The Role of Cross-Linguistic Variation in the Acquisition of Auxiliary Inversion in *Wh*-questions

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1. Introduction[1]

A common error in young English-speaking children's use of auxiliaries is failure to invert the auxiliary before the subject as in (1) and (2). Despite the long history of research on children's acquisition of questions, the source of these errors is still unknown.

(1) *Where daddy is going?
(2) * What mommy can do?

This paper addresses two central issues related to the problem of auxiliary inversion in English *wh*-questions: 1) there are multiple proposals of the source of the error but none can explain the data in full; 2) the data on children's *wh*-questions are inconsistent, due to differences in methods and techniques.

We propose that language-specific structural characteristics of the target grammar (e.g., variable movement of the auxiliary across clause types in English) determine the types of errors children produce and the length of time required for acquisition. To test the hypothesis that cross-linguistic variation accounts for different patterns in acquisition, we conducted a cross-sectional study combining observation of spontaneous speech and elicited imitation to compare English- and Bulgarian-speaking children's production of *wh*-questions. Bulgarian differs from English in several crucial aspects that, we predict, will result in earlier mastery of inversion in *wh*-questions in Bulgarian compared to English. The relevant properties are: a) obligatory inversion of both auxiliaries and verbs in *wh*-questions; b) inversion in all *wh*-questions, whether matrix or embedded; c) lack of homonymy of relative and interrogative pronouns (e.g., *where*).

2. Background

The literature on English *wh*-question acquisition offers a number of approaches which differ substantially both theoretically and empirically[2]. The theoretical debate has concentrated on the

[2] In this paper, we limit the discussion to generative accounts of auxiliary inversion in children's *wh*-questions, setting aside a large body of research within other frameworks.

sources of children's inversion errors and whether children's grammars are qualitatively different from the adult target grammars. On the empirical side, analyses disagree even on basic measures such as the frequency of errors and the contexts in which they occur.

Here we discuss analyses which attribute children's errors to deficient competence that could take one of three forms: an optional inversion rule in the child grammar (Erreich, 1984; Valian, Lasser & Mandelbaum, 1992); incorrect location of adjunct *wh*-words in IP (Plunkett, 1991; Stromswold, 1990; de Villiers, 1991); difficulties with *do* support and verb *be* raising (Santelmann, Berk, Austin, Somashekar, & Lust, 2002).

2.1. The Optional Inversion Rule Account

Valian et al. (1992) propose that children's concurrent production of inverted as well as non-inverted *wh*-questions is a result of their application of an optional inversion rule that applies to *yes-no* and *wh*-questions. The optionality arises from two sources of misleading evidence: lack of inversion in embedded *wh*-questions and optional inversion in *yes-no* questions.

Valian et al. (1992) analyze adult English questions as containing a maximal projection, QuesP, which is headed by a Q marker and takes CP as its complement, although – crucially – it does not subcategorize CP. In English *yes-no* questions, where inversion is optional, the head of QuesP, Q, can lower to C, preventing inversion in observance of the doubly filled COMP constraint. In *wh*-questions, in contrast, lowering of Q to C is not possible, resulting in obligatory inversion. Since there are adult languages such as French in which Q-to-C lowering is possible for both *yes-no* and *wh*-questions, the authors hypothesize that, in English, Q can occupy C only if [Spec,CP] is empty, i.e., in *yes-no* questions.

On this analysis, English-speaking children must learn the restriction on movement from Q to C. English-speaking children's errors in questions are attributed to a grammar allowing optional Q-to-C lowering in all questions, which is licit in French but prohibited in adult English; their grammar is thus consistent with continuity. Among the problems for this analysis are the postulation of a lowering rule, an explanation for why English has such a special restriction, and the lack of a learning procedure for acquiring the restriction.

2.2. The Adjunction Analysis

De Villiers (1991), Plunkett (1991), and Stromswold (1990) treat auxiliary inversion errors as a function of a landing-site difference between argument and adjunct questions. According to this adjunct analysis, children incorrectly represent the location of the adjunct *wh*-element and thus move argument and adjunct *wh*-elements to different positions in the structure (CP or IP, respectively), resulting in consistent inversion with argument *wh*-words (*what*) and lack of inversion with adjunct *wh*-words (*where*).

The central argument in Stromswold (1990) focuses on three major points. First, *wh*-operators which have left a trace in their base-generation site have to be in [Spec,CP] to be able to properly govern their traces. Second, within the Government and Binding framework, arguments and adjuncts play different roles with respect to the subcategorization requirements of the main verb. Argument *wh*-elements have to leave a trace in their base position in order to meet the Theta Criterion. Adjunct *wh*-elements are not subject to the Theta Criterion and therefore do not need a trace. Instead, they can be base-generated directly into a sentence-initial position, which need not be a specifier position. Third, a *wh*-element moved to [Spec,CP] triggers auxiliary inversion because of the need for spec-head agreement. Thus, argument *wh*-words will always occupy a specifier position and will cause auxiliary inversion. Adjunct *wh*-words, in contrast, may occupy a non-specifier position and need not trigger inversion.

Plunkett (1991) and de Villiers (1991) further extend the adjunct vs. argument analysis, arguing that children apply two different movement rules when forming *wh*-questions. Inversion errors are viewed as either due to an adjunct scrambling rule independently present in the adult grammar (Plunkett, 1991), or to IP adjunction of non-argument *wh*-phrases (De Villiers, 1991).

A crucial problem for the adjunct vs. argument explanation, as Valian et al. (1992) note, is that it does not account for the empirical facts. Children both fail to invert with some argument *wh*-questions and correctly invert with some adjunct *wh*-questions. For example, data from several studies (Labov & Labov, 1978; Stromswold, 1990; Valian et al., 1992) show that inversion errors do exist in *what* and *which* argument questions while some adjunct questions, contrary to predictions, appear correctly inverted most of the time (e.g., Kuczaj & Brannick, 1979 for *where* and *why*; Stromswold, 1990 for *how*, *where* and *why*).

2.3. The Morphology-based account

Santelmann et al. (2002) propose that children's inversion errors in questions do not result from lack of knowledge about auxiliary inversion but from a different type of competence deficit. They hypothesize that development in question formation requires integration of language-specific knowledge about the inflectional system. Children's inversion errors are specifically due to difficulties with *do* support and verb *be* raising. On this account, performance is expected to improve with development as knowledge about the interaction of language-specific factors with inversion is acquired over time. The drawback of this analysis is that it is limited to *yes-no* questions and it is unclear whether it could be extended to *wh*-questions.

2.4. The Data Problem

The available data on the acquisition of English *wh*-questions are characterized by enormous variability brought about by differences in experimental techniques, age groups, and scoring and coding procedures. There may be no other area of acquisition in which the facts are so difficult to settle. Reported auxiliary inversion error rates range from 0 % to 55 % in *wh*-questions, depending on the study. The facts come from three principal data sources: observational studies of spontaneous speech (Bellugi, 1971; Ingram & Tyack, 1979; Klee, 1985; Stromswold, 1990; Valian, Lasser, & Mandelbaum, 1992), elicited imitation or elicited production tasks (Erreich, 1984; Santelmann, Berk, Austin, Somashekar, & Lust, 2002; Valian & Casey, 2003), and grammaticality judgment tasks (Stromswold, 1990). Some studies (Bellugi, 1971) use data from a single child; others have larger samples, ranging from 14 to 65 participants.

Another point of disagreement concerns the extent to which inversion varies depending on the type of the *wh*-question. Stromswold (1990) found higher inversion rates in spontaneous speech with questions containing *who* (100 %), *what* (94 %), *where* (95 %), and *how* (97 %) than with those containing *why* (87 %), *which* (79 %) and *when* (77 %). Data from spontaneous speech tend to yield lower error rates than data from elicited imitation or production, perhaps because spontaneous speech selectively reveals what children can ask. Valian & Casey (2003), for example, found that children's spontaneous *wh*-questions were largely inverted but lacked variety in the type of *wh*-word used (70 % of the questions were *what* questions) and in the verbs and auxiliaries used (inversion occurred only with main verb and Aux *be* and not with modals or *do*). Erreich (1984) similarly noted that inversion is more likely in spontaneous speech (46 %) than elicited questions (34 %).

The existing evidence on error rates in children's acquisition of questions in English is thus inconclusive. The great variability leads to disagreement among researchers on how frequently children invert auxiliaries when auxiliaries are included and whether correct inversion seems to be acquired earlier with certain *wh*-words. The present study addresses these issues by providing new cross-linguistic data from controlled experiments and offering an alternative approach to auxiliary errors in early English *wh*-questions. Particularly, we ask whether auxiliary errors are a result of a set of language-specific properties. We discuss this alternative explanation in the next section.

3. The Hypothesis Search Space Model: An Alternative Approach

We propose a different model from those reviewed above. On our hypothesis-testing model, the unique combination of language-specific properties of the target determines how easily the child can narrow down the hypothesis search space. We assume that all children begin with a similar hypothesis space (possibly given by universal grammar) and that all children prefer the most general possible hypotheses. If the properties of a particular target language are compatible with those general hypotheses, it will be learned easily. If they are incompatible, learning will require more time. The difference between questions in English and Bulgarian illustrates our model. Three main distinctions are required for English-speaking children to identify and use to refine the hypothesis search space for *wh*-questions: a) the auxiliary – main verb dissociation, b) matrix vs. embedded clause differences, and c) relative vs. interrogative pronouns.

English auxiliary verbs and main verbs behave differently (the importance of which was noted by Guasti, 2000). Auxiliaries must invert with the subject while main verbs (except for copula *be*) cannot. If children aim for the most general hypothesis, they will treat auxiliary and main verbs similarly, leading to three possible but incorrect hypotheses: A1) invert all verbs with the subject; A2) do not invert any verbs with the subject; A3) optionally invert all verbs with the subject. In order to reject all three of these erroneous hypotheses children have to learn which verbs belong to the equivalence class of auxiliaries. Only then would they be able to consider a hypothesis like 'invert only auxiliary verbs; do not invert main verbs'. Before learning the difference between the two types of verbs, a child who sees that some verbs undergo inversion and others do not should opt for A3), since it fits the facts best.

English main questions require auxiliary inversion as in example (3) while embedded questions prohibit it (4). But if children's initial hypothesis space is formulated broadly, it will contain another triad of hypotheses: B1) always invert in *wh*-questions; B2) never invert in *wh*-questions; B3) optionally invert in *wh*-questions. Again, none of the hypotheses is correct. Instead, children have to be able to distinguish between root and embedded questions and accept B1) for root questions and B2) for embedded questions. Before learning the difference between the two types of structures, a child who sees that inversion occurs sometimes but not always should opt for B3).

(3) Where could Maria *could go?
(4) I want to know [where *could Maria could go].

The third relevant variation is related to interrogative and relative pronouns. Interrogative pronouns require inversion (5) while relative pronouns do not (6). In English, the pronouns are homonymous, encouraging the general hypothesis that they should behave similarly. Children have to learn to distinguish the two structures in (5) and (6) to recognize that relative clauses like (6) are not in fact examples of non-inversion in *wh*-questions. Thus, the child has the following set of hypotheses: C1) always invert with a *wh*-word; C2) never invert with a *wh*-word; C3) optionally invert with a *wh*-word. Before acquiring the distinction, the child forming the most general hypothesis will again pick C3) as her first guess.

(5) Where does she live?
(6) Maria loves the city where she lives.

4. The Role of Cross-linguistic Variation

In our view, cross-linguistic variation can be thought of as differences in the ease of narrowing the hypothesis search space. It is these differences that account for different patterns of acquisition. We predict that in a language like Bulgarian, which makes none of the three distinctions described for English, learning of auxiliary inversion in *wh*-questions will be faster even though the English learner and the Bulgarian learner start with the same sets of hypotheses.

For example, the Bulgarian learner also starts with A1 – A3. But in her case, A1 is immediately compatible with the facts, because Bulgarian does not differentiate between auxiliaries and main verbs (7a, 7b).

(7) a. Kude shte iade kuklata dnes?
    Where will eat doll-the today
    Where will the doll eat today?

  b. Kude iade kuklata dnes?
    Where eats doll-the today
    Where does the doll eat today?

Similarly, the Bulgarian learner also starts with B1 – B3, but Bulgarian treats main and embedded questions (8a, 8b) the same way, requiring inversion in both. Thus, Bulgarian supports only one hypothesis: 'invert all verbs in all questions'.

(8) a. Kakvo e igral s tebe Ivan?
    What has played with you Ivan
    What has Ivan played with you?

  b. Kazi kakvo e igral s tebe Ivan.
    Tell (me) what has played with you Ivan
    Tell me what Ivan has played with you.

Finally, Bulgarian interrogative pronouns (e.g., *kude = where*) and relative pronouns (e.g., *kudeto = where*) are not homonymous and therefore do not need to be distinguished with respect to their inversion requirements (9a, 9b).

(9) a. Kude zivee Maria?
    Where lives Maria
    Where does Maria live?

  b. Maria obicha grada, kudeto tia zivee.
    Maria loves city-the where she lives
    Maria loves the city where she lives.

Since Bulgarian features no contrasts regarding inversion, i.e., it supports a general hypothesis, we predict that Bulgarian-speaking children a) will master inversion in *wh*-questions earlier than their English-speaking peers, b) will correctly invert auxiliaries when present, c) will invert the verb and the subject at a high rate.

5. Methodology
5.1. Participants

The participants in the cross-sectional study were 18 monolingual Bulgarian-speaking children aged between 2;2 and 3;3, with mean age 2;9, and 29 monolingual English-speaking children aged between 2;6 and 3;2 with mean age 2;9. The children were recruited through day care centers, nursery schools, and personal contacts. The children had no known history of language or other delays.

5.2. Procedure

The study consisted of one approximately 60-minute session administered at a daycare center or

the child's home[3]. The entire session was audio-recorded. At the beginning of the session, the experimenter brought out a children's book to develop a conversation with the child and gather spontaneous speech. Approximately 20-25 minutes of spontaneous speech were collected. In the second segment, the researcher introduced the elicited imitation task as a game in which the child was to say what the experimenter said. Each target sentence was accompanied by a picture of the agent (subject). The child was asked to repeat the question to a character – Freddy the frog in the Bulgarian version, Gabby Bear in the English version. The prop toy was used to facilitate children's engagement in the task. A child could hear a sentence a maximum of 2 times.

5.3. Materials

Bulgarian and English materials were comparable in structure and length. The mean number of words per target was 4.88 for Bulgarian and 4.96 for English. Both versions of the study used 4 practice questions and 24 experimental *wh*-questions.

5.4. English stimuli

The English part of the study manipulated 2 variables: 1) *wh*-word: *when* and *where* and 2) auxiliary type: *be*, *can, do*, and *will*. The 2 (*wh*-word) X 4 (auxiliary type) design yielded 8 combinations with 3 trials each. Examples of target *wh*-questions are shown below:

(10) Where will she go today?
(11) When can they play?
(12) Where are Gabby's toys?
(13) When does the telephone ring?

5.5. Bulgarian stimuli

The Bulgarian version of the experiment used the *wh*-words *what* and *where* and two auxiliary types: *sum* (*be*) and *shte* (*will*). These are the only auxiliaries in the language. Since Bulgarian *wh*-questions do not require the presence of an auxiliary unless the corresponding declarative sentence also contains one, we added the variable presence or absence of Aux (+AUX, - AUX). To control for length in questions without an auxiliary we introduced a third level of the new variable by adding the reflexive clitic *si,* which is very similar in its syntactic behavior to the auxiliary clitic. Like the auxiliary, this clitic is monosyllabic and precedes the verb. Examples demonstrating the 3 levels of the Aux presence or absence condition are shown below:

(14) Kakvo shte iade kuklata dnes? (Main Verb + Aux)
    What will eat doll-the today
    What will the doll eat today?

(15) Kakvo chete s nas tatko? (Main Verb – Aux)
    What reads with us daddy
    What does daddy read with us?

(16) Kakvo si igrae Ivan s tebe? (Main Verb + Clitic)
    What refl-cl. plays Ivan with you
    What does Ivan refl-cl. play with you?

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[3] The English data are from the first session of a larger project investigating the role of structured input in the acquisition of *wh*-questions (Valian & Casey, 2003).

5.6. Coding and Data Analyses

There were two dependent measures: auxiliary inversion and main verb inversion (in Bulgarian only). Auxiliary and main verb inversion measured correct placement in those utterances that contained an auxiliary or verb and an overt subject[4]. The data were also coded for overall correct imitation which was calculated based on the number of completely correctly repeated words out of the total words in any given target sentence.

6. Results

The results strongly support our hypotheses. Overall auxiliary inversion for Bulgarian children was 100 %, significantly higher than the 81 % for English, (t(28) = -3.337, p < 0.001). Even if we just compare inversion with the auxiliary *will*, Bulgarian children performed significantly better (100%) than their English counterparts (79%, t(23) = -4.029, p = 0.001). This result rules out any effects due to problems with English modal verbs or the copula *be*.

As predicted, children showed high inversion rate of Bulgarian lexical verbs as well (93%). High auxiliary and verb inversion rates were stable across conditions and did not vary with respect to aux type (*be* vs. *will*), presence or absence of an aux, verb form (present vs. past), or *wh*-word (*what* vs. *where*). This provides evidence for the robustness of the effect in our findings.

Overall correct imitation was (67%) for Bulgarian and (70%) for English. The difference was not significant. Bulgarian children's near-perfect performance on auxiliary and verb inversion thus cannot be attributed to ceiling effects, since their overall correct imitation is comparable to that of their English-speaking counterparts.

7. Discussion

The results from our Bulgarian experiment show that Bulgarian two-year-olds exhibit high auxiliary and inversion rates indicating that, as predicted, they acquire *wh*-questions earlier than their English-speaking peers. They know a) that auxiliaries and lexical verbs invert with the subject and b) that subject-aux and subject-verb inversion is obligatory in *wh*-questions. The near-perfect performance of Bulgarian children argues that the errors in English are due to a specific combination of properties of the target language rather than to broader factors such as problems with movement or incorrect structural representations of questions.

On our analysis, the difficulty of aligning the properties of English input with the hypotheses specified in the hypothesis space makes English *wh*-questions hard to learn. The ease of aligning the Bulgarian input with the hypotheses makes Bulgarian *wh*-questions easy to acquire. We propose that differences between English and Bulgarian regarding 3 distinctions account for the differences in children's performance.

First, English auxiliaries must invert and lexical verbs cannot; Bulgarian auxiliaries and lexical verbs behave similarly. English-speaking children thus face a challenge their Bulgarian peers do not: distinguishing auxiliaries and verbs.

Second, English embedded *wh*-questions prohibit auxiliary inversion even though matrix *wh*-questions require it. Bulgarian, in contrast, requires inversion in both main and embedded *wh*-questions, providing consistent evidence for obligatory inversion in *wh*-questions.

Third, in English, relative and interrogative pronouns are homonymous; in Bulgarian they are not (e.g., *kude* vs. *kudeto* (= *where*)), so relative clauses do not count as misleading evidence for lack of inversion in *wh*-questions.

There are three important implications of our cross-linguistic comparison. First, children have functional projections very early. English positional errors are not attributable to a lack of capacity. Second, inversion errors in English are not due to problems with syntax, such as difficulty with movement. Third, inversion errors are due to a unique combination of language-specific properties of

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[4] The presence of an overt subject is necessary to determine whether inversion has taken place.

the target grammar. Specifically, the apparent compatibility between a very general rule – invert optionally – and the input draws out the length of time required for acquisition.

Our analysis is consistent with an optional inversion rule account but also explains why the English learner would be drawn to such a rule, namely, that the learner's very general optional hypotheses are superficially compatible with the input. Our analysis is also compatible with approaches that focus on language-specific properties but it emphasizes a combination of relevant distinctions which determine the time course of acquisition. Our investigation, however, disconfirms the incorrect location hypothesis. The lack of an adjunct vs. argument distinction in English and Bulgarian predicts no difference in inversion with adjunct questions in either language. In fact, this is what our Bulgarian data show – there were no differences in inversion rate as a function of *wh*-word (*what* vs. *where*). (See Ambridge, Rowland, Theakston, & Tomasello, 2006, and Valian & Casey, 2003 for similar results for English.)

8. Conclusion

Our cross-sectional study of English- and Bulgarian-speaking children's production of *wh*-questions shows that differences in performance can be accounted for in terms of cross-linguistic variation. Language-specific combinations of certain distinctions (e.g., Aux vs. verb dissociations, clause type differences, and interrogative vs. relative pronoun homonymy in English) affect acquisition of *wh*-questions. Languages in which general rules must be narrowed to particular morphosyntactic environments will be harder to learn. This explains children's difficulties with inversion in English *wh*-questions. Languages with fewer or no contrasts, like Bulgarian, are compatible with the child's initial general hypotheses and do not require further narrowing and partitioning. That makes Bulgarian inversion easy to acquire.

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