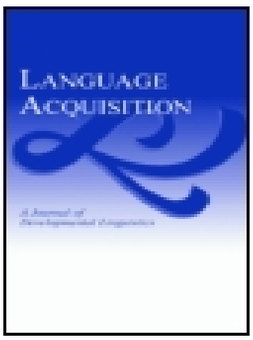

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Asking Questions in Child English: Evidence for Early Abstract Representations

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ABSTRACT

We compare the predictions of two different accounts of first language acquisition by investigating the relative contributions of abstract syntax and input frequency to the elicited production of main and embedded questions by 36 monolingual English-speaking toddlers aged 3;00 to 5;11. In particular, we investigate whether children's accuracy rates across different interrogative structures (main vs. embedded, *yes/no* vs. *wh-*, argument vs. adjunct) can be explained by difference in terms of input frequency in parental speech or whether abstract structural factors are needed to account for such asymmetries. In main-clause questions, children correctly invert the order of the subject and auxiliary more often with *yes/no* than *wh*-questions, despite a higher input frequency of uninverted *yes/no* questions. Furthermore, in main-clause *wh*-questions, inversion rates are higher for argument than adjunct *wh*-questions, independent of input frequencies. Finally, in embedded-clause questions, children correctly avoid inversion more often in *yes/no* than *wh*-questions and show no effect of input frequency or type of *wh*-word. A significant positive correlation between (correct) inversion rates in main and (incorrect) inversion rates in embedded questions suggests that inversion in embedded contexts stems from rule overgeneralization. Taken together, the results highlight the importance of abstract structural factors in children's production, above and beyond the role of frequency distributions in the input.

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1. Introduction

A crucial debate in language acquisition concerns the extent to which children's early representations are based on abstract generalizations or are primarily input driven. If early representations are genuinely abstract, young children are expected not only to produce structures that they have not heard before but to generalize over abstract categories and syntactic relations (e.g., determiner, subject, object, argument, adjunct, and so on), while also being influenced by the input they receive. If, conversely, representations are primarily data driven, young children's grammatical knowledge should be tightly linked to the specific properties of the adult input. We argue here for the view that children's syntactic knowledge is abstract from early on in development (e.g., Bencini & Valian 2008; Fernandes et al. 2006; Fisher 2002; Gernter, Fisher & Eisengart 2006; Pinker 1989; Valian, Solt & Stewart 2009), contrasting that view with usage-based lexicalist accounts, according to which children's early representations are lexically specific and heavily dependent on the frequencies—or usage—of specific co-occurrences in the adult input (e.g., Ambridge & Lieven 2015; Braine 1963; Lieven, Pine & Baldwin 1997; Rowland and Pine 2000; Rowland 2007; Tomasello 2003). Both accounts include a role for adult input, but only the early abstract syntax account includes a role for syntactic primitives like *subject* or *object* from early on in acquisition (e.g., Pinker 1989; Valian 1991).

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We focus here on the development of children's questions—an ideal test case of the two approaches. As we will detail, we can derive competing predictions for the types of errors that children will make when forming questions. Our elicited production procedure allows us to systematically compare *yes*/*no* and *wh*-questions, as well as main-clause and embedded-clause questions. Corpus studies are limited to what children produce naturally; those productions are heavily influenced by the topics under discussion and the people they are talking to. By using an experimental paradigm, we can ensure that all children's data are comparable.

The key dimension on which the accounts differ is not whether there is a role of input—both accounts agree that input patterns and the frequency of different patterns is important. For instance, frequency effects have been observed across language domains: Higher-frequency words tend to be acquired earlier (e.g., Goodman, Dale & Li 2008), are accessed and judged more quickly in lexical decision tasks by adults (e.g., Forster 1976), and are more resistant to change across time (Lieberman et al. 2007; Pagel, Atkinson & Meade 2007).

Rather, the accounts differ in the claims they make about the relation between early and late grammatical representations. Early abstract syntax accounts argue for continuity between children's and adults' linguistic processing and representations (e.g., Crain 1991; Crain & Pietroski 2002; Lidz & Musolino 2002; Musolino & Lidz 2003; Pinker 1984; Valian 2013, 2014). Continuity implies that, from the start, children have access to and use abstract linguistic principles and representations to form generalizations across words and phrases, based on the abstract categories those words belong to. On usage-based accounts, in contrast, children proceed from having no syntax at all to having abstract representations via some form of exemplar learning and prototype formation (Abbott-Smith & Tomasello 2006; Ambridge & Lieven 2015). Usage-based accounts predict that children's performance will be uneven across syntactic structures because the input is uneven (Ambridge & Lieven 2015).

Early abstraction accounts predict that, on occasion, children will systematically depart from the adult input and entertain grammatical representations that do not conform to the target grammar, by over- or undergeneralizing across categories. Importantly, however, the over- and undergeneralizations will be constrained by grammatical principles. Children will not entertain "rogue" hypotheses. Usage-based lexicalist accounts, on the other hand, hypothesize that children's initial representations are based on specific words and word combinations in the adult input. At later stages of development, children generalize across lexically specific examples on the basis of distributional and semantic cues. For example, they might construct the general category "PROCESS"—notably, not a syntactic category or relation—by grouping together words that share semantic characteristics (e.g., words that refer to actions, motions, states) and distributional features (e.g., words that can be combined with *-ing*; be preceded by *is, are, have*, etc.; see Ambridge & Rowland 2009). Children would move from there to eventually constructing something akin to an abstract category "verb," though the mechanism responsible for this process is unclear.

For early abstraction accounts, the challenge is to demonstrate that children's nontarget performance is indeed rule governed and that abstract linguistic principles and categories contribute to explaining children's performance, above and beyond the role of input frequency. For purely usage-driven accounts, the challenge is to show two things—that children's departures from the adult input occur when the input has few instances of a given target form and that children's nontarget productions closely mirror patterns otherwise present in the input they receive (i.e., children's incorrect productions in a given context mirror patterns that actually occur in other contexts). Importantly, even at later developmental stages, when children's representations are considered to be more abstract, nontarget productions will be organized around a combination of concrete and abstract schemas derived from distributional patterns in the input (e.g., Dąbrowska & Lieven 2005; Ambridge & Rowland 2009).[1]

[1]Usage-based theorists may vary in their assumptions and proposals, just as early abstraction theorists vary. We have chosen what we believe is a representative version of usage-based accounts.

As a test of the two frameworks, the studies presented here return to the classic topic of subject-auxiliary-inversion[2] in question formation. Subject-auxiliary inversion occurs in the adult grammar of Standard English main questions (as exemplified in (1)–(2)) but does not occur in embedded-clause ((3)–(4)) questions:

(1) Is Mary (is) going to New York this weekend?
(2) When is Mary (*is) going to New York?
(3) I wonder if (*is) Mary is going to New York this weekend.
(4) I wonder when (*is) Mary is going to New York.

We choose question formation for a number of reasons. First, English questions are among the few structures where children produce a considerable number of word order errors until late in development, thus allowing us to better examine how children's production patterns deviate from the input and to do so with children who are old enough to participate in studies where a range of specific structures can be easily elicited. More specifically, the age of children tested in the present article (3 to 5 years of age) was chosen to match the range used in much of the literature on this topic (e.g., Ambridge et al. 2006; Ambridge & Rowland 2009; Kuczaj and Brannick 1979; Rowland 2007; Rowland & Pine 2000; Sarma 1991).

Second, English questions have been the focus of extensive research efforts within both early abstraction and usage-based accounts. Those efforts have helped refine and sharpen the predictions of the two accounts. In this article, we compare the predictions of a specific early-abstraction account, according to which children's acquisition of interrogative structures is affected by the abstract category of the syntactic elements present in the structure (e.g., argument vs. adjunct) with the predictions of a specific usage-based account, according to which the crucial factor modulating children's acquisition of questions is the frequency with which specific word combinations occur in the adult input. The former account is exemplified by the work of Stromswold (1990), Villiers (1991), and Thornton (2008), while the latter is exemplified by the work of Ambridge et al. (2006), Ambridge and Rowland (2009), Dąbrowska and Lieven (2005), Rowland and Pine (2000), and Rowland (2007).

The two accounts will be compared with respect to their ability to account for children's elicited production of a range of English interrogative structures that differ both in their abstract syntactic properties and in their frequency in the adult input. Specifically, we investigate three outstanding issues in the literature:

(i) Do children's inversion patterns differ across main-clause *wh-* and main-clause *yes/no* questions? If so, are the differences best explained by the frequency with which such structures occur in the adult input, by differences in the syntactic properties of the question types, or by a combination of those two factors?
(ii) Do children's inversion patterns differ across main-clause argument (e.g., *what, which*) and adjunct (e.g., *when, why*) *wh*-questions? If so, are those differences best explained by the frequency with which such structures occur in the adult input, by differences in the syntactic properties of the *wh*-word, or by a combination of the two?
(iii) Do children's inversion patterns differ across main and embedded questions? If so, are those differences best explained by the frequency with which such structures occur in the adult

[2]The classic term "subject-auxiliary inversion" refers to the well-known phenomenon observed in English main-clause questions in which the surface order of the subject and the auxiliary is "inverted" (e.g., "What is$_1$ Mary$_2$ eating?") compared to the declarative clauses the questions are related to (e.g., "Mary$_2$ is$_1$ eating pizza"). In more recent (generative) treatments, the phenomenon is known as T-to-C movement. That refers to the (hypothesized) movement of a tense-bearing element from the head of the tense phrase (TP) to the head of the complementizer phrase (CP). In this article, in keeping with the early literature and common usage, we use "subject-auxiliary inversion" to refer to the phenomenon and "inversion error" to refer to the absence of subject-auxiliary inversion in main-clause questions and to the nontarget presence of subject-auxiliary inversion in embedded-clause questions.

input, by the different syntactic properties of the clause types, or by a combination of the two?

The present study is intended to provide robust experimental results that will resolve some of the existing controversies in the literature (described in the following). To the best of our knowledge, no study to date has systematically elicited questions from children, simultaneously

(i) using the same experimental protocol to elicit both *yes*/*no* and *wh*-questions,
(ii) in a within-subjects design,
(iii) parametrically pitting against each other input frequency and syntactic structure (including high- and low-frequency arguments and adjuncts), and
(iv) directly comparing main- and embedded-clause questions.

In contrast to main-clause questions, the acquisition of English embedded-clause questions has not received much attention in the literature. The two main studies that have systematically investigated the acquisition of this structure have reported contradictory results (Sarma 1991; Stromswold 1990). Sarma found virtually no inversion errors in an elicited production study of embedded *wh*-clauses, while Stromswold's investigation of the CHILDES corpus found substantial inversion errors in embedded *wh*-contexts but not in embedded *yes*/*no* contexts. By administering a similar protocol for both clause types to the same participants, the present study can reveal the similarities and differences in the acquisition of interrogatives at different levels of embedding and provide further data to resolve existing inconsistencies.

In the remainder of this section, we discuss each of the issues outlined in (i)–(iii) individually, provide a brief summary of the relevant prior findings, and lay out a series of critical predictions.

1.1. *Yes/No vs. wh-questions*

Main-clause *yes*/*no* and *wh*-questions differ in terms of their syntactic structure, input frequency, and inversion patterns in the adult grammar. *Wh*-questions require fronting both the *wh*-word and the main auxiliary to the left periphery of the clause, while *yes*/*no* questions only involve the movement of an auxiliary. The fact that *wh*-questions involve two movement chains, rather than one, makes them more complex to process (Jakubowicz 2011; Jakubowicz & Strik 2008) and, by some accounts, more prone to inversion errors (Bellugi 1971; Klima & Bellugi 1966). On the other hand, *yes*/*no* questions are less consistently associated with subject-auxiliary inversion in the input to children than *wh*-questions are: Main-clause *wh*-questions without subject-auxiliary inversion are never grammatical in Standard English, but noninverted *yes*/*no* questions are grammatical and frequent in the adult input (e.g., "You're going out tonight?").[3]

Reported rates of children's inversion in *wh*- and *yes*/*no* questions are highly variable across different studies. In some studies, *yes*/*no* questions are associated with higher accuracy and more frequent inversion than *wh*-questions (Bellugi 1971; Klima & Bellugi 1966; Kuczaj and Brannick, 1979; Rowland 2007) but only when *why*-questions are included in the analyses (Rowland 2007). Other studies have reported either no difference in inversion rates between *yes*/*no* and *wh*-questions (Derwing & Smith 1988; Stromswold 1990; Tyack & Ingram 1977 for older children) or better performance in *wh*-questions (Tyack & Ingram 1977, for younger children; Ingram & Tyack 1979;

[3]Noninverted *yes*/*no* questions in English are pragmatically marked, in that they are associated with an epistemic bias toward an answer "with the same propositional content as the question" (Huddleston & Pullum 2002:881, see also Munaro & Obenauer 2002). That is, the expected answer to (ia) is (ib), while the expected answer to (iia) is (iib).
(ia) They've finished?
(ib) Yes, they've finished.
(iia) They haven't finished?
(iib) No, they haven't finished.

Erreich 1984; Valian, Lasser & Mandelbaum 1992). The unresolved inconsistencies might be due to a number of factors, including differences in coding criteria,[4] materials, and data collection methods (i.e., parental diaries, spontaneous production, elicited production, etc.). By using the same experimental protocol (elicited production) for main-clause *yes*/*no* and *wh*-questions with the same children during the same experimental session, and by scoring with the same coding scheme, the current study allows for a genuine comparison.

To assess the role of input frequency, we first determined how often children hear the types of questions used in our study. We calculated frequency of inversion from adults in six American English longitudinal and cross-sectional CHILDES corpora (MacWhinney 2000), representing a range of communicative circumstances and spanning the age range from 1;04 to 5;02 (see Table 1).

Main *yes*/*no* questions without inversion are common in the speech to young children. Tables 2a and 2b show the numbers of inverted and noninverted *yes*/*no* questions using the auxiliaries *is* and *are*—the auxiliaries elicited in our study—and those with *is* and *are* combined with the subjects used in our study. About 38% of *yes*/*no* questions are noninverted (Table 2a), with the percentages almost identical for *is* and *are*. Similarly, about 37% of *yes*/*no* questions containing the auxiliaries *is* and *are* in combination with the specific subjects used in our study are noninverted. These numbers correspond well with those from an adult-to-adult corpus study,[5] where noninverted *yes*/*no* questions occurred 35% of the time in new-information contexts and 76% of the time in contexts in which a confirmation answer is expected (Williams 1990).

In stark contrast to the input for *yes*/*no* questions, the input contained zero noninverted main-clause *wh*-questions. Thus, children hear noninverted *yes*/*no* questions often, but they never hear noninverted *wh*-questions.

If frequency of inversion in specific auxiliary and auxiliary-subject combinations in the adult input is the main determinant of children's inversion rates, children should invert less frequently in *yes*/*no* questions than in *wh*-questions. On the other hand, if children's inversion rates are mainly

Table 1. Distribution of Utterances in Six CHILDES Corpora.

Corpus	Number of Children	Age Range	Child Utterances	Adult Utterances	Total Utterances
Bates*	27	1;08–2;04	42,86	11,274	15,560
Bloom 70	3	1;04–2;10	31,334	40,385	71,719
Clark	1	2;03–3;02	22,539	32,349	54,888
Gleason*	24	2;01–5;02	17,459	37,698	55,157
Snow	1	2;03–3;09	13,152	19,801	32,953
Valian*	21	1;09–2;08	14,094	26,250	40,344
Total	**77**	**1;04–5;02**	**102,864**	**167,757**	**270,621**

*Cross-sectional corpora.

Table 2a. Input Distribution of Main and Embedded *Yes/No* Questions across the Six Corpora for All Questions Containing Auxiliaries *Is* and *Are*.

	Main-Clause Questions		Embedded-Clause Questions	
Auxiliary Type	Inverted	Noninverted	Total	Noninverted
Are	536	322	858	13
Is	321	200	521	9

[4]For example, some researchers (e.g., Thornton 2008) count questions with an omitted auxiliary as noninverted, while others either do not include these productions or code them in a separate category (e.g., Rowland & Pine 2000). Differences in coding criteria can cause dramatic changes in the estimate of inversion in child English. For instance, according to the coding scheme used by Valian, Lasser & Mandelbaum (1992), the percent of noninverted questions in the Valian corpus is 2.5%, while it would be 34.7% if coded according to Thornton's scheme. Another problem, as Rowland (2007) points out, is that a great number of child language acquisition studies analyze transcripts of spontaneous speech samples for which audio files are not available. This results in some researchers excluding noninverted *yes*/*no* questions "because it is often difficult to determine from the transcript whether a true question was asked or whether the utterance had been given a question mark in error" (Rowland 2007:116).

[5]The relevant portion of the corpus included six 45-minute conversations between previously acquainted native speakers of American English. The corpus contained a total of 141 new information and 175 confirmation *yes*/*no* questions.

Table 2b. Input Distribution of Main and Embedded *Yes/No* Questions across the Six Corpora for Questions Containing Auxiliaries *Is* and *Are* Combined with the Specific Subjects Used in Experimental Study.

		Main-Clause Questions		Embedded-Clause Questions	
Auxiliary Type	Subject Type	Inverted	Noninverted	Total	Noninverted
Are	*you*	456	258	714	6
Is	*he/it/brother/dog*	184	108	292	2

affected by structural factors, and in particular, if they are affected by derivational complexity, children should invert more often in *yes/no* questions than in *wh*-questions (see Jakubowicz 2011): The latter involve two independent movements (e.g., the fronting of the *wh*-element and the auxiliary) rather than one (e.g., the fronting of the auxiliary).

1.2. *Argument vs. adjunct wh-questions*

By including different types of *wh*-words, we can directly compare the relative contribution of syntax and input frequency on children's production. The syntactic contrast we focus on here is that between arguments—constituents that are selected for by the main verb in a clause and the omission of which often leads to ungrammaticality (as in (5))—and adjuncts—constituents that are not selected for by the main verb and the omission of which does not affect the grammaticality of the structure (as in (6)):

(5) Bill bought *(a new shirt).
(6) Bill bought a new shirt (at Macy's) (yesterday).

Differences between arguments and adjuncts are ubiquitous in the languages of the world, and argument and adjunct questions are associated with different word-order patterns cross-linguistically. For example, in Spanish, argument questions are associated with obligatory subject-verb inversion, while adjunct questions are associated with optional inversion (Torrego 1984). Furthermore, the adjunct *why* is associated with word-order patterns that distinguish it from other *wh*-words in a number of languages (e.g., French: Rizzi 1990; Korean, Chinese, Japanese: Ko 2005; Italian: Rizzi 1990, 2001; Irish: McCloskey 2006). A number of syntactic accounts have been put forth to explain this latter pattern. Among them, Rizzi's proposal has been particularly influential and has been adapted to account for the behavior of *why* in child English (see Thornton 2008). In particular, Rizzi (2001) proposed that the Italian counterpart of *why* (*perché*) can be optionally generated in the specifier of an interrogative phrase (IntP) in the left periphery of the clause (CP). IntP is located higher in the clause than FocP and is endowed with a [+*wh*] interrogative feature. When *why* is generated in IntP, movement of the [+*wh*] verb to C° is not required, since a [+*wh*] element is already present in the left periphery. As a consequence, the verb does not move to the left periphery of the clause, in accordance with economy principles (movement as "last resort," see Chomsky 1995) and appears after the subject.

Argument *wh*-words (e.g., *what, who*) tend to be acquired earlier and associated with higher accuracy and inversion rates than adjunct *wh*-words in English (e.g., *how, why, where, when*; see Erreich 1984; Sarma 1991; Stromswold 1990). In parallel with cross-linguistic tendencies, English *why*-questions display particularly low inversion rates in both first and second language acquisition (for L1, see Berk 2003, Villiers 1991; Labov & Labov 1978; Thornton 2008, among others; for L2, see Lee 2008; Pozzan & Quirk 2014).

It is possible, however, that the reported argument/adjunct asymmetry is only apparent and is actually due to the frequency of specific combinations of different *wh*-words and auxiliaries in the input (Rowland & Pine 2000; Ambridge et al. 2006). To tease apart the relative contributions of abstract syntactic information and input frequency, we prompted children to use two frequent

auxiliary forms (auxiliary *is* and *are*) with two argument *wh*-words (*what, which*) and two adjunct *wh*-words (*why, when*). These four *wh*-words can help dissociate the effect of syntax from that of input frequency. As Table 3 shows, questions with argument *what* are frequent, while questions with argument *which* are rare, even less frequent than questions with adjunct *why*[6] and as infrequent as questions with adjunct *when* (see Table 3).

If input frequency is the main factor affecting children's inversion rates, the two low-frequency *wh*-elements (*which* and *when*) should pattern together and be associated with lower inversion rates than the two higher-frequency *wh*-elements (*why* and *what*), cutting across *wh*-word type. On the other hand, if children are mainly affected by abstract structural factors, the arguments *what* and *which* should pattern together, and the adjuncts *when* and *why* should pattern together. Further, in line with cross-linguistic data, inversion should be more frequent in argument than adjunct questions. Distinctions based on abstract syntactic categories like "argument" or "adjunct" are hard to explain within a usage-based prospective because the frequency patterns of adult English input do not naturally group arguments separately from adjuncts.

1.3. *Main vs. embedded-clause questions*

In Standard English, subject-auxiliary inversion only occurs in main-clause contexts, as the contrast between (1) and (2) versus (3) and (4) shows. In addition, main-clause questions are much more frequent than embedded-clause interrogative, as Tables 2 and 3 show. On any approach, the very low frequency of embedded questions would make them harder to acquire, more likely to change over time, and more likely to give rise to dialectal variation (Henry & Tangney 1999). In line with this, nonstandard inversion in embedded contexts is documented across a range of native (AAVE, Scottish English, Hiberno and Belfast English, Appalachian English, among others) and nonnative English varieties (e.g., Pozzan & Quirk 2014). This pattern, however, has been reported exclusively for embedded *wh*-questions, not *yes/no* questions, in both native and nonnative varieties of English (e.g., Labov 1972; Henry 1995; Filppula 1999; Green 2002; Pozzan & Quirk 2014) and in child language acquisition (Stromswold 1990).

Usage-based theorists have not examined the relation between main and embedded clauses, so we consider two predictions that we believe are congruent with their general approach. The first prediction relies on the hypothesized method by which children form questions: combining a *wh*-word with a declarative "frame"—a combination of specific words ("fillers") with more abstract, semantically driven, categories ("slots"). If children's noninversion errors in main questions stem from the combination of a given *wh*-element (e.g., *why*) with frequent declarative-order frames (e.g., "THING"+"is"+"PROCESS," see Dąbrowska and Lieven 2005; Rowland 2007; Ambridge & Rowland 2009), then the converse error (i.e., nontarget inversion) should not occur in embedded contexts because the juxtaposition of a *wh*-element (e.g., *why*) and a default declarative-order frame (e.g.,

Table 3. Input Distribution of Main and Embedded *Wh*-Questions across the Six Corpora for Questions Containing the *Wh*-Word and Auxiliary Combinations Used in Experimental Study.

Wh-*Word*	Wh-*Word Type*	*Auxiliary* (is/are + *V*-ing)	*Main-clause Questions*	*Embedded-clause Questions*
what	*argument*	*are*	1,016	50
		is	867	52
which	*argument*	*are*	14	0
		is	5	2
when	*adjunct*	*are*	12	0
		is	10	2
why	*adjunct*	*are*	65	1
		is	89	10

[6]The low-frequency *wh*-argument (*which*) and *wh*-adjunct (*when*) questions are well matched in frequency. Ideally, the same match would obtain for the higher frequency *wh*-questions, but it did not because *what*-questions are much more frequent than any other *wh*-question.

Table 4. Summary of Predictions for Accuracy of Inversion Patterns (Inversion in Main Clauses; Noninversion in Embedded Clauses).

Clause Type	Question Type	Early Abstraction	Usage-Based
Main-clause	*Yes/no* vs. *Wh*-questions	*Yes/no* > Wh-	*Wh-* > *Yes/no*
	Wh-questions	Argument (*what/which*) > Adjuncts (*when/why*)	High frequency (*what/why*) > Lower frequency (*which/when*)
Embedded-clause	*Yes/no* vs. *Wh*-questions	*Yes/no* > Wh-	High frequency (*wh-*) > Lower frequency (*yes/no*)
	Wh-questions	Adjuncts (*when/why*) > Argument (*what/which*)	No errors in either. High frequency (*what/why*) > Lower frequency (*which/when*)

Note. " > " indicates higher accuracy, i.e., higher inversion rates in main-clause questions and higher noninversion rates in embedded-clause questions.

"THING"+"is"+"PROCESS") will always result in a target, noninverted string (e.g., "I wonder" + "why" + "she is laughing").

Alternatively, children's production patterns might instead reflect the frequency with which different embedded-clause word combinations occur in the input. That is, children might produce target noninverted embedded questions for embedded word combinations that occur relatively frequently in the input, such as *what* + "THING" + "is" + "PROCESS." For word combinations that occur rarely in the input (e.g., *why* + "THING" + "is" + "PROCESS"), children might instead resort to applying the (inverted) word order with which those same word combinations occur in main-clause questions, as the latter are overall more frequent in the input (see Tables 2–3 for frequency of embedded-clause *yes*/*no* and *wh*-questions in the six corpora).

A structural account makes a different set of predictions. It proposes that learners are sensitive to differences associated with the different syntactic structure of the complementizer phrase (CP) in main and embedded questions for both *yes*/*no* and *wh*-questions. In embedded *yes*/*no* questions, the head of the CP—C°—is filled by *if*, as in "I wonder $[_{CP}$ ø $[_{C'}$ if $[_{TP}$ Mary is going to New York]]]." In *wh*-questions, in contrast, the head is not filled by any overt element, and the *wh*-elements are found in Spec, CP, as in "I wonder $[_{CP}$ when $[_{C}$ ø [Mary is going to New York]]]." Since C° is arguably the target landing position of the tensed auxiliary, auxiliary movement can occur when C° is not overtly filled (i.e., embedded *wh*-structures) but not when it is overtly filled by *if* (embedded *yes*/*no* structures).

For embedded questions, then, the predictions of early-abstraction accounts are straightforward: Embedded inversion should not occur in *yes*/*no* questions (*"I wonder if is Mary going to New York") but can occur in *wh*-contexts ("I wonder when is Mary going to New York"). Further, asymmetries between arguments and adjuncts should be observed in *wh*-contexts: In line with main-clause patterns, argument *wh*-elements might be associated with higher nontarget inversion rates than adjunct *wh*-elements.

To summarize, we prompted 3-, 4-, and 5-year-olds to produce *yes*/*no* and *wh*-questions that use argument and adjunct *wh*-words in both main and embedded clauses with both frequent and less-frequent combinations of auxiliaries and subjects. By testing the full range of structures and word combinations, we can establish rates of inversion in different contexts and determine whether children are driven primarily by the frequency of different patterns in the input or are also affected by abstract syntactic properties. For a complete summary of the predictions, see Table 4.

2. Experimental investigation

2.1. *Method*

2.1.1. *Participants*

Forty monolingual English-speaking children were recruited through local daycare centers, personal contacts, and Experian (a credit information group that collects and provides information on people

and businesses). At the end of the experimental session, the children took a standard expressive language test normed on preschool English-speaking children aged 3;00–5;11 (SPELT-P2). Only children who scored within or above the normal range for their age were included in the analyses. Four children were excluded: One had been diagnosed with auditory processing impairment and was receiving speech-language therapy at the time of testing; one had a SPELT score more than 2 *SD* below the mean for his age group; two were tired after completing Part 1 and did not participate in Part 2. Results are thus based on data from 36 children. The average age of the these children was 4;03 (Range = 3;03–5;09, *SD* = 9 months; Median = 4;02),[7] and their average SPELT score was 32.3/40 (Range = 24–38; *SD* = 3, Median = 33). This age range was chosen because children continue to produce inversion errors (e.g., Ambridge et al. 2006; Thornton 2008) but have also started using subordination productively (Brown 1973; Bowerman 1979; Limber 1973).

2.1.2. *Materials*

The study consisted of a computerized elicited production task, administered through Microsoft PowerPoint. In order to elicit main-clause questions (Part 1), children were asked to help a child (Katie) ask her mother some questions. There were 6 practice items and 16 experimental items. In items intended to elicit *yes*/*no* questions, the experimenter read a prompt printed on an index card, such as "Maybe Katie's mom is buying ice cream soon, *but maybe not* . . . . Katie wants to find out, so she says: "Mom . . . ?" The slide depicted a girl in the act of asking her mother a question; the thought bubble next to the girl (see Appendix A) always depicted an object mentioned in the prompt (e.g., an ice cream cone) to help children remember the prompt. Children then asked the relevant question and clicked on a sound icon to hear the prerecorded answer to their question; the answer was recorded by the second author. After playing the answer, the experimenter handed the index card with the prompt to the child, who then put it in a box, a procedure that children enjoyed.

Items eliciting *wh*-questions followed the same general format but differed in the wording of the prompt. Prompts were of the form "Katie's mom is buying ice cream soon. Katie wants to find out *when*, so she says "Mom . . . ?" Appendix A presents examples of prompts together with an example of a slide aimed at eliciting main-clause questions. Appendix B lists all the main-clause prompts.

In order to elicit embedded-clause questions (Part 2), children were instructed to play a memory game called "Katie Wanted to Know." As in Part 1, there were 6 practice items and 16 experimental items. Children saw a picture of a girl (Katie) sitting on a couch, talking to a boy (her brother). A sound file icon was placed in a speech bubble next to the girl. Children clicked on the icon to hear Katie's question (e.g., "When is mom buying ice cream?"). At this point, the experimenter, who was sitting alongside the child, asked: "What did Katie want to know?" The child's task was to produce an embedded-clause question, such as "Katie wanted to know when her mother was buying ice cream." Children were instructed to start their answers by saying "Katie wanted to know," since this was the name of the game. Appendix C presents examples of prompts together with an example of a slide aimed at eliciting embedded-clause questions. Appendix D includes all embedded prompts.

All the stimuli contained the auxiliary *be* and a transitive verb in the present progressive form. The experimental items were in present tense (*is, are*), while the practice items were in past tense (*was* or *were*). To limit potential structural priming effects from practice to experimental trials, practice *wh*-questions prompted children to produce subject *wh*-questions, a structure that does not provide evidence for subject-auxiliary inversion in English. The lexical verbs used in the prompts were all monosyllabic, transitive verbs (e.g., *eat, call, brush*, etc.). For main-clause questions, half of the prompts were aimed at eliciting a question with a third person subject (e.g., "My brother," "the

[7]An additional analysis was conducted excluding the five children whose age was above 5 at the time of testing. The pattern of results was not affected by the exclusion of these participants, so the following results are based on the entire sample of children run in the experiment.

dog," etc.), and half were aimed at eliciting a question with a second person subject (e.g., "you"). The main-clause prompts used to elicit embedded-clause questions in Part 2 similarly contained either third person subjects (e.g., "Mom," "the dog") or a second person subject (i.e., "you"). In this latter case, the second person pronoun contained in the main-clause prompt needs to be substituted by a third person pronoun in reported speech (e.g., "When are *you* washing the dog?" should become "Katie wanted to know when *her brother* was washing the dog"). This manipulation allowed us to determine whether participants were producing authentic embedded-clause questions, rather than quotative questions (e.g., "She wanted to know: 'When are *you* washing the dog?'").

To investigate the relative contribution of input frequency and syntactic structure on children's production patterns, we elicited argument and adjunct words that differ in the frequency with which they occur in adult speech to children: a high-frequency argument (*what*), a low-frequency argument (*which*), a (relatively) high-frequency adjunct (*why*), and a low-frequency adjunct (*when*). Input frequency was calculated on the basis of the six corpora of American English child-directed speech described in Table 1. The full set of verbal experimental materials for main- and embedded-clause questions are given in Appendixes B and D respectively.

For each part of the experiment, two experimental lists were constructed. Type of question (*yes*/*no* vs. *wh*-) was a fully within factor, while type of *wh*-word (arguments *what* and *which* vs. adjuncts *why* and *when*) was manipulated within subjects but between items. The two lists differed with respect to the fully within variable: Items that appeared as prompts for *yes*/*no* questions in List 1 appeared as prompts for *wh*-questions in List 2 and vice versa. *Yes*/*no* questions and *wh*-questions were elicited in blocks because pilot testing showed that children had a strong tendency to perseverate with the question type used in the previous item, thus producing a high number of nontarget responses (e.g., *wh*- instead of *yes*/*no* questions and vice versa).

To control for order effects, two additional lists were created by switching the order of the first four and last four items in each block (i.e., the last four items in the first block in one list appeared as the first four items in the reverse-order list). *Wh*-questions were thus elicited in the first block in two lists, while *yes*/*no* prompts appeared in the first block in the remaining two lists. Each block of experimental questions was preceded by three practice items, for a total of six practice items. Participants were randomly assigned to the experimental lists.

2.1.3. *Procedure*

All children completed Part 1 before Part 2, due to the fact that main-clause questions (the target structure in Part 1) were used to prompt participants to produce embedded-clause questions (the target structure in Part 2).

Each child was tested individually in a quiet room. After the child was seated comfortably in front of the computer, the experimenter explained the first game (Part 1) to the child: "This is an asking game. Look, this is Katie and this is her mom. Katie wants to know some things. We are going to help her ask her mom questions. Let's play!"

The second game (Part 2) was presented in a similar way: "This time, we are going to play a remembering game. It's called 'Katie Wanted to Know.' Can you say 'Katie wanted to know'? Katie is going to ask her brother some questions. Listen to her questions and remember them. You always start with 'Katie wanted to know.' Let's play!"

After explaining the game, the experimenter presented the child with the first block of three practice items. During practice, if the child did not ask a target question (e.g., if the child asked a *yes*/*no* question instead of a *wh*-question), the experimenter repeated the prompt a second time; if the child still failed to produce any question or produced a nontarget question, the experimenter produced the target structure and prompted the child to repeat it. After the practice trials, the first eight experimental trials were presented. If the child forgot the prompt, was distracted, or produced a nontarget question (e.g., a nontarget *wh*-element, a *yes*/*no* rather than a *wh*-question or vice versa) during the experimental phase, the experimenter prompted the child a second time. Each child heard a given prompt a maximum of two times. If, after being prompted twice, the child still

did not produce the target question, the experimenter moved on to the next prompt. Children were never prompted a second time if they produced an inversion or a morphological error. After the first eight experimental trials, the child began the second block of questions and was presented with three practice items and eight additional experimental items. Part 1 took approximately 10 to 12 minutes.

At the end of Part 1, the experimenter asked the child to play another game. The experimenter explained the new game to the child and went through the first three practice items, the first experimental block (eight items), the second block of practice items (three items), and the second experimental block (eight items).

Part 2 took approximately 12 to 14 minutes. At the end of Part 2, children took the SPELT, which required about 10 minutes. The whole experimental session lasted approximately 40–50 minutes.

2.1.4. *Transcription and coding*

Each experimental session was recorded via a digital recorder, transcribed by a trained research assistant, and then checked by a second research assistant. If a discrepancy between the transcriber and the checker emerged (e.g., presence vs. absence of a subject or auxiliary), the first author listened to the relevant production and discussed it with the primary transcriber. All discrepancies were resolved through discussion. All utterances were then scored according to the following scheme; the scoring was then checked by a second researcher. Disagreements were again resolved by discussion.

For embedded-clause questions, only productions in which the second person pronoun, if present in the prompt, was correctly transformed into a third person possessive pronoun were scored for presence or absence of inversion. Consider, for example, a question that accompanied a picture in which Katie asked her brother something. If the prompt was: "What are *you* building?," the desired target response would be "Katie wanted to know what *her* brother was building." A response like "Katie wanted to know what was *her* brother building?" would be considered inverted, while responses like "Katie wanted to know what *you* are building" or "Katie wanted to know what are *you* building" would be considered "other."

Each production was coded as either correct (adultlike) or incorrect (nonadultlike) with respect to word order, verbal morphology, and presence of target lexical items (e.g., subject and *wh*-words). Lack of inversion in main *yes*/*no* questions was scored as incorrect for ease of comparison with *wh*-questions. Following Ambridge et al.'s (2006) coding scheme, incorrect questions were further coded into four categories:

(i) Subject-auxiliary inversion errors, as in the uninverted auxiliary in (7), or errors in which no auxiliary verb was present but tense morphology was present on the lexical verb, as in (7):

(7) Why you are calling dad?
(8) When my brother sings a song?

(ii) Double tense/double auxiliary errors, as in (9)–(10):

(9) What does my brother builds?
(10) What are you are cooking?

(iii) Omitted auxiliary errors, as in (11), or errors that, due to lack of morphology, were ambiguous between noninversion and omitted auxiliary errors, as in (12):

(11) Which cat you brushing?
(12) Why you call dad?

(iv) Other errors. Other errors included questions that differed in type from the target (*yes*/*no* instead of *wh*-questions and vice versa), subject *wh*-questions instead of object *wh*-questions, as in (13), productions that differed from the target for more than half of the lexical items, questions without a subject, questions with VP movement/a postverbal subject, as in (14), and questions in which the *wh*-word produced differed from the target one, as in (15). Skipped items and unintelligible productions were also included in this category.

(13) Which one is brushed? (Target: "Which cat is mom brushing?")
(14) Which toy was chewing the dog? (Target: "Which toy was the dog chewing?")
(15) Why are you feeding the doll? (Target: "Which doll are you feeding?")

The dependent variable in both Part 1 and Part 2 was the number of inversion and raising errors compared to the total number of productions.

2.1.5. *Statistical analyses and frequency measures*

Mixed effects logistic regressions were applied to the data. In all analyses, the fixed effect structure of the models always included the effects of abstract structure (i.e., question type or *wh*-word type, depending on the analysis), input frequency, and child's age. For main-clause *yes*/*no* questions, frequency of inversion in the input was calculated as the frequency, across the six CHILDES corpora, of the relevant inverted *yes*/*no* questions (e.g., "Did you eat?") over the frequency of all questions (e.g., "Did you eat," "You ate?") containing the subject-auxiliary combinations used in the experimental prompts (see Table 2a). For example, the frequency of inversion for main-clause *yes*/*no* questions containing the auxiliary *are* was calculated as the frequency of inverted *yes*/*no* questions containing the auxiliary *are* and the subject pronoun *you* (e.g., 456) by the frequency of inverted and corresponding noninverted *yes*/*no* questions (e.g., 456 + 258 respectively).[8] For the other structures, input frequency was simply the frequency of the relevant word combinations across the six corpora (see Table 3). For example, the frequency of main-clause *what* + *are* questions was 1,016.[9]

Our models always included the maximal random effect structures justified by the data but were simplified when convergence problems arose (see the following). For all analyses, the dependent variable was inversion errors, either failure to invert in main clauses or inversion in embedded clauses. While statistical analyses were performed on untransformed binary data (inversion error = 1, 0 otherwise), results are graphed in terms of proportions for ease of presentation.

2.2. *Results*

Children's elicited production data were used to test the predictions of two different accounts of children's questions, the early abstraction structure-based account, and the frequency-based lexicalist account. The structural characteristics of the items included the type of question (*yes*/*no* vs. *wh*-) and the type of *wh*-expression (argument vs. adjunct). Our structure-based account predicted that, in main clauses, *yes*/*no* questions would be inverted more reliably than *wh*-questions because they require only one, as opposed to two, movement chains. Within *wh*-questions, we predicted that arguments (*what* and *which*) would pattern together and show higher inversion rates than adjuncts (*why* and *when*). The fact that *which* is less frequent than *why* (see Table 3) should matter less than the fact that *which* is an argument. For embedded-clause questions, we predicted that *yes*/*no* structures would (correctly) show lower inversion rates than *wh*-questions because the filled C° in *yes*/*no* questions blocks inversion of the auxiliary (and children have the correct abstract representation of the relevant sentence structure).

The frequency characteristics measured were the input frequencies of different question types, i.e., different combinations of auxiliaries and subjects. Usage-based accounts predict that, in main clauses, children will invert more reliably in *wh*-questions than *yes*/*no* questions because the adult input contains no noninverted *wh*-questions but many noninverted *yes*/*no* questions. Within *wh*-questions, the frequency with which different word combinations occur in the input, regardless of their syntactic type, should influence inversion rates. Based on the frequencies presented in Table 3, inversion rates in main clauses should be highest for *what* questions, next highest for *why* questions,

[8]A parallel analysis conducted using the corpus frequency of all *yes*/*no* questions containing auxiliaries *is* and *are*, regardless of the particular subject used (see Table 2b) yielded comparable results.
[9]An additional analysis using the logarithm of the input frequencies, rather than raw count frequencies, returned comparable results. For simplicity of exposition, results based on raw frequencies are reported.

and lowest for *which* and *when* questions. Thus, the accounts make very different predictions about how the different *wh*-terms will pattern. For embedded clauses, usage-based accounts predict either no inversion errors, as children should match the most frequent, unmarked SVO word order of English declarative clauses, or an effect of frequency, with more frequent word combinations in embedded-clause questions being associated with higher (target) noninversion rates.

2.2.1. *Part 1: Main-clause questions*

Analysis 1 included question type (*wh-* vs. *yes/no*) and frequency of inversion in the adult input as fixed effects in a mixed-effects logistic regression. Analysis 2 included phrase-type within *wh*-questions (argument vs. adjunct) and input frequency.[10] To control for age effects, the effect of age was included in all the analyses. Due to convergence failure, the random effect structure in both models only included by-subject random intercepts.

Inversion was high across all question types. Lack of inversion was virtually nonexistent (1/264) in *yes/no* questions, despite the fact that noninverted main *yes/no* questions are very frequent in spontaneous speech. Figure 1 presents the mean proportions of inverted, noninverted, and "other" responses associated with main-clause *yes/no* questions and *wh*-questions. The results of the linear mixed-effect regression show that inversion errors were more common for *wh*-questions than *yes/no* questions (*Estimate* = 1.83, *SD* = .61, p = .002). Input frequency, on the other hand, did not have a significant effect on children's inversion errors (*Estimate* = .00, *SD* = .00, p = .14). Children's age did not account for additional variance (*Estimate* = .03, *SD* = .06, p =.60).

For *wh*-questions, noninversion errors never occurred with arguments (*what* and *which*), despite the fact that *which* questions are extremely rare in adult speech to children. Noninversion errors only occurred in adjunct questions; error rates were comparable across low-frequency *when* questions and high(er) frequency *why* questions (8% and 9% respectively). Figure 2 presents the average proportions of inverted, noninverted, and "other" responses associated with different *wh*-word and auxiliary combinations.

Children's inversion rates in *wh*-questions were significantly affected by the type of *wh*-expression, with argument *wh*-questions being associated with higher inversion rates than adjunct ques-

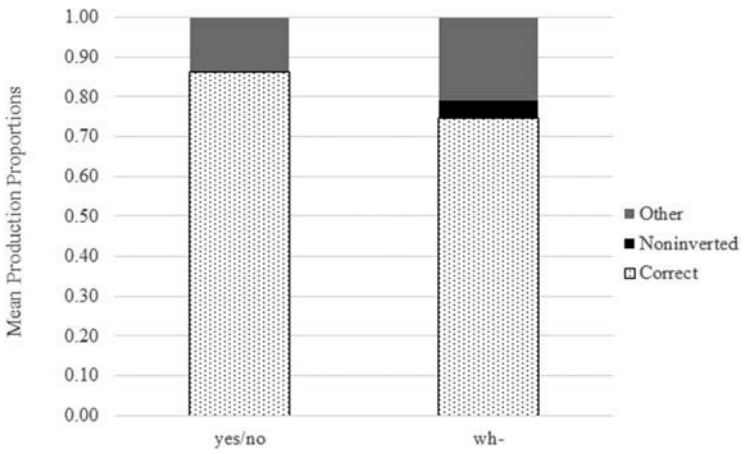

Figure 1. Main-clause questions: Average production proportions by question-type (*yes/no* vs. *wh*).

[10]The original model did not converge due to lack of variance, due to the fact that argument *wh*-questions were associated with no inversion errors; to overcome this problem, the coding associated with one production was changed from "correct" to "error." In line with the predictions of usage-based accounts, the production that was turned from "correct" to "error" was not chosen arbitrarily but among the productions uttered in response to prompts containing the lowest frequency *wh*-word-auxiliary combination (i.e., argument *which* and auxiliary *is*).

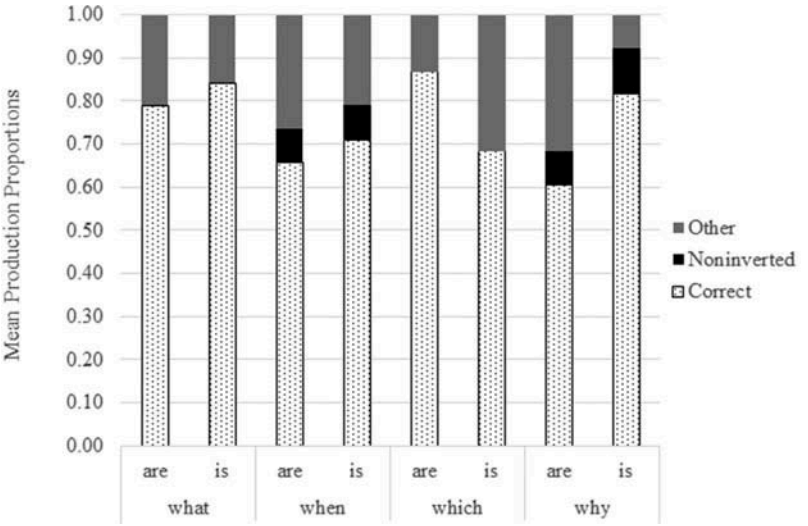

Figure 2. Main-clause *wh*-questions: Average production proportions by *wh*-word and auxiliary combination.

tions (*Estimate* = 1.39, *SD* = .67, p = .04). Input frequency, in contrast, did not have a significant effect on children's inversion errors (*Estimate* = .00, *SD* = .00, p = .46). Inversion rates were also not modulated by age (*Estimate* = .05; *SD* = .08, p = .53).

2.2.2. *Part 2: Embedded questions*

Analysis 1 included the effects of question type (*wh-* vs. *yes/no*), input frequency, and children's age as fixed effects in a mixed-effects logistic regression. The maximally converging random effect structure for this model included by-subject and by-item random intercepts and by-subject random slopes for the effect of input frequency.

As shown in Figure 3, (nontarget) inversion in embedded questions was virtually nonexistent in children's production of *yes/no* questions (3/264), as predicted by our early abstraction account. In contrast, (nontarget) inversion was high for *wh*-questions (27% on average); this difference was significant (*Estimate* = 2.61, *SD* = .42, p <.001). This finding is not compatible

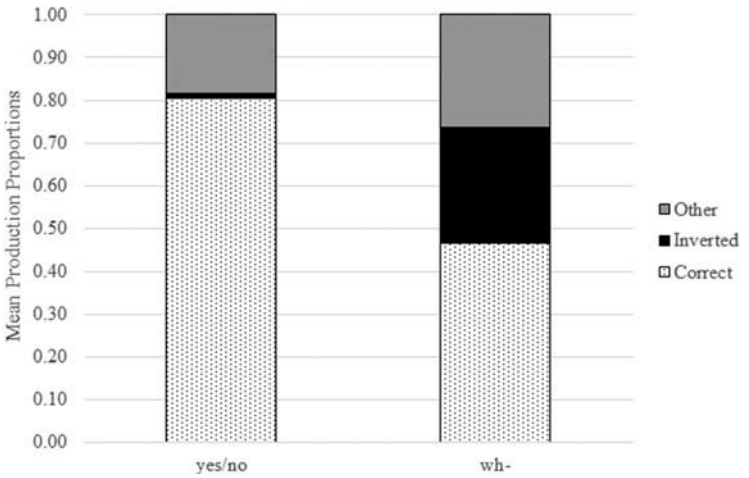

Figure 3. Embedded-clause questions: Average production proportions by question-type (*yes/no* vs. *wh-*).

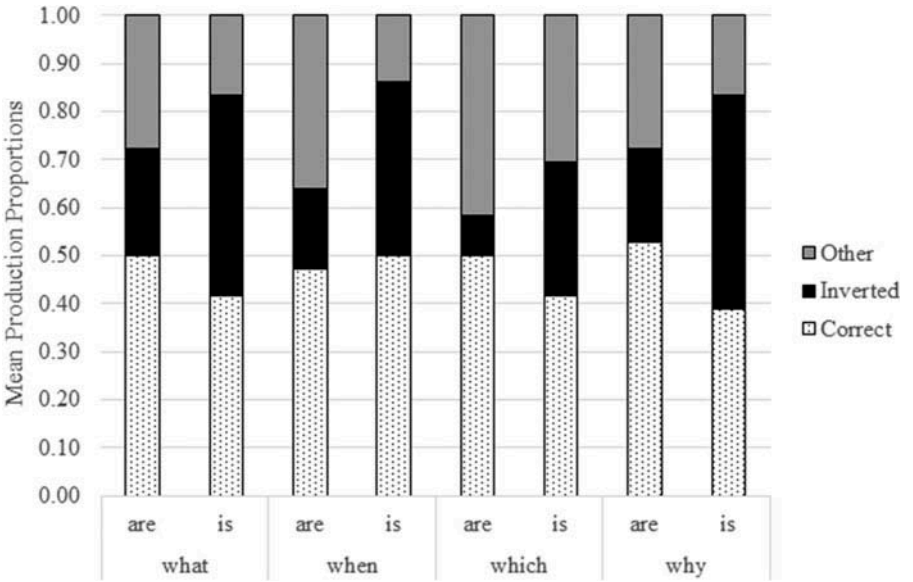

Figure 4. Embedded-clause questions: Average production proportions by *wh*-word and auxiliary combination.

with either set of predictions derived for usage-based accounts. First, children's productions do not mirror the default SVO order of declarative sentences in embedded *wh*-questions; instead, children produce a substantial number of inversion errors in embedded *wh*-contexts. Second, inversion was not affected by the frequency with which different embedded-clause word combinations occur in the adult input (*Estimate* = –.00, *SD* = .02, *p* = .87). Moreover, inversion rates were not modulated by children's age (*Estimate* = –.05, *SD* = .05, *p* =.35). The rate of nontarget "other" responses was also high, possibly reflecting the fact that this was a demanding task for children in this age range.

Analysis 2 included type of *wh*-expression (argument vs. adjunct), frequency in the input, and children's age as fixed effects in a mixed-effects logistic regression. The maximal converging random-effect structure for this model included by-subject and by-item random intercepts and by-subject random slopes for the effect of input frequency. Children's (nontarget) production of inversion was not affected by the type of *wh*-expression in the clause (*Estimate* = .91, *SD* = .81, *p* = .26), nor by input frequency (*Estimate* = –.02, *SD* = .02, *p* = .36), nor by children's age (*Estimate* = –.05, *SD* = .06, *p* =.40). Inversion rates for the *wh*-expressions elicited in the study are shown in Figure 4.

To ensure that our method of measuring frequency in embedded-clause contexts was not obscuring a potential effect of input frequency, we ran an additional analysis in which the independent variable of input frequency was not the absolute frequency of occurrence of noninverted embedded questions but rather the *relative* occurrence of noninversion (i.e., frequency of embedded questions) compared to inversion (i.e., frequency of main questions) in the adult input, for each word combination separately. For example, the relative frequency of noninverted, embedded *why* + *is* questions was calculated by dividing the number of embedded, noninverted *why* + SUBJECT + *is* combinations in the input (i.e., 10) by the frequency of the corresponding main, inverted *why* + *is* combinations (i.e., 89). In this analysis, type of *wh*-word and *relative* input frequency were entered as fixed effects in a mixed effects logistic regression. The random effect structure for this model included by-subject and by-item random intercepts and by-subject random slopes for the effect of (relative) input frequency. Children's production of embedded *wh*-questions was not affected by the type of *wh*-expression (*Estimate* = .09, *SD* = .75, *p* = .90), nor by the relative frequency of inversion in the adult input (*Estimate* = –2.63, *SD* = 2.36, *p* = .26), nor by children's age (*Estimate* = .01, *SD* = .05, *p* =.83).

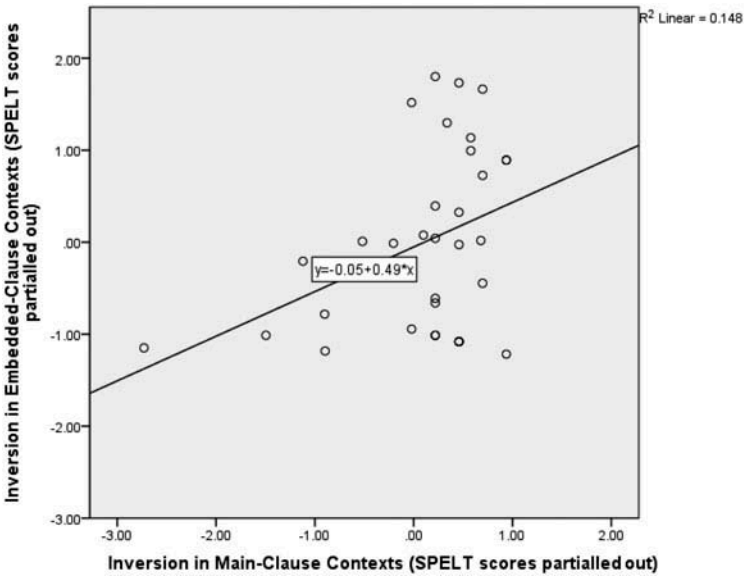

Figure 5. Correlation between inversion rates in main-clause and embedded-clause questions.

A final analysis investigated whether nontarget inversion in embedded *wh*-questions might be due to overgeneralization of subject-auxiliary inversion from main to embedded contexts. If so, a correlation should exist between inversion rates in main and embedded questions across individual children. In order to ensure that any observed generalization would not be driven (or obscured by) children's developing grammatical abilities, we regressed out children's grammatical abilities, as measured by their performance on the SPELT-P2. We found a significant correlation between (target) inversion rates in main-clause contexts and (nontarget) inversion rates in embedded-clause contexts, $r(30) = .39$, $p = .03$): As target inversion rates in main questions increased so did nontarget inversion rates in embedded questions (see Figure 5). This result is in line with what Stromswold (1990) found in a study of children's spontaneous production and suggests that children might use evidence from more frequent and syntactically simpler structures to inform their hypotheses about less frequent and more complex structures, overgeneralizing across levels of embedding.

3. General discussion

The main purpose of this study was to test the predictions of early abstraction structure-based and usage-based lexicalist (frequency) approaches to the study of child language acquisition. We investigated the elicited productions of children aged 3–6 to determine whether their production of main and embedded *yes*/*no* and *wh*-questions is affected by the syntactic type (*yes*/*no* vs. *wh*-; within *wh*-; argument vs. adjunct) of the question being produced or the frequency with which different word combinations occur in the adult input. By comparing different question types within the same experiment, we could establish how those types are related to each other in the child's production system. Our findings for main-clause and embedded-clause questions support our structure-based account more than they support frequency approaches. To summarize:

3.1. *Main-clause questions: Structural differences; no frequency effects*

- *Yes*/*no* questions showed higher inversion rates than *wh*-questions, as predicted by the greater structural complexity of *wh*-questions. Despite the fact that the input is mixed for *yes*/*no* and perfect for *wh*-questions, there was no effect of input frequency.

- In *wh*-questions, argument and adjunct *wh*-words behaved differently: As with *yes*/*no* questions, argument *wh*-questions were error-free. Failure of inversion in main clauses occurred only with adjunct *wh*-questions, as predicted by the structural differences between arguments and adjuncts. Once again, there was no effect of input frequency.

3.2. *Embedded-clause questions: Structural differences (yes/no vs. wh-); no frequency effects*

- *Yes*/*no* questions showed fewer errors of inappropriate inversion than did *wh*-questions, as predicted by our structural account, in which children understand that C is filled. It also parallels findings from nonstandard native varieties of English and data from adult L2 acquisition, suggesting that the same structural factors affect the application of subject-auxiliary inversion in different populations of English users. There was no effect of input frequency.
- In *wh*-questions, there was no significant effect of argument type or input frequency. That finding is inconsistent with the predictions of both early abstraction and frequency accounts. In line with Stromswold's (1990) findings, however, there was a significant positive correlation between inversion rates in main and embedded-clause questions, suggesting generalization from main to embedded clauses.

3.3. *Main-clause questions*

Our data for main-clause questions are in line with a number of previous studies in the literature: Children's accuracy and inversion rates in main questions are affected by the syntactic type of question they are producing, independent of the frequency of different word combinations in the adult input. More specifically, (a) inversion rates are significantly higher for *yes*/*no* than for *wh*-questions overall, and (b) inversion rates in *wh*-questions are significantly higher for *wh*-arguments (*what, which*) than for *wh*-adjuncts (*when, why*). Children produced virtually no inversion errors in either *yes*/*no* questions or argument *wh*-questions. Rather than showing an asymmetry between *wh*- and *yes*/*no* questions, children show an asymmetry between adjunct *wh*-questions and all other questions.[11]

The error-free performance on main-clause *yes*/*no* questions is particularly noteworthy because noninverted *yes*/*no* questions are grammatical and common in spoken English. The absence of noninverted productions probably stems from the fact that the pragmatic conditions for noninversion were not met in the communicative context of our study: The prompts participants heard were not biased toward either a positive or negative answer. English noninverted *yes*/*no* questions tend to occur in contexts in which the speaker is trying to confirm some preexisting belief (see footnote 1). Other studies may have found higher rates of noninversion either because they tested younger children, who might not yet have mastered the pragmatic conditions for noninversion (e.g., Santelmann et al. 2002) or because they examined spontaneous production, where pragmatic conditions are neither controlled nor coded for (e.g., Rowland 2007; Stromswold 1990)

The poor performance of *wh*-adjunct questions is compatible with some syntactic accounts of subject-auxiliary inversion errors in child (and L2) English (e.g., Villiers 1991; Stromswold 1990). We propose that the explanation should capitalize on the intuition expressed in much of the literature: The crucial difference between internal arguments like *which* and *what* and adjuncts like *when* and *why* lies in differences in the position from which they are originally merged into a structure. Direct object *wh*-words, like their non-*wh* counterparts, are obligatorily generated in a VP-

[11]The fact that inversion rates for *yes*/*no* questions and *wh*-arguments were at ceiling in this study might explain why some studies have found a *wh*- vs. *yes*/*no* asymmetry, while others have not: Differences among studies might stem from (uncontrolled) differences in the proportion of arguments and adjuncts present in the various corpora under examination.

internal position in English. *Why* and *when*, on the other hand, like their non-*wh* causal and temporal adverbial counterparts, can optionally be generated high in the clause in an event-external position (for a detailed typology of adverbials, see Frey 2003). The difference becomes clear if one compares the acceptability of structures in which either a temporal or a causal adverbial appears clause-initially (see (17) and (18) respectively) with parallel structures in which an argument appears clause-initially (as in (19)). (17) and (18) are quite natural; (19) is quite marked:

(16) John ate a sandwich at midnight because he was hungry
(17) At midnight, John ate a sandwich because he was hungry
(18) Because he was hungry, John ate a sandwich at midnight
(19) ???A sandwich, John ate at midnight because he was hungry

Argument preposing, as in (19), is acceptable only under specific pragmatic conditions (i.e., topicalization and contrastive focus, see Rodman 1974; Ward & Prince 1991 among others). The data suggest that temporal and causal adverbials (and their *wh*-counterparts) can be merged in different positions during a syntactic derivation, while arguments need to be merged within the VP.

For the adult, all interrogative *wh*-words, regardless of whether they are merged within the VP or in a VP-external position, move to the left periphery of the clause (CP) with consequent movement of the auxiliary to C° (forced either by the theta criterion, or some featural specification on C°). The child's grammar is similar to the adult's in one way: English *wh*-words that are generated within the VP are obligatorily moved to the CP, with consequent subject-auxiliary inversion. But the child, we suggest, treats *wh*-words that are generated clause-initially differently, allowing them to remain in their clause-initial (TP) base-generated position, with consequent lack of auxiliary movement, while still appearing in a position to the left of the subject.

Learners know early on that *wh*-words are located clause-initially in English: Both child and adult learners immediately front the *wh*-word (e.g., for L1, Becker & Gotowski 2015; for L2, Batmanian, Sayehli, & Valian 2008; Eckman, Moravcsik & Wirth 1989; Kellerman 1979; White et al. 1991). When the *wh*-word found in clause-initial position is an argument that is obligatorily generated within the VP, the only analysis compatible with its clause-initial location is movement to the CP. Since the presence of an interrogative *wh*-element within the CP triggers movement of the tensed auxiliary to the CP, subject-auxiliary movement should be, and is, consistently associated with argument w*h*-questions.

In contrast, when the *wh*-word found clause-initially belongs to a category of adverbials that can consistently appear in a VP-external position (i.e., temporal and causal adverbials), its clause-initial surface position is compatible with its having been generated in a clause-initial non-CP position (i.e., within the TP). In such cases, auxiliary movement does not occur because there is no [+*wh*] trigger within the CP.

This account predicts that inversion rates should be higher for adjunct *wh*-words (i.e., *where*) if their noninterrogative counterparts are typically generated within the VP position and if they are associated with a marked interpretation when found clause-initially. That is the case for locative adverbials, as shown in (21):

(20) John ate a sandwich in the kitchen at midnight because he was hungry
(21) ??In the kitchen, John ate a sandwich at midnight because he was hungry

In line with this prediction, *where* is consistently associated with higher inversion rates than other adjunct *wh*-words (for L2, see Haznedar 2003; Lee 2008; Pozzan & Quirk 2014; Spada & Lightbown 1999; for L1, see Erreich 1984; Labov and Labov 1978; Rowland and Pine 2000; Stromswold 1990).

3.4. *Embedded-clause questions*

The results for embedded *yes*/*no* questions are parallel to the results for main *yes*/*no* questions—they are error free. The syntax of embedded *yes*/*no* questions shows why children do not treat embedded clauses the way they treat main clauses: Movement of the auxiliary to C° is not possible because the head of the complementizer phrase is filled by the overt complementizer *if* (e.g., Mary doesn't know [$_{CP}$ C°+if [$_{TP}$ Paul is [$_{VP}$ cooking tonight]]]). In main *yes*/*no* questions, the auxiliary can move freely; in embedded *yes*/*no* questions, it cannot. Thus, children's knowledge that *if* fills C° prevents the too-broad generalization of treating main and embedded clauses similarly. By their error-free performance on *yes*/*no* questions in both main and embedded questions, children show that their grammars represent fine-grained structural properties.

The results for embedded *wh*-questions are more complex. Here, the fact C° is empty allows children to generalize across main and embedded clauses. Inversion in embedded contexts is correspondingly frequent, roughly 30%. With embedded *wh*-questions, our expectation that children will have an overly broad generalization is fulfilled. In child English the tensed auxiliary in embedded *wh*-questions has the option of moving to the same position it moves to in main-clause questions, i.e., the empty complementizer phrase (CP), thus giving rise to inversion (e.g., Mary doesn't know [$_{CP}$ what C°+is [$_{TP}$ Paul [$_{VP}$ cooking tonight]]]).

The presence of this option in child grammars (and in adult nonstandard varieties) might be the result of learners' general preference for grammatical systems where a given rule (e.g., inversion) applies to all relevant syntactic contexts (e.g., all interrogative structures), rather than to a subset of them (e.g., to main-clause contexts only).[12] The lure of this empty position is apparent from the fact that inversion errors are occasionally attested in the written and spoken production of adult native speakers of Standard English (as attested by its presence in the *New York Times*: "Let's not nitpick or wrangle over to what extent is reading in decline," see Rich 2007) and are widespread in L2 English speakers' spoken and written productions (e.g., Pozzan 2011; Pozzan & Quirk 2014). The difference in inversion rates for embedded *yes*/*no* and *wh*-questions cannot be explained by the frequency with which different types of embedded constructions occur in the adult input, since embedded *yes*/*no* questions are less common than embedded *wh*-questions in the adult speech (see Tables 2 and 3).

Contrary to our predictions, an effect of *wh*- phrase type (argument vs. adjunct) did not emerge in embedded clauses in our study. However, the existence of a significant positive correlation between inversion rates in main and embedded questions suggests that similar factors determine inversion rates in both.

By using parallel protocols to elicit main and embedded questions of different syntactic categories (*yes*/*no* vs. *wh*-, adjuncts vs. arguments) and different frequencies in the adult input, the present study was able to replicate and systematize a number of findings in the child acquisition literature. Our data help resolve differences in previous reports over the past 30 years. We have shown the existence of structural effects on inversion rates both in main and embedded questions, with *yes*/*no* questions being produced more accurately in both contexts. For main-clause contexts, this finding is particularly important because it shows that, when pragmatic conditions are controlled for, *yes*/*no* questions are associated with virtually 100% inversion rates.

We have also shown that *wh*-questions are neither unitary nor determined by input frequencies. The syntactic status of the *wh*-word in the structure is essential in predicting main-clause inversion rates, regardless of the frequency with which different word combinations occur in the input. Finally, the present study has confirmed the findings of the most comprehensive study conducted on children's production of questions in the literature (Stromswold 1990), showing that children have a tendency to assume that syntactic phenomena apply across levels of embedding for structures that are syntactically and semantically similar (e.g., *wh*-questions). Protracted exposure to the syntactic

[12]For a proposal along these lines, see Henry & Tangney 1999; see also Tornyova & Valian 2009, for a compatible account of differences between acquisition of main questions between L1-Bulgarian and L1-English.

patterns associated with more infrequent and structurally complex contexts is thus needed for children to retreat from overgeneralization.

4. Closing comments

Interrogative structures are among the few syntactic structures in which English-learning children produce word-order errors, making it inherently important for researchers in language development to better describe the extent and nature of the phenomenon and ultimately understand and explain its sources. In addition, interrogative structures are a paradigmatic case of syntactic movement and as such have been used a test of competing structure-based generativist accounts and usage-based lexicalist accounts (Ambridge et al. 2006). Despite the theoretical interest and the considerable number of studies on this topic, the available data have been inconclusive and often contradictory, with estimates of error rates ranging from 0% to 100% in main-clause contexts and from 10% to nonexistent in less-studied embedded-clause contexts. We suggest that the inconsistencies are due to differences in coding and definition of errors, differences in the methods employed (parental diaries, spontaneous production samples, elicited imitation, elicited production, and grammaticality judgments), the small number of items in many studies, uncontrolled differences between the populations being studied, and so on. The net result of the inconsistencies is that even basic data on the relative prevalence of errors have been lacking. The present study, by systematically contrasting children's productions of interrogative structures that differ in their frequencies and structural properties (*yes/no* vs. *wh-*, argument vs. adjunct, embedded- vs. main-clause contexts) and by using a large number of items and the same experimental protocol in the same population, suggests that some of these inconsistencies can be resolved. Our results indicate that abstract syntactic factors, but not frequencies of occurrence in the input, are essential in accounting for patterns of production across a range of interrogative structures.

References

Abbot-Smith, Kirsten & Michael Tomasello. 2006. Exemplar-learning and schematization in a usage-based account of syntactic acquisition. *The Linguistic Review* 23. 275–290.

Ambridge, Ben & Elena V. M. Lieven. 2015. A constructivist account of language acquisition. In Brian MacWhinney & William O'Grady (eds.), *The handbook of language emergence*, 478–510. Chichester: Wiley & Sons.

Ambridge, Ben & Caroline F. Rowland. 2009. Predicting children's errors with negative questions: Testing a schema-combination account. *Cognitive Linguistics* 20. 225–266.

Ambridge, Ben, Caroline F. Rowland, Anna Theakston & Michael Tomasello. 2006. Comparing different accounts of inversion errors in children's non-subject *wh*-questions: What experimental data can tell us? *Journal of Child Language* 33. 519–557.

Batmanian, Natalie, Susan Sayehli & Virginia V. Valian. 2008. Inclusion of auxiliaries: Competence and performance differences in early learners. *EUROSLA Yearbook* 8. 215–234.

Becker, Misha & Megan Gotowski. 2015. Explaining children's *wh-* in situ questions: Against economy. *Proceedings of the 39th annual Boston University Conference on Language Development [BUCLD 39]*, 127–137. Somerville, MA: Cascadilla Press.

Bellugi, Ursula. 1971. Simplification in children's language. In Renira Huxley & Elisabeth Ingram (eds.), *Language acquisition: Models and methods*, 95–119. New York: Academic Press.

Bencini, Giulia M. L. & Virginia V. Valian. 2008. Abstract sentence representations in 3-year-olds: Evidence from language production and comprehension. *Journal of Memory and Language* 59. 97–113.

Berk, Stephanie. 2003. Why "why" is different. *Proceedings of the 27th annual Boston University Conference on Language Development [BUCLD 27]*, 127–137. Somerville, MA: Cascadilla Press.

Bowerman, Melissa. 1979. The acquisition of complex sentences. In Michael Garman & Paul Fletcher (eds.), *Studies in language acquisition*, 285–305. Cambridge: Cambridge University Press.

Braine, Martin D. S. 1963. The ontogeny of English phrase structure: The first phase. *Language* 39. 3–13.

Brown, Roger. 1973. *A first language: The early stages*. Cambridge, MA: Harvard University Press.

Chomsky, Noam. 1995. *The minimalist program*. Cambridge, MA: MIT Press.

Crain, Stephen. 1991. Language acquisition in the absence of experience. *Behavioral and Brain Sciences* 14. 597–650.

Crain, Stephen & Paul Pietroski. 2002. Why language acquisition is a snap. *The Linguistic Review* 19. 163–183.

Dąbrowska, Ewa & Elena V. M. Lieven. 2005. Towards a lexically specific grammar of children's question constructions. *Cognitive Linguistics* 16. 437–474.
de Villiers, Jill G. (see Villiers)
Derwing, Tracey & Ronald H. Smyth. 1988. Auxiliary placement revisited. *Journal of the Atlantic Provinces Association* 10. 1–15.
Eckman, Fred, Edith Moravscik & Jessica Wirth. 1989. Implicational universals and interrogative structure in the interlanguage of ESL learners. *Language Learning* 39. 173–205.
Erreich, Anne. 1984. Learning how to ask: Patterns of inversion in yes-no and *wh*-questions. *Journal of Child Language* 11. 592–597.
Fernandes, Keith J., Gary F. Marcus, Jennifer A. DiNubila & Athena Vouloumanos. 2006. From semantics to syntax and back again. *Cognition* 100. B10–B20.
Filppula, Markku. 1999. *The grammar of Irish English: Language in Hibernian style*. New York: Routledge.
Fisher, Cynthia. 2002. Structural limits on verb mapping: The role of abstract structure in 2.5-year-olds' interpretations of novel verbs. *Developmental Science* 5. 55–64.
Forster, Kenneth. 1976. Accessing the mental lexicon. In Roger J. Wales & Edward Walker (eds.), *New approaches to language mechanisms*, 257–287. Amsterdam: North Holland.
Frey, Werner. 2003. Syntactic conditions on adjunct classes. In Ewals Lang, Clauia Maienborn & Cathrine Fabricius-Hansen (eds.), *Modifying adjuncts (Interface Explorations 4)*, 163–209). Berlin: Mouton de Gruyter.
Gertner, Yael, Cynthia Fisher & Julie Eisengart. 2006. Learning words and rules: Abstract knowledge of word order in early sentence comprehension. *Psychological Science* 17. 684–691.
Goodman, Judith C., Philip S. Dale & Ping Li. 2008. Does frequency count? Parental input and the acquisition of vocabulary. *Journal of Child Language* 35(3). 515–531.
Green, Lisa. 2002. *African American English: A linguistic introduction*. Cambridge: Cambridge University Press.
Haznedar, Belma. 2003. The status of functional categories in child L2 acquisition: Evidence from the acquisition of CP. *Second Language Research* 19. 1–41.
Henry, Alison. 1995. *Belfast English and Standard English: Dialect variation and parameter setting*. Oxford: Oxford University Press.
Henry, Alison & Denise Tangney. 1999. Functional categories and parameter setting in the second-language acquisition of Irish in early childhood. In Michel DeGraff (ed.), *Language creation and language change: Crealization, diachrony, and development*, 139–253. Cambridge, MA: MIT Press.
Huddleston, Rodney & Geoffrey K. Pullum. 2002. *The Cambridge grammar of the English language*. Cambridge: Cambridge University Press.
Ingram, David & Dorothy Tyack. 1979. Inversion of subject NP and Aux in children's questions. *Journal of Psycholinguistic Research* 8. 333–341.
Jakubowicz, Celia. 2011. Measuring derivational complexity: New evidence from typically developing and SLI learners of L1 French. *Lingua* 121. 339–351.
Jakubowicz, Celia & Nelleke Strik. 2008. Scope-marking strategies in the acquisition of long distance *wh*-questions in French and Dutch. *Language and Speech* 51. 101–132.
Kellerman, Eric. 1979. Transfer and non-transfer: Where we are now. *Studies in Second Language Acquisition* 2. 37–57.
Klima, Edward S. & Ursula Bellugi. 1966. Syntactic regularities in the speech of children. In John Lyons & Roger J. Wales (eds.), *Psycholinguistic papers: The proceedings of the 1966 Edinburgh Conference*, 183–219. Edinburgh: Edinburgh University Press.
Ko, Heejeong. 2005. Syntax of *why*-in-situ: Merge into [Spec, CP] in the overt syntax. *Natural Language & Linguistic Theory* 23. 867–916.
Kuczaj, Stan A. & Nancy Brannick. 1979. Children's use of the *wh*-question modal auxiliary placement rule. *Journal of Experimental Child Psychology* 28. 43–67.
Labov, William. 1972. *Language in the inner city: Studies in the Black English vernacular*. Philadelphia: University of Pennsylvania Press.
Labov, William & Teresa Labov. 1978. Learning the syntax of questions. In Robin Campbell & Philip T. Smith (eds.), *Recent advances in the psychology of language*, 1–44. New York: Plenum Press.
Lee, Sun Y. 2008. Argument-adjunct asymmetry in the acquisition of inversion in *wh* questions by Korean learners of English. *Language Learning* 58. 625–663.
Lidz, Jeffrey & Julien Musolino. 2002. Children's command of quantification. *Cognition* 84. 113–154.
Lieberman, Erez, Jean-Baptiste Michel, Joe Jackson, Tina Tang & Martin A. Nowak. 2007. Quantifying the evolutionary dynamics of language. *Nature* 449. 713–716.
Lieven, Elena V. M., Julian M. Pine& Gillian Baldwin. 1997. Lexically-based learning and early grammatical development. *Journal of Child Language* 24. 187–219.
Limber, John. 1973. The genesis of complex sentences. In Timothy Moore (ed.), *Cognitive development and the acquisition of language*, 169–186. New York: Academic Press
MacWhinney, Brian. 2000. *The CHILDES project: Tools for analyzing talk*. Mahwah, NJ: Lawrence Erlbaum.

McCloskey, James. 2006. Questions and questioning in a local English. In Raffeella Zanuttini, Héctor Campos, Elena Herburger & Paul H. Portner (eds.), *Crosslinguistic research in syntax and semantics: Negation, tense, and clausal architecture*, 87–126. Washington, DC: Georgetown University Press.
Munaro, Nicola & Hans-Georg Obenauer. 2002. On the semantic widening of underspecified *wh*-elements. In Manuel Leonetti et al. (eds.), *Current issues in generative grammar*, 165–194. Madrid: Universidad Alcalà de Henares—Servicio de Publicaciones.
Musolino, Julien & Jeffrey Lidz. 2003. The scope of isomorphism: Turning adults into children. *Language Acquisition* 11. 277–291.
Pagel, Mark, Quentin D. Atkinson & Andrew Meade. 2007. Frequency of word-use predicts rates of lexical evolution throughout Indo-European history. *Nature* 449. 717–720.
Pinker, Steven. 1984. *Language learnability and language development*. Cambridge, MA: Harvard University Press.
Pinker, Steven. 1989. *Learnability and cognition*. Cambridge, MA: MIT Press.
Pozzan, Lucia. 2011. Asking questions in learner English: First and second language acquisition of main and embedded interrogative structures (Unpublished doctoral dissertation). CUNY Graduate Center, New York, NY.
Pozzan, Lucia & Erin Quirk. 2014. Second language acquisition of English questions: An elicited production study. *Applied Psycholinguistics* 35. 1055–1086.
Rodman, Robert. 1974. On left dislocation. *Papers in Linguistics* 7. 437–66.
Rich, Motoko. 2007. Study links drop in test scores to a decline in time spent reading. *The New York Times*, November 19, E1. http://www.nytimes.com/2007/11/19/arts/19nea.html?_r=1&adxnnl=1&oref=slogin&adxnnlx=1428779654-fWZq4L/OS7TSCifSk7KfWw.
Rizzi, Luigi. 1990. *Relativized minimality*. Cambridge, MA: MIT Press.
Rizzi, Luigi. 2001. On the position "int(errogative)" in the left periphery of the clause. In Guglielmo Cinque & Giampaolo Salvi (eds.), *Current studies in Italian syntax: Essays offered to Lorenzo Renzi*, 287–296. Amsterdam: Elsevier.
Rowland, Caroline F. 2007. Explaining errors in children's questions. *Cognition* 104. 106–134.
Rowland, Caroline F. & Julian M. Pine. 2000. Subject-auxiliary inversion errors and *wh*-question acquisition: "What children do know?" *Journal of Child Language* 27. 157–181.
Santelmann, Lynn M., Stephanie Berk, Jennifer Austin, Shamitha Somashekar, & Barbara Lust. 2002. Continuity and development in the acquisition of inversion in yes/no questions: dissociating movement and inflection. *Journal of Child Language* 29. 813–42.
Sarma, Jaya. 1991. *The acquisition of* wh*-questions in English*. Storrs, CT: University of Connecticut dissertation.
Spada, Nina & Patsy Lightbown. 1999. Instruction, first language influence and developmental readiness in second language acquisition. *The Modern Language Journal* 83. 1–22.
Stromswold, Karin. 1990. *Learnability and the acquisition of auxiliaries*. Boston, MA: Massachusetts Institute of Technology dissertation.
Thornton, Rosalind. 2008. Why continuity. *Natural Language and Linguistic Theory* 26. 107–146.
Tomasello, Michael. 2003. *Constructing a language: A usage-based theory of language acquisition*. Cambridge, MA: Harvard University Press.
Tornyova, Lydia & Virginia V. Valian. 2009. The role of cross-linguistic variation in the acquisition of auxiliary inversion in *wh*-questions. In Jean Crawford, Koichi Otaki & Masahiko Takahashi (eds.), *Proceedings of the 3rd conference on Generative Approaches to Language Acquisition of North American [GALANA 2008]*, 282–290. Somerville, MA: Cascadilla Press.
Torrego, Esther. 1984. On inversion in Spanish and some of its effects. *Linguistic Inquiry* 15. 103–130.
Tyack, Dorothyn & David Ingram. 1977. Children's production and comprehension of questions. *Journal of Child Language* 4. 211–224.
Valian, Virginia V. 1991. Syntactic subjects in the speech of young Italian and American children. *Cognition* 40. 21–81.
Valian, Virginia V. 2013. Determiners: An empirical argument for innateness. In M. Sanz, I. Laka & M. Tanenhaus (eds.). *Language down the garden path: The cognitive and biological basis for linguistic structure*, 272–279. New York: Oxford University Press.
Valian, Virginia V. 2014. Arguing about innateness. *Journal of Child Language* 41. 78–92.
Valian, Virginia V., Ingebord Lasser & Deborah Mandelbaum. 1992. Children's early questions. Paper presented at the 17th annual Boston University Conference on Language Development [BUCLD 17], October 23–25, Boston University, Boston, MA.
Valian, Virginia V., Stephanie Solt & John Stewart. 2009. Abstract categories or limited-scope formulae? The case of children's determiners. *Journal of Child Language* 36. 743–778.
Villiers, Jill G. de1991. Why questions? In Thomas Maxfield & Bernardette Plunkett (eds.), *University of Massachusetts occasional papers in linguistics: The acquisition of Wh*, 155–174. Amherst, MA: GLSA.
Ward, Gregory & Ellen F. Prince. 1991. On the topicalization of indefinite NPs. *Journal of Pragmatics* 16. 167–77.
White, Lydia, Nina Spada, Patsy M. Lightbown & Leila Ranta. 1991. Input enhancement and L2 question formation. *Applied Linguistics* 12. 416–432.
Williams, Jessica. 1990. Another look at yes/no questions: Native speakers and non-native speakers. *Applied Linguistics* 11. 159–182.

Appendix A

Protocol for main-clause questions

Verbal prompts examples

(i) *Yes/no*: "Maybe Katie's dog is digging a hole, but maybe not. Katie wants to find out, so she says: "Mom … "
(ii) *Wh-*: "Katie's dog is digging a hole. Katie wants to find out why, so she says: "Mom … "

Setup



Appendix B: Main-clause prompts[13]

Yes/no *prompts*

Practice items

Maybe Katie's dog was barking, but maybe not. Katie wants to find out so she says: "Mom …"
Maybe Katie's mom was drinking juice, but maybe not, etc.
Maybe Katie's brother was jumping, but maybe not.

Experimental items

Maybe Katie's mom is reading a book, but maybe not. Katie wants to find out.
Maybe Katie's mom is drawing a flower, but maybe not.
Maybe Katie's brother is eating cookies, but maybe not.
Maybe Katie's mom is cooking pizza, but maybe not.
Maybe Katie's brother is buying ice-cream now, but maybe not.
Maybe Katie's mom is writing a letter, but maybe not.
Maybe Katie's dog is chasing the cat, but maybe not.
Maybe Katie's dog is digging a hole, but maybe not.

Wh-*prompts*

Practice items

Someone was watching the birds. Katie wants to find out who.
One of the dogs was running. Katie wants to find out which dog.
Something was flying in the sky. Katie wants to find out what.

[13]Material are reported for List 1; List 2 differed from List 1 in that *wh*-question prompts were modified to elicit *yes/no* questions and vice versa. List 3 and 4 were identical to List 1 and 2 respectively, but the order of the blocks was reversed

Experimental items

Katie's mom is cleaning something. Katie wants to find out what.
Katie's brother is washing the dog. Katie wants to find out why.
Katie's mom is singing a song. Katie wants to find out when.
Katie's dog is chewing one of the toys. Katie wants to find out which toy.
Katie's brother is doing his homework soon. Katie wants to find out when.
Katie's mom is calling the doctor. Katie wants to find out why.
Katie's brother is building something. Katie wants to find out what.
Katie's mom is feeding one of the dolls. Katie wants to find out which doll.

Appendix C

Protocol for embedded questions

Verbal prompts examples

(i) Yes/no: "Is the dog digging a hole?"
  (a) What did Katie want to know?
(ii) *Wh*-: "Why is the dog digging a hole?"
  (a) What did Katie want to know?

Setup



Appendix D: Embedded-clause prompts[14]

Yes/no *prompts*

Practice items

Was the dog barking?
Were you drinking juice?
Was my brother jumping?

Experimental items

Are you reading a book?
Are you drawing a flower?
Is my brother eating cookies?
Are you cooking pizza today?
Is my brother buying ice-cream now?

[14]Materials are reported for List 2; List 1 differed from List 1 in that *wh*-question prompts were modified to elicit *yes/no* questions and vice versa. List 4 and 3 were identical to List 1 and 2 respectively, but the order of the blocks was reversed

Are you writing a letter?
Is the dog chasing the cat?
Is the dog digging a hole?

Wh-*prompts*

Practice items

Who was watching the birds?
Which dog was running?
What was flying in the sky?

Experimental items

What are you cleaning?
Why is my brother washing the dog?
When are you singing a song?
Which toy is the dog chewing?
When is my brother doing his homework?
Why are you calling dad?
What is my brother building?
Which doll are you feeding?