86.93	78.98
Anne	38	68	8	19	86.85	80.62
Becky	60	82	29	39	92.76	88.73
Carl	13	38	4	15	94.93	85.71
Dominic	8	16	2	5	81.58	63.16
Gail	18	54	5	14	93.78	77.78
John	6	29	3	10	94.81	68.83
Joel	27	46	9	15	88.95	78.42

Table 7.3. (cont.) The number of combinations, the number of productive combinations and the percentage of total wh-question data accounted for by the productive combinations - mothers and children

Child	Number of combinations in total		Number of productive combinations		% total wh-question data accounted for	
	Child	Mother	Child	Mother	Child	Mother
Liz	17	43	4	15	90.22	82.61
Nicole	10	33	4	4	86.44	59.32
Warren	9	50	5	9	95.77	66.20
Mean	21.45	45.73	7.73	14.45	90.27	75.49

Ruth produced only 3 wh-question types in total, therefore with a matched sample size, Ruth's mother, like Ruth, produced no productive combinations. Their data were not included in the table. Table 7.3 details the number of combinations, the number of productive combinations and the percentage of the total accounted for by these productive combinations for the 11 mothers and children.

As was the case for the children's data, the majority of the mothers' data were accounted for by productive wh-word+auxiliary combinations (mean for mothers = 75.49% x mean for children = 90.27%). This would suggest that sampling does have an effect on the lexical specificity of the data.

However, significantly less of the mother's data was accounted for by these productive combinations (median for mothers = 78.42% x median for children = 90.22%, Wilcoxon $z = 2.93$, $n = 11$, $p = 0.003$). In addition, the mothers produced significantly more productive combinations (mother's median = 14.00 x children's median = 5.00, Wilcoxon $z = 2.81$, $n = 11$, $p = 0.005$) as well as significantly more combinations in total (mothers' median = 44.00 x children's median = 17.00, Wilcoxon $z = 2.94$, $n = 11$, $p = 0.003$). Thus, the mothers were using a much larger number of combinations than the children, despite the fact that they were producing the same amount of speech.

In addition, the mothers used *what's* and *where's* much less often than the children. Table 7.4 details the number of times *what's* and *where's* was used and the percent of the total number of wh-question types accounted for by *what's* and *where's* for mothers and children. All twelve children were included in this analysis.

What's and *where's* accounted for much less of the mother's total data (mothers' median = 32.96% x child median = 84.27%, Wilcoxon $z = 3.06$, $N = 12$, $p = 0.002$). Thus, the mothers seemed to be using a greater range of wh-word+auxiliary combinations with a greater frequency than the children, who restricted most of their use to *what's* and *where's*. Taken together, these results suggest that there is significantly more variability in the mothers' data than in the children's data. The mothers produced a greater variety of combinations in total, and a greater number of productive combinations but these productive combinations explained significantly less of the data. In other words, mothers' use was more evenly distributed over a wider range of combinations. This difference, of course, may be due to the fact that the mothers have more wh-words and auxiliaries in their lexicon. However, it does show that the lexical specificity in the child's data cannot be attributed solely to the sampling problem[28]. These results uphold the prediction of the lexical constructivist theory that children's early wh-questions will be restricted to a small number of lexically specific wh-word+auxiliary combinations.

Table 7.4. Number of *what's* and *where's* and percentage of the total number of wh-question types accounted for by *what's* and *where's* for mother and child data

Child Name	Number of *what's* and *where's* questions produced		% of the total number of wh-questions	
	Child	Mother	Child	Mother
Aran	150	41	59.66	31.25
Anne	225	92	77.86	31.83
Becky	229	127	46.08	25.55
Carl	195	90	89.86	41.47
Dominic	31	11	81.58	28.95
Gail	200	74	88.89	33.53
John	70	26	90.91	33.77
Joel	139	43	73.15	22.63
Liz	160	63	86.96	34.24
Nicole	36	20	61.01	33.90
Ruth	3	2	100	66.67
Warren	127	46	89.44	32.39
Mean	130.42	52.91	78.78	34.68

[28] Alternatively, it may be that the mothers' knowledge too is more lexically specific than current linguistic theory implies. However, for the purposes of the present analysis it is assumed that adults are constructing wh-questions using grammatical movement rules.

7.3.2. Analysis 2 - Order of acquisition and input frequency

The second analysis considered whether the order of acquisition of wh-word+auxiliary combinations in the children's speech would correlate with the frequency of such combinations in their mothers' input. The input measure consisted of maternal object/adjunct wh-questions taken from the first four transcripts recorded and the number of wh-question types produced with each wh-word+auxiliary combination was calculated. Mother combinations that were not produced by the child were not included in the analysis. This is because the theory only predicts that early-acquired items will have high input frequency, not that all high frequency items will be learnt by the child as there are a variety of possible reasons, apart from input frequency, why certain combinations may not be learnt (see section 7.4).

For child data, the order of acquisition of wh-word+auxiliary combinations was calculated. As for the previous analysis, only wh-questions in which both wh-word and auxiliary were present and correctly placed were included. However, all wh-word+auxiliary combinations produced at least once were included, not simply those which had occurred in 3 or more types. This was because most of the children produced too few productive combinations for the analysis. The rank order of acquisition of combinations in each child's data was determined and correlated with the frequency of the same combinations in the mother's speech.

Only seven of the 12 children produced sufficient numbers of wh-word+auxiliary combinations (12 or over) for the analysis. For six of these seven, the order of acquisition correlated strongly with the frequency of the combinations in the mother's data (Aran: $r_s = 0.55$, $N = 30$, $p=.002$; Anne: $r_s =$

0.55, N = 38, p <0.001; Becky: r_s = 0.54, N = 60, p < 0.001; Carl: r_s = 0.58, N = 13, p = 0.04; Gail: r_s = 0.73, N = 18, p = 0.001; Liz: r_s = 0.64, N = 17, p = 0.006)[29]. If the significance value is reduced to compensate for the number of correlations, five remain highly significant and one becomes nearly significant (that for Carl). The only non-significant result to come from sufficient data was for Joel (r_s = 0.17, N = 27, p = n.s.). However, as was detailed in section 7.3.1, the children's use of wh-questions is restricted to a very small number of productive combinations, in particular *what's* and *where's*. Thus, even for the seven children whose data was rich enough for the correlation, very few of these combinations were productive even by a relatively lax productivity criterion of three or more question types (see table 7.1). It may have been that the correlation detailed above included many wh-word+auxiliary combinations that occurred only in rote-learned formulae. For example, Joel produced 27 different wh-word combinations but only 12 of these occurred more than once. If the remaining 15 were rote-learned phrases, their use would not be expected to correlate with high type frequency in the input data.

[29] Correlations were also calculated between order of acquisition in the children and the frequency of all wh+aux combinations produced by the mothers in order to ascertain whether constraining the analysis simply to input combinations acquired by the child would have biased the results unacceptably in favour of the lexical constructivist account. For this analysis, items not acquired by the child were assigned an '18' to indicate that they had not been acquired by datapoint 17. In all cases the children failed to acquire a large number of the combinations produced by their mothers. This meant that a significant number of the items in the correlation had tied final ranks (68.33% of combinations for Aran, 64.15 for Anne, 42.86% for Becky, 74.51% for Carl, 82.35% for Gail, 67.69% for Joel and 63.64% for Liz were not acquired by the end of testing and were therefore recorded as being acquired at a fictitious datapoint 18). Despite this problem, four of the seven correlations, though low, reached significance (for Carl, rs = -0.28, N = 51, p = 0.05; for Gail p = -0.26, N = 74, p = 0.03; for Joel p = -0.24, N = 71, p = 0.04; and for Liz p= -0.35, N = 37, p = 0.03). More interestingly, the vast majority of the maternal combinations that failed to be acquired by the children occurred fewer than three times in the input sample (a mean of 86.36% of the maternal combinations that were not acquired by the children only occurred once or twice (range = 76.32% to 90.48%)). This suggests that many of the combinations not acquired by the children were of low frequency in the input sample. In addition, of the combinations that occurred with relatively high frequency in the input but were not acquired by the child, most occurred with contracted have or are, or with a form of the auxiliary 'do'. It may be that these

The analysis was, therefore, recalculated on the two children who had sufficient productive wh-word+auxiliary combinations for the analysis - Becky (29 productive patterns) and Aran (12 productive patterns). Correlations between the order of acquisition of these patterns in the child's data and their corresponding frequency in the input sample were calculated. Both of these correlations were highly significant (Aran: $r_s = 0.65$, $N = 12$, $p = 0.02$; Becky: $r_s = 0.50$, $N = 29$, $p = 0.006$). There seems to be some support for the prediction that order of acquisition will correlate with frequency in the mother's data. However, due to the problems associated with the thinness of the data in this analysis, the implication of these results will be returned to and considered in greater depth in the discussion section.

7.3.3. Analysis 3 - Omission rates

The third analysis was conducted on the Manchester corpus data and tested the prediction that children will be more likely to learn wh-word+auxiliary combinations that are of high frequency in the input. Combinations occurring with low frequency will tend either to occur with omitted auxiliaries or will not occur in the child's data

For both mother and child data, only the wh-questions that occurred in copula/auxiliary *be* or auxiliary *have* contexts were included in the analysis because it is only in these cases that it is possible to identify the form of the omitted auxiliary (see chapter 6 for full rationale for this decision). Seven different auxiliaries were distinguished: - *'s, is, has, 're, are, 've,* and *have*. The analysis was conducted only on the 5 wh-words which were used by six

combinations were not acquired because they are hard to hear or, in the case of 'do', semantically empty. Further work is necessary to investigate this suggestion.

or more of the children with *be* or *have* contexts (*what, where, who, why and how*). This allowed the exclusion of combinations that were very infrequent and likely to be used by neither mother nor child. Thirty-five combinations were considered. Due to the fact that very few of the children used a wide range of wh-word+auxiliary combinations productively (i.e. in three or more different contexts) all combinations that occurred with the wh-words and auxiliaries listed above were considered.

Table 7.5. Mean input frequency of the 'learnt' and 'not learnt' combinations

Child	Mean input frequency of wh+aux learnt by child (range)	Mean input frequency of wh+aux not learnt by child (range)
Aran	10.86 (0-59)	1.57 (0-16)
Anne	5.58 (0-31)	0.94 (0-9)
Becky	3.87 (0-23)	0.25 (0-2)
Carl	17.30 (0-71)	0.80 (0-9)
Dominic	11.67 (1-23)	0.76 (0-6)
Gail	18.38 (1-85)	0.70 (0-3)
John	10.33 (0-30)	0.52 (0-6)
Joel	7.86 (0-36)	0.43 (0-3)
Liz	7.13 (0-29)	0.93 (0-17)
Nicole	14.56 (2-48)	0.50 (0-5)
Ruth	32 (22-42)	1.36 (0-8)
Warren	11.50 (0-42)	1 (0-7)
Mean	12.60	0.81

For the child data, the 35 possible combinations were divided into those that had been learnt (i.e. were produced at least once with a present auxiliary) and those that had not been learnt (i.e. were produced only with an omitted auxiliary or not produced at all). For the input data, the frequency of type use of each of the 35 possible wh-word+auxiliary combinations was calculated. These were categorised according to whether the combination had been learnt by the child or not.

The mean input frequency of the 'learnt' and 'not learnt' combinations is illustrated in Table 7.5 (see Appendix L for raw scores). For all mothers, the mean input frequency for 'learnt' combinations was greater than the mean input frequency for 'not learnt' combinations. In line with the prediction, the wh-word+auxiliary combinations learnt and produced by the child were significantly more frequent in the mother's data than the combinations that had not been learnt (median frequency in input of learnt combinations = 11.18 x median frequency in input of not learnt combinations 0.78, Wilcoxon $z = 3.06$, $N = 12$, $p = 0.002$).

7.3.4. Analysis 4 - Uninversion

The fourth analysis tested the prediction that the inverted wh-word+auxiliary combinations the child uses will be of higher frequency in the input than the wh-word+auxiliary combinations the child fails to use (i.e. that occur divided by a subject in uninverted questions). The analysis was conducted on the data produced by Adam and Adam's mother (Brown, 1973). For the child data, inverted and uninverted combinations were extracted from the 17 one hour transcripts under consideration (see chapter 6 for more details of the procedure). For the input data, all inverted wh-questions were extracted from the ten-hour input sample but those that had occurred neither inverted nor uninverted in the child's data were discarded. As this is only a sample of the mother's data, we cannot expect to be able to identify all the wh-word+auxiliary combinations that the mother uses. However, from 10 one-hour transcripts it should be possible to distinguish the relative frequency of different wh-word+auxiliary combinations in the mother's speech in order to investigate whether the combinations the child uses tend to be more frequent in the input sample than those the child fails to use.

Table 7.6. Total number wh-word+auxiliary combinations that occur inverted and/or uninverted and their frequency in the input sample

Inverted wh+aux	No. in input sample	Uninverted wh+aux	No. in input sample	Inverted & uninverted wh+aux	No. in input sample
how could	0	how can't	0	why is	1
what was	0	what can	0	how can	3
what have	0	what may	0	what'is	7
what'has	0	what shall	0		
where'is	0	what should	0		
where had	0	where should	0		
where shall	0	which should	0		
which does	0	why'is	0		
who are	0	why can	0		

Table 7.6. (cont.) Total number wh-word+auxiliary combinations that occur inverted and/or uninverted and their frequency in the input sample

Inverted wh+aux	No. in input sample	Uninverted wh+aux	No. in input sample	Inverted & uninverted wh+aux	No. in input sample
who're	0	why can't	0		
who do	0	why couldn't	0		
how does	2	why doesn't	0		
what am	2	why 'has	0		
what is	2	why might	0		
where could	2	why won't	0		
what're	4	where will	1		
where do	4	what will	3		
how did	5	why didn't	3		
where does	6	why did	6		
why do	13	why don't	22		
how do	14				
what does	18				
what did	19				
where did	22				
what are	25				
what do	37				
Total	175		35		11

Table 7.6 details the wh-words and auxiliaries the child used in inverted and uninverted questions together with the number of times each occurred (correctly inverted) in the input sample. The three wh-word+auxiliary combinations that occurred in inverted wh-questions and, divided by a subject, in uninverted questions were present in inverted form in the input sample. These were excluded from the analysis. In line with the predictions of the hypothesis, the wh-word+auxiliary combinations the child used were more frequent in the mother's input than those the child failed to use (i.e. that occur divided by a subject in uninverted wh-questions) (median = 2 vs median = 0, Mann-Whitney U = 164.5, $n1=20$, $n2=26$, $p<0.05$ 2-tailed).

7.4. Discussion

The results for the four analyses presented in the chapter can be summarised as providing evidence for two main lexical constructivist ideas. First, they support the more general lexical constructivist argument that children's early multi-word utterances are best described in terms of lexically specific knowledge. For 11 of the 12 children studied, a few wh-word+auxiliary combinations accounted for over 80%, sometimes over 90%, of the range of wh-question types produced. More surprisingly, only two wh-word+auxiliary combinations (*what's* and *where's*) accounted for the majority of data for eleven of the twelve children. These effects were not mirrored in a matched size sample of adult data. Such lexically specific effects have been found in many different grammatical structures but the present study is the first to report them in any but the earliest produced wh-questions.

Second and perhaps more controversially, the findings of the present chapter also support the idea that lexically specific effects can best be explained in terms of a learning mechanism that learns how high frequency markers in the child's input interact with the lexical items with which they occur (see e.g. Pine et al, 1998). First, there was some evidence of significant positive correlations between the order of acquisition of wh-word+auxiliary combinations in the child's speech and the frequency of such combinations in a sample of input data. Second, the questions the children produced with uninverted/omitted auxiliaries were significantly less likely to occur in the input sample than those they produced with present, inverted auxiliaries.

These results are not unequivocally supportive of the lexical constructivist position. Samples of data are likely to capture only the most frequently used utterances, not the whole range. For example, the child for whom the lexical analysis worked least well was Becky, the child with the most wh-question types (523 types). Although the children's data were consistently more lexically specific and more restricted in scope than an equal sized sample of input data, the lexically specific effects may disappear altogether with a bigger sample of data (though see Tomasello & Lieven, in prep., for an examination of lexical specificity in a much richer sample). More research on much larger samples is necessary at this point.

Second, the correlational data did not provide unambiguous results. Only seven children produced enough data for a correlation to be calculated and of these, six produced significant correlations. It was suggested that the fact that the order of acquisition of all wh-word+auxiliary combinations was calculated could have meant that wh-word+auxiliary combinations that occurred only in rote-learned formulae were included. Unfortunately, only two children produced enough productive wh-word+auxiliary data for the statistical tests to be carried out; the data from these two children showed a highly significant relationship between order of acquisition and frequency.

The problems encountered in calculating the correlations suggest two important conclusions. First, it may be that the relationship between the input and the order of acquisition, although present, is mediated by strong effects on acquisition by other factors. These will be discussed below. Second, the results suggest that the data presented here are too thin to support a secure statistical analysis. Even for the most productive child, Becky, the majority of wh-questions were produced only with the combinations *what's* and *where's*. It may be that a larger sample is necessary in order to investigate the issue further. Alternatively, it may be that even by age 3, children's knowledge of wh-questions is restricted almost entirely to how to use two or three highly frequent wh-word+auxiliary combinations together with a few rote-learned phrases. Further analyses should be conducted before stronger conclusions about the relationship between order of acquisition and input frequency can be drawn.

The two final analyses examined the relationship between acquisition and input frequency in more detail by concentrating on the types of error produced by children. For both omission and uninversion, a significant difference between the input frequency of the wh-word+auxiliary combinations the children learn and fail to learn was reported. The omission results, as will be discussed later and in chapter 8, are the least persuasive. It may be that the results can be explained in terms of the fact that certain wh-questions are more likely to occur in discourse than others. Critics could argue that both mother and child are likely to use a similar subset of questions during a conversation, and thus are both apt to leave other wh-questions out. However, the uninversion result cannot be explained in these terms. In this case, it is not that Adam was failing to use low frequency structures, therefore we cannot conclude that the results are due to mother and child not having the opportunity or inclination to use particular structures in the interaction. The implication of the uninversion results is, instead, that if no high frequency model for a particular wh-question is available to the child, s/he may make errors trying to construct the utterance. Although there were a few wh+auxiliary combinations that did not fit the general pattern (e.g. *why don't* structures were of relatively high frequency in Adam's input but occurred only in uninverted forms in the child's data; see below), the overall results support the prediction that the frequency of particular lexical items in the input has a direct effect on the types of structures that children can learn.

The lexical constructivist explanation has, thus, proved moderately successful at explaining the early multi-word speech data. However, there are some outstanding issues that have not been considered and for which the present theory can only provide suggestions for an explanation. The first issue concerns the nature of the high frequency markers that provide the pivots around which children can organise their learning of grammatical knowledge. The present work has focused on wh-word+auxiliary combinations as high-frequency markers but this is merely an operational decision based on the grounds, first, that a child's earliest wh-questions may be explained with reference to patterns beginning with a few wh-word+auxiliary combinations

(Fletcher, 1985) and, second, that the limited range of possible wh-words and auxiliaries makes these more likely constants than verbs and/or subjects. However, there is no reason why only wh-word+auxiliary combinations should function as wh-question markers for the child. In fact, it is much more likely that these markers will vary depending on the nature of the input. It has been suggested that, in contexts in which the relevant wh-word+auxiliary structure is of low frequency, children may use the wh-word only, omitting the auxiliary. Other effects, too, could be the result of children picking up different wh-frames dependent on context. For example, when Adam's data (Brown, 1973) is examined closely, it is possible to see that although all maternal *why don't* questions were *why don't <u>you</u>* questions, only one of Adam's six uninverted *why don't* questions were used with *you* as subject. A possible explanation for why Adam only produced <u>un</u>inverted *why don't* questions despite the fact that his mother modelled the inverted pattern is that he may have picked up a *why don't you* formula from the input that was not suitable for use in most of his *why don't* questions. Further research is necessary on this issue.

Second, the issue of why children produce uninversion and omission errors, given that such utterances are never heard in adult data, is relevant. It is possible that these kinds of error can be seen as instances of 'groping' patterns (Braine, 1976), said to be produced when the child attempts to construct a question for which s/he has not yet acquired the necessary knowledge. There is some evidence that in forming uninverted wh-questions, the child may be adding a pre-subject wh-word to a declarative utterance, either one that has just occurred in his input (e.g. after the mother says *you* *don't throw things*, the child asks **why you don't throw things?*, Brown, Cazden & Bellugi, 1969) or one that s/he has constructed. For example, twelve of Adam's 60 uninverted forms (i.e. 20%) followed a mother's declarative sentence that modelled the same auxiliary in post-subject position (within the previous 5 mother utterances). Such an explanation would be compatible with the lexically-specific nature of children's knowledge as presented here and in other studies (e.g. Braine, 1976; Ninio, 1988; Tomasello, 1992; Pine & Martindale, 1996; Lieven, Pine & Baldwin, 1997; Pine, Lieven & Rowland, 1988). It could also account for omission errors by positing that in cases where the relevant wh-word+auxiliary combination has not been learnt, the child adds a pre-subject wh-word to an auxiliaryless sentence (e.g. *you like cakes* would become **why you like cakes?*). It is interesting to note, in relation to this idea, that children tend not to make many uninversion errors until their mean length of utterance reaches about 3 morphemes; about the same time auxiliaries start to appear in declarative sentences. It is possible that omission occurs when children are adding wh-words to declarative sentences with missing auxiliaries, and uninversion errors occur when children are adding wh-words to declarative sentences with present auxiliaries. Double auxiliary errors would be made when the child adds a wh-word+auxiliary combination to a declarative sentence (e.g. *you don't like cakes* becomes **why don't you don't like cakes?*). Further work is necessary to investigate this possibility.

Third, the constructivist explanation cannot easily explain why children sometimes fail to learn some items that are of high frequency in the input. In particular, input frequency fails to explain some of the wh-word+auxiliary combinations that are omitted by children. For instance, Aran's mother produced a relatively high number of examples of *what're* (16) but Aran produced none. Thus, it is probable that other factors have an effect on auxiliary omission. For example, the child's cognitive ability (for example, the ability to understand temporal and spatial relations) is likely to constrain her/his understanding and, therefore, her/his acquisition of certain wh-words (Clancy, 1989). Phonological salience is also likely to be an important factor - contracted forms such as *'re* and *'ve* are likely to be much less easy to hear than contracted *'s* (see Chapter 8 for a more thorough discussion). The effect of such factors and their interaction with input frequency needs to be considered if the theory is to make more definite predictions about the nature of the acquisition mechanism.

However, it is not easy to see how to incorporate such effects in a principled way into the lexical constructivist account as it stands. These examples and those presented above clearly illustrate that the knowledge of language-learning children may take different forms depending on a variety of factors. In order to take effects such as these into account, it is necessary to construct detailed process models of how the learning mechanism analyses incoming data. In other words, there is a need to construct a well-specified distributional learning mechanism that makes strong predictions about the nature of the lexically-specific knowledge such a mechanism would produce, and about the exact relationship between the child's knowledge and the frequency distribution of the child's input. Only with such a model will it be possible to determine how much of early multi-word speech data can be explained in terms of input-driven lexically specific knowledge and how much must be attributed to other factors such as the phonological salience of items in the input and/or semantic and syntactic constraints.

To conclude, the present chapter has attempted to unite some of the findings reported in the body of this thesis under one frequency-based lexical constructivist explanation of acquisition. The chapter has provided some support for this idea. Much of children's wh-question production can be explained in terms of a few lexically specific wh-word+auxiliary combinations and the order of acquisition of these combinations predicted relatively successfully from the frequency of such items in the input data. Patterns of auxiliary omission and uninversion can also be predicted successfully in terms of children learning or failing to learn wh-word+auxiliary combinations that occur with differential frequency in their input. At the very least, these results suggest that future category-general theories must account for lexical specificity in early wh-questions and that analyses must be applied which discriminate between positive evidence for category-general and lexically specific knowledge in the child. In addition, the results provide some support for the claim that a learning mechanism that pays attention to the distributional patterning of the input could learn to produce wh-questions in the absence of category-general grammatical knowledge. However, the problem of how to establish the exact nature of the child's lexically-specific knowledge argues strongly for the need to develop a well-specified model that makes explicit and detailed predictions about the nature of the distributional learning mechanism involved. The development of such a model will make it possible to derive more precise, testable predictions about the exact nature of the child's knowledge and its relationship to the patterning of the input.

Section 3: Final Discussion

Chapter 8

Discussion

8.1 Introduction

8.2. Aim 1 : Describing the data

8.3. Aim 2: Testing the theories

8.4. Outstanding issues

8.5. Conclusion

8.1. Introduction

The studies in the present work have been conducted with two broad aims in mind. The first aim was to describe and compare the wh-question acquisition data from 12 children who had been studied for 2 hours every three weeks for a year between the ages of approximately 2 and 3 years. The second aim was to test the predictions of two nativist and one constructivist theory of wh-question development. The present chapter summarises the conclusions that have been made in these two areas, discusses some outstanding issues and provides some suggestions for future research.

8.2. Aim one: Describing the data

There were five main issues to be addressed in the task of describing the wh-question acquisition data. The first of these considered whether different wh-structures were acquired at different times. Previous work (Stromswold, 1995) had suggested that there is little interdependence between the acquisition of subject and object/adjunct wh-structures but no comparision had been made across all four wh-structures. The present work addressed this issue and found that, although children may acquire subject and object/adjunct wh-structures simultaneously, single wh-words and embedded wh-phrases seem to be acquired independently.

The second analysis investigated the sequence of wh-word acquisition. Previous research has provided conflicting results. Although individual studies have reported invariant acquisition orders (e.g. Bloom, Merkin & Wootten, 1982; Smith, 1933; Tyack & Ingram, 1977) these orders have actually differed from study to study. In addition, no previous study has compared wh-word acquisition across different wh-structures. The findings of chapter 4 suggested that there were differences in the order of acquisition of wh-words not only between wh-structures but also between children. In other words, little evidence for an invariant acquisition order was discovered.

The third aim was to study the acquisition of auxiliary forms in object and adjunct wh-question structures. The study found that, consistent with previous research (e.g. Fletcher, 1985; Ingham, 1993; Klima & Bellugi, 1966), very early auxiliary use was restricted to a few wh-word+auxiliary combinations centring mainly around the wh-words *what* and *where*. The data also supported the idea that negatives and modals would be acquired late in development (e.g. Klima & Bellugi, 1966). However, contrary to previous research (e.g. Bellugi, 1971), the present study concluded that there was no one stage in development during which a large number of auxiliary forms were acquired. Instead, the children's knowledge of auxiliary forms seemed to increase gradually over the year.

The fourth aim was to investigate the pattern of correct use and errors in the children's production. Previous research has argued for a universal sequence of acquisition for object/adjunct wh-questions: routines followed by questions with omitted auxiliaries, followed by errors of commission (especially uninversion errors) and finally, by correct production (e.g. Bellugi, 1965; Klima & Bellugi, 1966; Brown, 1968). There was no evidence for such a sequence in the children studied here. Errors of commission were rare at the earliest datapoints but were present even at datapoint 1. Correct wh-questions and omission errors were produced throughout the year and auxiliary omission errors were by far the most frequent error produced at all times.

Much of the work on errors has looked at the question of whether there is an uninversion period during which children produce a large number of uninversion errors (e.g. **what John will do*) and whether uninversion is restricted to *why* questions and/or questions with negatives and modals. The analysis conducted on the Manchester corpus reported that there was no evidence for an uninversion stage, nor for the claim that uninversion was restricted to modals, negatives or *why* questions. However. the children in the Manchester corpus were younger than those studied by Bellugi so the analyses were repeated using data from an older child (Adam from the Brown corpus, 1973). These analyses revealed that uninversion occurred with six wh-words (*what, who, how, why, which* and *where*) although it was indeed most prevalent with *why* (91.7% of *why* questions with auxiliaries present were uninverted). Uninversion also occurred most often with modals and negatives (75% of uninverted questions occurred with modals and negatives). However, there was again no evidence for an uninversion 'stage' - uninverted questions co-occurred with inverted questions and omission errors, both of which occurred with higher frequency than uninversion errors.

The fifth, and final, aim of the chapter was to investigate whether the failure of previous studies to reach consensus on many of these issues could be due to the presence of large variation between children. The present study reported that this was, indeed, the case. The number of wh-questions produced in each wh-structure varied, the order of production of auxiliary forms and errors differed across children and the only consistency in wh-word acquisition was that *what* was uniformly acquired first.

The findings of chapter 4 led to two main conclusions. First, it was concluded that the acquisition process reflects a slow, gradual build-up of knowledge of how to use particular lexemes and structures in different constructions. The implication of this conclusion for theories of wh-question acquisition will be discussed in more depth below (see section 8.3). The second conclusion made was that the different methodologies used across studies combined with the individual differences that seem to exist across children in their wh-question acquisition could explain why previous studies have reported contradictory results. For example, low frequency but early occurring errors of commission are less likely to be observed in cross-sectional studies, which will report that such errors only occur later in development. Longitudinal data-rich studies of one or two children's data will, however, conclude, correctly, that the errors are early occurring. On the other hand, longitudinal studies will fail to pick up on the differences in acquisition patterns across a range of children. For example, eight of our 12 children (66.67%) produced *who* as their third acquired wh-word form. If only these children had been studied, the false conclusion that there is an invariant *what/where* → *who* acquisition order would have been drawn.

In order to avoid these problems, much larger samples of data are necessary. The CHILDES project (MacWhinney, 1985, MacWhinney, 1990) provides a way to compare the naturalistic data from several children collected by different researchers, meaning that the time and effort necessary to gather data from a number of children is no longer as critical as it could be. However, much richer samples of data are still necessary in order to avoid errors such as categorising certain constructions as absent when they are, in fact, merely infrequent. Only once these are available will it be possible to track confidently the exact pattern of acquisition in early multi-word speech.

8.3. Aim two: Testing the theories

The second aim of the present work was to investigate the predictions of some current theories of wh-question acquisition. In chapter 2 it was noted that there are two broad approaches to the study of wh-question acquisition: nativist and constructivist approaches. Nativist approaches start from the premise that children are born with a set of universal principles for language learning and that their task is to map the language they are hearing onto these innate principles. Given universal grammar, the task of the nativist researcher is to find the innate principles that are common to all languages and to discover how children come to apply these properties to their own language.

The first type of nativist approach discussed in chapter 2 was the competence approach. Competence theories suggest that although children have innate language ability, some aspects of UG are not available from birth. Within this approach there are two types of theories – parameter setting and maturational theories. Parameter setting theories state that errors in acquisition occur while the child is learning how to set her innate parameters to the correct value for constructing grammar in her/his language. Thus, Weinberg (1990) has suggested that children make errors in wh-question acquisition because they have not correctly set the parameter that determines whether the language being learnt allows CP positions. Until the child correctly sets this parameter, s/he will not be able to produce correctly inverted, fully realised wh-questions.

In chapter 2 it was pointed out that this prediction is not borne out by the data: uninversion seems wh-word specific and co-occurs with correctly inverted wh-questions with fully realised auxiliaries (Labov & Labov, 1978). The results of the present study support this conclusion. Uninversion is, to an extent, wh-word specific, and is much more common with *why* than with other wh-words. In addition, correctly inverted forms occurred very early on in the study, concurrently with omission and uninversion errors. At datapoint 1, although most correctly inverted wh-questions did occur with cliticized auxiliaries, some fully-realised forms were produced - *what is, where is* and *what did.* Our results, thus, confirm that the parameter-setting account as detailed by Weinberg (1990) cannot fully account for the pattern of wh-question acquisition reported.

An alternative competence account relies on maturation to explain why children produce errors in early acquisition. Maturational accounts posit that some aspects of UG only come on-line after the child has started to produce multi-word speech. To explain wh-question acquisition, such theorists tend to argue that part of, or all of, the CP node is not available to the child until later in development. Some argue that no wh-questions will be produced correctly until after maturation of the CP node (e.g. Vainikka, 1992, Roeper, 1988) or that mainly adjunct wh-questions (*why, how*) will be affected (e.g. deVilliers, 1991, Plunkett, 1991). However, again, none of these theories can account for the acquisition sequence, especially why correct questions co-occur with uninversion and auxiliary omission errors. The results from chapter 4 support this criticism – there is no clear evidence within the data for a stage model of development. All the children studied produced correct wh-questions and errors with both adjunct and argument wh-words concurrently. In addition, although, in Adam's data, the adjunct wh-word *why* occurred with uninversion more often than any other wh-word, as predicted by deVilliers (1991) and Plunkett (1991), the other adjunct word studied – *how* – showed a very low rate of inversion (14.6%). Uninversion, therefore, seems to be wh-word rather than adjunct-specific.

It was suggested in chapter 2 that one maturational account – Radford's small clause hypothesis (1990, 1992, 1995, 1996) – could account for the data. Radford's hypothesis states that, although there are two clear stages in the development of grammatical competence, such stages may not be observable in early multi-speech data. Therefore, although children at the earliest stages of multi-word speech do not have access to the CP node, they may produce wh-questions that seem correctly inverted but are, in fact, either routines rote-learnt from the input or errors made as a result of the child misanalysing adult wh-questions in lexical terms. Children at the later functional stage of development who are hypothesised to be working with adultlike grammatical knowledge may make errors until they have mastered the complexities of this new grammatical knowledge. Thus, according to the theory, children's speech may seem to reflect a gradual acquisition of knowledge but, in fact, hides a stage-like change in grammatical competence.

However, as pointed out in chapter 5, these provisos have the effect of making it impossible to distinguish between the two stages of development on the basis of child data. In fact, the results of the analyses in chapter 5 showed that there was no evidence for a qualitative shift in the nature of the children's production. Instead, the types of error made by the 12 children studied were virtually identical at three stages of development, the first of which corresponded to Radford's lexical stage and the second and third to Radford's functional stage. More surprisingly, the differences between the children's production at the two functional stages were greater than the differences between the lexical and functional stages. Therefore, although most of the wh-questions produced could be explained in terms of Radford's theory, the notion of maturation itself was not supported by the data since this relies on the ability to make maturational predictions about the nature of the child data. It was concluded that the data indicated that older and younger children do not construct utterances with qualitatively different grammars.

This conclusion would seem, on the face of it, to support an alternative nativist idea that suggests that children are working with adultlike grammatical knowledge from the start of multi-word speech. Rather than posit stages in development to explain the differences between adult and child production, these performance limitation theorists argue that children are working under severe limitations that restrict the complexity of the types of utterances they can produce. Chapter 6 considered one such account - that of Valian (Valian, Lasser & Mandelbaum, 1992). Valian et al's explanation of wh-questions production hinges on the idea that, although children have adultlike grammatical competence, there are some language-specific aspects of grammar that children still have to learn. Therefore, children's wh-questions may go through a phase during with they mistakenly apply an optional inversion rule which leads them to making both uninversion and omission errors. The rule can apply differentially to separate wh-words and is corrected gradually, as children learn that all object/adjunct wh-questions must occur with inversion. Together with the fact that children have to learn lexical items during acquisition and the idea that some wh-questions carry a more complex syntactic structure than others, the optional inversion rule explains why children's production is impoverished compared to that of the adult

Valian et al's theory avoids some of the criticisms that can be applied to competence theories. Because it does not rely on stages in development to explain early multi-words speech, the theory predicts that the acquisition sequence would reflect a gradual building up of knowledge. Children's production would be expected to improve gradually and slowly over a long period of time as the restrictions imposed by performance limitations lift, and as children become more familiar with the target language. The fact that children have to learn to apply the inversion rule wh-word by wh-word also explains why some wh-words (e.g. *why*) seem to occur more frequently with uninversion than others (e.g. *what*) and why others (e.g. *who*) tend not to occur with uninversion at all.

However, in chapters 2 and 6 it was argued that Valian et al's theory made certain predictions about the nature of auxiliary use that had not been explicitly tested against the data. Thus, in chapter 6, two main predictions of Valian et al's theory were tested. First, it was predicted that auxiliary omission should be no more likely to occur with one lexical form of an auxiliary than with another. In fact, contrary to the prediction, auxiliary omission rates varied according to the lexical form of the auxiliary. The results from an analysis of omission suggested that second person/plural *are* and *have* were more likely to be omitted than third person singular *is* and *has*. Second, the uninversion analysis conducted on the data from Adam (Brown, 1973) also failed to uphold the predictions of the optional inversion rule. Uninversion was not wh-word specific but wh-word+auxiliary combination specific.

In chapter 6 it was argued that two implications stem from these results. First, it was concluded that the optional inversion rule theory cannot explain the pattern of early wh-question acquisition as there is no reason, within the theory, why certain lexical forms of the same auxiliary should be more or less likely to occur with inversion than others. Second, it was suggested that the pattern of data suggests that early acquisition may best be explained in terms of lexically specific rather than category-general patterns. In other words, children's knowledge may best be captured by descriptions at the lexical level. Valian's theory at the present moment cannot incorporate the presence of such effects.

Thus, the two nativist theories considered in the present work have failed to explain the nature of early wh-question data successfully. There was very little evidence from the children's speech that they were constructing utterances according to category general grammatical rules. Instead, the questions seemed best explained in terms of lexically specific formulae. Of course, although none of the nativist theories covered in the present work can explain the acquisition data, other accounts may be able to incorporate these findings. There are many possible explanations for these results that could be included in an account positing innate universal grammar (as discussed in chapter 6). However, in order to make claims about the child's category-general knowledge of movement rules, rule-based theorists must support their conclusions with positive evidence for category-general, as opposed to lexically specific, knowledge in children's data. If, as the present study would seem to indicate, this evidence is not forthcoming, nativist theorists are reduced to relying on logical arguments about the unlearnability of language to support their approach, arguments which are increasing coming under attack (see Chater, 1999; Elman, Bates, Johnson, Karmiloff-Smith, Parisi, & Plunkett, 1996).

The second type of theory discussed in the present work is based on the premise that language is, in fact, not unlearnable. Constructivists theorists argue that since some aspects of grammar must be learnt, it is possible that all aspects of grammar may be learnt. In fact, such researchers suggest that the restricted nature of early multi-word speech provides evidence for the view that languages are learnt. They argue that the nature of early knowledge is best captured in terms of the properties of particular words and/or sub-grammatical situational, semantic or cognitive roles.

The first constructivist theory discussed in chapter 2 was the cognitive theory based on the idea that children can learn certain aspects of language only when the relevant cognitive skills have been mastered. It was suggested that although cognitive theories cannot explain why wh-questions carry specific structural properties, nor how children learn these properties, they have been successful as explaining the order of acquisition of wh-words. However, the results from chapter 4 suggest that this is not the case. There was variability in the acquisition order across children; with some children acquiring wh-questions with the cognitively more complex *how* and *why* before those with the simpler *who*. In fact, the results are perhaps more consistent with the conclusion drawn by Clancy (1989) who suggested that a child's cognitive understanding has only an indirect effect on acquisition, in that the frequency with which a given form occurs in the input is affected by the caregiver's sensitivity to the child's cognitive level.

The second type of constructivist account discussed in chapter 2 – the traditional semantic account – makes no specific claims about wh-question acquisition. However, the third approach – the semantic distributional approach – at least offers a possible explanation. In chapter 2, it was argued that the fact that children's early speech seems to pattern lexically points towards the conclusion that children's knowledge is restricted to how lexical items behave in particular structures. Unfortunately, accounts based on this idea have been heavily criticised. Many (e.g. Braine, 1976; Maratsos, 1982, 1988) are too unconstrained, allowing the possibility of serious word class error or involving the child in a lengthy process of sifting through a vast number of possible distributional regularities (see Pinker, 1984). Accounts designed to restrict the child's search space have had more success but most fail to specify exactly what the hypothesised acquisition mechanism would look like or have problems explaining the nature of the early multi-word speech data. Tomasello's (1992) theory, in particular, cannot explain the findings of the present work that suggest that children's early wh-questions seem to pivot around wh-word+auxiliary patterns rather than around specific verbs.

However, in chapter 7 it was argued that the nature of the children's data could best be captured by a lexical theory that posited that children initially learn wh-questions as low scope lexical structures based around specific lexical items; in particular wh-word+auxiliary or wh-word frames. Thus, children's initial wh-questions would not be formed by the application of category general movement rules such as the subject-auxiliary inversion and wh-fronting rule but simply by combining wh-question specific pivots that have occurred with high frequency in the input with a variety of subject and verb phrases. This accounts predicts that as children learn more frames, their knowledge gradually generalises over all members of the relevant grammatical categories as links between structurally and semantically similar items are made. Thus, adult grammatical competence could begin with lexically specific knowledge.

The lexical constructivist theory was tested in chapter 7 and two main conclusions drawn. First, it was concluded that, as predicted, it was possible to explain many of the children's wh-questions in terms of a few lexically specific wh-word+auxiliary frames. Most of the children's wh-questions, unlike those of their mothers, could be explained with reference to only a few wh-question frames. In particular, the wh-words *what* and *where* accounted for much more of the children's data than would be expected if the children had access to knowledge of grammatical categories and rules.

This finding does not necessarily show that the children's knowledge is lexically specific. As has already been suggested, until more work is conducted on very rich samples of data, the analysis could simply be picking up on the most frequently produced of the children's questions. However, these results add to a growing body of evidence that suggests that children's early multi-word speech may reflect low scope lexically specific knowledge, not abstract category-general rules (see e.g. Braine, 1976; Ninio, 1988; Tomasello, 1992; Lieven, Pine & Baldwin, 1997; Pine, Lieven & Rowland, 1998). At the very least, the results suggest that analyses conducted at the level of the grammatical category rather than the lexical item are failing to pick up on important detail about the nature of children's early multi-word speech.

The second conclusion reached in chapter 7 was that the order of acquisition of these frames could be predicted relatively successfully from their relative frequency in the child's input. Significant correlations between the order of acquisition and the input frequency of wh-word+auxiliary combinations were found for six of the seven children who produced enough data. In addition, it was argued that the pattern of auxiliary inversion and omission would be predicted from the relative frequency of wh-word+auxiliary frames in the input. This prediction was upheld – the present and inverted wh-questions occurred with wh-word+auxiliary frames that were of significantly higher frequency in the input.

These input effects are perhaps the most controversial. Although some evidence has been found for the effect of frequency in wh-question before (e.g. Clancy, 1989) few studies have concluded that input effects can have a direct effect on the order of acquisition of wh-questions. The reason for this, I would suggest, is the focus of the analysis: those that have failed to find correlations (e.g. Brown, 1973) have tended to assume a direct relationship between acquisition and frequency. In these analyses, examples of high frequency items in the input that are not produced early by children have counted against the analysis. However, this assumption effectively ignores the fact that there are many factors that influence acquisition and are, thus, certain to mediate between input frequency and acquisition. These include the derivational and cognitive complexity of the structure (Brown & Hanlon, 1979; Moerk, 1980, Ninio, 1988), pragmatic and semantic distinctions (deVilliers & Tager-Flusberg, 1975; Rispoli, 1991), perceptual salience (Moerk, 1980; Gleitman & Wanner, 1982) and even the immediate interactional context (Moerk, 1980). There are also different frequency effects that need to be considered. For example, Allen (1997) has shown that connectionist models of verb learning can make use of a variety of distributional information including the frequency with which a verb is used, the set of constructions the verb appears in, the semantic relations between two verbs used in similar constructions, the combined frequencies of related verbs and the size of the set of semantically related verbs. In order to capture the role of frequency we first need to control for, and define, these effects. This involves distinguishing between what the child hears (the input) and what the child actually learns (the uptake) (Plunkett & Marchman, 1991). In other words, a child-centred approach that starts with what the child actually produces and then compares early and late or correct and incorrect acquisition will capture in more precise terms what is and what is not salient to the child. The consequences of adopting this approach may be that more studies will begin to report a role for the distributional patterns of the input in the acquisition procedure.

8.4. Outstanding issues

The conclusion has been drawn that the lexical constructivist position is the one that best explains the pattern of acquisition detailed in the analyses presented here. However, there are two ways in which the theory needs to be improved and expanded. First, the theory is too underspecified to illuminate many of the issues about acquisition that have been presented in the present work and in previously reported studies. Thus, the theory has not explained why omission is more frequent with some forms of auxiliaries than others, why some relatively low frequency wh-words are acquired before other high frequency ones or why embedded clauses tend to occur later in development than matrix wh-questions. It also cannot account for why negatives, *why* and modals are more frequent with uninversion or even why uninversion should occur at all. Some of these effects may be explicable in frequency terms. For example, from an examination of the input data from chapter 7 it is clear that wh-questions with negatives, *why* and modals are less frequent in the input than other questions. This may be the reason these items occur most often with uninversion. Similarly, it is probable that embedded wh-phrases are less frequent than matrix wh-questions which would explain why they are learned later. However, other effects, such as the fact that the auxiliaries *are* and *have* were more likely to be omitted than *is* and *has*, cannot be explained solely in these terms. For example, the combination *what've* was produced almost as frequently as the combination *what is* in the children's input data (see appendix L) but, unlike *what is*, was learnt by very few children. These effects may be due more to the phonological salience of particular items rather than differences in input frequency statistics. Future versions of distributional theories will need to incorporate a role for non-distributional information in order to incorporate such effects.

Second, the lexical constructivist theory as presented here has focused very much on the acquisition of productive matrix object and adjunct wh-questions and has ignored the other aspects of wh-question acquisition. Thus, the acquisition of other wh-structures such as subject wh-questions and single wh-word phrases has not been dealt with. In particular, the theory has not explained how children learn the rules governing long distance dependencies in embedded wh-phrases. Work on this issue is especially important if the lexical approach is to challenge the conclusion made in previous work that children obey the grammatical rules on movement in these structures from very early on (see e.g. deVilliers & Roeper, 1990).

The theory has also not been applied to the issue of how children comprehend wh-questions. There is some evidence from the comprehension literature that is compatible with the lexical constructivist account. For example, Gathercole (1985) has argued that children respond to the surface structure, rather than the semantic or referential properties of utterances. However, such evidence needs to be studied in much greater depth and predictions about the comprehension data made in order for a complete theory to be produced.

Finally, the issue of the acquisition of wh-questions in other languages has not been covered, despite the wealth of literature on this issue (see Clancy, 1989, for work on Korean questions; Felix, 1990, for German; Guasti, 1996, for Italian; Misra & Misra, 1993, for Hindi; Perez-Leroux, 1991, for Carribean Spanish; and Weissenborn, Roeper and deVilliers, 1991, for studies on German and French questions). The lexical constructivist account must be able to incorporate cross-linguistic differences (see Gathercole, Sebastian & Soto, 1999, for an analysis of Spanish verb morphology from a lexical perspective). In particular, it must account for how children learn the language-specific rules governing movement from the input that they are exposed to.

In order to achieve these aims, the lexical constructivist position needs to be elaborated in two ways. First, the account needs to present a well defined explanation of how children's initially lexically specific knowledge builds up to approximate grammatical categories and how children come to obey the complex movement rules that seem to govern adult productions. Second, the extent to which the linguistic environment constrains the learning mechanism needs to be made clear and the exact distributional learning mechanisms that would underlie this view of acquisition must be specified. Such a task, I propose, argues perhaps for a role for computational work which could model the complex interactions between a number of linguistic and non-linguistic factors and their effect on the child's learning mechanism. One preliminary attempt at such a model - MOSAIC - has been shown to reproduce both rote-learned phrases and generate new structures, and has had some success at modelling certain phenomena such as optional infinitives and verb islands (see e.g. Croker, Pine & Gobet, 2000; Gobet & Pine, 1997; Gobet & Pine, 2000; Jones, Gobet & Pine, 2000). However, further work is necessary to incorporate a role for non-distributional effects such as the semantic content or the phonological salience of an item and to start making predictions about how children's speech will pattern given the influence of a number of interacting linguistic and non-linguistic effects.

This is not to say that future language acquisition research should now be restricted to computational work. Many computer simulations rely on rich sets of data and detailed analyses both to feed the model and to provide descriptions of child speech for comparison. Therefore, detailed, lexical analyses of large samples of children's speech are also essential to expand our knowledge of the precise nature of the data, together with theoretical work that can direct and support computational simulations of the mechanisms underlying children's language acquisition.

8.5. Conclusion

The present work has suggested that the lexical constructivist account is the one that currently best fits the early wh-question data. It has also been argued that the input is far from impoverished as has been suggested (Berwick & Weinberg, 1984; Lightfoot, 1982) but provides, in its statistical distribution, a route that children can take into grammar. That is not to say that frequency is the only factor that must be accounted for. As Slobin (1997) has suggested, it is impossible to make claims about acquisition without incorporating the impact of a variety of interacting psycholinguistic and non-linguistic factors. However, work on the influence of frequency statistics may be a good starting point, given that the speech that a child hears is arguably the most direct, easily observable, perhaps most intuitively plausible, influence on language acquisition. I would maintain that in order to build a successful constructivist model of language acquisition, we need first to know what impact the input has; in particular, what frequency effects can and cannot explain. Only then will the influence of other factors be clear: the role of stress and phonetics, of semantics and of pragmatics and even perhaps of innately specified linguistic knowledge.

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Appendices

Appendix A. MLU of each child by transcript

Transcript Number	Aran	Anne	Becky	Carl	Dominic	Gail
1	1.41	1.62	1.55	2.12	1.25	1.79
2	1.57	1.84	1.46	2.30	1.48	1.71
3	1.83	1.80	1.53	2.40	1.32	1.91
4	2.20	1.92	1.54	2.15	1.48	2.07
5	2.18	1.88	1.54	2.32	1.61	2.15
6	2.31	1.97	1.61	1.98	1.55	2.17
7	2.37	2.30	1.90	2.28	1.88	2.43
8	2.31	2.21	1.99	2.18	1.82	2.46
9	2.58	2.14	2.05	2.21	1.84	2.68
10	2.78	2.27	2.19	2.42	1.83	2.64
11	2.49	2.63	2.44	2.56	2.18	2.83
12	2.76	2.69	2.53	2.4+	2.33	3.11
13	2.98	2.60	2.69	2.71	2.43	2.87
14		2.91	2.65	2.57	2.19	3.01
15	2.88	3.07	2.86	2.64	2.14	2.95
16	2.97	3.12	2.67	2.76	2.32	2.88
17	3.08	2.88	2.94	3.07	2.45	2.56
18	3.44	2.78	3.30	3.19	2.56	2.77
19	3.48	2.74	3.33	3.32	2.44	2.89
20	3.83	2.94	3.35	3.47	2.33	2.80
21	3.33	2.95	3.18	3.45	2.54	2.88
22	3.60	2.86	3.30	3.09	2.90	3.32
23	3.69	2.98	3.18	3.43	2.89	3.15
24	3.49	3.27	3.35		3.05	2.82
25	3.49	2.96	3.14	3.73	3.48	3.64
26	3.36	2.99	3.11	4.14	2.98	3.37
27	3.47	3.16	3.38	3.82	3.45	3.39
28	3.43	3.08	3.12	3.59	3.52	3.06
29	4.22	3.41	3.30	3.34	2.95	3.25
30	3.75	3.17	3.02	4.20	2.64	3.44
31	3.87	3.00	2.95	3.60	2.99	3.67
32	3.71	2.98	3.51	3.33	2.79	3.57
33	3.70	3.14	3.40	3.36	3.12	3.42
34	3.84	3.54	3.31	3.92	2.88	3.47

Appendix A. (cont.) MLU of each child by transcript

Transcript Number	John	Joel	Liz	Nicole	Ruth	Warren
1	2.23	1.39	1.38	1.06	1.40	2.01
2	2.10	1.39	1.44	1.35	1.45	1.98
3	2.21	1.53	1.67	1.17	1.52	2.40
4	2.10	1.63	1.87	1.28		2.39
5	1.98	1.72	1.91	1.32	1.34	2.35
6	2.39	1.76	2.00	1.41	1.54	2.33
7	2.24	1.71	2.04	1.53	1.61	2.53
8	2.09	1.92	2.10	1.52	1.65	2.54
9	2.37	2.06	2.13	1.54	1.66	2.65
10	2.26	2.10	2.30	1.62	1.82	2.87
11	2.14	2.20	2.43	1.71	1.49	2.74
12	2.39	2.20	2.42	1.82	1.96	3.15
13	2.24	2.33	2.66	1.83	2.08	3.13
14	2.36	2.18	2.82	1.67	2.10	3.12
15		2.53	2.94	1.86	2.17	3.45
16		2.53	3.05	2.40	2.10	3.29
17	2.33	2.61	2.81	1.76	1.95	3.47
18	2.30	2.63	2.71	2.12	2.38	3.32
19	2.58	2.74	3.05	2.29	2.08	3.62
20	2.38	2.93	3.29	2.46	2.32	3.27
21	2.19	2.72	3.64	2.28	2.31	3.82
22	2.44	3.07	3.78	2.29	2.35	4.34
23	2.54	2.89	3.74	2.45	2.14	4.12
24	2.50	3.13	3.86	2.23	2.41	3.94
25	2.98	3.31	3.61	2.45	2.06	4.04
26	3.14	2.89	3.99	2.50	2.85	3.82
27	3.29	3.01	3.57	2.28	2.64	3.26
28	3.07	3.09	4.17	2.60	2.74	3.32
29	3.28	3.23	3.89	2.53	2.57	3.21
30	3.20	2.86	3.69	2.39	2.90	3.33
31	3.20	3.24	3.59	2.99	3.26	3.74
32	3.01	2.81	3.62	2.44	3.19	4.14
33	2.89	3.61	3.61	2.77	3.29	3.91
34	2.69	3.38	4.11	3.29	3.35	4.14

Appendix B. Screeing Procedure Forms

B.1. Telephone screening form

TELEPHONE SCREENING FORM

MOTHER NAME:

CHILD NAME: CHILD GENDER

ADDRESS: TELEPHONE NO:

DATE OF BIRTH: AGE OF CHILD:

BIRTH ORDER: AVAILABILITY OF MOTHERS

(we want first borns)

LANGUAGE

MONOLINGUAL:

STARTED COMBINING WORDS: YES/NO

(If no, politely decline but ask if can keep on file)

10 COMBINATIONS:

SENTENCES	ASSOCIATED FRAME
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

INTERESTED: YES/NO

DATE SENT CHECKLIST:

DATE TO RING:

Appendix B.2. Parents' information pack

(4 NOTT) REVISED 20/2/96

Dear Parent

Thank you for your interest in our study of Early Language Development. We are enclosing further details of what will be involved to enable you to come to an informed decision. We would be grateful if you would read the information provided and be ready to come to a decision about whether you would like to take part. You are, of course, under no obligation and, even should you agree to participate, you will be free to withdraw at any time should you so wish.

If, after reading the information, you decide that you are interested in the study we would appreciate it if you would complete the enclosed checklist of words and phrases and send it back to us in the stamped addressed envelope. All information we receive now, and, if you decide to take part in the study, later on will, of course, be confidential. Once we have received the completed checklist we will phone you to answer further queries that you may have. Naturally, if you have any questions you wish to ask before completing the checklist, we will be happy to deal with them. The number to ring is 0115 951 5151, ext. 8348 (please ask for Caroline Rowland).

Many thanks again for your interest.

Yours faithfully

Julian Pine Caroline Rowland

Encs

Dr. Julian Pine is a psychologist at Nottingham University with a particular interest in young children's language development.

Caroline Rowland is the principal research assistant working on the project.

5 (NOTT) REVISED 20/2/96

A STUDY OF CHILDREN'S LANGUAGE DEVELOPMENT

What is the study about?

The study in which you have expressed an interest is an investigation of children's early language development, which forms part of a programme of research currently being conducted at the Department of Psychology, University of Nottingham and Department of Psychology, University of Manchester.

Children tend to start to talk at around the age of 12 months using one-word 'sentences'. At about 2 years of age they begin to discover how these words are combined and begin to string words together. For example, a child wanting her/his ball may start to say 'want ball' or 'get ball' instead of just 'ball'. The older the child gets, the more words s/he learns, and the longer her/his sentences become. By five years old most children talk like 'small adults'.

We are interested in following children who have only just started to put words together. We believe the way children combine words can tell us a lot about the methods children use to learn language. Language development is still not fully understood, and yet the ability to communicate is both necessary and extremely important for children (and adults!). We believe the results of our study will be very useful for all those involved with small children - the family, teachers, child psychologists, speech therapists, doctors and so on.

What will the study involve for me and my child?

The most important thing to mention is that the study is intended to take a year to complete and during this time the researchers will need to visit you twice every three weeks. Each visit could well take a couple of hours. It is vital that you realise the length and time span involved.

If you agree to take part, the study will involve you and your child in the following ways:

1. First, you will be visited at home by Caroline Rowland. The purpose of the first visit is simply to allow you and your child to get to know the researcher and to give us the opportunity to answer and queries you may have. There will also be a 15 minute audio recording during this visit. This is an example recording to familiarise you and your child with the recording situation.

2. After this initial visit. the recording will begin. Caroline Rowland will need to visit yoru home twice every three weeks as already stated. The format will be two visits on two separate days in one

week, then a break of two weeks; or one recording a session a week for two weeks then a week off. Each visit will include a half hour tape recording, a break and then another half hour tape recording of your child playing with some toys provided by us. Each block of two visit will normally also include one test session. This test will help us ascertain what sort of things your child is saying. These visits will continue for a year.

How far am I committing myself?

Obviously, we would very much hope that those who volunteer for the study will want to carry on until the end. However, even after agreeing to take part, you are free to withdraw from the study at any point and with no questions asked. In fact, our experience is that mothers tend to enjoy taking part in studies of their children's language development. In addition, we will provide all mothers who complete the study with a sample tape of their children's developing speech and a summary of the aims and the results of the study.

CHILD NAME: ______________________

VOCABULARY CHECKLIST

PART 1 WORDS CHILDREN USE

A. VOCABULARY CHECKLIST

The following is a list of words which typically appear in young children's vocabularies. Could you please circle any word which you have heard your child say. If your child has a different pronunciation (e.g. 'raffe' for 'giraffe' or 'sketti' for 'spaghetti') circle the word anyway. **Remember this is a 'catalogue' of all words that are used by many different children so don't worry if your child is saying only a few at the moment.**

SOUND EFFECTS AND ANIMAL NOISES

baa baa	mieow	uh oh
choo choo	moo	vroom
cockadoodledoo	ouch	woof woof
grrr	quack quack	yum yum

VEHICLES (real or toy)

aeroplane	fire engine	sledge
bicycle	lorry	tractor
boat	motorcycle	train
bus	pram	truck
car	pushchair	

TOYS

ball	bubbles	jigsaw
balloon	chalk	pen
bat	crayon	pencil
block	doll	play dough
book	game	story
brick	glue	toy

ANIMAL NAMES (real or toy)

ant	duck	penguin
bear	elephant	pig
bee	fish	pony
bird	fly	puppy
bunny	frog	sheep
butterfly	giraffe	squirrel
cat	hen	teddy bear
chicken	horse	tiger
cockerel	kitten	turkey
cow	lamb	turtle
crocodile	lion	wolf
deer	monkey	zebra
dog	mouse	
donkey	owl	

FOOD AND DRINK

apple	drink	potatoes
banana	egg	raisin
biscuit	food	sandwich
bread	grapes	soup
butter	ice cream	spaghetti
cake	juice	strawberry
carrot	meat	sweets
cereal	milk	tea
chicken	noodles	toast
chips	orange	water
chocolate	peas	yoghurt
coffee	pizza	
crisps	pop	

CLOTHING

beads	jeans	shorts
belt	jumper	slipper
bib	mittens	sock
boots	nappy	sweater
button	necklace	tights
coat	pyjamas	trousers
dress	pants	underpants
gloves	scarf	zip
hat	shirt	
jacket	shoe	

BODY PARTS

ankle	feet	nose
arm	finger	poor poor (cut or sore)
belly button	hair	shoulder
bottom	hand	teeth
cheek	head	toe
chin	knee	tongue
ear	leg	tummy
eye	lips	
face	mouth	

FURNITURE AND ROOMS

bath	fire	potty
bathroom	fridge	rocking chair
bed	garage	sink
bedroom	high chair	stairs
chair	kitchen	stove
cot	living room	table
couch	lounge	television
door	oven	toilet
drawer	play pen	window

SMALL HOUSEHOLD ITEMS

basket	glass	plant
blanket	glasses	plate
bottle	hammer	purse
bowl	hoover	radio
box	keys	rubbish
broom	knife	scissors
brush	lamp	soap
bucket	light	spoon
camera	medicine	tape
clock	money	telephone
comb	paper	tissue
cup	penny	toothbrush
dish	picture	towel
fork	pillow	watch

PEOPLE

aunt	fireman	child's own name
baby	friend	people
babysitter	girl	person
babysitter's name	grandma	pet's name
boy	grandad	police
brother	lady	postman
child	man	sister
daddy	mummy	teacher
doctor	nurse	uncle

OUTSIDE THINGS

backyard	pavement	spade
bucket	pool	star
flag	rain	stick
could	road	stone
flower	rock	street
garden	roof	sun
grass	sandpit	swing
hose	sky	tree
ladder	slide	water
lawn mower	snow	wind
moon	snowman	

PLACES TO GO

beach	home	playground
camping	house	school
church	outside	shops
cinema	park	woods
circus	party	work
country	petrol station	zoo
farm	picnic	

GAMES AND ROUTINES

bathtime	nap	sleep
breakfast	night night	ta
bye bye	no	wait
dinner	patacake	want
hello	peekaboo	yes
hiya	please	
lunch	shush	

DESCRIPTIVE WORDS

all gone	full	orange
asleep	gentle	poor
awake	good	pretty
bad	green	quiet
better	happy	red
big	hard	sad
black	heavy	scared
blue	high	sick
broken	hot	sleepy
brown	hungry	slow
careful	hurt	soft
clean	last	sticky
cold	little	stuck
cute	long	thirsty
dark	loud	tiny
dirty	mad	tired
dry	naughty	wet
empty	new	white
fast	nice	windy
fine	noisy	yellow
first	old	yucky

ACTION WORDS

bite	drive	hug	read	swim
blow	drop	hurry	ride	swing
break	dry	jump	rip	take
bring	dump	kick	run	talk
build	eat	kiss	say	taste
bump	fall	knock	see	tear
buy	feed	lick	shake	think
carry	find	like	share	throw
catch	finish	listen	show	tickle
chase	fit	look	sing	touch
clap	fix	love	sit	wait
clean	get	make	stake	wake
climb	give	open	sleep	walk
close	go	paint	slide	wash
cook	hate	pick	smile	watch
cover	have	play	spill	wipe
cry	hear	pour	splash	wish
cut	help	pretend	stand	work
dance	hide	pull	stay	write
draw	hit	push	stop	
drink	hold	put	sweep	

WORDS ABOUT TIME

after	morning	today
before	night	tomorrow
day	now	tonight
later	time	yesterday

PRONOUNS

he	me	their	we
her	mine	them	you
hers	my	these	your
him	myself	they	yourself
his	our	this	
I	she	those	
it	that	us	

QUESTION WORDS

how	when	which	why
what	where	who	

PREPOSITIONS AND LOCATIONS

about	down	on top of
above	for	out
around	here	over
at	inside/in	there
away	into	to
back	next to	under
behind	of	up
beside	off	with
by	on	

QUANTIFIERS AND ARTICLES

a	each	other
all	every	same
a lot	more	some
an	much	the
another	not	too
any	none	

HELPING VERBS

am	does	need/need to
are	don't	try/try to
be	going to	want to
can	got to	was
could	have to	were
did you	is	will
do	let me	would

CONNECTING WORDS

and	but	so
because	if	then

B HOW CHILDREN USE WORDS

Please tick the category that most applies to your child

	Not yet Sometimes often
1. Does your child ever talk about past events or people who are not present? For example, a child who went to the park last week might later say swing or slide	

	Not yet	Sometimes	often
2. Does your child ever talk about something that's going to happen in the future, e.g. saying choo choo or car before you leave the house for a trip?			
3. Does your child talk about objects that are not present such as asking about a missing or absent toy or asking about someone not present?			
4. Does your child understand if you ask for something that is not in the room, e.g. by going to the bedroom to get a teddy bear when you say 'teddy bear?			
5. Does your child ever pick up or point to an object and name an absent person to whom the object belongs, e.g. a child might point to daddy's shoes and say Daddy.			

PART 11 SENTENCES AND GRAMMAR

A. WORD ENDINGS PART 1

Please tick the category that most applies to your child.

	Not yet	Sometimes	often
1. To talk about more than one thing we add an 's' to many words. Examples include cars, shoes, dogs and keys. Has your child begun to do this?			
2. To talk about ownership we add an 's', e.g. Daddy's keys, cat's dish, baby's bottle. Has your child begun to do this?			
3. To talk about activities we sometimes add an 'ing' to verbs. E.g. looking, running, crying. Has your child begun to do this?			
4. To talk about things that happened in the past we often add an 'ed' to the verb. Examples include kissed, opened and pushed. Has your child begun to do this?			

B. WORD FORMS

Following are some other words children learn. Please mark any of these words that your child uses.

NOUNS

children	men	teeth
feet	mice	

VERBS

ate	fell	made
blew	flew	ran
bought	got	sat
broke	had	saw
came	heard	took
drank	held	went
drove	lost	

C. <u>WORD ENDINGS PART 2</u>

Young children often place the wrong endings on words. For example, a child might say 'Auntie goed home'. Mistakes like these are often a sign of progress in language. In the following lists please mark all the mistakes of this kind you have heard your child say recently.

NOUNS

blockses	mans	sockses
childrens	mens	teeths
childs	mices	toeses
feets	mouses	tooths
foots	shoeses	

VERBS

ated	comed	goed	ranned
blewed	doed	gotted	runned
blowed	dranked	haved	seed
bringed	drinked	heared	satted
buyed	eated	holded	sitted
breaked	falled	losed	taked
broked	flied	losted	wented
camed	getted	maked	

HAS YOUR CHILD BEGUN TO COMBINE WORDS YET SUCH AS 'MORE BISCUIT' OR 'DOGGIE DINNER'?

Not Yet　　　　Sometimes　　　　Often (please tick)

IF YOU ANSWERED NOT YET PLEASE STOP HERE. IF YOU ANSWERED SOMETIMES OR OFTEN PLEASE CONTINUE.

D. <u>EXAMPLES</u>

PLEASE LIST THREE OF THE LONGEST SENTENCES YOU HAVE HEARD YOUR CHILD SAY RECENTLY.

1. ____________________

2. ____________________

3. ____________________

E. <u>COMPLEXITY</u>

In each of the following pairs please circle the one that sounds MOST like the way your child talks right now. If your child is saying sentences even longer or more complicated than the two provided, just pick the second one.

two shoe two shoes	(talking about something that's already happened) I fall down I fell down	(talking about something that's already happened) Dad pick me up Dad picked me up
two foot two feet	more biscuit more biscuits	(talking about something that already happened) Kitty go away Kitty went away
daddy car daddy's car	these my tooth these my teeth	doggie table doggie on table

(talking about something happening right now) Kitty sleep Kitty sleeping	baby blanket baby's blanket	that my truck that's my truck
(talking about something happening right now) I make tower I making tower	(talking about something that's already happened) doggie kiss me doggie kissed me	baby crying baby is crying
you fix it? can you fix it?	coffee hot that coffee hot	baby want eat baby want to eat
read me story mummy read me a story mummy	I no do it I can't do it	look at me look at me dancing
no wash dolly don't wash dolly	I like read stories I like to read stories	look it look it what I got
want more juice want juice in there	don't read book don't want you read that book	where's my dolly where's my dolly name Sam
there a kitty there's a kitty	turn on light turn on light so I can see	we made this me and Paul made this
go bye bye wanna go bye bye	I want that I want that one you got	I sing song I sing song for you
where mummy go where did mummy go	want biscuits want biscuits and milk	baby crying baby crying cos she's sad
biscuit mummy biscuit for mummy		

F. WAYS OF EXPRESSING ONESELF

Children who are at the same stage of language often talk about the same things in different ways. For each of the sentence pairs that follow, pick the one that sounds MOST like something your child would say. In sentences in which 'Adam' is used, substitute your own child's name.

my truck Adam truck	you pretty mummy pretty	open it open door
me dirty Adam dirty	go bye bye mummy bye bye	that hot coffee hot
carry me carry Adam	comb it hair comb mummy hair	no do that no wash hair
want juice Adam juice	he sleeping cat sleeping	juice in there juice in cup

THANK YOU EVER SO MUCH FOR COMPLETING THE CHECKLIST. COULD YOU NOW RETURN IT IN THE ENCLOSED STAMPED ADDRESSED ENVELOPE AND WE'LL CONTACT YOU AS SOON AS WE RECEIVE IT.

Appendix B.3. Pre-initial visit screening form

PRE-INITIAL VISIT SCREEING FORM

(involve J at this point)

MOTHER'S NAME: DATE OF BIRTH:

CHILD'S NAME:

ADDRESS: TEL NO:

Date checklist received:

Total number of words:

Developmental Level:

Suitability: YES/NO

If no:

Date rejection letter sent:
(child too advanced or other plausible excuse)

If yes:

Date phoned to arrange initial visit
(how difficult/easy to contact)

On phone:

Answer any questions about the project
Ask if still interested

If yes:
Suggest initial visit - explain what will happen

Date and time arranged for initial visit:
(how difficult/easy to arrange)

Appendix B.4.Initial visit screening form

INITIAL VISIT SCREENING FORM

DATE OF INITIAL VISIT:

MOTHER'S NAME: DATE OF BIRTH:

CHILD'S NAME:

ADDRESS: TELEPHONE NO.:

Number of words from checklist:

Developmental level from word complexity:

Follow up from checklist (e.g. inconsistencies)

AVAILABILITY:

Daily routine:

Weekly routine:

Any inconvenient time/day:

Day/time most convenient:

SAMPLE TAPE:

Tape recorded: YES/NO

Tape number and name:

Appendix B.5. Consent form

CONSENT FORM

I have read the description of the investigation into children's language development and consent to my child being involved in the study.

I understand that our participation in the study is entirely voluntary and that we can withdraw at any time, if we so wish.

I also understand that all use of the data will be entirely confidential and anonymous.

Signature of Parent: ________________Date: _____

Signature of Researcher: ________________Date: _____

POST INITIAL VISIT SCREENING FORM

(involve J at this point)

NAME: DATE OF BIRTH:

ADDRESS: TEL NO:

Listened to tape: YES/NO

Child suitable from IV: YES/NO

Child suitable from tape: YES/NO

If NO;

Date rejection letter sent:

If YES:

Date rang to check for final time that mum still interested and to organise date and time of first testing session:

Date and time organised for first testing session:

Any changes to date and time organised for first testing session:

Appendix C. Progress monitoring

Appendix C.1. Record of visit form

Record of visit

Name of Child: Tape number:

Date of visit: Time: Session No: One Two

Who present:

General comments:

General comments on parent:

General comments on child:

Anything else about child language

Any breaks in recording session:

Wug test: YES/NO

Phonological Memory test: YES/NO

Wug test tape number and side:

Phonological memory tape number and side:

Any problems with wug test:

Repeat testing: YES/NO

Date of next visit:

Appendix C.2. Sample progress chart

DATE UPDATED: 23/11/1998

Name: ANNE

	TAPE NUMBER				
	01	**02**	**03**	**04**	**05**
AGE	1;10.7	1;10.21	1;11.4	1;11.6	1;11.18
MLU	1.62	1.84	1.8	1.92	1.88
TEST PERIOD	15.7.1996 - 4.8.1996	15.7.1996 - 4.8.1996	5.8.1996 - 25.8.1996	5.8.1996 - 25.8.1996	26.8.1996 - 15.9.1996
DATE	17.7.1996	31.7.1996	14.8.1996	16.8.1996	28.8.1996
WUG?	YES	NO	YES	NO	YES
WUG TAPE	anne01.wug	--	anne02.wug	--	anne03.wug
RESULTS **PL** **PO** **PR** **PA**	 NN NN NN NN	--	 <u>Y</u>N NN NN NN	--	 NN N<u>Y</u> NN NN
TRANS? **A** **B**	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
CODED? **A** **B**	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
FILENAME **A** **B**	 anne01a.mor anne01b.mor	 anne02a.mor anne02b.mor	 anne03a.mor anne03b.mor	 anne04a.mor anne04b.mor	 anne05a.mor anne05b.mor
COMMENT		Workmen outside so occasionally noisy	passed one plural wug		passed possessive wug Rachel's visit Checked Rachel's transcript

Name: ANNE

	TAPE NUMBER				
	06	**07**	**08**	**09**	**10**
AGE	1;11.20	2;0.15	2;0.17	2;0.29	2:1.18
MLU	1.97	2.3	2.21	2.14	2.27
TEST PERIOD	26.8.1996 - 15.9.1996	16.9.1996 - 6.10.1996	16.9.1996 - 6.10.1996	7.10.1996 - 27.10.1996	7.10.1996 - 27.10.1996
DATE	30.8.1996	25.9.1996	27.9.1996	9.10.1996	18.10.1996
WUG?	NO	YES	NO	YES	NO
WUG TAPE	--	anne04.wug	--	anne05.wug	--
RESULTS					
PL		NN		YN	
PO		NN		YY	
PR		NN		NN	
PA		NN		NN	
TRANS?					
A	YES	YES	YES	YES	YES
B	YES	YES	YES	YES	YES
CODED?					
A	YES	YES	YES	YES	YES
B	YES	YES	YES	YES	YES
FILENAME					
A	anne06a.mor	anne07a.mor	anne08a.mor	anne09a.mor	anne10a.mor
B	anne06b.mor	anne07b.mor	anne08b.mor	anne09b.mor	anne10b.mor
COMMENT	Rachel's visit Checked Rachel's transcript	Rachel's visit Checked Rachel's transcript	Rachel's visit Checked Rachel's transcript		Rachel's visit Checked Rachel's transcript

Name: ANNE

TAPE NUMBER					
	11	**12**	**13**	**14**	**15**
AGE	2;1.20	2;1.22	2;2.10	2;2.12	2;3.1
MLU	2.63	2.69	2.60	2.91	3.07
TEST PERIOD	28.10.1996 - 17.11.1996	28.10.1996 - 17.11.1996	18.11.1996 - 8.12.1996	18.11.1996 - 8.12.1996	9.12.1996 - 29.12.1996
DATE	30.10.1996	1.11.1996	20.11.1996	22.11.1996	11.12.1996
WUG?	YES	NO	YES	NO	YES
WUG TAPE	anne06.wug	--	anne07.wug	--	anne08.wug
RESULTS **PL** **PO** **PR** **PA**	 YY NN NN NN	--	 YY NN NN NN	--	 YY NN NN NN
TRANS? **A** **B**	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
CODED? **A** **B**	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
FILENAME **A** **B**	 anne11a.mor anne11b.mor	 anne12a.mor anne12b.mor	 anne13a.mor anne13b.mor	 anne14a.mor anne14b.mor	 anne15a.mor anne15b.mor
COMMENT		Both Anne and MOT used 'a one' at one point. Anne uses 'can't', 'isn't' but not 'don't' Rachel's visit	Now uses 'don't'	Unfortunatley said 'wee-ed' when the tape was off	

Name: ANNE

TAPE NUMBER					
	16	17	18	19	20
AGE	2;3.20	2;3.28	2;4.0	2;4.12	2;4.14
MLU	3.12	2.88	2.78	2.74	2.94
TEST PERIOD	9.12.1996 - 29.12.1996	30.12.1997 - 19.1.1997	30.12.1996 - 19.1.1997	20.1.1997 - 9.2.1997	20.1.1997 - 9.2.1997
DATE	30.12.1996	8.1.1997	10.1.1997	22.1.1997	24.1.1997
WUG?	NO	NO	YES	YES	NO
WUG TAPE	--	--	anne09.wug	anne10.wug	--
RESULTS PL PO PR PA	--	--	 YY YY NN NN	 YY YY NN NN	--
TRANS? A B	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
CODED? A B	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
FILENAME A B	 anne16a.mor anne16b.mor	 anne17a.mor anne17b.mor	 anne18a.mor anne18b.mor	 anne19a.mor anne19b.mor	 anne20a.mor anne20b.mor
COMMENT		PWM performed so WUG delayed	WUG performed		

Name: ANNE

	TAPE NUMBER				
	21	**22**	**23**	**24**	**25**
AGE	2;5.2	2;5.4	2;5.25	2.6.4	2.6.29
MLU	2.95	2.86	2.98	3.27	2.96
TEST PERIOD	10.2.1997 - 2.3.1997	10.2.1997 - 2.3.1997	3.3.1997 - 23.3.1997	3.3.1997 - 23.3.1997	24.3.1997 - 13.4.1997
DATE	12.2.1997	14.2.1997	5.3.1997	14.3.1997	9.4.1997
WUG?	YES	NO	YES	NO	YES
WUG FILENAME	anne11.wug	--	anne12.wug	--	anne13.wug
RESULTS **PL** **PO** **PR** **PA**	 YY YY NN NN	--	 YY YN Y?N NN	--	 YN YY YN NN
TRANS? **A** **B**	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
CODED? **A** **B**	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
FILENAME **A** **B**	 anne21a.mor anne21b.mor	 anne22a.mor anne22b.mor	 anne23a.mor anne23b.mor	 anne24a.mor anne24b.mor	 anne25a.mor anne25b.mor
COMMENT				PWM 2 performed	

Name: ANNE

TAPE NUMBER					
	26	**27**	**28**	**29**	**30**
AGE	2;7.1	2;7.13	2;7.15	2;7.27	2;7.29
MLU	2.99	3.16	3.08	3.41	3.17
TEST PERIOD	24.3.1997 - 13.4.1997	14.4.1997 - 4.5.1997	14.4.1997 - 4.5.1997	5.5.1997 - 25.5.1997	5.5.1997 - 25.5.1997
DATE	11.4.1997	23.4.1997	25.4.1997	7.5.1997	9.5.1997
WUG?	NO	YES	NO	NO	YES
WUG FILENAME	--	anne14.wug	--	--	anne15.wug
RESULTS **PL** **PO** **PR** **PA**	--	YN NY YN NN	--	--	YY YY NN NN
TRANS? **A** **B**	YES YES	YES YES	YES YES	YES YES	YES YES
CODED? **A** **B**	YES YES	YES YES	YES YES	YES YES	YES YES
FILENAME **A** **B**	anne26a.mor anne26b.mor	anne27a.mor anne27b.mor	anne28a.mor anne28b.mor	anne29a.mor anne29b.mor	anne30a.mor anne30b.mor
COMMENT				INV not present	

Name: ANNE

TAPE NUMBER					
	31	32	33	34	PWM TAPE
AGE	2;8.24	2;8.26	2;9.8	2;9.10	3;0.7
MLU	3.00	2.98	3.14	3.54	3.44
TEST PERIOD	26.5.1997 - 15.6.1997	26.5.1997 - 15.6.1997	16.6.1997 - 29.6.1997	16.6.1997 - 29.6.1997	AGE 3 YEARS
DATE	4.6.1997	6.6.1997	18.6.1997	20.6.1997	17.9.1997
WUG?	NO	YES	NO	YES	NO
WUG FILENAME	--	anne16.wug	--	anne17.wug	--
RESULTS PL PO PR PA	--	 YY YY NY NN	--	 YY YY YY NN	--
TRANS? A B	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
CODED? A B	 YES YES	 YES YES	 YES YES	 YES YES	 YES YES
FILENAME A B	 anne31a.mor anne31b.mor	 anne32a.mor anne32b.mor	 anne33a.mor anne33b.mor	 anne34a.mor anne34b.mor	 anne35a.mor anne35b.mor
COMMENT	Anne asleep at visit time so Mum did tape herself		PWM done so WUG delayed	WUG done	PWM performed

Appendix D: Wh-context analysis - data for individual children

Appendix D.1. Total number of object wh-questions produced by each child at each datapoint

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nic-ole	Ruth	War-ren	Total	Mean
1	2	13	4	76	2	7	16		3			7	130	10.83
2	6	20	2	35	4	9	10	1	13	1		11	112	9.33
3	10	35	12	88	3	17	6	2	12	1		5	191	15.92
4	0	19	27	59	4	9	15	2	15	5		4	159	13.25
5	9	15	26	32	4	17	9	8	9	3		4	136	11.33
6	15	43	32	57	9	25	7	9	17	2		5	221	18.42
7	6	31	55	24	4	36	5	7	19	2		29	218	18.17
8	23	44	51	19	6	30	0	7	53	8		10	251	20.92
9	35	34	50	12	15	21	7	34	32	15	4	25	284	23.67
10	26	31	45	27	22	22	12	18	23	22	10	30	288	24
11	28	56	58	9	11	16	9	22	21	26	18	16	290	24.17
12	39	35	59	13	6	27	10	33	12	31	14	20	299	24.92
13	35	12	70	15	7	26	8	38	31	21	25	22	310	25.83
14	24	27	84	17	8	28	13	24	10	28	31	24	318	26.5
15	45	22	84	22	10	16	5	22	21	21	32	20	320	26.67
16	21	28	66	22	6	20	17	25	8	29	14	30	286	23.83
17	15	29	60	31	3	11	6	38	26	35	14	11	279	23.25
Tot.	339	494	785	558	124	337	155	290	325	250	162	273	4092	341.01

Appendix D.2. Total number of single wh-words produced by each child at each datapoint

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nic-ole	Ruth	War-ren	Total	Mean
1	2	1	1	1	1								6	0.5
2		1	1	1	1				1	1			6	0.5
3		2	2	1	1				1				7	0.58
4		1	2	1				1	2				7	0.58
5		2	3	2	1					2		1	11	0.92
6	1	2	2	1	1			2	2		1		12	1
7		2	3							2			7	0.58
8		3	3	2				1	3				12	1
9		1	3				1	1	2	1	1		10	0.83
10		3	3		1	1		1		2	2		13	1.08
11		4	2		1	1	1	2		3	2	1	17	1.42
12	1	1	3			1	1	2		2	2		13	1.08
13	5	3	5		1	1				1	2		18	1.5
14	3	4	3	1	1			1	1	3	3		20	1.67
15	5	3	4	1	2	1		3	1	4	2		26	2.17
16	5	1	4	1		2		1		4	2		20	1.67
17	6	2	4	2	1	2		1	2	3	2	1	26	2.17
Tot.	28	36	48	14	12	9	3	16	15	28	19	3	231	19.25

Appendix D.3. Total number of subject wh-questions produced by each child at each datapoint

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nic-ole	Ruth	War-ren	Total	Mean
1				13		1	3						17	1.42
2			1	5		4	4						14	1.17
3		1		6		1	2		1				11	0.92
4				7			3		1				11	0.92
5		3		9			2		2				16	1.33
6		6	5	14		2	2	1	1				31	2.58
7		2	3	3			4	1	3	1			17	1.42
8		1	15	1				1	1	1		1	21	1.75
9	6	1	5	5		1		5	1				24	2
10	3		1	3		2	2	2	1	1		5	20	1.67
11	3	2	6	2				2			2	2	19	1.58
12	4	3	2	1		1	5	1		3	1	4	25	2.08
13	9	4	4	1			1	7		4		5	35	2.92
14	3	4	6			2	3	5			1	3	27	2.25
15	11	2	3		1		1	14		3	2		37	3.08
16	2	2	3	2	2	3	2	2	1		3	4	26	2.17
17	3	4	9	3			3	2		2		3	29	2.42
Tot.	44	35	63	75	3	17	37	43	12	15	9	27	380	31.68

Appendix D.4. Total number of embedded wh-phrases produced by each child at each datapoint

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nic-ole	Ruth	War-ren	Total	Mean
1						1		1					2	0.17
2														
3	1	1											2	0.17
4														
5								1		1			2	0.17
6	1												1	0.08
7														
8		4	1			1		5				4	15	1.25
9	1		3		1	1				2			8	0.67
10	3	3			1	1		2		1		7	18	1.5
11	15	4	2	1		1		1	4			3	31	2.58
12	2	2	4			3		3	10			1	25	2.08
13	3	2	4		1	6		4	3	3		6	32	2.67
14	6	2	12		15	1	2	8		1	1	2	50	4.17
15	15	3	4		2	2	1	5	2	2	8	4	48	4
16	9	6	8		4	10		2	4	2	18	32	95	7.92
17	14		6		2	7	3	6	2	11	5	9	65	5.42
Tot.	70	27	44	1	26	34	6	38	25	23	32	68	394	32.85

Appendix E. Wh-word order of acquisition analysis using 3rd use criterion - data for individual children

Appendix E.1. Order of acquisition of wh-words in object wh-questions using 3rd use criterion

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
1		where		what/ where		what	what/ where					where
2	where	what			what	where			what/ where			
3			what/ where									
4										where		
5								what/ where	who			
6	what				where							
7	who		who									
8			how			how				what		
9		who	why					how			where	what
10												
11											what	
12	why											
13	how/ when							who			why	
14		which				who		whose	why	who		
15									which			who
16			which							why		
17												

Appendix E.2. Order of acquisition of wh-words in subject wh-questions using 3rd use criterion

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
1				what			what					
2						what						
3												
4												
5												
6		what	who						what			
7									who			
8								what				
9	who							who				
10												what
11	what	who	what									who
12										who		
13												
14						who						
15											what	
16					what						who	
17										what		

Appendix E.3. Order of acquisition of wh-words in embedded wh-phrases using 3rd use criterion

Data point	Aran	Anne	Becky	Carl	Dom-inic	Gail	John	Joel	Liz	Nicole	Ruth	War-ren
1												
2												
3												
4												
5												
6												
7												
8		what						what				what
9	what											
10										when		
11	when/ where	when	when						how			
12		where						where	what			
13			what			what/ when			where			when/ where
14	why				when/ what			when				
15	who/ how				where	where					what	
16			where			how			when		when	
17							what			what	why	

Appendix F. Object wh-questions with auxiliaries produced by children at datapoint 1 (NB: data taken from datapoint 2 for Joel, 4 for Nicole and 14 for Ruth)

Aran
what is it

Anne
what-'is that
what-'is this
where-'is baby-s
where-'is pram
where-'is tissue-s

Becky
what-'is that
what-'is this
where-'is her dinner

Carl
what is a this
what is that on doggie
what is this
what-'is
what-'is he do
what-'is it
what-'is that
what-'is that a daddy
what-'is that there
what-'is that window
what-'is this
what-'re you do-ing
where is a man and a horse
where is he
where is it
who-'is this

Dominic
what-'is that
what-'is that car

Gail
what did you do
what this is
what-'is this
what-'is this in there
what-'is this one
what-'is this one big
what-'is those thing-s

John
what-'is that
what-'is this
where-'has the willy gone
where-'is the abby+babby
where-'is the hair
where-'is the money
where-'is the willy
where-'is willie

Joel
what-'is that

Liz
what-'is that

Nicole
what-'is that

Ruth
where-'is anna baby

Warren
where-'has fat+controller gone
where-'has it gone
where-'has the trailer gone

Appendix G: Uninversion errors produced by the 12 children in the Manchester corpus

ARAN
what that train can do
where Bumbo can go
what he was laugh-ing about
why I can-'nt come out
what he was look-ing for
when Anna-'is go-ing
where he-'is take-ing that

ANNE
who you are

BECKY
what that is
where it is
what you do want
where the duck is
where he can sit

CARL
where they are

DOMINIC
No uninversion

GAIL
what this is
what you-'re have-0ing
which one it is
what you would like

JOHN
No uninversion

JOEL
what that is
what these are
what that one is
what he-'has done
how much that is
where I-'m go-ing to live

LIZ
why it-'has all gone

NICOLE
what the name-s are
where creche is
where it is

RUTH
what that is
where this is away

WARREN
No uninversion

Appendix H: Order of acquisition of auxiliary lexemes using 3rd use criterion

Data pt.	Aran	Anne	Becky	Carl	Dominic	Gail	John	Joel	Liz	Nicole	Ruth	Warren
1		cop is	cop is	cop is		cop is	cop is		cop is/aux is			has
2					cop is							cop is
3		does		has								
4		has						cop is				
5	cop is			aux is		has						
6									has			
7		aux is	has			does/ aux is						
8		cop are	aux is/ does							cop is		
9	has/does							has				
10			cop are/do /have/ did/ can			do	has					aux is
11			aux are									
12	aux is		shall		has	aux are		aux is/cop are				does
13	cop was			aux are				have/ does				
14	cop are	aux are						cop was				
15	did/do	did	cop was						does/ do		cop is	
16	will	have/ do				cop are		did		aux are		cop are
17			cop are			cop was		aux are/shall	cop are	has		

Appendix I. Number of correct wh-questions and errors produced at each stage

Appendix I.1. Stage 1

Child	Aran	Anne	Becky	Dominic	Gail	Joel	Liz	Nicole	Warren	Total
Correct	1	8	6		1		6	3	3	28
Agreement error		3			1	1				5
Omitted auxiliary		26	9		1		4	5	2	47
Case error										
Cliticised copula		14	7	4	6	2	5	3	1	42
Omitted copula	3	12	17	5	1	1	6	17	1	63
Omitted Subject		6	5					1		12
Tense on mv (no aux)										
Tense on mv (+ aux)										
Uninv.					1					1
Omit wh-word + aux		4		1			4			9
Wh-word in situ										
Total	4	73	44	10	11	4	25	29	7	207

Appendix I.2. Stage 2

Child	Aran	Anne	Becky	Dominic	Gail	Joel	Liz	Nicole	Warren	Total
Correct	3	24	39	5	35	19	31	25	1	182
Agreement error	2	8	15		16	7	6	5	1	60
Omitted auxiliary	21	21	32	11	26	18	14	50	4	197
Case error		2			1	1	3	3		10
Cliticised copula	10	37	46	12	66	43	53	22	10	299
Omitted copula	29	10	25	41	4	12	28	72	10	231
Omitted Subject	1	3	10	1	6	6	2	9		38
Tense on mv (no aux)								1		1
Tense on mv (+ aux)			7			2	1	2		12
Uninv.		1	2		2	4	1	3		13
Omit wh-word + aux		11		2		1	4			18
Wh-word in situ								1		1
Total	66	117	176	72	156	113	143	193	26	1062

Appendix I.3. Stage 3

Child	Aran	Anne	Becky	Dominic	Gail	Joel	Liz	Nicole	Warren	Total
Correct	90	73	251	9	38	53	46		40	600
Agreement error	8	29	23	1	13	9	7		10	100
Omitted auxiliary	41	19	27	1	10	9	24		34	165
Case error	1	1	1				2		1	6
Cliticised copula	66	109	111	10	59	64	41		79	539
Omitted copula	22	40	3	2	3	6	9		40	125
Omitted Subject	4	5	16	1	2	2	3		1	34
Tense on mv (no aux)	4	1								5
Tense on mv (+ aux)	1	2	5							8
Uninv.	8	1	3		1	2				15
Omit wh-word + aux	1	2		1						4
Wh-word in situ										
Total	156	209	189	16	88	92	86		165	1001

Appendix J: Number of wh-questions that occur with present and omitted copula *be*, *is* and are, auxiliary *have* (category), *has* and *have* (lexeme) and auxiliary *be*, *is* and *are*.

NRC = the auxiliary did not reach criterion (i.e. was not produced in 2 different contexts)

Child		Aran	Anne	Becky	Carl	Dominic	Gail	John	Joel	Liz	Nicole	Ruth	Warren
cop be	present	109	209	253	144	24	156	66	140	113	50	4	106
	absent	57	58	51	113	43	8	36	19	38	84	81	51
cop is	present	97	194	231	141	24	147	64	126	109	47	4	103
	absent	41	46	35	97	33	7	30	14	35	69	61	46
cop are	present	7	14	11	3	0	4	2	10	3	2	0	3
	absent	16	12	15	16	9	2	5	5	2	15	8	4
aux have (cat.)	present	19	39	51	36	8	32	9	24	31	5	NRC	20
	absent	15	16	10	22	6	10	3	8	11	16	NRC	21
has	present	17	35	36	35	8	32	9	21	30	4	NRC	19
	absent	4	12	5	16	5	7	1	1	5	13	NRC	20
have	present	1	2	13	1	0	0	NRC	3	1	0	NRC	0
	absent	5	2	5	0	1	3	NRC	5	2	3	NRC	0
aux be	present	16	17	61	21	2	17	0	12	20	6	0	10
	absent	11	9	12	17	2	7	1	4	17	11	0	7
aux is	present	13	14	29	16	0	13	0	8	18	3	NRC	9
	absent	2	5	0	6	2	4	0	0	9	7	NRC	4
aux are	present	1	4	30	4	2	3	NRC	5	2	3	NRC	0
	absent	1	3	9	10	0	1	NRC	3	7	4	NRC	0

Appendix K - Name and number of productive wh-word+auxiliary combinations and percentage of the total number of wh-questions they account for (for 11 children - Ruth has no productive combinations)

Child	Productive combination	Number of types	% of total no. types
Aran	how does	5	2.84
	what do	5	2.84
	what is	8	4.55
	what will	4	2.27
	what's	37	21.02
	where did	3	1.7
	where is	7	3.98
	where's	68	38.64
	who's	6	3.41
	why are	3	1.7
	why did	3	1.7
	why do	4	2.27
Anne	what are	4	1.38
	what did	4	1.38
	what is	6	2.08
	what's	28	9.69
	where are	4	1.38
	where is	3	1.04
	where's	197	68.17
	who's	5	1.73
Becky	how do	5	1.01
	how's	6	1.21
	what are	19	3.82
	what can	16	3.22
	what did	17	3.42
	what do	5	1.01
	what does	13	2.62
	what has	5	1.01
	what have	6	1.21
	what is	30	6.04
	what shall	5	1.01
	what was	5	1.01
	what's	48	9.66
	what're	3	0.6
	where are	8	1.61
	where did	9	1.81
	where do	4	0.8
	where does	10	2.01
	where is	13	2.62
	where's	181	36.42

Appendix K (cont.) Name and number of productive wh-word+auxiliary combinations and percentage of the total number of wh-questions they account for (for 11 children - Ruth has no productive combinations)

	who is	4	0.8
	who's	7	1.41
	why are	5	1.01
	why did	13	2.62
	why do	4	0.8
	why has	3	0.6
	why have	4	0.8
	why is	9	1.81
	why's	4	0.8
Carl	what is	7	3.23
	what's	53	24.42
	where is	4	1.84
	where's	142	65.44
Dominic	what's	13	34.21
	where's	18	47.37
Gail	how do	4	1.78
	what are	4	1.78
	what's	58	25.78
	where's	142	63.11
	who's	3	1.33
John	what's	7	9.09
	where is	3	3.9
	where's	63	81.82
Joel	what are	5	2.63
	what did	4	2.11
	what is	5	2.63
	what shall	4	2.11
	what's	34	17.89
	what're	4	2.11
	where is	5	2.63
	where's	105	55.26
	who's	3	1.58
Liz	what are	3	1.63
	what do	3	1.63
	what's	34	18.48
	where's	126	68.48
Nicole	what is	4	6.78
	what's	9	15.25
	where is	11	18.64
	where's	27	45.76

Appendix K (cont.) Name and number of productive wh-word+auxiliary combinations and percentage of the total number of wh-questions they account for (for 11 children - Ruth has no productive combinations)

Warren	what are	3	2.11
	what colour's	3	2.11
	what's	21	14.79
	where is	3	2.11
	where's	106	74.65

Appendix L - Frequency in the mother of wh-word+auxiliary combinations (with *be* and *have* only) that were learnt and not learnt by the children

Le. = learnt, Not Le. = not learnt

Wh+aux	Aran		Ann e		Bec- ky		Carl		Dom -inic		Gail	
	Le.	Not Le.	Le.	Not Le.	Le.	Not Le.	Le.	Not Le.	Le.	Not Le.	Le.	Not Le.
how is		0		0	0			0		0		0
how has		0		0		0		0		0		0
how's		0		2	0			0		0		0
how are	0		0			0	0			0		1
how're		0		0		0		0		0		1
how have		3		0		0		0		0		0
how've		0		0		0		0		0		0
what is	7		1		12		5		2		15	
what has	0		0		0			0		0		1
what's	59		31		23		71		22		85	
what are	34		11		14		7		1		13	
what're		16	12		1		23		23		8	
what have		7	2		3		2			1		0
what've		1		9		2		4		3		3
where is	4		1		4		2			2		3
where has		0	0			0		0		0		0
where's	26		25		19		35		18		13	
where are	12		10		5		4			1	1	
where're		5	3		1			9		6	3	
Where have	0		0	0			0		0		0	
where've		0	0			1		2		0		1
who is	1		2		1			2		1		1
who has		0		0		0		0		0		0
who's	5		7		4		24		4		9	
who are		1	0		0			1		0		2
who're		0	0		0			1		0		2
who have	0			0		0		0		0		0
who've		0	1			0		1		0		2
why is	1			4	0			0		1		0
why has	0			0	0			0		0		0
why's		0		0	2			0		1		0
why are	3		0		0			0		1		2
why're		0		0	0			0		3		0
why have		0		0	0			0		0		0
why've		0		0		0		0		2		0
TOTAL	152	33	106	15	89	3	173	20	70	22	147	19

Appendix L (cont.). Frequency in the mother of wh-word+auxiliary combinations (with *be* and *have* only) that were learnt and not learnt by the children

Wh+aux	John		Joel		Liz		Nicole		Ruth		Warren	
	Le.	Not Le.	Le.	Not Le.	Le.	Not Le.	Le.	Not Le.	Le.	Not Le.	Le.	Not Le.
how is		0	0			0		0		4		0
how has		0		0		0		0		0		0
how's		0		0		0		0		1		0
how are	0		0			0		0		0		0
how're		0	0			0		0		0		0
how have		0		0		0		0		0	0	
how've		0		0		0		0		0		0
what is	4		1		5		6			3	2	
what has		0		0		0		0		0		0
what's	30		36		29		48		22		31	
what are		6	11		5		24			8	8	
what're		3	13			17	16			4		4
what have		1		3		3		5		5		4
what've		0	8			1	3			1		3
where is	7		1		1		2			3	7	
where has		0		0		0		0		1		0
where's	18		19		11		24		42		42	
where are	3		10		3		4			2		7
where're		0		3		1		1		1	0	
where have	0		0		0		0		0		0	
where've		1	1		0			0		0		1
who is		0		1		1		2		3		0
who has		0		0		0		0		0		0
who's		3	8		3		4			7	2	
who are		0	2			0		1		0		1
who're		0		0		0		0		0		0
who have		0		0		0		0		0		0
who've		0		1		0		0		1		1
why is		0		0		0		1		1		3
why has		0		0		0		0		0		1
why's		0		1		0		1		0		1
why are		0		0		2		0		0		1
why're		1		0		0		1		0		0
why have		0		0		0		1		0		0
why've		0		0		0		0		0		0
TOTAL	62	15	110	9	57	25	131	13	64	45	92	27