
The Acquisition of Auxiliary Syntax: A Longitudinal Elicitation Study. Part 1: Auxiliary BE

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Purpose: The question of how and when English-speaking children acquire auxiliaries is the subject of extensive debate. Some researchers posit the existence of innately given Universal Grammar principles to guide acquisition, although some aspects of the auxiliary system must be learned from the input. Others suggest that auxiliaries can be learned without Universal Grammar, citing evidence of piecemeal learning in their support. This study represents a unique attempt to trace the development of auxiliary syntax by using a longitudinal elicitation methodology.

Method: Twelve English-speaking children participated in 3 tasks designed to elicit auxiliary BE in declaratives and yes/no and *wh*-questions. They completed each task 6 times in total between the ages of 2;10 (years;months) and 3;6.

Results: The children's levels of correct use of 2 forms of BE (*is, are*) differed according to auxiliary form and sentence structure, and these relations changed over development. An analysis of the children's errors also revealed complex interactions between these factors.

Conclusion: These data are problematic for existing accounts of auxiliary acquisition and highlight the need for researchers working within both generativist and constructivist frameworks to develop more detailed theories of acquisition that directly predict the pattern of acquisition observed.

KEY WORDS: syntax, auxiliary acquisition, preschool children

The study of auxiliary acquisition is central to research on language development for two reasons. First, the complexity of the semantic and syntactic rules governing the presence and positioning of the auxiliary (Langacker, 1991) means that a deeper understanding of how children learn its properties should take us some way toward a better explanation of acquisition in general. Second, it is relatively easy to track auxiliary development and to identify patterns of correct use and errors because the category contains a small number of items that are easily identifiable, even when the auxiliary is omitted (e.g., "Where he going" has an omitted auxiliary *is*). We present two related studies. In the first study, reported here in Part 1, we examined children's acquisition of auxiliary BE in declaratives and positive yes/no and *wh*-questions. In the second study, reported in Part 2, we examined children's acquisition of DO and the modal auxiliaries CAN and WILL in declaratives and in positive and negative yes/no questions.¹

¹Throughout this article, uppercase letters are used to refer to auxiliary types; for example, BE and DO refer to all forms of BE or DO combined. Lowercase letters are used to refer to individual forms of that auxiliary (e.g., *is, are, do, does*).

The auxiliary verb system in English is not straightforward to learn. Children must learn to generalize across different auxiliary forms in declaratives where the auxiliary appears between the subject and verb (e.g., “He *can* swim,” “She *is* eating”), how to produce yes/no and *wh*-questions containing auxiliaries in which subject–auxiliary inversion occurs (e.g., “She *is* eating,” “*Is* she eating?”, “What *is* she eating?”), and how these constructions are linked. Although most auxiliary forms appear in both declaratives and questions, auxiliary DO tends to occur in its positive form only in questions, because its use in declaratives is associated with added emphasis (e.g., “She *likes* cake” vs. “She *does like* cake”). It does, however, appear in negative declaratives, often concatenated with the contracted negator *'nt* (e.g., “He *doesn't* like cheese”). An added complication concerns the placement of the negator in questions, because it is grammatical to either invert both the auxiliary form and a contracted negator (e.g., “*Can't* you reach it?”) or to leave negation within the verb phrase while inverting the auxiliary (e.g., “*Can* you *not* reach?”). However, it is ungrammatical to mark either the auxiliary or negation (except in rare pragmatic contexts) twice (e.g., “*Can* you *can't* reach?”, “*Can't* you *not* reach?”). To further complicate matters, there are some auxiliary-like forms that appear in declaratives but cannot be inverted in questions; neither can they combine with contracted negators or appear in tag questions (e.g., “You'd *better* go now,” “**Better* you'd go now?”, “*You'd *bettern't* go now,” “*You'd *better* go now, *better* you?”).² Finally, noninverted questions (e.g., “*He's* eating it?”, “He *is* doing what?”) are acceptable in some contexts as a request for clarification on a previous statement or an indication of surprise.

Although a considerable amount of work has investigated the acquisition of auxiliaries in English, there seem to be only two points of broad agreement in the literature: (a) that very early utterances with auxiliaries are unanalyzed forms (e.g., Bellugi, 1965; Pinker, 1984) and (b) that some learning is required for children to work out how auxiliaries behave in their language (e.g., Pinker, 1984; Stromswold, 1990). Far less agreement exists about what mechanisms underlie acquisition or even how to describe the developmental sequence. These disagreements in part reflect theoretical differences between researchers working within a generativist tradition and those working within a more constructivist framework, but they also reflect disagreements within a particular tradition as well as seemingly contradictory results produced from different studies.

Current generativist theories of auxiliary acquisition concur about the role for Universal Grammar (UG) in acquisition but differ in their explanations of how it

interacts with language-specific knowledge and, in particular, in what aspects of language-specific knowledge are thought to be problematic for the child. One point of agreement is that UG is thought to equip children with an understanding of abstract properties such as case, agreement (person and number), and tense, and abstract operations, such as MOVE, that determine how different grammatical constructions relate to each other (e.g., subject–auxiliary inversion from declaratives to questions). Another is that the problem in acquiring auxiliary syntax comes from the need to integrate language-specific properties, such as how grammatical features are realized in the target language, with the rules governing inversion specified in UG. However, exactly how this interaction might occur is viewed differently in different accounts, generating a range of predictions about the specific patterns of error expected in children's language (e.g., Pinker, 1984; Santelmann, Berk, Austin, Somashekar, & Lust, 2002; Stromswold, 1990; Valian & Casey, 2003; Wexler, 1998).

With respect to auxiliary BE, both Pinker (1984) and Stromswold (1990) have argued that although children have to work out separately for each auxiliary how that form should be used according to the various combinations of finiteness and sentence modality (e.g., inversion, negation), this knowledge should apply across different forms of an auxiliary reflecting an abstract knowledge of tense, number, and person. As a consequence, one might expect to see similar patterns of use of different forms of BE within a specific sentence modality, although there may be differences in levels of performance across sentence modalities. Santelmann et al. (2002), on the other hand, argued that, because the knowledge required to perform subject–auxiliary inversion is part of UG, all auxiliaries that straightforwardly follow the inversion rule should be produced error free relatively quickly in both declaratives and questions, with errors occurring only with those forms (copula BE and auxiliary DO) that exhibit peculiar English-specific idiosyncrasies. Thus, children should show similar levels of performance with auxiliary BE in questions and declaratives, irrespective of the specific form of BE. De Villiers (1991) suggested that the problem of integrating subject–auxiliary inversion with language-specific properties lies specifically with adjunct *wh*-words, with error rates higher on questions requiring the use of *why* and adjunct *how* (e.g., “Why are you going to the park?”). The prediction, therefore, is that children should make few errors in their production of argument *wh*-questions such as *what* questions, regardless of the auxiliary form required. On the other hand, Valian, Lasser, and Mandelbaum (1992) suggested that error rates might differ according to *wh*-word but posited that this is because children believe that inversion is optional in English *wh*-questions and have to learn, *wh*-word by *wh*-word, that inversion is obligatory.

²Asterisks indicate ungrammatical sentences.

According to this account, children may find questions associated with any individual *wh*-word difficult, but any such difficulty should be evidenced across a range of auxiliary forms, for example, across all forms of BE.

Current constructivist researchers concur in their opposition to the existence of innate constraints such as UG but differ as to the nature of the acquisition process. For example, Van Valin (2002), working within a Role and Reference Grammar framework, argued that illocutionary force (IF) determines whether children invert auxiliaries in questions and that IF is signaled by morphemes marking tense. IF is marked core internally in declaratives but core initially in questions through subject–auxiliary inversion. Van Valin predicted that auxiliary forms that are overtly marked for tense, such as BE, will be inverted correctly early in development, and there is no apparent motivation within his theory for supposing that different forms of BE (e.g., *is*, *are*) should behave any differently from one another.

However, constructivist researchers working within a usage-based framework take a rather different approach to auxiliary acquisition. They contend that, instead of learning a generative grammar, children are acquiring a set of constructions that are thought to form the basic units of adult language (e.g., Croft, 2001; Goldberg, 1995, 2006; Langacker, 1991). These constructions can be characterized as form–meaning pairings that express particular relations between semantic roles (e.g., the agent and patient in a transitive construction). Adults are thought to operate with constructions specified at different levels of abstraction, so that alongside highly abstract representations such as subject–verb–object, intermediate lexically based frames (e.g., “I want X,” where *X* represents a variety of different noun phrases [NPs]) and lexically specific, frequently used instantiations of the abstract constructions are also stored (e.g., “I need some coffee”).

The basis of children’s early linguistic productions within the usage-based approach is a learned knowledge of utterance–meaning pairings based on lexically specific constructions that are of high frequency in the input (e.g., Tomasello, 2000, 2003). Children begin with a store of separately acquired, lexically based constructions and only gradually over the course of development are they able to recognize the relations between similar lexically based constructions to derive the intermediate and more abstract constructions that underlie adult language use. The prediction following from this account is that high-frequency items or frames will be acquired earlier in development and will be produced correctly, whereas lower frequency items are likely to be acquired later and to be more error prone. For example, Rowland and Pine (2000) posited an item-based learning account of the pattern of correct use and uninversion error in one child’s *wh*-question data, arguing that the pattern of errors reflected differences in the use of lexical frames. Correct

questions, they argued, were based around high-frequency frames (e.g., “What do + X”), whereas errors occurred when such frames were absent from, or of low frequency in, the child’s input and thus unlearned (see also Rowland, 2007).

The constructivist approach predicts that once a sufficient store of lexically based constructions has been acquired, generalization across constructions based on the many commonalities between them (e.g., “He’s V-ing it,” “I’m V-ing it,” in which *V* represents a verb) will take place. This enables the child’s acquisition mechanism to link constructions together to build more abstract constructions (e.g., pronoun + auxiliary + V-ing + X) that themselves are linked to other constructions (e.g., NP + V + NP) until higher order constructions such as the transitive are acquired. These are then linked to other higher order constructions such as the intransitive construction by second-order *structure mapping* to create more abstract relations, such as subject–predicate (Tomasello, 2000, p. 242). The prediction that follows is that evidence of generalization across auxiliaries within a given construction should occur before evidence of generalization across constructions, because the latter requires higher order relations that emerge only when children have acquired a number of separate abstract constructions. Thus, one might expect to find that children’s use of different forms of BE may be more similar in some constructions than in others, depending on the extent to which the child is working with a more or less abstract representation of the syntactic construction in question.

Finally, the constructivist approach makes very specific predictions with regard to patterns of error. As explained earlier, high-frequency items are thought to be protected from error, whereas lower frequency items (or combinations) are predicted to be more error prone when acquired relatively early in development, before the child has developed the abstract constructions needed to support correct use. A further prediction, therefore, is that low-frequency items are likely to be replaced with higher frequency items because higher frequency items are better known and more readily available for retrieval. Indeed, there is evidence to support this claim. Research into the acquisition of verb argument structure and complex sentences suggests that children frequently substitute high-frequency lexical forms with which they are familiar for lower frequency forms in elicited production and imitation tasks (Akhtar, 1999; Kidd, Lieven, & Tomasello, 2006; Matthews, Lieven, Theakston, & Tomasello, 2005), and Theakston and Lieven (2005) reported that children frequently produced auxiliary *has* in place of *have* in yes/no questions and that some children substituted forms of BE in place of HAVE in yes/no questions, even when this resulted in ungrammatical sentences.

The fact that there are a large number of very different theories of auxiliary acquisition is due in part to

the fact that, although there is a substantial body of data on children's use and acquisition of auxiliaries, much of it is contradictory and/or piecemeal (investigating only one auxiliary type, one construction type, or one error type). With respect to auxiliary BE, for example, Stromswold (1990) provided a comprehensive description of children's auxiliary acquisition that seems to support her prediction that children can generalize very quickly across different forms of the same auxiliary (e.g., two forms of BE: *is* and *are*). Similarly, Santelmann et al. (2002) carried out an imitation task that showed that children exhibited equal performance in declaratives and questions with auxiliary BE, but differing levels of performance with DO, providing support for the claim that integrating language-specific knowledge with UG causes problems with idiosyncratic auxiliary forms.

However, earlier studies have reported that there is very little evidence that children who produced a given form of BE in declaratives (e.g., *is*) could also produce that same form in questions, perhaps suggesting that the rules governing the use of each auxiliary are learned piecemeal (e.g., Fletcher, 1985; Kuczaj & Maratsos, 1983; Labov & Labov, 1978; Richards, 1990). Although these early studies are compromised by the relative sparsity of the data, more recent studies, using larger naturalistic data sets, have reported similar results. In regard to declaratives, Theakston, Lieven, Pine, and Rowland (2005) and Wilson (2003) have both reported that rates of provision of auxiliary BE in obligatory contexts differ according to both the form required (provision with *is* is higher than with *are*) and the particular lexical subject (high-frequency subjects tend to occur with higher rates of auxiliary provision than do lower frequency subjects). Moreover, the order in which particular subject + BE combinations are acquired reflects their frequency in the input (Theakston et al., 2005), and whether auxiliary omission occurs depends in part on whether that same subject + BE combination (but not the same auxiliary form with a different subject) has recently been produced in discourse (Theakston & Lieven, 2008). In fact, much of this research shows that children's early auxiliary provision is very closely tied to the use of high-frequency pronoun + auxiliary combinations. In regard to questions, Rowland, Pine, Lieven, and Theakston (2005) reported that 2-year-olds produced significantly more correct *wh*-questions with auxiliary and copula *is* than with auxiliary and copula *are* based on analyses of naturalistic data samples. Experimental data provide further evidence to suggest a gradual, piecemeal pattern of acquisition of auxiliaries in questions. Three- and 4-year-olds produced different rates of uninversion errors in *wh*-questions according to the specific combination of the *wh*-word, auxiliary, and number (Ambridge, Rowland, Theakston, & Tomasello, 2006), and 3-year-olds produced different levels of correct use of different forms of BE and HAVE

in declaratives versus yes/no questions and different error patterns in the two constructions (Theakston & Lieven, 2005). More specifically, Theakston and Lieven (2005) found that omission errors were frequent in declaratives whereas agreement errors were more common in yes/no questions, but error rates varied according to auxiliary form.

Overall, then, studies that have investigated the acquisition of declaratives and yes/no and *wh*-questions across a wide range of auxiliaries suggest a complex pattern of acquisition: The pattern of acquisition of auxiliaries in declaratives and yes/no and *wh*-questions differs for different forms of the same auxiliary, and across different auxiliaries and constructions, and often patterns of acquisition can be related to the language children hear (Rowland, 2007). This pattern cannot be explained solely in terms of auxiliary identity (e.g., Santelmann et al., 2002; Van Valin, 2002), or *wh*-word (e.g., de Villiers, 1991; Valian et al., 1992) or with theories that credit children with an abstract knowledge of number marking (Santelmann et al., 2002; Stromswold, 1990). However, much of the data on which this conclusion is based have been collected from children in natural conversations with caregivers or from elicitation studies conducted cross-sectionally. It is difficult to establish conclusively from such data when children are able to generalize from one auxiliary to another, or from one construction to another, because the children may not produce enough examples of all the target utterances for robust analyses. In addition, all of the theoretical approaches outlined thus far predict that some lexical learning must take place in the acquisition of the auxiliary system in English because, even assuming knowledge of UG, there are a number of idiosyncrasies that must be integrated with the innate grammar. Any such learning must take place over a period of development, and therefore longitudinal data are required to establish more precisely the pattern of acquisition. Although a number of longitudinal studies of naturalistic data have been carried out (e.g., Fletcher, 1985; Richards, 1990; Stromswold, 1990; Theakston et al., 2005), these have often failed to capture many of the errors children produce due to sampling restrictions or limitations on the age range of the children studied, and in particular they have tended to miss errors with low-frequency items (Rowland & Fletcher, 2005; Tomasello & Stahl, 2004). This has led some researchers to claim that children's production of the auxiliary system is relatively error free (Radford, 1990). Moreover, studies that have examined error rates over long time periods tend to overlook relatively short time periods in which high levels of error occur, resulting in the reporting of low overall error rates (e.g., Stromswold, 1990). If children do in fact produce high error rates in subparts of the auxiliary system, or error patterns that persist over development, this could be potentially problematic for generativist

approaches because these kinds of error patterns would suggest that learning is more effortful than is normally assumed if the child is equipped with UG.

In this article we report a longitudinal elicitation study in which we examined 12 children's acquisition of the English auxiliary system between the ages of 2;10 (years; months) and 3;6. The children completed a series of three tasks designed to elicit auxiliary BE in declaratives and yes/no and *wh*-questions. Each task (with varied items) was administered six times over the course of the study at regular intervals to allow us to determine how auxiliary use changed over development. To our knowledge, this is the first time an elicitation methodology has been used longitudinally to examine the acquisition of auxiliary syntax, and it provides a unique insight into the process of acquisition. (Although Richards [1990] included a structured imitation task that was administered approximately 10 times per child over the course of his longitudinal study of auxiliary acquisition, the task was mainly based on the use of positive auxiliary forms in declaratives and included only a single imitation of each auxiliary form at each data point.)

The aim of the study was to address the question of the extent to which children generalize knowledge between forms of auxiliary BE in a given construction, and between constructions, and to examine the kinds of errors children make in the context of the theoretical accounts outlined earlier. Auxiliary BE was chosen to shed light on the controversies and contradictions in the literature concerning the acquisition of forms marked for tense, person, and number. We aimed to test the following three predictions.

Prediction 1. Children will show similar levels of correct use of different forms of BE within a specific construction (as predicted by Stromswold [1990] and Santelmann et al. [2002] for both declaratives and questions, and by de Villiers [1991]/Valian et al. [1992] with respect to *wh*-questions, and as implied in Van Valin's [2002] non-generativist Role and Reference Grammar approach, and predicted by usage-based approaches [e.g., Tomasello, 2000] for some constructions but not for others).

Prediction 2. Children will show similar levels of correct use of forms of BE across constructions (Santelmann et al., 2002; Stromswold 1990, based on her data). Usage-based approaches predict different levels of correct use of forms of BE across constructions.

Prediction 3. Children's performance will be influenced by the frequencies of the auxiliary forms concerned, both in isolation and in combination with high-frequency pronouns in the form of pronoun + auxiliary or auxiliary + pronoun chunks (usage-based approach); more specifically, high-frequency lexical items/combinations will be more likely to be produced correctly, whereas lower frequency items/combinations may be error prone, and

high-frequency forms are likely to be substituted for lower frequency forms.

Method

Participants

Twelve monolingual English-speaking children (7 girls and 5 boys) living in northwest England participated in this study. The children were recruited to take part in a longitudinal study of early language development by means of advertisements in local newspapers, university magazines, and other local publications. The children were approximately 2;10 (years;months) at the beginning of the study (range: 2;8.26–2;11.07), with mean lengths of utterance (MLUs) ranging between 2.59 and 3.79, and were approximately 3;6 at the end of the study (range: 3;4.03–3;7.04). with MLUs ranging from 2.94 to 4.40. Once parents had expressed an interest in the study they were asked to complete the MacArthur Communicative Development Inventory (Fenson et al., 1993). Children who scored above the 25th percentile on the vocabulary, grammar, and use measures were then visited at home, where an initial audio recording was made and the Clinical Evaluation of Language Fundamentals–Preschool UK Edition (CLEF; Wiig, Secord, & Semel, 2000) was administered. Children who scored within the normal range on the CLEF–Preschool UK Edition and who had MLUs of approximately 2.5 to 3.5 at the initial visit were asked to participate in the study. The study started when the children were approximately aged 2;10, although we started slightly earlier for children with higher MLUs in an attempt to match children on linguistic ability. It should be noted, however, that MLU is not a particularly good predictor of linguistic level beyond approximately MLU 2.5, and this can be seen by the fact that MLU fluctuated throughout the 8 months of the study for our children.

Procedure

The children took part in three different games designed to elicit auxiliary BE (*is* and *are*) in declaratives and yes/no and *wh*-questions. Each child completed each game once in every 6-week period throughout the study, resulting in six data points for each child for each form of BE in each construction examined. A child would typically complete two of the three games in one session and the third game a week later. There was then a 4-week break before the games were repeated. During this period, the games described in Part 2 of the study (Rowland & Theakston, this issue) were carried out (see Appendix A for an approximate timetable for the administration of the games across sessions). To minimize the possibility of carryover effects (either within a task or between

tasks), the order in which children completed the games was counterbalanced both across children and across test sessions, and the order in which the children completed the test items within each game was randomized and was different in each session (see Appendix B for a sample script showing the procedure for each of the tasks).

At each of the six test sessions, *is* and *are* were each elicited three times. In addition, children imitated six sentences: three containing *is* and three containing *are*. Imitations were included to ensure that the children understood the nature of the task and to provide a model of the target verb. However, imitations were not included in the analysis. To ensure that we had sufficient data to allow meaningful analysis, we combined data across each pair of test sessions, resulting in three data points for *is* and *are* in each construction. This meant that there were six opportunities for the children to produce *is* and *are* at each combined data point. On average, there were 6 weeks between each attempt at a given game and, once the data from sessions were combined, there were, on average, 12 weeks between the three data points for each game, corresponding to mean ages of 2;11, 3;2, and 3;5.

Across the three games, 18 transitive verbs were included, 6 per game, counterbalanced across children in each test session and across test sessions for each child. Three different sets of animals were used as sentence subjects, and each verb was paired with two different objects. We counterbalanced the pairing of animals with verbs across test sessions and across children to ensure that children did not learn to associate a given animal with a given action or with a given sentence type.

Declaratives. First, the children took part in a warm-up task. The experimenter enacted three intransitive actions using toy animals and produced a model sentence to describe the action, for example, "The lion is running." The child was encouraged to repeat the sentence. Two of the sentences modeled *are*, and one modeled *is*. After the warm-up, children were shown 12 transitive actions enacted using toy animals and assorted play pieces. Six of the actions were enacted with a single animal as sentence subject, thus requiring the third person singular form of BE (*is*; e.g., "The pig is holding the racquet"), and 6 actions were enacted with a plural sentence subject, thus requiring the third person plural form of BE (*are*; e.g., "The tigers are holding the pen"). For half of the actions, the experimenter provided a modeled description that the child was required to imitate (3 with *is*, 3 with *are*); for the other half, the experimenter simply enacted the action and asked the child to describe what had happened, using the prompt "Now what's happening?" (3 with *is*, 3 with *are*). Actions were paired together such that children imitated a sentence containing one form of BE and were then required to describe a second

action in which the sentence verb was the same as for the prior sentence but the sentence subject changed from singular to plural, or vice versa (using different animals), requiring a different form of BE. The ordering of actions requiring singular versus plural forms of BE was randomized across children and across test sessions for the same child. If the child failed to produce a declarative containing a sentence subject and a verb in his or her response, he or she was prompted to reply again. If the child still failed to provide a sentence subject and verb on the second attempt, the experimenter produced the sentence subject, allowing him or her to complete the auxiliary and verb form (e.g., "What's happening? The dog ...").

Yes/no questions. The procedure for these tasks was similar to that used to elicit declaratives. To increase the pragmatic validity of the task, the children's mothers took part. The mothers were given toy animals and instructions to enact a variety of actions behind a screen out of view of the child and the experimenter. The experimenter and the child took turns asking the mother questions about what the animals were doing. There was a warm-up task in which three intransitive actions were enacted using toy animals (two plural subjects, one singular subject). The experimenter questioned the mother about the actions, for example, "Are the dogs walking?" The child was then encouraged to repeat the question before the mother removed the screen to reveal the action. After the warm-up, as for declaratives, 12 transitive actions were enacted: 6 with singular subjects and 6 with plural subjects. Of these, 6 were imitated questions (3 with *is*, 3 with *are*), and 6 were questions elicited from the child with no accompanying model from the experimenter (3 with *is*, 3 with *are*). Each pair of actions required the same verb, but the sentence subject changed from singular to plural, or vice versa (using different animals). The first question in each pair was modeled by the experimenter, and the second was elicited from the child. This allowed the experimenter to model the target verb (the experimenter and the child could not see the action taking place, so the experimenter had to guess each time, and by doing so provided the child with a verb to use in the child's own subsequent question). The ordering of questions requiring each form of BE and the pairing of animals to actions was randomized across children and across test sessions for each child. Children were given three opportunities to respond for each test item. Appropriate responses were any that contained a subject, verb, and inverted auxiliary. If children produced declarative word order with or without rising intonation, they were encouraged to produce another response to ensure that they understood the need to ask rather than answer a question. However, if they subsequently failed to provide a more adult-like response, uninverted questions (declarative word order with rising intonation) were

included in the analyses because even with further prompting the child seemed unable to give a more adult-like response. However, no prompt was used by the experimenter if the child failed to respond because it is not possible to start a yes/no question without modeling the target auxiliary.

Wh-questions. We used a slightly different procedure to elicit *wh*-questions, to maintain the children's interest in the tasks. Two sets of pictures were created that depicted a series of actions. In the first set, each picture was complete. In the second set, the pictures depicted the same action but had something obscured, represented by a blank box. The mother was given the set of complete pictures, and the experimenter and the child had the set of incomplete pictures. The task was to ask the mother questions to find out what was missing from the pictures. As before, there was a warm-up task consisting of three pictures depicting intransitive actions. In each incomplete picture, only part of the sentence subject was visible; thus, the experimenter asked the mother subject *wh*-questions of the form "Who's V-ing?", for example, "Who's jumping?" The child was encouraged to repeat the question before the mother revealed her picture. After the warm-up, the child looked at 12 pictures depicting transitive actions in which the object of the action was obscured. Six actions contained singular subjects, and 6 contained plural subjects. As before, actions were paired, and the experimenter asked a question about the first picture modeling the appropriate form of BE. The child was encouraged to repeat this question before moving on to the next picture, which depicted a different animal(s) performing the same action with the object obscured. This time, the child was encouraged to ask his or her mother about the picture. In total, there were three imitated questions for each form of BE (*is* and *are*) and three elicited questions with no model for each form of BE (*is* and *are*). Children were given three attempts to provide a question. Appropriate responses contained a *wh*-word, sentence subject, and verb (with or without an auxiliary form). Children who failed to produce an appropriate response were prompted again. There were three different sets of pictures; thus, the order of presentation of auxiliary forms and the pairing of animals with actions were counterbalanced across children and across test sessions.

Coding

Each of the children's nonimitative responses was coded as a target or nontarget response; that is, the responses in which children were required to imitate the experimenter were excluded from the analysis. This was done because we had not designed the imitation sentences to be difficult for the children to remember, as is typically done in elicited-imitation studies designed to

tap into children's grammatical knowledge (see, e.g., Dąbrowska, Rowland, & Theakston, 2009). Thus, these imitative responses are unlikely to provide an accurate indication of the children's grammatical knowledge. Target responses were those that were clear attempts at the target, whereas nontarget utterances were responses that were not attempts at the target, for example, comments about the games, no response, answering rather than asking questions, asking a question rather than describing an activity, and so on. Target declarative and question responses were coded as correct or incorrect, and the nature of any errors was recorded (see Appendix C for the inclusion criteria and criteria for correct and error responses). Errors were further subdivided into *auxiliary omission errors*, *uninversion errors* (questions only), *double marking errors*, and *agreement errors*. Omission errors in declaratives were errors in which the children produced the target sentence but omitted the auxiliary. In yes/no questions, omission and uninversion errors were errors in which the children produced a sentence with declarative word order but question intonation (e.g., "The tiger eating carrots?" for omission errors, "The tiger is eating carrots?" for uninversion errors).³ In *wh*-questions, omission and uninversion errors were errors in which the children produced the *wh*-word but either omitted the auxiliary ("What the zebra eating?") or failed to invert the auxiliary ("What the zebra is eating?"). Agreement errors occurred when the children produced a nonagreeing verb form (e.g., "The tigers is hitting the ball"). Double marking errors were errors in which the child produced two auxiliary forms (e.g., "Are the zebras are eating carrots?"). On occasions when the experimenter was unclear whether the child's response was a target response or not and had therefore prompted the child to respond again, only the first response that met our criteria for inclusion was coded. Although in principle children could have made auxiliary substitution errors—for example, by producing auxiliary DO or HAVE or a modal in place of BE (e.g., "Can the dogs hold[ing] the racquet?")—we did not observe any errors of this kind in our data.

The target form of BE was determined by the presence of a singular or plural subject that was clearly visible to the child; because both animals in a plural subject engaged in the target action there was no ambiguity as to the singular or plural nature of the sentence subject. Thus, utterances such as "The dogs holding the racquet" were coded as omission errors if there was a plural subject *dogs* but as correct if the subject was singular:

³Although yes/no questions containing an auxiliary in declarative word order are grammatically correct in some contexts within the children's dialect (to request clarification or express surprise), they are not correct within the context of this game. Because there were only two of these errors across the entire data set, the decision to code these responses as errors does not affect the overall pattern of results.

The form *dog's* was assumed with contracted auxiliary *is*.

Reliabilities. The research assistants who collected the data transcribed the children's responses from the audio recordings. They then entered these responses into spreadsheets, and the authors coded them according to the coding scheme. At the transcription stage, for each child three complete tasks—one for each of the three games—was checked by one of the authors to ensure that the transcription was accurate. In cases where there was disagreement, a third person was asked to listen to the recording and indicate what was said, and the majority decision was accepted. At the coding stage, each of the authors was responsible for coding half of the data. The coding was then checked by the other author, and any disagreements were resolved through discussion.

Results

Number of Attempts at Target

The mean number (and standard deviations) of target responses produced by the children for *is* and *are* in each construction at each age is shown in Table 1. We conducted a 3 (construction: declarative, yes/no, *wh*-questions) \times 3 (age: 2;11, 3;2, and 3;5) analysis of variance (ANOVA) to compare the number of target responses produced, averaging across *is* and *are*. In this and all other analyses involving multiple levels of a within-subject variable, Mauchley's test for sphericity was applied, but it was not necessary to apply any corrections to the data. The data showed that children were more likely to produce a target response for the declaratives than for the yes/no questions ($p = .008$; maximum score = 6; M declaratives = 5.07, M yes/no questions = 3.72, M *wh*-questions = 4.63), $F(2, 22) = 6.38$,

Table 1. Mean number of target responses produced with *is* and *are* in declaratives and in yes/no and *wh*-questions at each age (out of a possible six responses).

Age (years; months)	Declaratives		Yes/no questions		Wh-questions	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
2;11						
<i>Is</i>	5.00	1.54	2.67	2.60	3.17	2.21
<i>Are</i>	4.25	1.66	3.50	1.88	3.83	2.21
3;2						
<i>Is</i>	4.92	1.00	3.92	1.98	5.08	0.79
<i>Are</i>	5.42	0.79	3.50	1.57	5.08	1.00
3;5						
<i>Is</i>	5.17	1.11	4.50	1.68	5.33	1.23
<i>Are</i>	5.67	0.89	4.25	1.96	5.25	0.97

$p = .0007$, $\eta^2 = .37$. This difference was particularly prominent at 2;11, when the children produced on average 4.63 target declaratives and only 3.08 target yes/no questions. At 3;2 and 3;5 the children were producing more target responses in yes/no questions (M s = 3.71 and 4.38, respectively) but were producing even more target declarative responses (M s = 5.17 and 5.42). There was also an effect of age: The children produced more target responses at 3;2 and 3;5 than they produced at 2;11 across constructions (M 2;11 = 3.74, M 3;2 = 4.65, M 3;5 = 5.03), $F(2, 22) = 15.44$, $p < .001$, $\eta^2 = .58$. To control for these effects, we conducted the analyses on the proportion of correct responses calculated for *is* and *are* in each construction as a function of the total number of target responses provided by the child for that form in that construction at each developmental point.

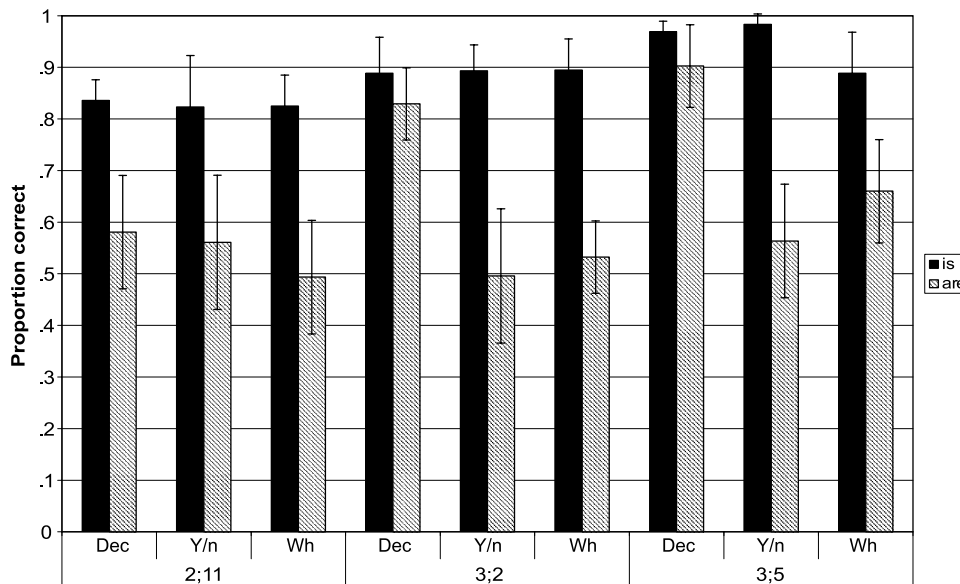
Proportion of Correct Responses

The children's performance with BE appears to show similarities across constructions at 2;11 but an advantage for declaratives over questions for *are* at later ages. The children's proportional correct use of auxiliary BE (*is* and *are*) in declaratives and yes/no and *wh*-questions at each data point are depicted in Figure 1. Because the data are in proportions, we applied arcsine transformations to them in the following analyses. Because we carried out a relatively large number of analyses, we adopted a p value of .02 to control for Type I errors for all ANOVAs. All post hoc tests have Bonferroni adjustments applied; thus, we adopted p values of .05 for these tests, as well as for nonparametric tests, which have less power.

Testing Predictions 1 and 2: Do Children Show Similar Use of *Is* and *Are* Within or Across Constructions?

To determine whether there were differences in the children's proportional correct use of *is* and *are* both within and across constructions, we conducted three separate 3 (construction: declaratives, yes/no questions, *wh*-questions) \times 2 (auxiliary: *is*, *are*) ANOVAs (at 2;11, 3;2, and 3;5). We conducted separate ANOVAs at each age rather than one ANOVA with age as an additional variable to allow the maximum number of children to contribute data at each data point. For some auxiliary forms, not all children produced attempts at the target at all three data points, resulting in only 7 children's data contributing in an overall ANOVA with age as a variable. Separate ANOVAs include data from 7, 12, and 11 children at 2;11, 3;2, and 3;5, respectively. At 2;11, the ANOVA showed a significant main effect of auxiliary, $F(1, 6) = 11.66$, $p = .01$, $\eta^2 = .66$; but no main effect of construction, $F(2, 12) = 0.25$, $p > .05$, $\eta^2 = .04$; and no interaction between auxiliary and construction, $F(2, 12) = 1.12$, $p > .05$,

Figure 1. Proportion correct responses for auxiliary BE in declaratives (Dec), yes/no (Y/n), and *wh*-questions (Wh) at each age (and standard errors).



$\eta^2 = .16$. This reflects the fact that the children produced more correct responses with *is* ($M = 82.8\%$) than with *are* ($M = 54.5\%$) across constructions. At 3;2, a slightly different pattern of responses was observed. There was a significant main effect of construction, $F(2, 22) = 5.94$, $p = .009$, $\eta^2 = .35$; and of auxiliary, $F(1, 11) = 9.94$, $p = .009$, $\eta^2 = .48$; and an interaction nearing significance between the variables, $F(2, 22) = 2.81$, $p = .08$, $\eta^2 = .20$. The apparent interaction between the variables was further explored. Post hoc comparisons revealed that there were no significant differences between constructions for *is* (M s for declaratives = 88.8%, yes/no questions = 89.3%, and *wh*-questions = 89.5%), whereas for *are* the children provided significantly more correct responses in declaratives ($M = 82.9\%$) than in either yes/no ($M = 49.6\%$, $p = .032$) or *wh*-questions ($M = 53.3\%$, $p = .011$). Further comparisons of the children's performance with *is* and *are* in each of the three constructions revealed that the children's performance with *is* and *are* was comparable in declaratives ($p > .05$), but in yes/no and *wh*-questions the children produced significantly more correct responses with *is* than with *are* (yes/no questions $p = .031$, *wh*-questions $p = .002$). The same pattern of results was observed at 3;5 as at 3;2. There was a significant main effect of construction, $F(2, 20) = 7.96$, $p = .003$, $\eta^2 = .44$; and of auxiliary, $F(1, 10) = 25.71$, $p < .001$, $\eta^2 = .72$; and a significant interaction between the variables, $F(2, 20) = 8.72$, $p = .002$, $\eta^2 = .47$. Post hoc comparisons revealed that, again, the children performed equally well across constructions with *is* (M s for declaratives = 96.9%, yes/no questions = 98.3%, and *wh*-questions = 88.8%) but

showed better performance in declaratives ($M = 90.3\%$) than in yes/no questions ($M = 56.4\%$, $p = .005$) and *wh*-questions ($M = 66.0\%$, $p = .002$) with *are*. Further comparisons of the children's performance with *is* and *are* in each construction again showed that their performance with the two forms in declaratives was comparable ($p > .05$), whereas in yes/no and *wh*-questions the children produced significantly more correct responses with *is* than with *are* (yes/no questions $p = .001$, *wh*-questions $p = .016$).

We then analyzed the data to determine whether performance improved with age for each auxiliary in each construction. We conducted separate 2 (auxiliary: *is*, *are*) \times 3 (age: 2;11, 3;2, 3;6) ANOVAs for each construction. The results showed that for declaratives there was a main effect of age, $F(2, 22) = 9.57$, $p = .001$, $\eta^2 = .47$; but no effect of auxiliary, $F(1, 11) = 2.44$, $p > .05$, $\eta^2 = .18$; and no interaction between the variables, $F(2, 22) = 0.88$, $p > .05$, $\eta^2 = .07$. The children's performance at 2;11 ($M = 70.9\%$) was significantly worse than their performance at 3;2 ($M = 85.9\%$, $p = .004$) and at 3;5 ($M = 93.6\%$, $p = .001$). In yes/no and *wh*-questions there was a main effect of auxiliary, yes/no questions: *is* = 89.0%, *are* = 54.0%, $F(1, 7) = 8.10$, $p = .025$, $\eta^2 = .54$; *wh*-questions: *is* = 86.9%, *are* = 56.2%, $F(1, 9) = 22.55$, $p = .001$, $\eta^2 = .72$, with the children performing better with *is* than with *are*, but no main effect of age: yes/no questions $F(2, 14) = 0.81$, $p > .05$, $\eta^2 = .10$; *wh*-questions $F(2, 18) = 1.38$, $p > .05$, $\eta^2 = .13$; and no interaction between the variables, yes/no questions $F(2, 14) = 1.61$, $p > .05$, $\eta^2 = .19$; *wh*-questions $F(2, 18) = 0.07$, $p > .05$, $\eta^2 = .008$. These analyses reveal that

Table 2. Input frequencies of *is* and *are* overall, in combination with *what*, and in yes/no questions.

<i>Is/are</i>	Full: Overall	Contracted: Overall	Total: Overall	<i>What</i> + full	<i>What</i> + contracted	<i>What</i> : Overall	Yes/no questions
<i>Is</i>							
Auxiliary	2,558	7,031	9,589	30	1,507	1,537	1,200
Copula	13,615	30,208	43,823	519	2,953	3,472	3,553
Total	16,173	37,239	53,412	549	4,460	5,009	4,753
<i>Are</i>							
Auxiliary	4,393	4,155	8,548	749	295	1,044	1,889
Copula	4,566	3,354	7,920	247	41	288	1,148
Total	8,959	7,509	16,468	996	336	1,332	3,037

although the children's performance in declaratives improved with age, their performance with questions did not show a comparable improvement.

These data suggest that the children's ability to produce two different forms of BE (*is* and *are*) in three different constructions (declaratives and yes/no and *wh*-questions) is developing differently. In declaratives, the children show comparable levels of performance with *is* and *are*, whereas in questions the children perform better with *is* than with *are*. *Is* is used correctly across constructions, whereas *are* shows better performance in declaratives than in both kinds of questions. Finally, declaratives show an improvement with age for both auxiliary forms, whereas yes/no and *wh*-questions do not.

Testing Prediction 3: Are High-Frequency Forms Less Error Prone Than Lower Frequency Forms, and Are High-Frequency Forms Used in Place of Lower Frequency Forms?

To test Prediction 3, it was first necessary to establish which of the two auxiliary forms elicited in this study is more frequent in the input to children. This is not a straightforward task, because auxiliary BE shares the same phonological form as copula BE, and both forms can be contracted onto the sentence subject (e.g., *He's*, *they're*, *the cat's*, *the men're*). If children begin by learning high-frequency subject + BE combinations, it is likely that overlap in the use of lexical subjects between auxiliary and copula contexts means that input of copula BE contributes to children's knowledge of auxiliary BE, and vice versa. We calculated the frequency of *is* and *are* in naturalistic data samples from the children's mothers recorded in their homes over the period from 2;10 to 3;6 (comprising approximately 28 hr of recordings per mother-child dyad). We used the Computerized Language Analysis (CLAN) programs (MacWhinney, 2000) to count the overall frequency of *is* and *are* as auxiliary verbs and as main verbs (i.e., copula BE). In addition, we calculated the

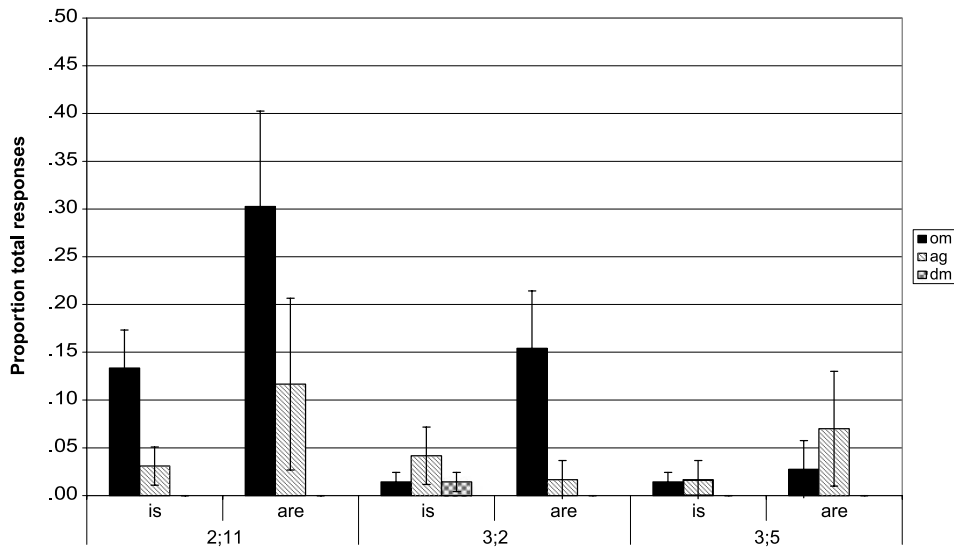
overall frequency of occurrence of full versus contracted forms of *is* and *are* and, more specifically, the frequency of use of these forms in combination with the target *wh*-word *what*. Finally, we calculated the frequency of occurrence of *is* and *are* in utterance-initial position, to give us a good estimation of the frequencies of these forms in yes/no questions. The frequency data are presented in Table 2.

It is apparent from the data in Table 2 that auxiliary *is* is slightly more frequent than auxiliary *are* overall, but once copula forms are included *is* is over three times more frequent than the form *are*; yes/no questions with auxiliary *are* are more frequent than those with auxiliary *is*, but this is reversed once copula questions are also included; and *what*-questions are more frequent with *is* than with *are* with both auxiliary and copula forms. On the basis of these data, a straightforward frequency account would predict that children should be more accurate in their production of *is* than *are*, although if one takes only forms of auxiliary BE into account the picture is less clear. On the basis of the overall auxiliary and copula data one might also expect to find that children replace the lower frequency form *are* with the higher frequency form *is*. To determine whether input frequencies might influence the apparent differences between forms of BE and between constructions, we analyzed the kinds of errors the children produced.

Errors. Errors were categorized as errors of omission, agreement, double marking, or uninversion. The children's errors as a proportion of their total responses for declaratives and yes/no- and *wh*-questions, respectively (uninversion errors were possible only in questions), are depicted in Figures 2 through 4, and the mean number of each error type produced by the children is shown in Table 3. Because only the first two categories of error applied to declaratives,⁴ we compared the relative occurrence of errors of omission and agreement across forms of BE in each construction at each age. The data

⁴Although double marking errors are possible in declaratives by the use of both a contracted and full auxiliary form, in fact we observed only one such error ("Cow's is holding the racquet"), and therefore we did not analyze double marking errors across all constructions.

Figure 2. Proportion of auxiliary omission, agreement, and double marking errors in declaratives with auxiliary BE (and standard errors).



violated the assumptions of parametric tests (there was no variance in some categories because at later ages children produced no errors of omission in yes/no questions); therefore, we carried out nonparametric tests on the data to compare whether errors of omission differed according to the form of BE in each construction, the construction for each form of BE, and age for a given form of BE in a given construction. We conducted similar tests to investigate the pattern of agreement errors.

Errors of omission. First we investigated whether *is* and *are* showed similar levels of omission errors in each construction at each age. Wilcoxon rank sum tests revealed that, in declaratives, the children produced a higher proportion of omission errors with *are* ($M = 15.4\%$) than with *is* ($M = 1.4\%$) at 3;2, $z(12) = 1.99, p = .046$, but there were no significant differences at 2;11 ($M is = 13.3\%$, $M are = 30.3\%$) or 3;5 ($M is = 1.4\%$, $M are = 2.8\%$). In yes/no questions there were no significant differences in

Figure 3. Proportion of auxiliary omission (om), agreement (ag), double marking (dm), and uninversion (un) errors in yes/no questions with auxiliary BE (and standard errors).

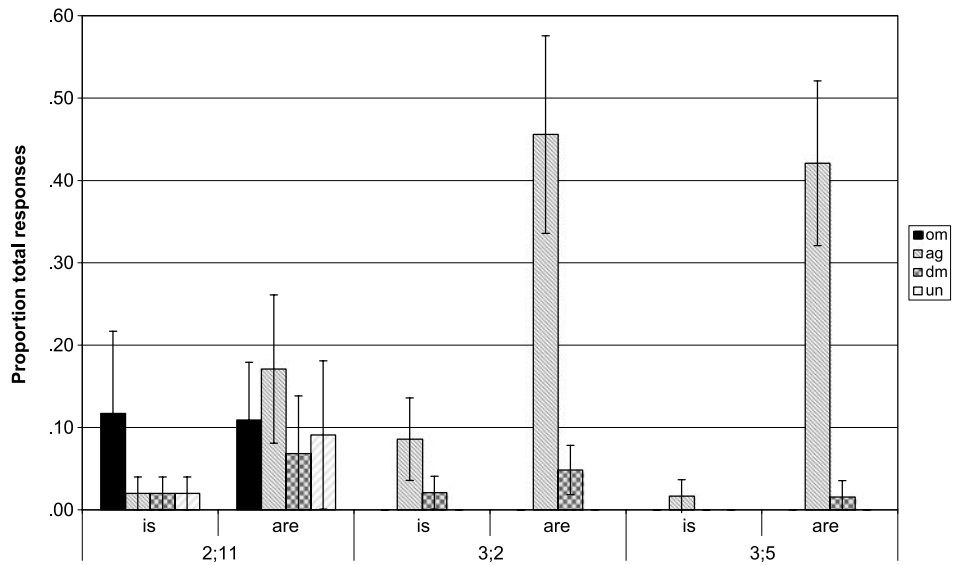
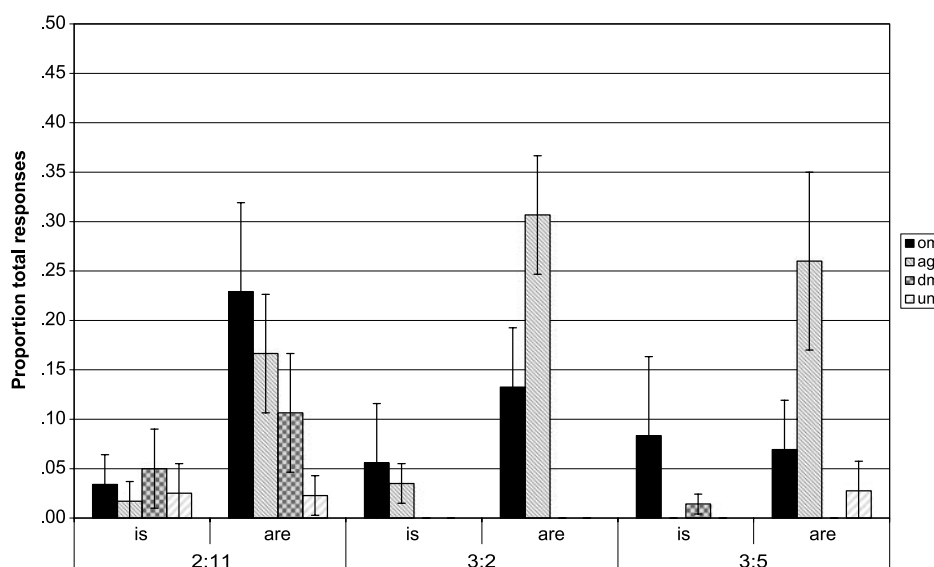


Figure 4. Proportion of auxiliary omission (om), agreement (ag), double marking (dm), and uninversion (un) errors in *wh*-questions with auxiliary BE (and standard errors).



levels of omission errors between *is* and *are* at any age (M across ages for *is* = 3.9%, M across ages for *are* = 3.6%), whereas in *wh*-questions the children produced a higher proportion of omission errors with *are* than with *is* at 2;11 (*is* = 3.4%, *are* = 22.9%, $z(11) = 1.99$, $p = .046$, but there were no significant differences at 3;2 (*is* = 5.6%, *are* = 13.3%) or 3;5 (*is* = 8.3%, *are* = 6.9%). Second, we investigated whether errors of omission were equally common across constructions for a given form of BE. Friedman's tests revealed that there were no significant differences between constructions in the proportion of omission errors at any age for *is*, or at 2;11 or 3;5 for *are*; however, at 3;2 there was a significant difference between constructions for *are*, $\chi^2(2, N = 12) = 6.33$, $p = .042$. Wilcoxon rank sum tests revealed that the children produced significantly fewer omission errors in yes/no questions ($M = 0\%$) than in either declaratives ($M = 15.4\%$), $z(12) = 2.03$, $p = .042$, or *wh*-questions ($M = 13.3\%$), $z(12) = 2.02$, $p = .043$. Third, we investigated whether there was a decline in errors of omission for each form in each construction with age. For *is*, Friedman's and Wilcoxon's tests revealed that in declaratives the children produced significantly more omission errors at 2;11 ($M = 13.3\%$) than at either 3;2 ($M = 1.4\%$) or 3;5 ($M = 1.4\%$), $\chi^2(2, N = 12) = 8.27$, $p = .016$; at 2;11 versus 3;2, $z(12) = 2.20$, $p = .027$; or at 2;11 versus 3;5, $z(12) = 2.05$, $p = .041$. However, there were no differences in levels of omission errors at different ages for yes/no or *wh*-questions: yes/no questions $\chi^2(2, N = 10) = 4.00$, $p > .05$, *wh*-questions $\chi^2(2, N = 10) = 0.80$, $p > .05$. For *are*, Friedman's and Wilcoxon's tests revealed that in declaratives the children produced significantly more

omission errors at 2;11 ($M = 30.3\%$) than at 3;5 ($M = 2.8\%$), $\chi^2(2, N = 12) = 6.90$, $p = .032$; 2;11 versus 3;5, $z(12) = 2.04$, $p = .042$. In yes/no questions there is a significant difference overall between ages in the proportion of omission errors, *are* $\chi^2(2, N = 10) = 6.00$, $p = .05$, but pairwise comparisons revealed no significant differences between ages (M s at 2;11 = 10.9%, 3;2 = 0%, and 3;5 = 0%, $p > .1$). The data suggest a trend toward a higher level of omission errors at 2;11 than at later ages. In *wh*-questions there were no significant differences in levels of omission errors with *are* across ages, $\chi^2(2, N = 11) = 2.96$, $p > .05$.

These data reveal that children are more likely to produce errors of omission with *are* than with *is* in *wh*-questions at 2;11 and in declaratives at 3;2; the children's levels of omission errors in yes/no questions are very low with both auxiliary forms at all ages. With *is*, the children make similar levels of omission error across constructions, whereas with *are* at 3;2 children make more omission errors in declaratives and *wh*-questions than in yes/no questions. Finally, errors of omission for *is* in declaratives showed a significant decline between 2;11 and 3;2, whereas a similar decline for *are* was observed only between 2;11 and 3;5, implying a much slower rate of decline.

Agreement errors. First we investigated whether *is* and *are* showed similar levels of agreement errors in each construction at each age. Wilcoxon rank sum tests revealed that in declaratives there were no differences at any age in the proportion of agreement errors produced by the children with *is* and *are* ($p > .5$). In yes/no questions there were no significant differences in levels of

Table 3. Mean number of errors of omission, agreement, double marking, and uninversion produced with *is* and *are* in declaratives and *yes/no* and *wh*-questions at each age (out of a possible six responses).

Age (years; months)	Declaratives		Yes/no questions		Wh-questions	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
2;11						
<i>Is</i>						
Omission	0.75	0.87	0.25	0.62	0.17	0.39
Agreement	0.17	0.39	0.08	0.29	0.08	0.29
Double Marking	0.00	0.00	0.08	0.29	0.17	0.39
Uninversion	N/A		0.08	0.29	0.08	0.29
<i>Are</i>						
Omission	1.42	1.73	0.33	0.65	1.08	1.51
Agreement	0.25	0.62	0.83	1.59	0.83	1.11
Double marking	0.00	0.00	0.25	0.87	0.33	0.65
Uninversion	N/A		0.08	0.29	0.08	0.29
3;2						
<i>Is</i>						
Omission	0.08	0.29	0.00	0.00	0.33	1.15
Agreement	0.25	0.62	0.33	0.65	0.17	0.39
Double marking	0.08	0.29	0.08	0.29	0.00	0.00
Uninversion			0.00	0.00	0.00	0.00
<i>Are</i>						
Omission	0.83	1.27	0.00	0.00	0.67	0.98
Agreement	0.08	0.29	1.42	1.44	1.50	1.00
Double marking	0.00	0.00	0.25	0.62	0.00	0.00
Uninversion	N/A		0.00	0.00	0.00	0.00
3;5						
<i>Is</i>						
Omission	0.08	0.29	0.00	0.00	0.50	1.73
Agreement	0.08	0.29	0.08	0.29	0.00	0.00
Double marking	0.00	0.00	0.00	0.00	0.08	0.29
Uninversion			0.00	0.00	0.00	0.00
<i>Are</i>						
Omission	0.08	0.29	0.00	0.00	0.42	1.00
Agreement	0.25	0.62	1.92	1.78	1.42	1.73
Double marking	0.00	0.00	0.08	0.29	0.00	0.00
Uninversion			0.00	0.00	0.17	0.58

agreement errors between *is* and *are* at 2;11 ($M_{is} = 2.0\%$, $M_{are} = 17.1\%$), but the children produced significantly more agreement errors where *are* was required than where *is* was required at 3;2 ($M_{is} = 8.6\%$, $M_{are} = 45.6\%$), $z(12) = 2.11$, $p = .035$, and at 3;5 ($M_{is} = 1.7\%$, $M_{are} = 42.1\%$), $z(11) = 2.53$, $p = .012$. A similar pattern was observed in *wh*-questions, where the children produced a higher proportion of agreement errors with *are* than with *is* at 2;11 ($M_{is} = 1.7$, $M_{are} = 16.6\%$), $z(10) = 2.02$, $p = .043$; 3;2 ($M_{is} = 3.5\%$, $M_{are} = 30.7\%$), $z(12) = 2.46$, $p = .014$; and 3;5 ($M_{is} = 0\%$, $M_{are} = 26.0\%$), $z(12) = 2.52$, $p = .012$. Second, we investigated whether agreement errors were equally common across constructions for a given form of BE at each age. Friedman's tests revealed that for *is*, there were no significant differences between constructions in the proportion of agreement errors at any age; this was also true for *are* at 2;11, $\chi^2(2, N = 10) = 1.14$,

$p > .05$. However, at 3;2 and 3;5 there was a significant difference between constructions in the proportion of agreement errors produced where *are* was required: 3;2 $\chi^2(2, N = 12) = 11.73$, $p = .003$, 3;5 $\chi^2(2, N = 11) = 11.56$, $p = .003$. Wilcoxon rank sum tests revealed that at 3;2 the children produced significantly fewer agreement errors in declaratives ($M = 1.7\%$) than in either *yes/no* questions ($M = 45.6\%$), $z(12) = 2.53$, $p = .011$, or *wh*-questions ($M = 30.7\%$), $z(12) = 2.68$, $p = .007$; and at 3;5 they produced significantly fewer agreement errors in declaratives ($M = 7.0\%$) than in *yes/no* questions ($M = 42.1\%$), $z(11) = 2.52$, $p = .012$. Third, we investigated whether there was a decline in agreement errors for each form in each construction with age. For both *is* and *are*, Friedman's tests revealed that there were no differences in the levels of agreement errors produced at each age in declaratives, *is* $\chi^2(2, N = 12) = 1.08$, $p > .05$,

are $\chi^2(2, N = 12) = 1.28, p > .05$; or yes/no questions, *is* $\chi^2(2, N = 10) = 4.67, p > .05$, *are* $\chi^2(2, N = 10) = 2.72, p > .05$; or *wh*-questions, *is* $\chi^2(2, N = 10) = 1.00, p > .05$, *are* $\chi^2(2, N = 11) = 3.53, p > .05$.

These data show that in questions (both yes/no and *wh*-questions), the children were much more likely to produce agreement errors when *are* was required than when *is* was required, even at 3;5. In contrast, there was no difference between *is* and *are* in the proportion of agreement errors produced in declaratives. Although the high level of agreement errors in *wh*-questions could reflect the use of the unanalyzed form *What's*, this cannot be the case in yes/no questions where the auxiliary cannot be contracted. Instead, children are using uncontracted *is* where *are* is required, but they do so only in questions. This finding is further supported by the fact that the children produce more agreement errors where *are* is required in questions than in declaratives. In these data, levels of agreement error do not decline with age.

Double marking and uninversion errors in questions.

The overall number of double marking and uninversion errors observed in the data was low (see Table 3). To determine whether error rates differed across forms of BE, and between question types, we carried out Wilcoxon rank sum tests that compared rates of double marking and uninversion errors with *is* and *are* at each age and rates between yes/no and *wh*-questions at each age for *is* and *are* separately. No significant differences were observed between *is* and *are*, or between yes/no and *wh*-questions, at any age.

Summary. We aimed to test a frequency-based account of acquisition by examining whether children made fewer errors with high-frequency *is* than with lower frequency *are* and by investigating whether children showed a tendency to replace *are* with *is*. These findings show that, on the whole, the children made similar levels of omission errors with *is* and *are*; however, they produced agreement errors in questions with *are* much more than they did with *is*, even at 3;5. This demonstrates that the children were not merely omitting *are* from their questions but were using the higher frequency singular form *is* where the plural form *are* is required. This contrasts with the pattern of use observed for declaratives, in which the children made very few agreement errors at 3;2 and 3;5. In these data, rates of double marking and uninversion errors in questions were low and did not differ between *is* and *are*; neither was there a developmental change in their occurrence.

Testing Prediction 3: Do Children Rely on High-Frequency Combinations to Support Auxiliary Provision?

The three games designed to elicit children's use of *is* and *are* in declaratives and yes/no and *wh*-questions

all relied on constantly changing the participants involved in the various actions. The experimenter always modeled full noun phrase (NP) subjects in each game, and in this sense, the children were encouraged to produce full NP subjects in their responses. Previous studies have indicated that high-frequency chunks tend to revolve around pronominal subjects in declaratives (Theakston et al., 2005; Wilson, 2003) and yes/no questions (Cameron-Faulkner, Lieven, & Tomasello, 2003), although *wh* + auxiliary chunks appear central in the production of *wh*-questions (Rowland, 2007). Moreover, in declaratives, contracted auxiliary forms are associated with high-frequency chunks; thus, one might expect to find that children rely on the use of contracted auxiliaries, in particular with *is*, because the data in Table 2 indicate that contracted forms of *is* are especially frequent in the input (overall proportion contracted form *is* = 70%, *are* = 46%; proportion contracted *what's* = 89%, *what're* = 25%).

To investigate the children's response patterns in more detail, we calculated the percentage of sentence subjects that were realized as pronouns in each sentence structure at each age (see Table 4) and the percentage use of contracted auxiliary forms in declaratives and *wh*-questions (only full forms can be used in yes/no questions because the auxiliary is in utterance-initial position).

The data show that although there is considerable variation between the children, they produced, on average, somewhere between 11% and 47% pronominal subjects in declaratives and yes/no questions at all ages, whereas there was a marked lack of pronominal subjects in *wh*-questions (with means ranging from 0% to 14%). Thus, although there is some evidence that children might be using subject and auxiliary combinations based on pronouns, this is clearly not sufficient to explain the children's performance. With respect to the use of full versus contracted auxiliary forms, the data show that, with the exception of *is* at 2;11, the children produced on average at least 67% full auxiliary forms, although there was again large variation between the children (at 2;11, *is* declaratives = 58%, *wh*-questions = 50%). Combining data across ages, the children showed a tendency to produce fewer full forms with *is* (declaratives = 67%, *wh*-questions = 62%) than with *are* (declaratives = 76%, *wh*-questions = 77%), following the greater tendency in the input for forms of *is* to be produced in contracted form.

Taken together, these results illustrate that although there is marked variation among the children, overall they were not relying exclusively on either the use of high-frequency pronominal subjects or contracted auxiliary forms; however, neither is their performance at ceiling on any of the tasks. It therefore appears that the children were beginning to build up a knowledge of the syntax of declaratives and yes/no and *wh*-questions that goes

Table 4. Percentage use of pronominal subjects and full auxiliary forms in the children's responses at each age.

Form	% Pronoun subjects					
	2;11		3;2		3;5	
	<i>Is</i>	<i>Are</i>	<i>Is</i>	<i>Are</i>	<i>Is</i>	<i>Are</i>
Declaratives	19.4 (22.7)	26.1 (34.8)	14.3 (18.7)	29.2 (22.7)	22.2 (31.2)	18.8 (31.0)
Yes/no questions	27.8 (40.0)	47.4 (44.8)	30.0 (45.5)	11.1 (20.5)	18.1 (30.5)	17.4 (21.7)
<i>Wh</i> -questions	2.5 (7.9)	13.7 (31.3)	0.0 (0)	5.6 (10.3)	0.0 (0)	0.0 (0)
	% Full (i.e., not contracted) auxiliary forms					
	2;11		3;2		3;5	
	<i>Is</i>	<i>Are</i>	<i>Is</i>	<i>Are</i>	<i>Is</i>	<i>Are</i>
Declaratives	57.8 (32.2)	73.5 (35.1)	77.9 (19.3)	73.0 (23.0)	67.5 (33.0)	81.2 (31.0)
<i>Wh</i> -questions	49.5 (34.7)	86.7 (21.9)	68.9 (27.1)	71.5 (29.7)	66.7 (41.7)	71.7 (39.8)

Note. Ages are presented in years;months. Numbers in parentheses are standard deviations.

beyond tightly defined lexically based formulae, yet their knowledge is still only partial and subject to error.

Discussion

The aim of the research reported in this article was to determine the pattern of auxiliary acquisition between 2;10 and 3;6 by testing 12 children in an elicitation paradigm at six time points over the course of development. We elicited two positive forms of auxiliary BE—*is* and *are*—in declaratives and in yes/no and *wh*-questions.

More specifically, we wanted to establish first whether children show an understanding of the relation between different forms of BE, as evidenced by similar patterns of use of *is* and *are* in and between constructions (Predictions 1 and 2). The data suggest a complex pattern of acquisition. For *is*, children showed similar levels of correct use in declaratives and yes/no and *wh*-questions, perhaps suggesting a knowledge of the relation between them. However, there were marked differences between constructions for *are*, suggesting that the children did not recognize the relation between them. In declaratives, the children's level of performance with *is* and *are* was similar, perhaps suggesting that they were aware of the person and number relation between the forms. However, the same pattern was not observed in questions for which the children performed better with *is* than with *are*; moreover, the types of errors produced differed between constructions such that children were more likely to make errors of omission in declaratives, whereas agreement errors were more common in questions. Although one could argue that the use of *is* in place of *are* shows some awareness of the relation between the two forms (in principle, *are* could be replaced by any other auxiliary form,

and yet substitution errors are restricted to the form *is*), it is not clear that this reflects anything more than a sensitivity to the co-occurrences of the specific lexical item *is* and the progressive verb inflection *-ing*—indeed, there is evidence that even very young infants show sensitivity to this relation (Santelmann & Juszyck, 1998), thus making *is* a potential candidate for substitution. Taken together, these data suggest that, to the extent that the children recognized the relation between *is* and *are*, and between declarative and question constructions at all, this appears to be based on relatively low-scope learning. If children recognized the relation between constructions, this seems to be restricted to the form *is*, whereas if children recognized a relation between *is* and *are*, this seems to be restricted to the declarative construction. Thus, the data fail to provide support for Stromswold's (1990) claim that children recognize the abstract relation between forms of BE or between declarative and question constructions, instead adding to previous work suggesting that different forms of BE are acquired separately and the relation between constructions develops gradually (Rowland et al., 2005; Theakston & Lieven, 2008; Theakston et al., 2005). We cannot tell whether the children actually related the use of *is* in the different constructions or whether they had learned each construction in isolation from the others and it is coincidental that levels of performance were similar. However, even if we give children credit for more abstract knowledge of the relation between constructions, it seems that such knowledge is restricted to the form *is* in these constructions and, as such, is at an intermediate level of abstraction rather than at the fully abstract level seen in adult language.

Second, we set out to investigate whether some of the core factors underlying constructivist approaches to

language acquisition might throw some light on our data (Prediction 3). A number of previous studies have highlighted a role for lexically based frames organized around specific *wh*-words, auxiliaries, and subjects (usually pronominal forms) in predicting children's use of correct questions (Dąbrowska, 2000; Dąbrowska & Lieven, 2005; Rowland, 2007; Rowland & Pine, 2000), a close relation between the frames children learn early in acquisition and the frequency of these combinations in the input (e.g., Rowland & Pine, 2000; Rowland et al., 2005; Theakston et al., 2005; Theakston, Lieven, Pine, & Rowland, 2001, 2002, 2004), and a tendency for children to substitute lower frequency forms with higher frequency forms (Akhtar, 1999; Kidd et al., 2006; Matthews et al., 2005). A detailed analysis of the children's responses revealed that children tended to produce more correct responses, particularly in yes/no and *wh*-questions, with the higher frequency form *is* and that they substituted the higher frequency form *is* for the lower frequency form *are*. They also tended to use more contracted forms of *is*, mirroring the relative use of full versus contracted forms in the input. However, the children used relatively few pronouns (pN) in their responses, suggesting that they were not relying exclusively on high frequency auxiliary + pN or *wh*- + auxiliary + pN frames. Thus, we have to assume that the children's knowledge extends beyond specific (*wh*) + auxiliary + subject combinations to include at least a variable subject (although this observation does not preclude the possibility that children's performance may be higher with specific high-frequency auxiliary + subject combinations than with combinations involving lower frequency NPs, because the former are likely to be more entrenched than the more abstract aux + NP construction). Future studies could examine this possibility in more detail by eliciting both auxiliary + pN and auxiliary + NP combinations.

Thus, the data fail to provide support for the claim that children understand the relation between different forms marked for tense, number, and person, even at age 3;5. On the other hand, although constructivist theories are perhaps better placed to explain the observed differences in use between auxiliaries by appealing to lexically based learning, they struggle to fully account for observed similarities in patterns of use that suggest some degree of abstraction or generalization across auxiliaries. Although constructivist approaches of course assume that children develop more abstract representations over development, the exact pattern of development predicted is somewhat underspecified. It is also difficult to differentiate between auxiliaries that show similar patterns of use but yet have been acquired separately and those for which similar patterns of use reflect an underlying abstraction. This leaves us with the potential problem that almost any pattern of acquisition can be accounted for, simply by claiming that children have reached some

intermediate stage in development where some linguistic representations are more abstract and others are still heavily lexically based. Although this is our theoretically preferred interpretation of the current data, it is clear that a lot more work is needed to pin down when and why some constructions become more abstract, allowing children to generalize between auxiliaries, and why some constructions resist abstraction and remain lexically based until much later in development. Although the development of abstraction is thought to depend on complex distributional patterns in the input, we currently know very little about exactly how such factors determine development. A detailed corpus-based analysis is needed to investigate the relation between the distributional nature of the input children receive and the pattern of acquisition observed, in particular for complex linguistic items such as auxiliaries.

In this study there was an obvious but necessary trade-off between sample size (12 children) and the benefit of having longitudinal data with which to track development. In addition, it is clear that the children found the yes/no questions task particularly difficult at the early data points (as measured by the mean number of codable responses produced), and this may be due in part to confusion arising from switching between tasks (although the order of presentation of tasks was counter-balanced both between and across children). Such confusion is likely to have led to some degree of noise in our data. It is important to note, therefore, that the results we report in this article would probably be stronger if more children were tested, and if children were tested on individual tasks, but future research is needed to confirm this.

In this study we investigated children's acquisition of *is* and *are*, forms of auxiliary BE, in declaratives and yes/no and *wh*-questions in a longitudinal elicitation study. The data suggest that, at least to some extent, the different forms of BE are acquired separately and follow different paths of development, but the data do not provide clear support for any current theory of acquisition. Our investigation of auxiliary BE casts light on how children learn the auxiliary system in English, but there are obvious questions that remain concerning whether these findings apply to the auxiliary system as a whole. There is a need to ask the same questions of data from a wider range of auxiliaries, in particular the modals and auxiliary DO. These auxiliaries have been reported in the literature to attract high rates of error, and they are at the center of a theoretical controversy over the processes involved in auxiliary acquisition. Unlike auxiliary BE, the modals do not inflect for tense or agreement, but their semantics are perhaps more complex than those of auxiliary BE, and the relation between positive and negative forms is not always straightforward. DO, like BE, inflects for tense and agreement but, unlike BE, forms

of DO are used only in declarative contexts for emphasis or to carry negation. Such data, when taken alongside those from auxiliary BE, would allow a more comprehensive picture of auxiliary acquisition and offer us a more integrated view of the factors that influence auxiliary acquisition. This is what we aimed to achieve in Part 2 of this research (Rowland & Theakston, this issue): the modals and auxiliary DO.

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Appendix A. Approximate timetable of task administration.

Children	Week																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 & 7	DY	W		Q	N		WD	Y		N	Q		YW	D		Q	N
2 & 8	YW	D		N	Q		DY	W		Q	N		WD	Y		N	Q
3 & 9	WD	Y		Q	N		YW	D		N	Q		DY	W		Q	N
4 & 10	DY	W		N	Q		WD	Y		Q	N		YW	D		N	Q
5 & 11	YW	D		Q	N		DY	W		N	Q		WD	Y		Q	N
6 & 12	WD	Y		N	Q		YW	D		Q	N		DY	W		N	Q
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1 & 7		DY	W		N	Q		WD	Y		Q	N		YW	D	N	Q
2 & 8		YW	D		Q	N		DY	W		N	Q		WD	Y	Q	N
3 & 9		WD	Y		N	Q		YW	D		Q	N		DY	W	N	Q
4 & 10		DY	W		Q	N		WD	Y		N	Q		YW	D	Q	N
5 & 11		YW	D		N	Q		DY	W		Q	N		WD	Y	N	Q
6 & 12		WD	Y		Q	N		YW	D		N	Q		DY	W	Q	N

Note. Auxiliary BE (Part 1) tasks were grouped such that two of the three tasks were carried out on one day, and the remaining task was completed on a second day. However, we retained flexibility such that if the child was tired, only a single task was carried out on the first of the two visits, with the remaining two tasks taking place on the second visit. DOES, CAN, and WILL (Part 2; see Rowland & Theakston, this issue) tasks were usually carried out on separate days. For both sets of tasks the experimenter sometimes carried out all associated tasks in a single visit, usually separated by a period of naturalistic play, if the child was eager to participate in more games. Twenty-nine percent of the tasks described in this article, and 21% of the tasks described in Part 2 were completed on the same day (the order of presentation was always counterbalanced as shown in the table). D = declaratives task auxiliary BE; Y = yes/no questions task auxiliary BE; W = wh-questions task auxiliary BE as described in this article; Q = questions task DOES, CAN, WILL; N = declaratives task DOES, CAN, WILL as described in Part 2.

Appendix B (p. 1 of 2). Sample script for each elicitation task.

1. Auxiliary BE: Declaratives

Experimenter (E): We're going to watch some animals, doing different things. Sometimes I'll tell you what's happening and sometimes I'll ask you to tell me.

Training Phase

Ask child (C) to name animal.

E: Look, the X is laughing, the X is laughing; can you say that?

C: Response (Target: "The X is laughing")

Change toys and model with plural subject.

E: What's happening here ?

C: Response (Target: "The Xs are laughing")

Repeat with Training Verbs 2 and 3.

Test Phase

Imitation (zebra × 2, carrots, eating)

Ask child to name animal.

E: Look, the zebras are eating the carrots, the zebras are eating the carrots; can you say that?

C: Response (Target: "The zebras are eating the carrots")

If correct: **E:** That's right, the zebras are eating the carrots.

If incorrect: **E:** Listen very carefully; the zebras are eating the carrots; can you say that?

Elicitation (Tiger, carrots, eating)

Ask child to name animal, model eating, with tiger singular.

E: Now what's happening?

C: Response (Target: "The tiger is eating the carrots")

If inappropriate/no response: **E:** What's happening? (action)

C: Response

If still no appropriate response: **E:** What's happening? The X...

C: Response (Target: "The tiger is eating the carrots / ... is eating the carrots")

Repeat for Test Verbs 2 through 6.

2. Auxiliary BE: Yes/No Questions

E: We're going to give some animals to your Mummy (M) and she's going to make them do different things. But we won't be able to see what's happening so we'll have to guess and your Mummy will tell us whether we're right or not.

Training Phase

M given animal in view of child, child asked to name animal.

E: I wonder what's happening? Let's ask Mummy. Is the X crying, is the X crying; can you say that? (Target: "Is the X crying?")

Toys changed and action enacted with plural subject. Ask child to name animal.

E: I wonder what's happening now. Can you ask Mummy?

C: Response (Target: "Are the Xs crying?")

Repeat for second and third training verbs.

Test Phase

Imitation (tiger, carrots, eating)

Name new animals and objects with the child.

E: Mummy's going to make the tiger do something, and we have to guess what it's doing.

Give tiger to M to enact eating carrots.

E: I'll guess first. Is the tiger eating the carrots? Is the tiger eating the carrots? Can you ask Mummy too?

C: Response (Target: "Is the tiger eating the carrots?")

If correct: **E:** Yes, is the tiger eating the carrots?

If incorrect: **E:** Listen very carefully; is the tiger eating the carrots? Can you ask Mummy?

Elicitation (zebra × 2, carrots, eating)

Name new animals and objects with the child. Give zebras to M to enact eating carrots.

E: It's your turn to guess first. Can you ask Mummy about the zebras?

C: Response (Target: "Are the zebras eating the carrot?")

If inappropriate/no response: **E:** I wonder what's happening. Can you ask Mummy about the zebras?

Repeat for Test Verbs 2–6.

Appendix B (p. 2 of 2). Sample script for each elicitation task.

3. Auxiliary BE: *Wh*-Questions

E: In this game, we have some cards with pictures on [them], and Mummy has some different cards with pictures on [them]. We need to know what is on Mummy's pictures, so we'll have to ask her. Let's look at the first picture.

Training Phase

Look at Picture 1.

E: There's someone missing from this picture. I wonder who it is. I bet Mummy could tell us because her picture is different. But we can't see her picture so we'll have to ask her about it. Shall I ask first? What's happening here? I think jumping, but we don't know who it is. Let's ask Mummy. Who's jumping? Who's jumping? Can you ask Mummy?

C: Response (Target: "Who's jumping?")

Repeat for Training Verbs 2 and 3.

Test Phase

Imitation (zebra × 2, carrots, eating)

E and C look at their card (zebras eating?). M given first card (zebras eating carrots).

E: Who's on this card?

C: Response

E: There's something missing on this picture; I wonder what it is. I bet Mummy could tell us because her picture is different. But we can't see her picture so we'll have to ask her about it. Shall I ask first? What's happening here? I think eating, but what? We don't know, do we? Let's ask Mummy. What are the zebras eating? What are the zebras eating? Can you ask Mummy?

C: Response (Target: "What are the zebras eating?")

If appropriate response: **E:** Let's see; what are the zebras eating? (M reveals picture)

If inappropriate/no response: **E:** Listen very carefully; what are the zebras eating? Can you ask Mummy?

Elicitation (tiger, eating, carrots)

E and C look at their card (tiger eating ?). Give M card (tiger eating carrots).

E: Who's on this card?

C: Response

E: What's happening here? I think eating again, but we don't know what. Can you ask Mummy?

C: Response (Target: "What is the tiger eating?")

If inappropriate/no response: **E:** I wonder what's happening here. Can you ask Mummy about the tiger?

C: Response

Repeat for Test Verbs 2–6.

Appendix C. Coding criteria.

Auxiliary BE	Inclusion criteria	Correct responses	Errors			
			Omission	Uninversion	Double marking	Agreement
Description	Must include subject and verb. Unclear material acceptable as long as target auxiliary and subject are unambiguous.	Correct subject and auxiliary required. Pronominal subjects accepted. Verb replacements accepted.	Auxiliary form omitted.	Auxiliary in declarative position.	Two auxiliaries produced, one of which must be a form of target auxiliary.	Incorrect person marked auxiliary produced.
Declaratives	Responses that E prompted with sentence subject coded for prompt and whether child repeated prompted part of utterance.	Correct auxiliary accepted if follows prompted subject produced by E.	"They banging a gate"		"The cow's is holding the racquet"	"Cats is catching the ball"
Yes/no questions	Must have rising intonation if declarative word order.		"Panda banging a stick?"	"The tigers are eating the eggs?"	"Are the lions are blowing the candles?"	"Is the tigers holding the pen?"
Wh-questions	Must have <i>wh</i> -word. Questions with <i>who</i> acceptable ^a		"What the dogs carrying?"	"What the bird is carrying?"	"What is the pig is blowing?"	"What is the cats catching?"

Note. Responses that did not meet the general inclusion criteria were coded as nontarget responses. E = experimenter.

^aQuestions with *who* instead of *what* were deemed correct attempts at the target because the syntax of object-who questions is identical to that of object-what questions; children may have been confused as to the animacy of some of the objects; and the warm-up questions used the *wh*-word *who*, which may have led some children to continue to use *who*.