Inversion in Interim Grammars

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Abstract

The aim this paper is to provide a straightforward and unified account for Subject-AUX inversion (SAI)in interrogatives and interrogative patterns which vary across the range of possible interim grammars by making use of Optimality Theoretic constraints. The constraints include the restriction on clause type, *wh*-operator, economy of representation, feature specification, head, and traces. The proposed hypothesis is that in Standard English, the constraints are stratified in the order enumerated. Thus the optimal representation of an interrogative in Standard English, whether it be a yes-no question or a *wh*-question, is the one that best satisfies the stratified constraints. Demonstrating that systematic failure of SAI in embedded questions of Standard English is also explained as a consequence of the interactions of the constraints, this paper argues that sporadic or systematic occurrence of SAI in embedded contexts of interim grammars of English immediately follows from the difference of the same set of constraints.

Key words: Subject-AUX inversion,interim grammars, Optimality Theory, constraints, ranking, acquisition

1. Introduction

In the framework of the principles and parameters approach and the Minimalist Program, many proposals have been presented concerning SAI in matrix clauses and the embedded contexts where SAI does not apply. Rizzi (1996)provides an account of such construction-specific manifestations of I-to-C movement in a language like English ("residual verb second") by making use of an independently necessary principle viz. the *wh*-criterion. Under the Minimalist Program, on the other hand, one category bearing [+wh] feature in *wh*-interrogatives in English moves to CP-SPEC in overt syntax (Chomsky and Lasnik (1993), Chomsky (1993), Chomsky (1995 a, 1995 b), among others). It is assumed that complementizers bearing [+wh] feature are always strong. As strong features must be eliminated before PF because of its uninterpretability to the interface, the [+wh] feature of the complementizer must be discharged before PF (see Chomsky (1993)). A *wh*-movement must therefore be present in CP-SPEC at some point in the derivation before PF so that the strong features can be discharged by the feature checking between the complementizer and the *wh*-phrase.[1)]

However, the analyses based on feature checking or the *wh*-criterion are in quandery as to how to provide a unified account for interrogative patterns which vary across the range of possible interim grammars. This paper is devoted to providing a straightforward and unified account for SAI in interrogatives and its cross-linguistic variation by making use of the following Optimality Theoretic constraints:

CLAUSE TYPE (CL-TYPE) : Clause type must be manifested.

OPERATOR (OP) : Syntactic operators must be in a c-commanding specifier position from which their scope is interpreted.

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CASE: One member of the chain of an argument must be Case-marked.

ECONOMY OF REPRESENTATION(ECO-REP): There can be no irrelevant symbols in a representation.

NO-REDUNDANCY (*REDUN) : Redundant feature specification is not allowed.

HEAD : A projection has an overt head.

*trace: Trace is not allowed.

2. Language Acquisition

From the view point of the Optimality Theoretic (henceforth, OT) framework, language consists of the universal constraints and the lexicon providing the particular underlying forms in the language particular inputs. Language acquisition follows from the role at the constraints within a particular language. That is, the difference of constraint ranking between child grammar and adult grammar characterizes the distinctive patterns and leads to variation between them. Part of acquiring a language is acquiring the critical ranking of that language and the lexicon. The formal characterization of language change in the course of learning is reduced to the reranking of constraints and the substantive knowledge of the lexicon. This means that the reranking of constraints is not the only factor to provide a unified account for interrogative patterns which vary across the range of possible interim grammars.

The issue that remains to be investigated is what is the mechanism of the constraint reranking and what is the relation between the substantive knowledge of the lexicon and the interrogative patterns. An examination of some of the various previous analyses on language acquisition is useful in that the analyses must be considered in giving a more complete account. In this section, therefore, we begin with reviewing such analyses.

2.1 Parameter Theory

Parameter theory, a version of a theory of UG developed by Chomsky (1981) and others, is designed to account for universal as well as particular aspects of grammars. It also offers theoretical concepts and mechanisms designed to deal not only with diversity among languages but also with variation across the range of possible interim grammars in language acquisition. In the parameter theory, the setting of a parameter value may cause a cluster of superficially unrelated grammatical properties to appear in the language. This can be illustrated by means of the "null-subject" or "pro-drop" parameter. Whereas some languages allow empty subjects in tensed clauses, e. g. Spanish, others normally require this position to be filled lexically. e. g. English. The null-subject parameter specifies the grammatical conditions which must be met for this empty category "pro" to occur. The use of expletive subjects, on the other hand, provides reliable information to the effect that the language is not a null-subject language (cf. Hyams (1986, 1989)). From an acquisitional perspective, properties of grammar are the parameterized principles of UG. Thus children need to find out how the values of the paramerers are set in the languages they are acquiring. Since UG allows for different solutions in these cases, children explore the range of variation defined by parameterized options of UG, since these choices have to be made on the basis of information available in the input not determined a priori.

Opinions vary with respect to triggering of parameter setting. It is likely that during the period of linguistic development when parameter values set, parameter setting is triggered by a certain type of linguistic data whose properties are narrowly defined, in terms of reliability or grammatical complexity. Under Lightfoot's (1989, 1991) learnability theory, in order to discover the positive evidence necessary to decide on the setting of many parameters, it is sufficient to have access to degree-0 plus a little; that is, only matrix clause structures and the front of the embedded clause need to be accessible (for degree-1 learnability, see Morgan (1986), and for degree-2 learnability, see Wexler and Culicover (1980)).

With regard to what parts of grammar can be parameterized, it had been hypothesized that universal principles themselves are parameterized (Chomsky (1981, 1986)).

Following Bore's (1983) suggestion of removing the burden of parametric choice from the computational component to the lexicon, Manzini and Wexler (1987) proposed the Lexical Parameterization Hypothesis, which means that the value of a parameter is associated with properties of individual lexical items. A more radical change is introduced by Chomsky (1991), who proposes that parameters of UG should only relate the lexicon, not to the computa-

tional component. He states further that if substantive elements are drawn from an invariant universal vocabulary, then only functional elements will be parameterized. Put differently, parameterization is restricted to a closed class of functional heads. The hypothesis is in line with hypotheses that early grammars only contain projections of referential categories, most importantly verbs and nouns, whereas functional categories are implemented in the course of further acquisition (this is termed as the "Structure Building Hypothesis" by Guilfoyle and Noonan (1988)). In effect, when children acquiring English first start to form productive syntactic structures during the period multiword utterance which typically lasts from around 20-24 months of age, sentence structures are projections of the four primary lexical heads (V, N, A, and P) and lack functional heads (complementizers, determiners, auxiliaries, inflectional suffix, etc.), in marked contrast to adult grammar.[2)]

An obvious prediction by the hypothesis that early child clauses lack functional category systems is that children at this stage will show no evidence of having developed a category of modal auxiliaries. According to Brown and Bellugi (1964), and Ervin-Tripp (1964), children systematically omit modals when asked to repeat model sentences containing them. Another type of evidence for the claim that early child clauses are lexical VPs comes from the fact that children at this stage make no productive use of tense and agreement affixes which are attached to finite non-auxiliary verbs in adult English.

(1) Mummy cry. Mummy sit down. Mummy go. Mummy take top off. Mummy get cross. Mummy smack Jem. (Jem 23)[3)]

Many studies of *wh*-questions in child speech claim that children under two years of age do not show any evidence of having acquired a productive use of *wh*-fronting. According to Radford (1990,1995), children under two years of age show no evidence whatever of auxiliaries preposed into C (e. g. SAI in direct questions).

(2) Chair go? Kitty go? car go? Jane go home? Mommy gone?

Radford (1995 : 488)

Furthermore, at this stage, interrogatives children produce do not exhibit *wh*-movement which moves *wh*-phrases into the specifier position of C, although they express interrogatives with rising intonation at the end of utterance.[4)]

(3) a.Bow-wow go? ("Where did the bow-wow go?"Louise 15)
b.Mummy doing? ("What is mummy doing?"Daniel 21)
c.Car going? ("Where is the car going?"Jem 21)
d.Doing there ?("What is he doing there?"John 22)
e.Mouse doing?("What is the mouse doing?"Paula 23)

Radford(1995 : 489)

Even if children do not omit *wh*-phrases, they produce no *wh*-questions containing initial *wh*-phrases.

(4) Adult: What are they doing there?
Child: Doing what there?

Radford (1990 : 124)

The omission of *wh*-phrases and preposed auxiliaries and no *wh*-fronting suggest that children have not developed a syntactic C-system yet and thus lack a landing site for the preposed auxiliaries and fronted *wh*-phrases. Put in another way, the lexicon in early grammars lacks CPs and IPs, i. e. extended projections of lexical verbal head.

Further evidence for the absence of non-lexical-thematic structures comes from the fact that children at this stage use indeterminate nominals lacking a syntactically projected D-system in contexts where adults would require nominals containing a D-system and do not productively attach the genitive suffix to possessor nominals.

(5) a.Hayley draw *boat*. Turn *page*. Reading *book*. Want *duck*. Want *book*. (Hayley 20)
b.*Blanket* gone. *Stick* gone. *Dog* barking. Got *lorry*. *Paper* off. Want *ball*. (Bethan 21)

Radford (1995 : 493)

The absence of functional constituents in Early Child Grammar is shown by the fact that children at this stage consistently omit the functional particle *of* before nominal complements of nouns.

(6) a.Cup tea (="a cup of tea,"Stefan 17)
b.Bottle juice (="a bottle of juice,"Lucy 20)

ibid.(1995 : 492)

From the observations presented above, it follows that parameter setting related to functional categories cannot be executed until functional categories are instantiated in acquisition of grammar. As Grimshaw (1991, 1993, 1997) proposes, IP and CP are extended projections of V and like-

wise DP is an extended projection of N(cf. Jackendoff (1977), Emonds (1985), Bresnan (1986)). A V-system must exist before an I-system or C-system can develop, and an N-system must exist before a D-system can develop. It follows then that the first stage of acquisition must of necessity be to build up lexical structure or lexical heads must be acquired before their functional counterparts. This conception is in line with the Structure Building Hypothesis.

As already noted, part of acquiring a language is acquiring the critical ranking of that language and the lexicon. The formal characterization of language change in the course of learning is reduced to the reranking of constraints and the substantive knowledge of the lexicon. Thus the constraint reranking related to functional categories cannot be executed until functional categories are instantiated in the acquisition of grammar. From this point of view, the learning problem makes the Structure Building Hypothesis a relevant and important one in the proposal to come.

We have seen the relation between the Structure Building Hypothesis and the lexicon. The next step is to show the mechanism to rerank the universal constraints. We therefore take a close look at the mechanism in the following section.

2．2 Constraint Demotion

Under OT, adult grammar is acquired by a totally ranked hierarchy of universal constraints. When children's learning is successful, the learned stratified hierarchy is one total ranking consistent with all the learning data. In the initial stage of grammar, there is no totally stratified hierarchy of constraints. Constraints therefore tie and lie in the same stratum.

OT is inherently comparative. The well-formedness of structural description is determined not in isolation, but with respect to competing candidates. Thus children do not determine the correct ranking only by positive data in isolation. The role of the competing candidates must be addressed. Each piece of positive evidence, a grammatical structural description, brings with it a body of implicit negative evidence in the form of the competing descriptions. Given access to GEN and the underlying form contained in the given structural description, children have access to these competitors. Any competing candidate, along with the well-formed structure, determines a data pair related to the correct constraint ranking. In the competitors, the well-formed structure becomes a winner. Selecting suitable set of winner/loser pairs, children find the correct constraint ranking.

To determine the correct constraint ranking after selecting suitable set of winner/loser pairs related to the ranking, we employ the constraint demotion mechanism proposed by Tesar (1998) and Tesar and Smolensky (1998). According to Tesar (1998) and Tesar and Smolensky (1998), the constraints violated by the winner are demoted down in the hierarchy so that they are dominated by the contraints violated by the loser. In the initial stage of learning, constraints are not ranked with respect to one another, as follows:

(7) $\{C_1, C_2, C_3\}$

Tableau 1

Candidates	C_1	C_2	C_3
P_1	*		**
☞P_2		*	

Tableau 2

Candidates	C_1		C_3	C_2
P_1	*		**	
☞P_2				*

Suppose that the first winner/loser pair is P_1 and P_2 (the two competing candidates related to the correct ranking) and P_2 is the winner. If C_2 is violated by the winner P_2, it is demoted down to the second stratum where the other constraints dominate it.

(8) $\{C_1, C_3\} >> C_2$

And another winner/loser pair P_2 and P_3 is selected in determining the constraint ranking of C_1 and C_3. If P_2 is the winner and the constraint C_3 is violated by the winner P_2, it is demoted down to the second stratum which C_2 belongs to.

(9) $C_1 >> \{C_2, C_3\}$

Tableau 3

Candidates	C_1		C_2	C_3
☞P_2			*	*
P_3	**			

Tableau 4

Candidates	C_1		C_3	C_2
☞P_2				*
P_4			**	

Another winner/loser pair P_2 and P_4 is selected in determining the constraint ranking of C_2 and C_3 which C_1 immediately dominates. If P_2 is the winner and the constraint C_2 is violated by the winner P_2, it is demoted down to the stratum which C_3 belongs to.

(10) $C_1 >> C_3 >> C_2$

By starting with all constraints at the top, constraints are demoted down toward their correct position. Since constraints are demoted only as far as necessary, a constraint never gets demoted below its target position and will not be demoted further once reaching its target position.[5]

Having introduced the constraint demotion mechanism, we now take a close look at interrogative patterns which vary across the range of possible interim grammars in language acquisition in the section that follows.

3. Acquisition of Interrogatives

3.1 Lack of Functional Category Systems

Children acquiring English first start to form productive syntactic structures during the multiword utterance period which typically lasts from around 20-24 months of age. From this stage, children express yes-no questions with rising intonation at the end of utterance. Since functional category system has not full fledged and auxiliaries have not been listed in the lexicon at this stage, SAI is not observed (stage 1).[6] In what follows, question particles (e. g. *Is*) are observed in the left edge of yes-no questions (stage 2).[7] In place of question particles, children begin to produce auxiliaries in medial position and invert them in yes-no questions and *wh*-questions. While some children begin to invert in yes-no questions before they begin to invert in *wh*-questions,and others begin to invert in yes-no and *wh*-questions simultaneously (see Weinberg (1990)). No children begin to invert in *wh*-questions before inverted yes-no questions are exhibited (stage 3). Inversion extends to embedded yes-no questions, whereas inverted embedded *wh*-questions are not exhibited (stage 4). In due course, inversion occurs in embedded *wh*-questions, and children begin to introduce the complementizer *if* in embedded yes-no questions (stage 5).[8]

(11) Acquisition of Interrogatives

stage 0 : a. one-word utterance (12-18 months)
b. two-words utterance (18-24 months)
c. telegraph speech (24-36 months)

stage 1 : No inversion in both yes-no questions and *wh*-questions
yes-no-Q: See my doggie? You want eat?
wh-Q: Where kitty?

stage 2 : Appearance of question particles
yes-no-Q: Is I can do dat? Is Ben did go dere?
Are you put this on me? Are this is broke?
wh-Q: How dat opened?
What you doing?

stage 3 : Inversion in yes-no questions
yes-no-Q:Can you do that? Is Ben going there?
wh-Q: How the door opened?
What are they doing?

stage 4 : Inversion in yes-no questions and *wh*-questions (no inversion in embedded *wh*-questions)

	Direct Questions	Embedded Questions
yes-no-Q:	Can you do that ?	I don't know[you can do that]
	Is Ben going there ?	I wonder [is Ben going there]?
wh-Q:	Who is she ?	I wonder [where the door is]
	(Where the door is?)	

stage 5 : Inversion in yes-no questions and *wh*-questions (appearance of complementizer *if* in indirect questions)

	Direct Questions	Embedded Questions
yes-no-Q:	Can you do that ?	I don't know[if you can do that]
	Is Ben going there ?	I wonder[can I find the bottle]?
wh-Q:	Who is she ?	Do you know [who is she]?
	(Where the door is?)	(I wonder[where the door is]

stage 6 : Adult Grammar: no inversion in embedded questions

3.2 Uninverted Interrogatives

It is suggested in the first section that syntactic phenomena in interrogatives in English are explained as a consequence of the interaction of the following constraints: CL-TYPE, OP, HEAD, *REDUN, ECO-REP, and *trace. We

now demonstrate how close the ranking of the constraints is associated with interrogative patterns which vary across the range of possible interim grammars in language acquisition presented above.

By starting with all the constraints at the top as in (12) and thus no constraint dominates any other.

(12){CL-TYPE, OP, ECO-REP, HEAD, *REDUN, *trace}

They are demoted down toward their correct position to determine the correct constraint ranking after selecting suitable set of winner/loser pairs related to the ranking. The conspicuous linguistic data on clause-type marking, e. g. declarative sentences vs. interrogative marking of any sentence confirm that CL-TYPE must be relatively high in the constraint hierarchy. At the very early stage of acquisition of English grammar, the constraints except CL-TYPE are therefore demoted down to the second stratum as in(13 b). In what follows, ECO-REP, HEAD, *REDUN, and *trace are demoted down to the third stratum below OP as in(13 c) on the basis of conspicuous linguistic data on *wh*-fronting observed in utterance of adult.

(13)a.{CL-TYPE, OP, ECO-REP, HEAD, *REDUN, *trace}

→b.CL-TYPE >> {OP, ECO-REP, HEAD, *REDUN, *trace}

→c.CL-TYPE >> OP >> {ECO-REP, HEAD, *REDUN, *trace}

By assumption, at the early stage in acquisition of interrogatives (i. e. stage 1), the given constraints are stratified as in(13 c)and the ranking remains as it is until a trigger for reranking is provided, precisely, at stage 4. Due to the fixed ranking of(13 c), interrogatives children produce exhibit some significant patterns according to the constraint ranking.

As already mentioned, grammatical properties related to functional categories like certain word order phenomena resulting from movement to IP or CP (e. g. Case-marking depending on properties of INFL and SAI, etc.) are absent during early phrases, since the lexicon in very early grammars lacks CPs and IPs, i. e. extended projections of lexical verbal head. At this stage, therefore, children resort to rising intonation at the end of interrogative sentences due to no syntactic mechanism to encode interrogatives.

In contrast to the early stage, at stage 1, inverted *wh*-questions are exhibited, which indicates that children have acquired extended projections of verbal head (i. e. IP and CP) at this stage. However, children at this stage have not acquired question particles yet, thus they have no morphological means to encode yes-no questions, thereby inducing a CL-TYPE violation. If rising intonation at the end of utterance encodes questions (indicated by a question mark) in place of a question particle or something like that, the sentence is recognized as a yes-no question despite its being disfavored by CL-TYPE due to no overt clause-type marker at the left edge of the sentence. For example, all the candidates in Tableau 5 violate CL-TYPE because of no overt clause-type marker at the left edge of the sentence. No overt head in CP results in a HEAD violation, as shown in the other candidates than the third one. And moreover, the last candidate aggravates a HEAD violation due to no overt head in IP.

Violation of a lower ranked constraint may be tolerated in order to satisfy a higher ranked constraint. Lower ranked constraints resolve ties of a higher ranked constraint induced by either the satisfaction of the higher ranked constraint or the violation of the higher ranked constraint. The third candidate is therefore the winner.[9)]

The fact that *wh*-fronting is observed at stage 1 indicates that a *wh*-operator at the left edge of a sentence plays an essential role of encoding an entire sentence as a *wh*-question in this case. Without *wh*-fronting, both a CL-TYPE violation and an OP violation will result. In Tableau 6, the second and third candidates, where *wh*-fronting has not been

Tableau 5 Stage 1 Yes-no Questions

Candidates	CL-TYPE	OP	*REDUN	ECO-REP	HEAD	*trace
[$_{CP}$ e[$_{VP}$ you want eat]]	*				*	
[$_{CP}$ e[$_{VP}$ you want[+Q]eat]] ?	*				*	
☞[[$_{VP}$ you want[+Q]eat]] ?	*					
[$_{CP}$ e[$_{IP}$ you e[+Q] [$_{VP}$ t want eat]]]	*				**	*

Tableau 6 Stage 1 *Wh*-questions

Candidates	CL-TYPE	OP	*REDUN	ECO-REP	HEAD	*trace
☞[$_{CP}$ Why e[$_{VP}$ you smiling[+Q]t]] ?					*	*
[$_{CP}$ e[$_{VP}$ you smiling[+Q]why]] ?	*!	*!			*	
[$_{CP}$ e[$_{IP}$ e[$_{VP}$ smiling[+Q]why]]] ?	*!	*			**	

implemented, violate CL-TYPE and OP. Although a HEAD violation is induced in the first and third candidates due to an empty C head of CP, the first candidate satisfies CL-TYPE and OP by virtue of *wh*-fronting. In the first candidate, the violation of *trace has the benefit of allowing CL-TYPE and OP to be satisfied. However, there is no way to eschew the HEAD violation due to no lexical element in the head of CP in this candidate, since auxiliaries have not been acquired yet in the lexicon at this stage.

For this reason, SAI is not executed in *wh*-questions at this stage. As already mentioned, Case-marking system has not been full fledged at this stage either, and thus the external argument does not undergo movement to IP-SPEC so as to have itself Case-marked by the INFL.

3.3 Appearance of Question Particles

In contrast to stage 1, I-system is available at stage 2 and thereby children produce auxiliaries in medial position. Some children who have acquired question particles (e. g. *Is* and *Are*) introduce them in the clause initial position of yes-no questions i. e. morphological encoding of yes-no questions. If both syntactic and morphological encodings are available, economy consideration will block the former bccause it aggravates a violation of *trace, which is one of Faithfulness constraints which ensure that the input and the output of a derivation differ as little as possible.

At this stage, as noted before, constraint demotion does not occur and thus the constraint ranking of stage 1 is retained as in (14).

(14) CL-TYPE >> OP >> {*REDUN, ECO-REP, HEAD, *trace}

Children who have acquired question particles introduce them in yes-no questions due to the requirement of CL-TYPE as shown in the OT calculation in Tableau 7; otherwise, inversion is a must. In Tableau 7, every candidate, including the optimal one, has a *trace violation, since a subject has been raised from VP-SPEC to IP-SPEC.

All the candidates except the last one do not satisfy CL-TYPE, since the head of CP is not occupied by the question particle. The first and third candidates violate HEAD because the head of CP is not filled by a lexical element. The last candidate violates only *trace, whereas all the other candidates violate the highest ranked constraint. The last candidate is encoded as a yes-no question because of the question particle *Is* with [+Q] feature being in the head of CP, respecting both HEAD and CL-TYPE. EVAL therefore selects the last candidate as optimal.

3.4 Inverted Yes-No Questions and Uninverted *Wh*-questions

3.4.1 Specifier-head Agreement in CP

Finite auxiliaries, finite tense/agreement affixes, and nominative pronouns are all acquired at the same stage of development typically shortly after children reach two years of age, suggesting that children at this stage have developed the full range of functional projections (i. e. extended projections) for verbs and nouns, and are already able to project VP into IP and CP, and NP into DP. Due to

Tableau 7 Stage 2 Yes-no questions

Candidates	CL-TYPE	OP	*REDUN	ECO-REP	HEAD	*trace
[$_{CP}$ e[$_{IP}$ I$_i$ can[$_{VP}$ t$_i$ do that]]] ?	*!				*	*
[$_{IP}$ I$_i$ can[$_{VP}$ t$_i$ do that]] ?	*!				*	*
[$_{CP}$ e[$_{IP}$ I$_i$ can[$_{VP}$ t$_i$ do that]]] ?	*!				*	*
☞[$_{CP}$ Is[$_{IP}$ I$_i$ can[$_{VP}$ t$_i$ do that]]] ?						*

the acquisition of the C-system in this point, as already mentioned before, children start to make productive use of SAI. However, this inversion is not precisely the same way as adults in that two and three years old children sporadically or systematically fail to invert some or all auxiliaries in contexs where inversion is obligatory in adult English, particularly in direct *wh*-questions (i. e. stage 3).

(15)a. Can I open that?

b. Why kitty can't stand up?

Radford (1995) suggests that this may be the result of an overgeneralization of specifier-head agreement on the part of the child. Following Kayne (1982), he assumes that an inverted auxiliary can be moved into a verbal C position, but not into a non-verbal C position; if complement clause C position in adult English is intrinsically a non-verbal position (as suggested by the fact, for example, that *for* is a prepositional complementizer), then there will be no auxiliary inversion in complement clauses, since a complement C is non-verbal and thus cannot accommodate a preposed verbal auxiliary. He posits that C in early child clauses is underspecified and lacks intrinsic categorial features, and in particular is unspecified with respect to whether it is a verbal/nominal constituent. If C lacks intrinsic categorial features at this stage, it would follow that SAI should be possible, since this would involve movement of a verbal auxiliary into a C position which is non-distinct in respect of the relevant categorial features (since C is neither specified as intrinsically verbal nor as intrinsically non-verbal). A sentence as (15 a) above suggests that SAI does indeed take place in yes-no questions. Furthermore, he accounts for the fact that SAI is blocked in *wh*-questions like (15 b) by positing that while the head of CP has no intrinsic (nominal/verbal) categorical features, it inherits (or is assigned) the categorical features of its specifier, via an overextension of specifier-head agreement. Noting that children at this stage overgeneralize specifier-head agreement within CP as in (16) and (17), he suggests that the *wh*-constituents *what* and *where* are in the CP-specifier position in (16) and (17) and the inverted auxiliary *is* / *'s* is agreeing with the specifier of CP with respect to third person singular and not with the subject in the specifier of IP.

(16)a. What's the wheels doing? (Holly 24)

b. What's those? (Alistair 30)

c. What's you doing? (Ellen 33)

d. What's they doing? What's they called now? (James 34)

(17)a. Where is his feet? (Jonathan 39)

b. Where's me? (Michelle 29="Where am I ?")

c. Where's we going tonight? (James 34)

d. Where is you? (Elspeth 39="Where are you?")

More concretely, he supposes that a sentence as *What he can ride in?* would have the skeletal structure as follows:

(18) $[_{CP}$What$[_{c}$ e$][_{IP}$ he $[_{I}$ can$]$ ride in $t]]$?

In (18), The specifier position within CP is filled by *what*, and the head C position of CP is empty. Since the *wh*-phrase *what* is intrinsically nominal, and since C carries no intrinsic categorical properties of its own at this stage of language acquisition but rather is assigned those of its specifier (via an overextension of specifier-head agreement), it follows that the head position of CP will inherit (or be assigned) the nominal properties of its specifier *what*. But since a verbal auxiliary like *can* cannot move into a nominal C position, SAI will be blocked in structures such as (18). More generally, since preposed *wh*-phrases are non-verbal constituents (by virtue of the fact that *wh*-movement cannot target VP, IP, or CP constituents), for children who have this type of system SAI will never be possible in *wh*-questions. In yes-no questions, since C has no specifier whose categorial properties it can inherit and thus remains unspecified in respect of the relevant core (i. e. nominal/verbal) categorial features, a verbal constituent can move to a categorially non-distinct position, predicting inversion in yes-no questions.

However, although Radford suggests that the *wh*-phrases in (16) and (17) exhibit specifier-head agreement in the C-system, the analysis based on agreement in C-system is confined to the syntactic phenomena at the stage where children are acquiring English interrogatives as (16) and (17), and does not establish empirical validity in that it cannot be extended to interrogatives of adult English as follows:

(19)a. Can you see the picture?

b. I wonder who John wanted to see.

Adult grammar of English does not exhibit an overgeneralization of specifier-head agreement. In (19 a), since the C has no specifier whose categorial properties it can inherit and thus remains unspecified in respect of the relevant core categorial features, the verbal constituent *can* undergoes I-

to-C movement. In (19 b), on the other hand, the *wh*-phrase has moved to the specifier position of the embedded C, which does not exhibit specifier-head agreement with the C by virtue of no overgeneralization of specifier-head agreement in adult grammar. The C remains unspecified in respect of the relevant core (i. e. nominal/verbal) categorial features, and thus a verbal constituent can move to a categorially non-distinct position. Inversion in (19 b) is thereby predicted, contrary to the fact. We shall return to this issue later.

3. 4. 2 Disappearance of Question Particles and Inversion

At stage 2, children introduce question particles to yes-no questions. Once children know the fact that the question particle does not appear in grammatical structural descriptions of yes-no questions in hand, they start to make productive use of SAI. On the other hand, they sporadically or systematically fail to invert some or all auxiliaries in direct *wh*-questions (i. e. stage 3). At this stage, as pointed out before, the constraint ranking is retained as CL-TYPE >> OP >> {*REDUN, ECO-REP, HEAD, *trace}, which is the same as stage 2.

From the view point of the analysis presented here, in cases of yes-no questions, if the head of CP does not bear a lexical element (e. g. question particles), it results in a HEAD violation. To eschew such a situation, SAI occurs as in the last candidate in Tableau 8. The I-to-C movement of an auxiliary leads to a *trace violation, which has the benefit of allowing HEAD and CL-TYPE to be satisfied.

In cases of *wh*-questions at this stage, on the other hand, given the constraint ranking CL-TYPE >> OP >> {*REDUN, ECO-REP, HEAD, *trace}, either failure or occurrence of SAI is predicted, as illustrated in Tableau 9. Without *wh*-fronting, a CL-TYPE violation and an OP violation will result as in the third and fourth candidates. A HEAD violation is induced in the second and fourth candidates because of an empty head of CP. The second candidate induces a *trace violation by virtue of the subject movement to IP-SPEC and has a HEAD violation induced by no I-to-C movement of the auxiliary (a *trace violation by *wh*-movement is omitted here), whereas the first candidate aggravates a *trace violation by virtue of the I-to-C movement of the auxiliary but respects HEAD. The two candidates tie with respect to the number of violations of HEAD and *trace. Notice that *REDUN, ECO-REP, HEAD, and *trace all tie on the ranking. The output of a set of tied constraints is the union of the outputs of every possible ranking of those constraints, predicting inverted and uninverted *wh*-questions. At this stage, as already mentioned, inversion in yes-no questions logically precede inversion in *wh*-questions or takes place at the same time, which is ascribed to CL-TYPE outranking HEAD and HEAD being equally ranked with *REDUN, ECO-REP, and *trace.

In the course of time, children begin to produce questions in embedded contexts. The interactions of the stratified constraints developed thus far predicts SAI in embedded yes-no questions and failure of inversion in embedded *wh*-questions, which are qualified as the significant aspects of interrogatives of stage 4. The head of CP in embedded questions is specified as [+Q] by the matrix verbs which

Tableau 8 Stage 3 Yes-no Questions

Candidates	CL-TYPE	OP	*REDUN	ECO-REP	HEAD	*trace
$[_{CP}$ e$[_{IP}$ you can[+Q]$[_{VP}$ eat it]]] ?	*!				*	
☞$[_{CP}$ Can$_i$[+Q]-C$[_{IP}$ you t$_i[_{VP}$ eat it]]] ?						*

Tableau 9 Stage 3 *Wh*-questions

Candidates	CL-TYPE	OP	*REDUN	ECO-REP	HEAD	*trace
☞$[_{CP}$ Why are$_j$ [+Q]-C$[_{IP}$ you$_i$ t$_j$ $[_{VP}$ t$_i$ smiling]]] ?						**
☞$[_{CP}$ Why e$[_{IP}$ you$_i$ are[+Q]$[_{VP}$ t$_i$ smiling]]] ?					*	*
$[_{CP}$ are$_j$[[+Q]-C$[_{IP}$ you$_i$ t$_j[_{VP}$ t$_i$ smiling why]]] ?		*!				**
$[_{CP}$ e$[_{IP}$ you$_i$ are[+Q]$[_{VP}$ t$_i$ smiling why]]] ?	*!	*			*	*

Tableau 10 Stage 4 Indirect Yes-no Questions

Candidates	CL-TYPE	OP	*REDUN	ECO-REP	HEAD	*trace
···V[$_{CP}$ e-[+Q][$_{IP}$ DP$_i$ AUX[+Q][$_{VP}$ t$_i$ V]]]	*!				*	*
☞···V[$_{CP}$ AUX$_j$[+Q]-C[+Q][$_{IP}$ DP$_i$ t$_j$[$_{VP}$ t$_i$ V]]]			*!			**

Tableau 11 Stage 4 Indirect *Wh*-questions

Candidates	CL-TYPE	OP	*REDUN	ECO-REP	HEAD	*trace
···V[$_{CP}$ AUX$_j$[+Q]-C[+Q][$_{IP}$ DP$_i$ t$_j$[$_{VP}$ t$_i$ V wh]]]	*!	*	*			**
···V[$_{CP}$ wh AUX$_j$[+Q]-C[+Q][$_{IP}$ DP$_i$ t$_j$[$_{VP}$ t$_i$ V]]]			*			**
☞···V[$_{CP}$ wh C[+Q][$_{IP}$ DP$_i$ AUX[+Q][$_{VP}$ t$_i$ V]]]					*	*

take them as their complement (i. e. a standard lexical selection). The head of IP in the embedded questions is also specified as [+Q]. The occurrence of SAI in the embedded questions therefore induces a *REDUN violation, since the head of CP in the embedded questions will bear redundant specification of [+Q] by the I-to-C movement of AUX. In the case of embedded yes-no questions, however, the failure of SAI leads to the result that the head of CP cannot encode the embedded clause as a yes-no question. Hence a CL-TYPE violation, as illustrated in the first and second candidates in Tableau 10. For this reason, SAI takes place in embedded yes-no questions at this stage.

Concerning embedded *wh*-questions, at this stage, SAI in them leads to a *REDUN violation, as well as in embedded yes-no questions, though the violation has the benefit of allowing HEAD to be satisfied. And moreover, this inversion aggravates a *trace violation.

In this context, *wh*-movement to CP-SPEC in embedded clauses respects CL-TYPE and OP. Notice that the constraints ranked immediately below OP tie on the ranking. As illustrated in Tableau 11, the inverted *wh*-question has one *REDUN violation and two *trace violations, whereas the uninverted one has one HEAD violation and one *trace violation. Consequently, the uninverted *wh*-question is selected as the winner by EVAL.

3. 5 Inversion in Direct and Indirect Questions

We have considered that the stratified constraint hierarchy from stage 1 to stage 4 is CL-TYPE >> OP >> {*REDUN, ECO-REP, HEAD, *trace}. The constraint ranking is not the same as that of adult grammar. The main point of the above discussion concerning acquisition of interrogatives is that the interactions of the stratified constraints can provide a straightforward account for the fact that inversion in yes-no questions logically precede inversion in *wh*-questions and for the alternativity of inversion in matrix *wh*-questions and non-occurrence of inversion in embedded *wh*-questions. What remains is to consider what is the trigger of inversion in embedded yes-no and *wh*-questions, which is the conspicuous interrogative pattern at stage 5.

We posit here that the constraints presented thus far are reranked by virtue of constraint demotion when children start to make productive use of embedded SAI. Lightfoot (1989, 1991) suggests that in order to discover the positive evidence necessary to decide on the setting of many parameter values, it is sufficient to have access to degree-0 plus a little. That is, only matrix clause structures and the front of the embedded clause need to be accessible. Following this, we assume that children access to degree-0 i.e. structural descriptions of matrix questions in adult English as in (20) when they begin to produce embedded questions, and constraint demotion is implemented to determine the correct constraint ranking after selecting suitable set of winner / loser pairs related to the ranking.

(20)a. Can you see the picture?

b. What did he buy yesterday?

c. *What e he did buy yesterday?

In interrogatives as (20 a, b), CL-TYPE is satisfied by virtue of encoding the entire sentence of (20 a) as a yes-no question due to the inversion and that of (20 b) as a *wh*-question due to the *wh*-fronting. In (20 b), OP is also satisfied by the *wh*-fronting. Children know, from the contrast

between positive evidence such as (20 a, b) and negative evidence such as (20 c), that the I-to-C movement of an auxiliary has the benefit of allowing HEAD to be satisfied. It follows then that *REDUN, ECO-REP, and, *trace are demoted down to the stratum immediately below HEAD as in (21 b), which is the stratified constraint hierarchy of stage 5.

(21) a. CL-TYPE >> OP >> {HEAD, ECO-REP, *trace, *REDUN}

→b. CL-TYPE >> OP >> HEAD >> {ECO-REP, *trace, *REDUN}

Owing to the dominance of HEAD, ECO-REP, *trace, and *REDUN by CL-TYPE and OP, inversion is obligatory in yes-no questions and no *wh*-fronting is ruled out. While at the previous stage, inverted and uninverted direct *wh*-questions are exhibited, inversion takes place in matrix *wh*-questions in a most consistent way at this stage, which is ascribed to the requirement of HEAD. Since HEAD dominates ECO-REP, *trace, and *REDUN, the head of CP must be filled by a lexical element via inversion, thereby predicting SAI in direct questions at stage 5, as shown in the winner candidates in Tableau 12 and 13.

And the partial ranking HEAD >> {*REDUN, ECO-REP, *trace} predicts SAI in indirect questions as well, in accordance with the interrogative patterns at stage 5, as illustrated in the winners in Tableau 14 and 15.

At this stage, once children acquire the complementizer *if*, they begin to introduce it in the head of CP in indirect yes-no questions. If either syntactic or morphological encoding is available, economy consideration will block double encoding of the same function in that syntactic operation aggravates a violation of *trace, which is one of economy constraints. SAI therefore does not take place in indirect yes-no questions from this period.

Tableau 12 Stage 5 Direct Yes-no Questions

Candidates	CL-TYPE	OP	HEAD	*REDUN	ECO-REP	*trace
$[_{CP}$ e$[_{IP}$ you can$[+Q][_{VP}$ eat it$]]]$?	*!		*			
$[_{IP}$ you can$[+Q][_{VP}$ eat it$]]$?	*!					
☞$[_{CP}$ Can$_i[+Q]$-C$[_{IP}$ you t$_i[_{VP}$ eat it$]]]$?						*

Tableau 13 Stage 5 Direct *Wh*-questions

Candidates	CL-TYPE	OP	HEAD	*REDUN	ECO-REP	*trace
☞$[_{CP}$ Why are$_j[+Q]$-C$[_{IP}$ you$_i$ t$_j[_{VP}$ t$_i$ smiling$]]]$?						**
$[_{CP}$ Why e$[_{IP}$ you$_i$ are$[_{VP}$ t$_i$ smiling$]]]$?			*!			*
$[_{CP}$ e$[_{IP}$ you$_i$ are$[_{VP}$ t$_i$ smiling why$]]]$?	*!	*				

Tableau 14 Stage 5 Indirect Yes-no Questions

Candidates	CL-TYPE	OP	HEAD	*REDUN	ECO-REP	*trace
⋯V$[_{CP}$ e-$[+Q][_{IP}$ DP$_i$ AUX$[+Q][_{VP}$ t$_i$ V$]]]$	*!		*			*
☞⋯V$[_{CP}$ AUX$_j[+Q]$-C$[+Q][_{IP}$ DP$_i$ t$_j[_{VP}$ t$_i$ V$]]]$				*		**

Tableau 15 Stage 5 Indirect *Wh*-questions

Candidates	CL-TYPE	OP	HEAD	*REDUN	ECO-REP	*trace
☞⋯V$[_{CP}$ wh AUX$_j[+Q]$-C$[+Q][_{IP}$ DP$_i$ t$_j[_{VP}$ t$_i$ V$]]]$				*		**
⋯V$[_{CP}$ wh C$[+Q][_{IP}$ DP$_i$ AUX$[+Q][_{VP}$ t$_i$ V$]]]$			*!			*
⋯V$[_{CP}$ C$[+Q][_{IP}$ DP$_i$ AUX$[+Q][_{VP}$ t$_i$ V wh$]]]$	*!	*	*			

Tableau 16 Stage 5 Indirect Yes-no Questions

Candidates	CL-TYPE	OP	HEAD	*REDUN	ECO-REP	*trace
···V[$_{CP}$ e-[+Q][$_{IP}$ DP$_i$ AUX[+Q][$_{VP}$ t$_i$ V]]]	*!		*			*
☞···V[$_{CP}$ if[+Q][$_{IP}$ DP$_i$ AUX[+Q][$_{VP}$ t$_i$ V]]]						*

The syntactic phenomena observed in interrogatives at this stage bear intriguing similarities to a variant of English, Belfast English, which shows SAI in indirect questions (see Henry (1995) and Munemasa (2000, Chapter 2)). A possible explanation of the matter is that in Belfast English, CL-TYPE, OP, and HEAD freeze as CL-TYPE >> OP >> HEAD in some interim grammar in language acquisition, whose ranking corresponds to the children's interim grammar i. e. the grammar at stage 5, and the appropriate stratified hierarchy of the rest of constraints i. e. *REDUN, ECO-REP, and *trace is determined on the basis of linguistic data bearing on the adult grammar of Belfast English. We return to the procedure of the reranking in Section 4.

3. 6 Inversion in Declarative Sentences

At the stage where inversion occurs in embedded yes-no questions and *wh*-questions (i. e. stage 5), children overgeneralize inversion even in embedded clauses which prima facie seem to be declarative sentences, when the matrix clauses which take them as their complement bear an interrogative force.

(22)a. How did the boy say can the girl play?

b. How did the boy say the girl can play?

Children can interpret a sentence like (22 a) as a regular embedded clause, even though this structure can only be a quote for adults.

What makes the matter fascinating is that in Belfast English a sentence like (22 a) is allowed as a regular embedded clause. Recall that a common property that lies between Belfast English and the children's grammar which allows inversion in embedded yes-no questions and *wh*-questions is that HEAD dominates *REDUN, ECO-REP, and *trace. It is therefore predicted that the dominance relation plays a critical role for inversion in the embedded clause in a sentence like (22 a). However, true understanding of the nature of inversion in a sentence like (22 a) is not provided yet. A clue to resolve what remains as a mystery lies in the semantics of the matrix clause of a sentence like (22 a).

When embedding verbs which select a proposition with a declarative clause type (e. g. *know*, *admit*, *hear*, *say*, etc.) take the form of a subordinate yes-no question, the structure yields an odd interpretation.

(23)a. I knew / admit / hear / said that the bartender was happy.

b. ?? I knew / admit / hear / said if the bartender was happy.

According to Adger and Quer (1997), however, there is a set of contexts where the oddness of a question embedded by such verbs disappears as in the case of a matrix yes-no question or of matrix negation.[10]

(24)a. Did Julie know / admit / hear / say if the bartender was happy? (yes-no)

b. Julie didn't know / admit / hear / say if the bartender was happy. (Neg)

The matrix predicates in (24) are in the modal context which expresses lack of information or desire for information and embedded questions are acceptable.[11] This suggests that the C of the embedded CP may be specified as [+Q].

Further confirmation that the embedded clauses from which *wh*-phrases are extracted yield interrogative contexts comes from some other languages. In some natural languages, *wh*-movement involves a morphological alternation in some functional category. In concrete terms, it triggers irrealis morphology. Cases in point are Kikuyu, Palauan, and Hausa. As discussed by Haík (1990), clauses from which a *wh*-phrase has been extracted can trigger irrealis morphology in INFL, and the irrealis morphology is exhibited only in the domain between its S-structure position and the variable it binds. In Kikuyu, when a *wh*-operator has moved to CP-SPEC, it triggers irrealis form in its clause, not realis from, as shown in (25). In Palauan, when movement of a *wh*-phrase to the matrix clause is involved as in (26 a), it triggers irrealis. But as in (26 b), when *wh*-phrases are in situ, all INFLs are realis. In Hausa as well, a *wh*-movement triggers irrealis form. The exam-

ple in (27), which contains both a moved *wh*-phrase and a *wh*-phrase in situ, shows that a moved *wh*-phrase triggers irrealis, while a *wh*-phrase in situ does not.

(25)Kikuyu

a. nó-ó$_i$ ó-γw-eciíri-a [Ngóγea-úγ-irε [áte t$_i$ o-On-irε
FP-who SP-T-think-T Ngui SP-say-T that PP-see-T
(irrealis) (irrealis) (irrealis)
Kaanakε]]
Kaanake
"Who do you think Ngũgĩ said saw Kaanake?"

b. nó-o$_i$ Kâma ú a-ér-$^!$ iré t$_i$ [áte karioki á-$^!$ tẽm-iré mo-tě$^!$]?
FP-who K. SP-tell-T that K. PP-cut T CP-tree
(irrealis) (realis)
"Who did Kamu tell (that) Karioki cut a tree?"
Haik (1990 : 352)

(26)Palauan

a. ng-nerga$_i$ a le-silse-ii (*silseb-ii)$_{\_i}$ a se? el-il?
CL-what irrealis-PF-burn-3 s realis friend-3 s
"What did his friend burn?"

b. t-oumerang [el ked-omdasu [e ng-mo er a
R-3p believe COMP R-lp-think PTC R-3s P (reposition)
Siabal a te ? ang]]
Japan who
"Who do they believe that we think will go to Japan?"
Haik (1990 : 348-352)

(27)Hausa

Ban sa ban waa$_i$ t$_i$ *yakee* tsammaanii wai
NEGls know NEG who 3 sm-IR-cont think that
yaa /**ya* sayi mee
3 sm compl-R / IR-compl buy what
"I don't know who thinks he bought what."
ibid.

A similar pattern is found in Belfast English, where interrogative context does not go lower than the clause from which the *wh*-phrase is extracted. That is, SAI does not occur below the clause from which the *wh*-phrase is extracted.

(28)a. *Who do you think did John convince did Mary go?

b. Who do you think did John convince that Mary went?
Henry (1995 : 118)

With this background, let us turn back to (22 a). In (22 a), [+Q] feature is specified in the embedded clause in concord with the matrix clause, since it bears an illocutionary force. Recall that the constraint ranking at the stage where children produce inversion in embedded questions is CL-TYPE >> OP >> HEAD >> {ECO-REP, *trace, *REDUN}. Furthermore, in Belfast English HEAD dominates ECO-REP, *trace and *REDUN, which holds true for the children's constraint hierarchy at the stage where productive use of inversion in embedded questions is exhibited. Thus, once the head of the embedded CP is specified as [+Q], SAI can occur.

In (22 a), the *wh*-phrase undergoes successive cyclic movement and thus has been raised to the clause initial position by way of the specifier position of the embedded CP. In the following configuration where the *wh*-phrase is raised to the specifier position of the embedded CP but has not been raised to the sentence initial position, the occurrence of the *wh*-phrase in CP-SPEC satisfies CL-TYPE and OP.

(29)...V [$_{CP}$ Wh AUX$_j$ [+Q]-C[+Q][$_{IP}$ DP$_i$ t$_j$ [$_{VP}$ t$_i$ V]]]

In (29), the embedded clause is selected as [+Q] by the matrix predicate, which expresses request for information. The I-to-C movement of the auxiliary yields a *REDUN violation due to double specification of [+Q] . However, the violation has the benefit of allowing HEAD to be satisfied. SAI therefore occurs in the embedded clause.

We have seen intriguing similarities between Belfast English and the children's grammar at the stage where productive use of SAI in embedded questions is found, which are ascribed to HEAD outranking *REDUN, ECO-REP, and *trace. However, the adult grammar of Standard English does not generates such an inversion, in marked contrast to Belfast English. This fact indicates that the domi-

Tableau 17

Candidates	CL-TYPE	OP	HEAD	*REDUN	ECO-REP	*trace
···V[$_{CP}$ e- [+Q] [$_{IP}$ DP$_i$ AUX[+Q] [$_{VP}$ t$_i$ V]]]	*!		*			*
☞···V[$_{CP}$t$_i$'(wh)AUX$_j$[+Q]-C[+Q] [$_{IP}$DP$_k$ t$_j$[$_{VP}$ t$_k$ V t$_i$]]]				*		**

nance of *REDUN, ECO-REP, and *trace by HEAD is retained and the constraints other than HEAD are stratified as ECO-REP >> *REDUN >> *trace in the adult grammar of Belfast English. The subsection that follows is devoted to considering such a procedure of constraint reranking up to adult grammar of English.

4. Adult Grammar

4.1 Standard English

We have seen that at the stage where inversion takes place in both direct and indirect questions (stage 5), the ranking CL-TYPE >> OP >> {ECO-REP, HEAD, *REDUN, *trace}, which is responsible for the prior stage, is reranked as CL-TYPE >> OP >> HEAD >> {ECO-REP, *trace, *REDUN}. When children execute the reranking, they have accessed degree-0 (only matrix clause structures and the left edge of the embedded clause need to be accessible). It follows then that they will subsequently access degree-1, that is, embedded clause structures, to discover the positive evidence necessary to decide on the reranking of the constraints.

With this in mind, let us consider the constraint reranking. Children access to positive evidence of embedded questions of adult English where the head of CP is not filled by a functionally or semantically empty element as in (30 a) unlike negative evidence (30 b), which induces an ECO-REP violation due to the occurrence of the semantically empty element *that* (cf. Belfast English and Middle English).

(30)a. I wonder [what e [John bought]].

b. *I wonder [what that [John bought]].

This indicates that the violation of HEAD in (30 a) has the benefit of allowing ECO-REP to be satisfied. Children therefore know that ECO-REP outranks HEAD and the other constraints i. e. *REDUN and *trace as in (31 b).

(31)a. CL-TYPE >> OP>> HEAD >> {ECO-REP, *trace, *REDUN}(stage 5)

→b. CL-TYPE >> OP >> ECO-REP >> {*trace, *REDUN, HEAD}

→c. CL-TYPE >> OP >> ECO-REP >> {*trace, *REDUN} >> HEAD

→d. CL-TYPE >> OP >> ECO-REP >> *REDUN >> HEAD >> *trace

Children access to positive evidence of embedded questions of adult English where the head of CP is not filled by a lexical element as in (32 a) and come to know that double specification of [+Q] viz. a *REDUN violation is banned.

(32)a. I wonder [how [+Q] [John can [+Q] fix the car]].

b. *I wonder [how can_i [+Q] C [+Q] [John t_i fix the car]].

In (32), the (b) sentence is the same indirect question as children makes productive use of at stage 5. Based on the contrast observed in embedded questions as (32 a) and (32 b), children know that *REDUN outranks HEAD and thus demote the latter as in (31 c). And positive evidence of inverted matrix *wh*-questions convinces children that a *trace violation has the benefit of allowing HEAD to be satisfied, and thus (*trace is demoted down to the lowest stratum as in (31 d).

In matrix questions, I-to-C movement of an auxiliary does not pose any problems, since such questions, whether they are *wh*-questions, or yes-no questions, have [+Q] feature in the head of IP and thus inversion does not incur *REDUN violation because no double specification of [+Q] feature is yielded in such a situation. HEAD is violated unless it does not take place, thereby predicting inverted matrix yes-no and *wh*-questions in adult English.

Tableau 18 Direct Yes-no Questions

Candidates	CL-TYPE	OP	ECO-REP	*REDUN	HEAD	*trace
$[_{CP}[_{C'}e[_{IP}$ you_i can$[_{VP}$ t_i buy the car$]]]]$	*!			*	*	*
☞$[_{CP}[_{C'}$ can_i-C$[_{IP}$ you_j $t_i[_{VP}$ t_j buy the car$]]]]$						**

Tableau 19 Direct *wh*-questions

Candidates	CL-TYPE	OP	ECO-REP	*REDUN	HEAD	*trace
☞[$_{CP}$ Why are-C[$_{IP}$ you$_i$ t$_j$[$_{VP}$ t$_i$ smiling]]] ?						**
[$_{CP}$ Why e[$_{IP}$ you$_i$ are[$_{VP}$ t$_i$ smiling]]] ?					*!	*

Tableau 20 Indirect Yes-no Questions

Candidates	CL-TYPE	OP	ECO-REP	*REDUN	HEAD	*trace
⋯V[$_{CP}$ e-[+Q][$_{IP}$ DP$_i$ AUX[+Q][$_{VP}$ t$_i$ V]]]	*!				*	*
☞⋯V[$_{CP}$ if[+Q][$_{IP}$ DP$_i$ AUX[+Q][$_{VP}$ t$_i$ V]]]						*

Tableau 21 Indirect *wh*-questions

Candidates	CL-TYPE	OP	ECO-REP	*REDUN	HEAD	*trace
⋯V[$_{CP}$ wh AUX$_j$[+Q]-C[+Q][$_{IP}$ DP$_i$ t$_j$[$_{VP}$ t$_i$ V]]]				*!		**
☞⋯V[$_{CP}$ wh C[+Q][$_{IP}$ DP$_i$ AUX[+Q][$_{VP}$ t$_i$ V]]]					*!	*

In embedded questions, however, by the selectional requirements of the matrix verb, [+Q] feature is imposed in the C head as well. Whilst in matrix questions, I-to-C movement of an auxiliary does not incur *REDUN violation, it does in embedded questions because it yields extra specification of [+Q] feature in the C head. To eschew such a situation, inversion does not occur in embedded questions despite its being disfavored by HEAD. Given the critical partial ranking *REDUN >> HEAD as in (3 1d), uninverted embedded yes-no and *wh*-questions are thereby exhibited, as illustrated in Tableau 20 and 21.

In embedded yes-no questions, as already noted, introduction of a complementizer *if/whether* in the C position of them will fulfill CL-TYPE. If a complementizer *if/whether* has been listed in the lexicon of a learner, economy consideration will choose the Merge operation of the complementizer with the C head of the embedded yes-no question instead of inversion, as shown in the optimal candidate in Tableau 20.

We have considered that any target grammar is consistent with the stratified hierarchy of constraints formed by virtue of constraint demotion, and that interrogative patterns that vary in the course of language acquisition are due to the difference of the stratified hierarchy of constraints as follows:

(33)a. CL-TYPE >> OP >>{ECO-REP, *REDUN, HEAD, *trace}

b. CL-TYPE >> OP >> HEAD >>{ECO-REP, *trace, *REDUN}

c. CL-TYPE >> OP >> ECO-REP >> *REDUN >> HEAD >> *trace

To sum up, the full range of syntactic phenomena in direct and indirect questions observed at stage 1, 2, 3, and 4 are derived from the constraint hierarchy (33 a), those observed at stage 5 are the constraint hierarchy (33 b), and those observed in adult English are the constraint hierarchy (33 c).

4. 2 Dialect Variation

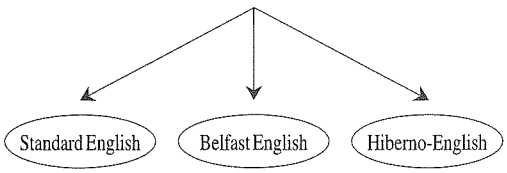
Part of acquiring a language is acquiring the critical rankings of that language. This point of view carries over to language variation or dialect variation. As argued before, when children start to make productive use of embedded questions according to degree 1, they execute constraint reranking of the ranking CL-TYPE >> OP >>{ECO-REP, *REDUN, HEAD, *trace}via constraint demotion, which is the ranking of the stage where they have not made productive use of embedded questions yet. Since data concerning embedded contexts children face vary across the range of possible grammars in various languages, we obtain the re-

sult that the constraint hierarchy of each language varies as well, which is highlighted by some varieties of English. Belfast English and Hiberno-English also allow inverted embedded questions. It follows then that the constraint ranking can trifurcate, as schematized in (34).

(34){CL-TYPE, OP, ECO-REP, *REDUN, HEAD, *trace}

↓

CL-TYPE >> OP >> {ECO-REP, *REDUN, HEAD, *trace}



A common property they share is that in genuine indirect questions inversion can take place. Although Belfast English and Hiberno-English allow inversion in embedded questions as in (32 b), the latter rules out a wh-COMP configuration in embedded *wh*-questions as in (30 b). When children who are acquiring the grammar of Belfast English access to degree-1, they face vastly common evidence of embedded questions in adult Belfast English where the head of CP is filled by a semantically empty element as in (30 b). However, such sentences induce an ECO-REP violation due to a semantically empty element in the C position of the embedded clause.

(30b) I wonder[what that[John bought]].

(32b) I wonder[how can$_i$[+Q]C[+Q][John t_i fix the car]].

This indicates that the violation of ECO-REP in (30 b) has the benefit of allowing HEAD to be satisfied. Children therefore know that HEAD outranks ECO-REP and the other constraints, *REDUN and *trace, as in (31 a). Recall that this dialect allows inversion even in the complement of semi-factive verbs and sentence subject CPs, in marked contrast to Hiberno-English. The I-to-C movement of an auxiliary in such embedded contexts will induce a *REDUN violation, since an abstract feature is doubly specified in the C head by virtue of the movement and the selection imposed by the matrix governing predicate. However, the requirement of HEAD triggers inversion. Although HEAD is respected by the I-to-C movement of the auxiliary, it puts on a semblance of an auxiliary in genuine indirect questions and only plays a role for satisfying HEAD. In this case, the C is rendered as a verbal head irrelevant to an interrogative context and thus violates ECO-REP. For this reason, ECO-REP dominates *REDUN in Belfast English, as shown in (35).

(35)Belfast English

CL-TYPE >> OP >> HEAD >> ECO-REP >> *REDUN >> *trace

Hiberno-English, on the other hand, disallows inversion in such embedded contexts, which leads to a HEAD violation. This indicates that the violation of HEAD has the benefit of allowing ECO-REP to be satisfied. When children who are acquiring the grammar of Hiberno-English access to degree-1, they face vastly common evidence of these embedded questions. Children therefore know that ECO-REP outranks HEAD and the other constraints, *REDUN and *trace. This dialect, however, does not always rule out inversion in embedded contexts. It is allowed only in genuine embedded questions. Therefore, the parametric difference to Standard English and Belfast English that is relevant in this context concerns the partial ranking of HEAD and *REDUN. Children stratify *REDUN immediately below HEAD as shown in (36), thereby inducing inversion in genuine embedded qestions in Hiberno-English despite its being disfavored by *REDUN due to the double specification of [+Q]feature in the embedded C(see Munemasa (2000, Chapter 2)).

(36)Hiberno-English

CL-TYPE >> OP >> ECO-REP >> HEAD >> *REDUN >> *trace

And positive evidence of inversion in genuine embedded questions convinces children that a *trace violation is allowed for the explicit calculation, and thus *trace is demoted down to the lowest stratum.

5. Concluding Remarks

This paper has demonstrated that in addition to the distinctive interrogative patterns in the varieties of English, interrogative patterns that vary across the range of possible interim grammars in language acquisition are explained as consequences of the distinctive rankings of CL-TYPE, OP, ECO-REP, HEAD, *REDUN, and *trace, and that the analysis based on the Optimality Theoretic constraints presented thus far establishes further empirical validity by providing a unified account for those syntactic phenomena.

In view of this, the analysis is simultaneously flexible enough to accommodate the broad cross-linguistic variation in interrogative patterns, which are recalcitrant to deal with within the framework of the instantaneous model of language acquisition, and strong enough to do primary work in a wide variety of explanations.

Notes

1. Under the framework of Chomsky (1998), a *wh*-phrase has an uninterpretable feature[wh-]and an interpretive feature[Q]. Driving force of *wh*-movement is due to attraction by the uninterpretable feature that the C of CP bears(i. e. Suicidal Greed).The[wh-]feature the *wh*-phrase bears is deleted after the checking between the *wh*-phrase and the C, while the[Q]feature remains after the checking (cf. Chomsky (1993, 1995 b)).
2. It has been argued in the acquisition literature that the fact that the structures produced by children at this stage contain lexical but not functional categories is attributed to the acquisition of thematic but not non-thematic relations (Abney(1987), Guilfoyle and Noonan(1989), Lebeaux(1987), among others). That is, structures in adult grammar are networks of both thematic and non-thematic sisterhood relations, whereas their child counterparts are pure networks of thematic relations. Under this lexical-thematic analysis, sentences without functional words which children around 20-24 months of age produce in a most consistent way will simply be a verbal projection, i. e. VP, in which a thematic relation is established.
   (i) $[_{VP}$ subject$[_{V'}$ V complement$]]$
3. First names and two-figure numbers indicate the name and (month) of the child who produces the utterance concerned.
4. In contexts where they attempt to imitate an adult question containing a preposed auxiliary and a fronted *wh*-phrase, children typically omit both the auxiliary and the *wh*-phrase.

(i)	Adult	Child
	Where does Daddy go?	Daddy go? (Daniel 23)
	Where shall I go?	Go? (Eve 25)
	Where does it go?	Go? (Adam 28)
		Radford(1990 : 123)

5. The amount of data that needs to be supplied to learn constraint rankings yields the data complexity. Given that any target grammar a person is learning is consistent with at least one total ranking of the constraints, the number of possible grammars is the number of possible total rankings. That is, the number of distinct total rankings is a factorial function of the number of constraints. For example, a set of 7 constraints has 7!=5040 distinct rankings. If the amount of data was required to determine the correct ranking as the number of possible rankings, a grammar having many constraints could require a large amount of data, leading to data complexity. However, if constraint rankings are determined by Constraint Demotion, it can reduce the data complexity (see Tesar (1998) and Tesar and Smolensky (1998)).
6. Interrogative patterns which vary across the range of possible interim grammars are shown by stages for expository convenience. And the observations of them are mostly based on the report of Inada (1997).
7. According to the report of Roeper (1990), *Are* as another type of question particle is inserted in place of raising an auxiliary to the left edge of the yes-no question young childen produce. It does not agree in Tense or polarity with the verb it is doubling.
   (i) a. Are you put this on me?
   b. Are this is broke?
   c. Are you don't know Sharon's name is?
8. Most of the data in (11) are cited in Inada (1997) , and some of them in Roeper (1990) and Radford (1990, 1995).
9. In this candidate, [+Q]feature is specified in the head of verbal projection, viz. V, because it does not have an IP.
10. Note that not all predicates allow for a question as complement (e. g. verbs like *claim / assume / maintain*), even if questioned or negated.
11. According to Adger and Quer (1997), the same observation is made for Icelandic, Spanish, and Catalan.

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