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Growing syntactic structure and code-mixing in the weaker language: The Ivy Hypothesis*

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We present a hypothesis for a specific kind of code-mixing in young bilingual children, during the development of their two first languages, one of which is considerably weaker than the other. Our hypothesis, which we label the Ivy Hypothesis, is that, in the interaction meant to be in the weaker language, the child uses portions of higher syntactic structure lexically instantiated in the stronger language combined with lower portions in the weaker language. Code-mixing patterns were studied in five Swedish-French/Italian children aged 2–4. The parts of the code-mixed utterances reflected as much syntactic structure of each language as was used in monolingual utterances in the same recording of each child. This uneven development, which is due to different amounts of input of the two languages, can be accounted for by assuming that syntactic structure is acquired by building each language from the bottom up through lexical learning.

Introduction

In this study, we argue that in some young bilingual children (here Swedish-Italian/French) with uneven development, having one language that is clearly weaker than the other, sentence-internal code-mixing is a result of uneven lexical development in the two languages. In these children, the utterances in the weaker language and the weaker language parts of the code-mixed utterances have the same amount of structure at a given time, and the mixing serves as a kind of gap-filler. As an illustration, consider the examples in (1), where the mixed utterances are from the interaction in the weaker language, French, and boldface represents the stronger language, Swedish (for more examples see Figure 1 and section 'Results' below).

(1)	a. mixed utterances:	b. weaker language only:
	ett table, 'a/table'	table
	han har cassé la voiture	cassé la voiture
	'he has/ broken the car'	

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We present a model to account for this kind of mixing, called the IVY HYPOTHESIS, since we see the Weaker Language – metaphorically – as growing like ivy on the structural tree of the Stronger Language. The Stronger vs. the Weaker Language distinction is defined here in terms of proficiency, which we measure by using MLU and Upper Bound (see section 'Results' below).

Our hypothesis has certain similarities with the DOMINANT LANGUAGE HYPOTHESIS (Petersen, 1988) and the BILINGUAL BOOTSTRAPPING HYPOTHESIS in its earliest version (Gawlitzek-Maiwald and Tracy, 1996), but differs from these in that our type of code-mixing is proposed to be related to development and a result of an overall difference in structural development between the two languages.

The theoretical background for the Ivy Hypothesis model is generative syntax within the Minimalist Program. This background is also the justification for the relation we postulate throughout the article between input, lexicon, syntactic development and code-mixing. Assuming points (i)–(v), we propose (vi)–(vii):

(i) Syntax is projected from the lexicon (Chomsky, 1995).

(ii) Syntactic development in L1 acquisition can be viewed as lexical instantiation of syntactic categories from the bottom up (Clahsen, Eissenbeiss and Penke, 1996; Grimshaw, 1994).

(iii) Bilinguals have one universal syntax and two lexicons (MacSwan, 2000).

(iv) Bilingual children with uneven development have one richer and one poorer lexicon.

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(v) The difference in the amount of lexicon is related to a difference in input (Huss, 1991).

(vi) Following (i)–(iv), bilingual children with uneven development project more syntactic structure in their Stronger Language than in their Weaker Language.

(vii) Communicating in their Weaker Language, such children often code-mix sentence-internally in the following specific way, predicted by the Ivy Hypothesis:
   a) elements of the lower portions of the tree are lexically instantiated in the Weaker Language, whereas elements of the higher portions are realized in the Stronger Language;
   b) with the development of the lexicon of the Weaker Language, more structure is projected in this language, and successively higher portions of syntactic structure of the mixed utterances can therefore be realized in the Weaker Language;
   c) elements realized in the Weaker Language, generated in the lower portion of the syntactic structure, may move up to higher positions.

In Figure 1 we illustrate our hypothesis using idealized utterances and their tree structures, of types that a child may use successively throughout development. The upper part, demarcated by a diagonal line, is lexically instantiated in the Stronger Language and the lower part, in the Weaker Language. In the last stage, we can suppose that mixed utterances of this type no longer occur, since there is no longer a functional gap that requires filling.

The model as represented in Figure 1 is idealized, and is presented here to illustrate the principle we wish to propose. There are clearly a great number of other intervening factors that make the concrete results more complex (cf. Milroy and Muysken (1995a), who mention that, in analyzing code-switching, there will always be counterexamples, but that this should not stop us from trying to find the relevant regularities).

In the figure, boldface indicates one or more words coming from the unexpected language, i.e. the one which is not the language of interaction (in this case Swedish, the Stronger Language). Some points need to be stressed:

- Not only single lexical words but also entire phrases from the two languages are mixed.
- What is relevant is the hierarchical structure of lower and higher phrases, not the distinction between Functional Categories and Lexical Categories. This means that we do not expect utterances like (2), for example (Sw = Swedish, Fr = French).

(2) ***jag** pense **att** **ett** enfant
'I Sw/ think Fr/ that Sw/ a Sw/ child Fr/
har cassé **min** voiture
has Sw/ broken Fr/ my Sw/ car Fr.'

- Counter-examples to the Ivy Hypothesis would be utterances in which elements of higher levels from the considerably Weaker Language are combined with lexical phrases or lower elements from the Stronger Language, such as those in (3) (assuming French is the Weaker Language):

(3) a. *une **bord**
'A Fr/ table Sw.'
b. *c'est **ett bord**
'It is Fr/ a table Sw.'
c. *il a **slagit sönder min bil**
'He has Fr/ broken my car Sw.'

- We do not claim that our hypothesis is valid for all children with uneven development. Less imbalance between the languages may lead to utterances such as in (3) (see further in sections 'Results' and 'Discussion' below). Furthermore, some children do not code-mix at all, but only use the relatively undeveloped structures of type (1b) above, when speaking in their Weaker Language.

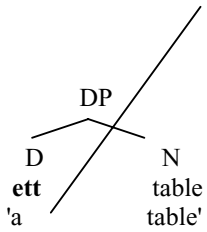
The article is structured as follows. We first discuss the Ivy Hypothesis in relation to earlier studies on bilingual development and sentence-internal code-mixing. Then we present empirical evidence from five bilingual children, giving first a general view of their use of the two languages, then studying their syntactic development in both languages, showing to what extent the Weaker Language has less developed structure, and the intra-sentential code-mixing in the interactions in the Weaker Language. In the final section we summarize and discuss the results.

The Ivy Hypothesis in relation to previous studies

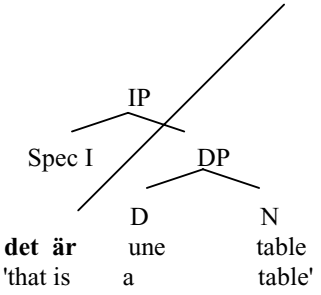
Theory of L1 acquisition

We adopt the view that the acquisition of syntax is a gradual building of structure (e.g. Radford, 1990, 1996). With Radford (2000) and Roeper (1996), who are influenced by the Minimalist Program maintaining the structure-building view, we posit that lexical acquisition drives the gradual development of syntax, through the operation MERGE (Chomsky, 1995). Simplifying, this means that there may be phrases in the child's production that are abstractly represented by less elaborated trees than adult utterances. By using the UG-given operation, children may construct unique Maximal Projections that differ from the target language (following Minimal

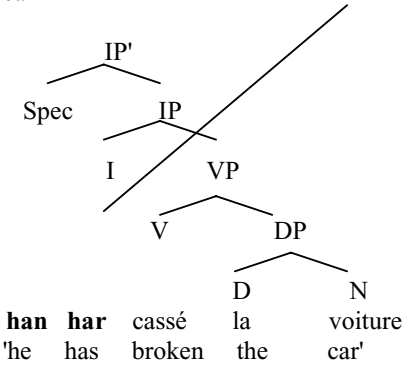
1a. Pure French, e.g. Noun: *table* 'table'
Mixed, e.g. ***ett*** *table* 'a/table'



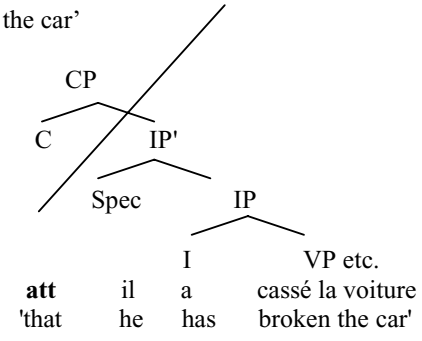
1b. Pure French, e.g. DP: *une table* 'a table'
Mixed, e.g. ***det är*** *une table* 'that is/a table'



1c. Pure French, e.g. VP: *cassé la voiture* 'broken the car'
Mixed, e.g. ***han har*** *cassé la voiture* 'he has/broken the car'



1d. Pure French, e.g. IP: *il a cassé la voiture* 'he has broken the car'
Mixed, e.g. ***att*** *il a cassé la voiture* 'that he has broken the car'



1e. Pure French, e.g. CP: *quand il a cassé la voiture* 'when he has broken the car'

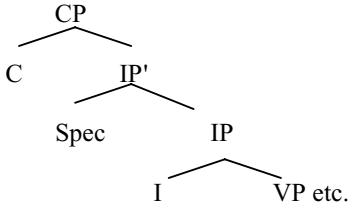


Figure 1. Idealized development of syntactic structure according to the Ivy Hypothesis, illustrated by examples of pure French and mixed utterances.

Default Grammar, see Roeper, 1999). As we see it, Merge cannot be sensitive to which language the lexical items come from, but must work with as much information as is available.

As MacSwan (2000) has pointed out, if the lexicons determine syntactic operations, the bilingual language faculty may consist of two lexicons, and just one computational system. This makes it possible to merge lexical items from both lexicons during syntactic derivation and create new syntactic nodes. As far as language-specific input is concerned, Pearson, Fernández, Lewedeg and Oller (1997) show that the amount of input is a predicting factor for vocabulary learning in bilingual Spanish-English children. Although the authors admit that there is no clear relationship between vocabulary learning and syntactic development, they suggest that it is not out of the question that the two are related. We assume that they are related, according to the lexicalist view of language acquisition (see point (ii) above): the more the child is exposed to and interacts in one language, the more lexemes of this language will be acquired, and the more syntactic structure will be developed (see also Huss, 1991). It is reasonable, as we understand it, under MacSwan's proposal, that consistent imbalance in the amount of input to the two lexicons (point (v) above) may be the reason why the utterances in one language reflect higher syntactic structure than the other language (point (vi)), given that syntactic learning is lexically driven. We propose therefore that lack of input and lexicon in one language (see point (v) above), which may cause an uneven syntactic development (point (vi)), might be helped by the child her/himself by having recourse to the other language in sentence-internal code-mixing (point (vii)).

Definition of 'code-mixing'

We study 'code-mixing' here in the sense of the child's use of words and morphemes from the two languages in the same utterance, without a specific functional intention, such as citing what was said in another language or addressing another person, etc. (which is often called 'language choice', see Köppe and Meisel, 1995; 'situational code-switching', see Jisa, 2000; or sometimes only 'code-switching'). Unlike some other studies of bilingual children (Meisel, 1994; Köppe, 2004), we do not distinguish 'code-switching' in the sense of being governed by syntactic rules (cf. Milroy and Muysken, 1995a) from 'code-mixing', where this is not the case. Since we are interested in a somewhat different type of syntactic regularity, we refer here to both types as 'code-mixing'. Furthermore, we consider as 'code-mixing' only those cases where lexical items from the other language are present, not syntactic structures like e.g. word order phenomena.

Language separation

There has been extensive discussion of the question of whether bilingual children initially have one linguistic system (Volterra and Taeschner, 1978, among others) or two (Meisel, 1989, 2001; De Houwer, 1995a; Genesee, Nicoladis and Paradis, 1995; Paradis and Genesee, 1997). Those who argue for the one-system hypothesis invoke intra-sentential language mixing, complementary lexical systems or identical syntax, such as word order (e.g. the order Adjective–Noun in both German and Italian). Arguing for the two-system hypothesis, the authors mention differences in syntax, such as different word order in the two languages used simultaneously by one bilingual child.

Since we assume here, with MacSwan (2000), that the computational system is common to the two languages and the difference lies in the two different lexicons (point (iii) above), the separation of two different syntactic systems is considered to be a result of different features in the different syntaxes projected by the lexicons. It seems that the children studied here separate the two languages in the sense that each part of a mixed utterance follows the syntax projected by its lexicon, and also in that the two languages develop at different speeds (see section 'Results' below). The separation issue is, however, not the main interest of study, and our aim is not to study the language-specific syntactic pattern of each part of the utterances, but the more general asymmetry in the place the two languages occupy in the hierarchical structure.

Uneven bilingual development and the Weaker Language

Earlier studies of bilingual L1 acquisition have mainly concentrated on cases in which the child's two languages develop in relative balance with respect to time and complexity. Recently, more general interest has been devoted to uneven development (e.g., Döpke, 2000; Meisel, 2001). Criteria for measuring language dominance were proposed by Schlyter (1993, 1994, 1995), followed by Jisa (1995). These criteria concern factors such as fluency, language preference, mixing from the other language, as well as MLU, word types, and qualitative criteria such as the presence of modals, subordinators, etc. In determining language dominance, Genesee et al. (1995) used factors such as MLU, Upper Bound (the longest utterance produced by the child during one session), word types and the percentages of multimorphemic utterances (MMU).

It is important, as Lanza (2000) proposes, to distinguish factors of use from factors of proficiency: 'dominance is not just a question of development but also of use . . . dominance and language proficiency, or unequal mastery, are not to be equated although they may be related' (Lanza,

2000, p. 234). In our study we maintain this distinction, using henceforth for what Lanza calls 'proficiency' the term 'syntactic development' (according to our point (vi) above, including lexical, syntactic and morphological development), which leads to what we call the Stronger Language and the Weaker Language (see point (vi) above, and for the criteria for establishing these, section 'Results' below). We do, however, keep the term 'language dominance' in its general sense when discussing earlier studies, since the distinction between use and proficiency is not always made. We believe that a child who has a clear difference in syntactic development between the two languages also has a preference for speaking in the Stronger Language, i.e. also uses it more, but this is not necessarily the case.

When discussing uneven bilingual development, there seems to be a general consensus that children, in the interactions in their non-dominant language, choose to speak more in the other, i.e. in the dominant language (Genesee et al., 1995; Köppe, 1997; Lanza, 1997a; Schlyter, 1999). Also, more sentence-internal code-mixing is reported in these cases (Huss, 1991; Nicoladis and Secco, 1998). In such interactions, entire monolingual utterances in the dominant language may alternate with entire utterances in the expected non-dominant language and with mixed utterances. In other words, children use their dominant language more, even in situations where one would expect a bilingual person to use the non-dominant language. Below, we show how the children studied here behave in this respect.

Some authors have shown that there may be an asynchronic development of certain specific phenomena in the two languages, although the general syntactic development in each language is equally strong (see Paradis and Genesee, 1996; Serratrice, 2001). Based on a comparison with monolingual children, Paradis and Genesee (1996) showed that IP was acquired later in English than in French, due to the fact that the languages differ in this domain. The asynchrony between IP/CP in English and German, in Gawlitzek-Maiwald and Tracy (1996) and Gawlitzek (2003), also seems to be of this type. There are, however, no studies showing asynchronic developments of this type in Swedish vs. French or Italian. In the present study, we claim instead that, in the children we are studying, the entire syntactic structure develops differently in the child's two languages (point (vi) above), not just parts of it.

Elements combined in code-mixing

The essential problem that the Ivy Hypothesis seeks to account for is the question of what kinds of elements are combined from the two languages. For adult bilinguals, many specific and detailed syntactic principles for restrictions on code-mixing have been proposed (for an overview, see Milroy and Muysken, 1995a). For children, some studies suggest that there may be a period before adult rules of this type are used (Meisel, 1994; Köppe, 2004), before the two syntactic structures are developed. This may be the case also in our study, since in the period we are studying here, only one of the languages has developed up to CP.

In a recent study (Muysken, 2000), many specific restrictions have been abandoned in favor of a few essential principles for adult code-mixing. These principles are more similar to what has also been proposed for child bilingualism, and are therefore interesting for us.[1] The principles are INSERTION, ALTERNATION and CONGRUENT LEXICALIZATION. There is a general FUNCTIONAL ELEMENTS EFFECT. Insertion and functional elements are interesting for our study, and we present them here along with two other proposals important for us.

- INSERTION concerns the insertion into the Matrix Language of a single constituent, usually a bare noun, often a content word.

According to the MATRIX LANGUAGE FRAME (Myers-Scotton, 1997), constituents from an Embedded Language are inserted into a Matrix Language. Inserted elements should have congruence with their Matrix Language counterparts, i.e. the two languages should have an equivalent structure at the point of insertion. The principle of insertion is proposed for adult bilinguals, but also for young bilingual children (De Houwer, 1995b; Allen, Genesee, Fish and Crago, 2002). The most typical insertion, of a single bare noun or other content word, is mainly reported as occurring when morpho-syntactic development is quite advanced, from about the age of three to four years (Vihman, 1985; Köppe and Meisel, 1995; Köppe, 1997; Schlyter, 1999; but see Paradis, Nicoladis and Genesee, 2000). We adopt the view of the former authors that this is a phenomenon related to high proficiency in both languages. Insertion of single content words at a later age is also supported by parts of our data, from the age of about 3;5 years, but to account for this type of mixing would exceed the frame of the present article. As for a discussion of possible insertion of these elements in the early ages studied here, see under 'Conclusions and discussion' below.

A problem with the insertion view, especially in child speech, is in what direction the insertion takes place, i.e. what to consider the base language: the language of the interaction? The dominant/Stronger language? Different languages in the same conversation according to changing

[1] We are not primarily concerned here with the typological differences between the child's two languages, as is studied extensively in Muysken (2000). Swedish is often not very different from Italian or French with respect to the linguistic phenomena studied.

language choices of the child? (Cf. Muysken, 2000, pp. 64–69; Paradis et al., 2000, for discussion.) In this way, utterances like (3a–c) above, for example, have received different interpretations according to what is considered the base or Matrix Language (cf. the discussion in Köppe, 1997, pp. 158–164). However, in many of the works assuming the Matrix Language Frame (MLF), it is evident that the Matrix Language is not equivalent to our Stronger Language: Bolonyai (1998), argues for different and changing Matrix Languages in one and the same speech sample, and in Myers-Scotton (2002, pp. 61–62), the definition of the Matrix Language as the dominant (more proficient) language is clearly rejected. Another problem is that the MLF is not related to first language development, and the general concept of ML–EL (Matrix Language–Embedded Language), used for adult language having two developed syntaxes, cannot be automatically transferred to data of the type discussed here, where at least the Weaker Language is not yet sufficiently developed (see further on in this paper; see also Jisa (2000), who clearly differentiates between code-mixing in children and adults). Some attempts have, nevertheless, been made to account for child data, similar to the data in this study, within the MLF (Lanza, 1997b; Schlyter, 1999).

- The Functional Elements Effect. In adult bilinguals, functional elements tend to come from the Matrix Language.

The examples presented in Muysken (2000, p. 155) to illustrate this effect are similar to our hypothetical example (2) above, i.e. they do not represent entire portions of higher structure but several isolated functional elements. His examples are from adult bilinguals, but in very young bilinguals, too, it has often been noted that function words behave differently from content words in code-mixing. In bilingual children's speech, function words are inserted in different contexts more often than content words (Deuchar, 1999) and are used independently with respect to the language designated for the session (see Deuchar and Quay, 1998). Many authors argue for a difference between function words and content words, neither implying nor accepting unidirectionality, i.e. that the former are from the dominant language and the latter from the non-dominant language (e.g., Klausen, Subritzky and Hayashi, 1993; Meisel, 1994; Vihman, 1998; Jisa, 2000). The difference between these studies and our proposal will be made clear below.

It has often been suggested that the dominant language (in its general sense) is important for the nature of sentence-internal code-mixing: mixing has been observed to consist of the use of functional elements from the dominant language combined with lexical elements from the non-dominant language (Petersen, 1988; Lanza, 1997a), the so-called Dominant Language Hypothesis.

- The Dominant Language Hypothesis, or variants of it, has been proposed for early child bilingualism, implying that functional elements from the dominant language are used in the non-dominant language.

The hypothesis is somewhat similar to the Functional Elements Effect mentioned above, but it is not clear whether several isolated elements can be inserted as in the speech of adult bilinguals. For children, Petersen claims (1988, p. 486):

> The dominant language hypothesis states that in word-internal code-switching, grammatical morphemes of the DOMINANT language may co-occur with lexical morphemes of either the dominant or the non-dominant language. However, grammatical morphemes of the NON-DOMINANT language may co-occur only with lexical morphemes of the non-dominant language.

Differently from our proposal, the Dominant Language Hypothesis accounts for code-mixing patterns in children above the age at which the acquisition of central syntax takes place. Petersen's study period is at age 3;2, where the subject of study has productive use of the morphemes studied in both languages. Petersen further stresses that the dominant language is not the same as the most proficient and most developed language (i.e. what we call Stronger Language, see section 'Results' below). Both these facts suggest that the Dominant Language Hypothesis is not conditioned by developmental stage, as in our proposal. The Ivy Hypothesis also differs from the Dominant Language Hypothesis in that it predicts code-mixing from the Stronger Language to be hierarchically governed and apply to all kinds of phrases, not only bound morphemes.

- The Bilingual Bootstrapping Hypothesis proposes that mixed utterances are the result of a strategy where the slower language profits from the faster developing one.

With respect to their Bilingual Bootstrapping Hypothesis, Gawlitzek-Maiwald and Tracy (1996) argued that in bilingual children 'their language mixing helps them bridge not only lexical but also structural gaps' (p. 901). This claim is similar to ours, and this work constituted an important source for us. The authors showed how, at a certain point, when the English IP had not yet been acquired, the child, Hanna, used the entire layer of the German IP combined with an English VP, when communicating in English. Later, a similar phenomenon appeared for CP (Gawlitzek-Maiwald, 2001).

According to the authors, code-mixing is domain-specific, occurring in a particular domain, here the IP-CP domain, because their subjects' English is developing more slowly than German with respect to this particular domain. This restriction does not hold our proposal (see further below). Another difference to our proposal is

Table 1. *Overview of children and languages.*

		Languages	
Child	Age	Stronger	Weaker
Lukas	2;0–3;4	Swedish	Italian
Paul	2;9–4;1	Swedish	French
Léo	1;10–3;10	Swedish	French
Alex	1;11–4;0	Swedish	French
Alice	3;2	French	Swedish

that, in Gawlitzek-Maiwald (2003), the Bootstrapping Hypothesis is mostly concerned with syntactic (not only lexical) differences between the languages, so that a VP with English words but a German word order is considered as 'German' (p. 148) and the utterance is considered as a mixed utterance, in spite of the fact that all lexemes are English.

The children studied

In this study, three children with clearly unbalanced bilingualism are studied (Lukas, Paul and Léo), and data from two other children (Alex and Alice) are also referred to. The data for Lukas come from a Swedish-Italian bilingual database, containing two children followed longitudinally from the age of about two to four years, recorded once a month (see Bernardini, 2001, 2003). Paul and Léo were selected from a Swedish-French bilingual database, containing six bilingual children followed longitudinally from the age of about two to four years (see e.g. Schlyter, 1993). These two children were recorded every four months. The three children were selected because they have one language that is clearly and consistently weaker throughout the early language acquisition period: Italian for Lukas, French for Léo and Paul (see Table 1 for an overview of children and languages).

The children were all growing up in Sweden: Lukas has a Swedish-speaking father and an Italian-speaking mother. He attended Swedish day care (from about 0;11), which gave him exposure to Swedish. Furthermore, Lukas had an elder sister with whom he spoke Swedish, a fact that also contributed to the predominance of the Swedish input. Paul and Léo grew up in Sweden with French-speaking fathers and Swedish-speaking mothers. They were predominantly exposed to Swedish, from their Swedish mothers and Swedish day care (from about 1;6). Their French-speaking fathers only spent evenings and weekends with their sons, which gave them very much less French input. Paul never went to France to see his paternal grandparents, whereas Léo did sometimes.

Lukas's parents spoke a good deal of Italian at home, in that the mother always spoke Italian to all members of the family, but in general kept to the 'one parent–one language' strategy. Paul's and Léo's parents mentioned that they kept to the 'one parent–one language' strategy, except that Paul's mother spoke French with him before the recordings started, but soon changed her strategy and subsequently spoke Swedish with him.

Supplementary data from two French-Swedish bilingual children are also presented: a diary from the boy Alex (Swedish dominant) during the age span 1;11–3;8, and from one recording of the child Alice (French dominant) at the age of 3;2. The mixed utterances in these data were not quantifiable in the same way as those of the other children. Nevertheless, we mention these data because of the difficulty of finding data from children with clearly unbalanced bilingualism, and because of the reversed dominance pattern of Alice.

Alex was born and grew up in Sweden, with a Swedish mother and a French father. The parents separated before Alex was two years old, so he only met his father on certain occasions, and therefore got very limited French input. He did, however, go to see his paternal grandparents in France on several occasions, which helped him to keep up his French. Alex's language development was studied by his mother, first with recordings (up to the age of 2;3, see Engelmark, 1996), later with diary notes on French or mixed utterances, produced during French interaction. Alice was born in France with a French-speaking father and a Swedish-speaking mother. Living in France, she clearly received more French than Swedish input. Her father did not, at that time, understand or speak Swedish. Up to the age of 3;0, Alice was clearly French dominant and spoke very little Swedish, according to her mother's impressions. Then the family moved to Sweden, where the Swedish input became richer than the French (Swedish day care, maternal grandparents, etc.). Some time after the recording studied here, Alice's Swedish became her dominant and Stronger Language (Persson, 2001).

The amount of input in the two languages is clearly related to language dominance: the reduced input in French for Paul, Léo and Alex, in Swedish for Alice, and in Italian for Lukas can be related to their syntactic development in their Weaker Language, according to the measures presented below.

During the sessions with Paul, Léo and Lukas, the recordings were made in such a way that the child was recorded for about 30–40 minutes with the French/Italian interlocutor (father, father and mother, respectively) and for about 20–40 minutes with the Swedish interlocutor (mother, mother and researcher, respectively). Each interlocutor kept strictly to his or her native language (with minor exceptions, such as uptake of a word produced by a child), thus creating a practically monolingual situation, or at least a situation in which the child was strongly encouraged to speak one language. We will therefore refer to this as 'the expected language'. Each

interlocutor understood, and was able to speak, the other language (both Swedish and Italian/French), which may have influenced the use of the unexpected language by the child.

Results

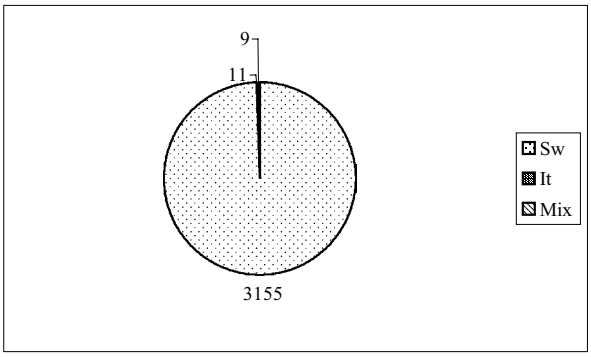
Use of the two languages in both Swedish and Romance (Italian/French) interaction

We start by giving a general view of the developing bilingualism of the three children Paul, Léo and Lukas. Before we go into the central subject of mixed utterances in the Weaker Language, in Figures 2 and 3 we present data from interaction in both of the Romance languages and in Swedish. The figures include the use of entire monolingual utterances from the expected as well as the unexpected language, as well as the proportions of mixed utterances. We have collapsed all the recordings for each child here. In this way, we see how strongly the children prefer to use Swedish throughout their development. The question of syntactic development, i.e., which is the Stronger and which is the Weaker Language (see point (vi) above), and to what extent the syntactic development is uneven, will be treated in the next section.

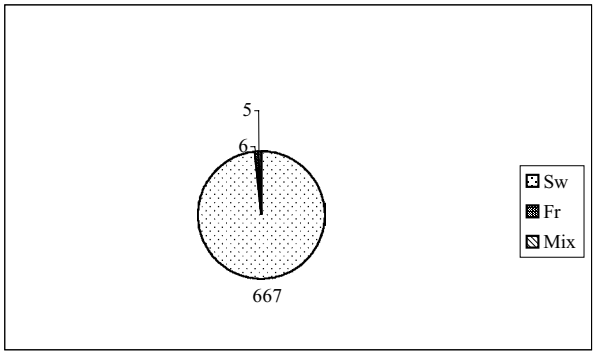
With the Swedish interlocutor, the children speak Swedish almost 100% of the time (Figure 2), and in the Italian and French recordings, over 50% of the utterances are also in Swedish (Figure 3). Mixed utterances were almost non-existent in the Swedish context (Figure 2), whereas they were relatively frequent in the Italian and French contexts (Figure 3).

Considering the use of each language and the amount of intra-sentential mixing over time in the Italian context (Figure 4), we note that Lukas, at certain ages, when he had recently been to Italy (age 2;5, 2;11), spoke much more Italian, and also that the rate of mixed utterances gradually decreased. With Léo we also note that he spoke more French at later ages, and mixed less, whereas Paul, who was hardly exposed to French except in his two first years, spoke less and less French in each recording.

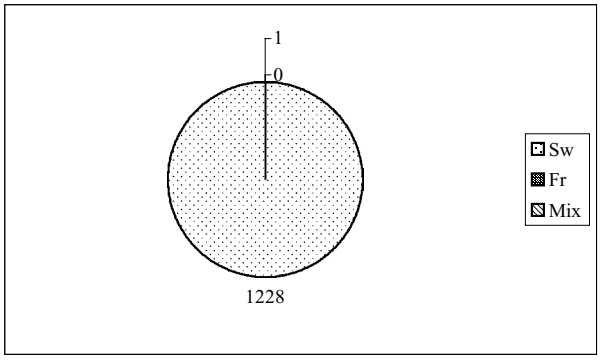
During interactions in the dominant language Swedish, the children hardly mixed at all sentence-internally, nor did they use entire Italian or French utterances (see Figure 2). The fact that the Swedish-speaking interlocutor in all cases also understood and could speak French/Italian apparently had very little impact here. The children's rare uses of the unexpected language (French/Italian), while speaking Swedish, only consisted of some isolated words. Therefore we will not study the code-mixing in the dominant language further. Except for comparing the proficiency levels in both languages, we will only study the sessions with the parent who speaks the child's Weaker Language.



2a. Lukas



2b. Paul

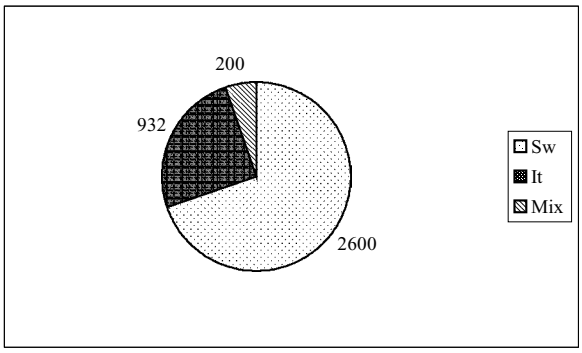


2c. Léo

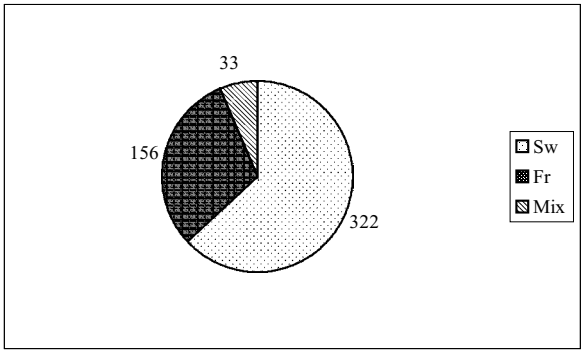
Figure 2. Monolingual and mixed utterances in the interaction with the Swedish interlocutor. (Sw = Swedish, It = Italian, Fr = French, Mix = utterances with intra-sentential code-mixing)

General linguistic level and syntactic development in each language and mixing pattern in the Weaker Language

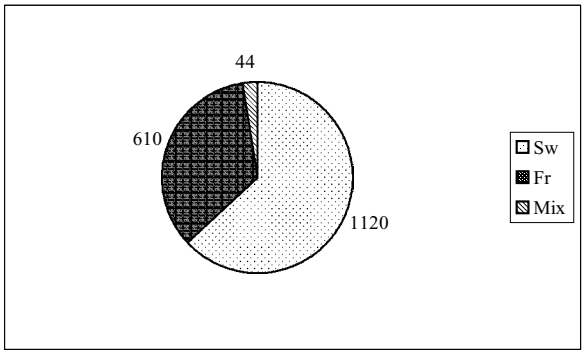
In the present section, we turn to syntactic development in relation to the mixing patterns. As will be shown below, quantitative (Figures 5 and 6) as well as qualitative criteria (Tables 2–3, 5–6 and 8–9) indicate that the lexicalized syntax of the two languages develops unevenly and separately. To determine which is the Stronger Language



3a. Lukas

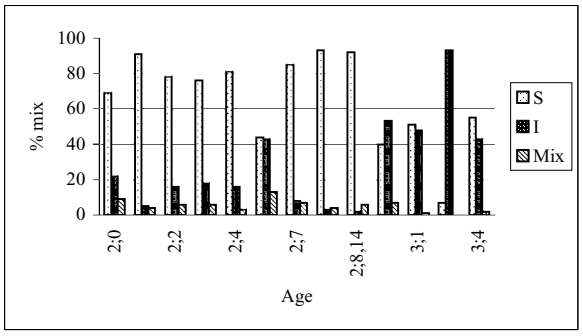


3b. Paul

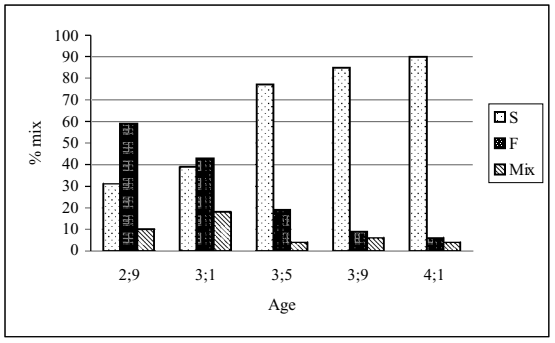


3c. Léo

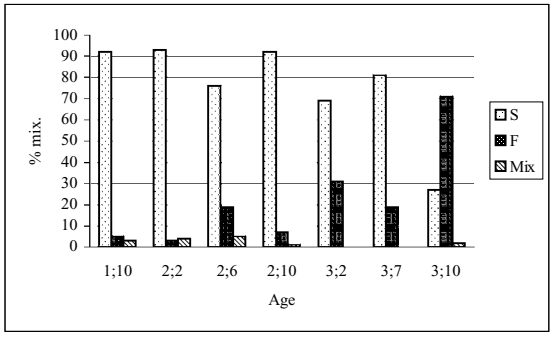
Figure 3. Monolingual and mixed utterances in the interaction with the Romance interlocutor.



4a. Lukas



4b. Paul



4c. Léo

Figure 4. Proportions of mixed utterances vs. pure Swedish (= Sw) and Italian (= It) or French (= Fr) utterances in each recording of the Romance interaction, in Lukas, Paul and Léo.

and which is the Weaker Language, and to what extent it is stronger/weaker, we consider two quantitative criteria of proficiency:

- MLU, counted in words;
- Upper Bound (cf. Brown, 1973), i.e. the child's longest (grammatically structured) utterance in the transcription.

We also consider the following qualitative criteria:

- the appearance and the frequency of use of items lexically instantiating categories (sometimes Functional Categories) that function as the heads of DP, PP, VP, IP and CP in both languages.

The vocabulary is quite evidently poorer in the Weaker Language than in the Stronger Language. We do not present extensive quantitative data on vocabulary, since the numbers would be strongly biased by the fact that the children sometimes speak very little in their Weaker Language. But calculations of one selected sample-point for each of the three children at which they spoke rather more in their Weaker Language, with an MLU of 1.7–2.0 (and of the Stronger Language around 3.0), showed a very clear difference: for about 200 utterances (of all

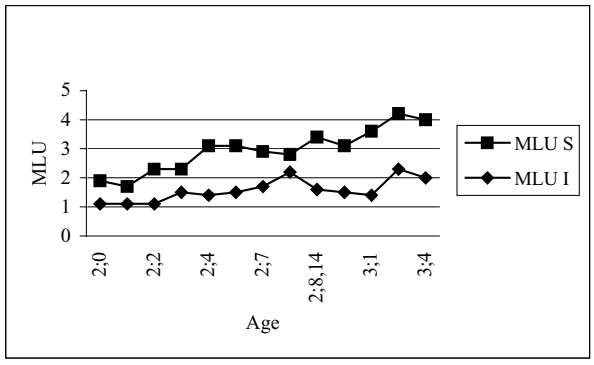
kinds) and about 20 minutes of dialogue, each child used 100–150 word types in Swedish, whereas this was 46 for Lukas in Italian, 31 for Paul in French and 47 for Léo in French. This means that each child produced in his Romance language about a third of the number of word types he produced in Swedish. In the other recordings, they used even fewer Romance words.

MLU was counted in words, and the MLU of each language was counted only in the context of that language (Swedish MLU only during Swedish interactions and vice versa). It was counted for pure Swedish, French or Italian utterances and for the Swedish/French/Italian parts of the mixed utterances.[2] All three children's MLUs differed greatly between the two languages, by about one entire word throughout their development (Figure 5). The MLU values given in Figure 5 are not an artifact of different language structures. Swedish is, inversely, expected to have generally lower MLUs, since it contains more bound morphemes (a suffixed definite article, where Italian and French have free morphemes, and a past tense suffix where Italian and French have a composed form – Passato Prossimo, Passé Composé).

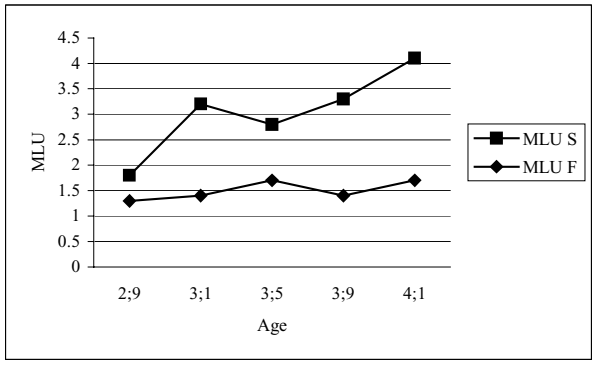
The difference in MLU between the two languages in Figure 5 is much more substantial than that reported for many of the children mentioned in the literature (Schlyter, 1993; Paradis and Genesee, 1996, p. 11; 1997, p. 103; Köppe, 1997, pp. 103–105). In these studies, the difference in MLU between the two languages varies between 0.2 and 0.9, but rarely exceeds 1 (unless counted in morphemes, which gives higher numbers). This difference may be the reason for the difference in the mixing pattern between our data (as will be shown below) and the studies just mentioned, where mixing is not unidirectional in the way postulated here.

The calculation of Upper Bound for the three children (Figure 6) also showed, clearly and consistently, lower numbers in the Weaker Language.

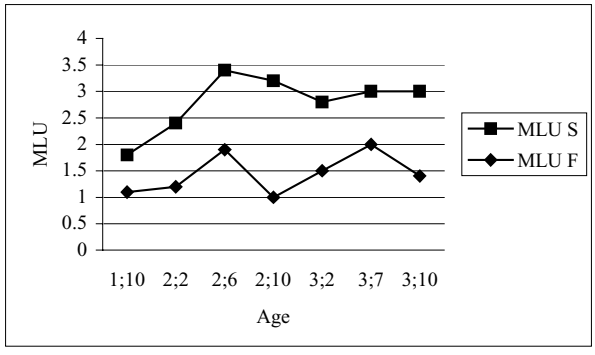
In what follows, we present the syntactic development (in terms of the lexical instantiations of syntactic constituents) in each child, in the monolingual utterances in both languages, and compare this with the mixing pattern in the interactions in the Weaker Language. We avoid the problem of the direction of mixing – which element is 'mixed into' which language – by only studying the interaction in the Weaker Language, and in considering both the Swedish and Italian/French parts of the utterances.



5a. Lukas



5b. Paul



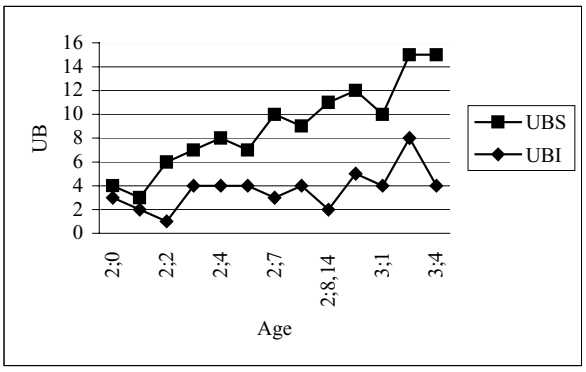
5c. Léo

Figure 5. MLU in both languages in Lukas, Paul and Léo.

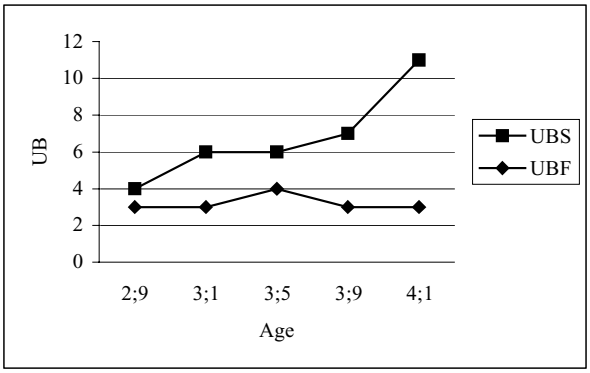
LUKAS: The Swedish-Italian boy

In the first recording, at 2;0, LUKAS's Swedish contains a majority of uninflected main verbs and a few auxiliaries and copulas, a pattern that will begin to change from 2;2 and will have completely changed at 2;4, after which age there are no more uninflected verbs. The majority of the Swedish nouns are complements to a determiner or a possessive already at the first recording at 2;0, with some bare nouns appearing from time to time during the following recordings. There are also PPs in the first recording. From 2;3, Lukas's Swedish regularly contains auxiliaries, modals and copulas, and from 2;5 to 2;8, complementizers and WH-questions are also produced regularly. For an overview, see Table 2.

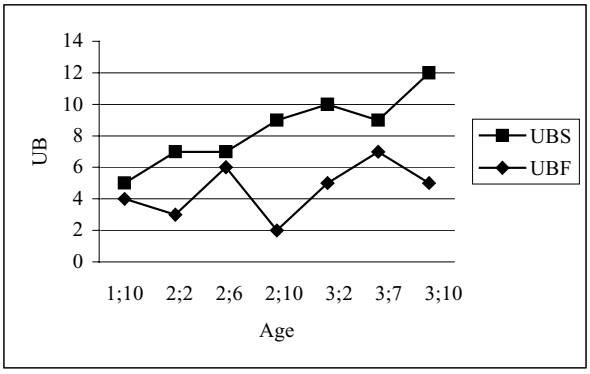
[2] Random samples of multi-morphemic utterances (MMU), calculated in order to exclude a possible bias of content word insertion, also showed very clear differences.



6a. Lukas



6b. Paul



6c. Léo

Figure 6. Upper Bound in both languages in Lukas, Paul and Léo.

Despite the comparatively rapid development of Swedish, seen in Table 2, it may be described as a gradual building of structure, where DP and PP are lexically instantiated from the first recording, followed by IP from 2;3 and CP from 2;5–2;8.

Lukas's pure Italian utterances follow the same syntactic development as his Swedish utterances, although comparatively delayed, building with lexical elements in a bottom-up sense. He often expresses himself with nouns, first bare Ns (2;0–2;3), then DPs and PPs (with a P and an N/DP). To a lesser extent, he uses Italian verbs, which are initially uninflected (in L1/L2 Italian, the 3sg form of

Table 2. *LUKAS, Swedish constituents in* PURE SWEDISH *utterances in the recordings with the Swedish interlocutor.*

Child, rec, age, MLU		V	N	DP	PP	IP	CP
LU1 2;0	1.9	28	4	33	3	2 (+2cop)	–
LU2 2;1	1.7	6	–	10	3	3 (+2cop)	1
LU3 2;2	2.3	2	4	24	5	7 (+17cop)	–
LU4 2;3	2.3	2	6	24	7	20 (+31cop)	4
LU5 2;4	3.1	–	–	15	4	+	3
LU6 2;5	3.1	–	–	55	+	+	11
LU8 2;7	2.9	–	–	58	+	+	–
LU9 2;7,21	2.8	–	3	15	+	+	1
LU10 2;8	3.4	–	–	51	+	+	13
LU12 2;11	3.1	–	–	50	+	+	+
LU14 3;1	3.6	–	2	71	+	+	+
LU16 3;3	4.2	–	2	54	+	+	+
LU18 3;4	4.0	–	–	94	+	+	+

N = bare noun, V = uninflected verb, DP = determiner + noun.
PP = preposition with complement (P + DP).
IP = copula/auxiliary/modal + VP or clearly inflected verb.
Cop = copula, CP = subordination with explicit subordinator.
'+' indicates further high frequency of occurrences.
CP = (C + IP).

verbs is considered as the basic, uninflected form, which is used before finiteness is acquired (cf. Bernini, 1990, for Italian L2 and Pizzuto and Caselli, 1992, for Italian L1). Only later, from approximately 2;7, does he have some verbs inflected for person, and verbs accompanied by copulas, auxiliaries and modals (see Table 3). The later recordings (ages 3;3–3;4) contain a large number of IPs and CPs (recall that in Swedish these elements are present much earlier (see Table 2)).

Thus, a comparison of the syntactic development of the two languages reveals that Lukas's Italian is delayed compared to his Swedish. This means that, if Lukas uses code-mixing to fill gaps of the lexically instantiated structure, he certainly does not need it when speaking Swedish. On the other hand, he may profit from this language when speaking Italian, since his Swedish lexically instantiates higher portions of syntactic structure from early on.

In what follows, we will see that the imbalance noted so far between what is lexically instantiated of syntactic structure in Swedish and Italian monolingual utterances is reflected by the mixing pattern of the mixed utterances (compare Table 4 with Tables 2 and 3).

The earliest mixed utterances consist mostly of an Italian noun combined with a Swedish determiner:

(4) **en** bacca (Lukas, 2;0)
'A/ berry.'

Table 3. *LUKAS: Italian constituents in* PURE ITALIAN *utterances in the recordings with the Italian interlocutor.*

Child, rec, age, MLU		A	V	N	DP	PP	VP	IP	CP
LU1 2;0	1.1	6	2	25	–	–	–	–	–
LU2 2;1	1.1	5	–	4	–	–	–	–	–
LU3 2;2	1.1	7	–	23	–	–	–	–	–
LU4 2;3	1.5	1	2	11	8	1	1	–	–
LU5 2;4	1.4	4	1	15	6	–	2	–	–
LU6 2;5	1.5	3	–	–	9	5	3	–	–
LU8 2;7	1.7	1	1	–	2	2	1	3	–
LU9 2;7;21	2.2	–	–	–	2	–	–	3	–
LU10 2;8	1.6	–	–	1	–	–	–	–	–
LU12 2;11	1.5	4	2	–	2	4	3	7	2
LU14 3;1	1.4	–	3	–	9	–	–	3	–
LU16 3;3	2.3	4	–	1	17	3	–	38	9
LU18 3;4	2.4	1	–	4	–	4	–	10	2

A = adjective, N = bare noun, V = uninflected verb.
DP = determiner + noun.
PP = preposition with complement.
VP = main verb (without aux or clear person marking) + complement.
IP = copula, auxiliary/modal or clearly inflected verb + VP/AP/DP.

Table 4. *LUKAS: Italian constituents in* MIXED *Swedish-Italian utterances in the recordings with the Italian Interlocutor.*

Child, rec, age,	A	V	N	DP	PP	VP	IP
LU1 2;0	4	3	29	–	–	–	–
LU2 2;1	1	–	12	–	–	–	–
LU3 2;2	3	–	12	–	–	–	–
LU4 2;3	4	–	4	3	–	4	–
LU5 2;4	2	–	6	1	–	2	–
LU6 2;5	5	3	5	3	–	1	–
LU8 2;7	–	2	6	5	2	1	–
LU9 2;7,21	–	–	2	6	2	1	4
LU10 2;8,14	2	3	3	6	–	1	–
LU12 2;11	–	1	3	3	–	1	4
LU14 3;1	–	–	–	–	–	–	–
LU16 3;3	1	–	1	–	–	–	–
LU18 3;4	–	–	2	–	–	–	–

Legend: A: see Table 3 (+ Sw VP/IP/CP).
V: see Table 2 (+ Sw IP/CP), N: see Table 2 (+Sw D/VP/IP/CP).
DP: see Table 2 (+ Sw V/IP/CP), PP: see Table 2 (+ Sw V/IP/CP).
VP: see Table 3 (+ Sw I/SpecI), IP: see Table 2 (+ Sw C).

After 2;3 Lukas begins to use Swedish modals, auxiliaries and copulas productively (cf. Table 2), but such constituents do not yet appear in Italian (cf. Table 3). In Italian (pure Italian as well as mixed utterances), DPs have now to a great extent replaced the bare Ns (cf. Tables 3 and 4). A more advanced combination is therefore possible in his mixed utterances:

(5) a. **var är** la mucca? (Lukas, 2;3)
'Where is/ the cow?'
b. **dom ska äta** la coda (Lukas, 2;3)
'They shall eat/ the tail.'
c. **jag ska ta** quella patatina (Lukas, 2;5)
'I will take/ that potato.'

From approximately 2;3 onwards, the combinations are essentially of the type in which the DP, PP or VP (uninflected 3sg, see above) are in Italian, and the IP in Swedish; examples are in (6).

(6) a. **jag måste gå in i en affär och** fa la spesa
'I must go into a shop and/ do.3SG the shopping.'
(Lukas, 2;3)
b. **den kan inte** mangia la coda (Lukas, 2;3)
'It cannot/ eat.3SG the tail.'
(A toy dinosaur which they are playing with cannot reach its tail to put it in its mouth.)
c. **han kan** guida (Lukas, 2;7)
'He can/ drive.3SG.'
d. **han kan inte se** con i occhi (Lukas, 2;7)
'He can not see/ with the eyes.'

From about the age of 2;5, there are some subordinated clauses in Swedish, which are introduced by a complementizer (see Table 2), i.e. direct indices of Swedish CP:

(7) om, om jag ätit upp så kan jag säga (Lukas, 2;7,21)
'If, if I have eaten up, then I can tell.'

In Italian this is not yet the case, but – judging by the Italian utterances (cf. Table 3) – Lukas has apparently acquired, or is acquiring, the Italian IP. Determining instances of CP vs. IP exactly is very difficult, since the structures of the two languages are different. One assumes in general that both Italian and Swedish raise the verb (unlike English), but the Swedish verb raises to C (cf. Platzack, 1986), which gives the V2 effect, and the Italian verb raises to I, as in French. Italian but not Swedish (or French) is a pro-drop language, which means that the D-feature of I is strong in Swedish and French, since Swedish and French have obligatory overt subjects in finite clauses, while in Italian the D-feature of I is weak. We propose that the following mixed utterance is analyzed as a Swedish

CP (hosting *då* 'then') with the Italian verb[3] raised into the C position:

(8) **då** chiude **du** i liocchi
'Then/ shut.3SG/ you (UNSTRESSED)/ the eyes.'
(Lukas, 2;7)

In (8), the subject pronoun *du* is unstressed, which makes it more plausible to interpret the phrase as having a Swedish structure, since Italian would require the overt pronoun in an equivalent phrase to be stressed, as in (9).

(9) allora chiudi TU/*(tu) gli occhi
'Then shut.2SG YOU the eyes.'

In (10), where Lukas is talking with his mother, repeating and modifying the same Italian utterance in different ways, he is apparently trying to figure out the form of the Italian IP. The Swedish CP has been lexically instantiated since the age 2;5, as has been the Italian VP (cf. (6) above). According to the Ivy Hypothesis, he should now be able to realize the Italian IP lexically:

(10) (Lukas, 2;7,0)
a. Lukas: **och nu** accendi il motore
'And now/ switch on.2SG the engine.'
Mother: accendi il motore?
b. Lukas: **och nu** accend**er**
'And now/ switch on.PRESENT Sw/
il motore, ja [= ?jag]
the engine,/ yes [= ?me]'
c. Lukas: **nu** accend**er**
'Now/ switch on Sw/
io il motore [brum]
I the engine.'
d. Lukas: accendo IO, questo motore
'I switch on this engine.'
e. Lukas: accendo il motore [brrum]
'(I) switch on the engine.'

What we see in (10) is what is to be expected from the Ivy Hypothesis and the theoretical assumption that it builds on. In the mixed utterances (10b, c), the verb morphology is Swedish, matching the Swedish CP. The temporal adverbs *då* and *nu* are generated in a very high position (Cinque, 1999, p. 106), in the present framework probably dominated by CP. It is therefore plausible to analyze these sentences as having a Swedish CP and an Italian IP or VP. The language differences must be confusing for the child, and he seems to be working with the switch point, as well as with the Italian subject pronoun *io*. In the monolingual Italian utterances (10d, e), the verb morphology is Italian, matching the Italian pro-drop IP.[4]

If (8) and the sentences in (10) were analyzed as Italian sentences with Swedish functional elements, independent of hierarchy, then we could also expect the articles to be in Swedish (cf. the hypothetical example in (2) above). We would also have problems with examples like (5b, c) and (6d), which have not only functional but also lexical elements (main verbs) from Swedish. Instead of accounting for (8) and (10) with the Functional Elements Effect, and for (5b, c) and (6d) with insertion of DP, we can use the single Ivy Hypothesis for both types of utterances.

At the age of 2;11, the first C elements appear in Lukas's Italian, in the form of WH-elements with complements:

(11) cos'é quello? (Lukas, 2;11)
'What is that?'

(12) hai visto che salto, questo?
'Have.2SG seen what jump, this one?'
(Lukas, 2;11)

At the age of 2;11, there are still a number of occurrences of mixed utterances, but at 3;1, despite there being more utterances, there are no cases of intra-sentential mixing (cf. Table 4). From this moment, we find instances of CP in Lukas's pure Italian utterances (cf. example (12) above) and his mixed utterances decrease radically from this age onward (cf. Table 4).

At 3;3, Lukas has been to Italy, and his Italian has made considerable progress (cf. Table 3). He has clearly instantiated CP in Italian also, now including subordination (mostly with *che* 'what'):

(13) guarda che mi ha dato Daniela (Lukas, 3;3)
'Look what Daniela has given to me.'

According to the Ivy Hypothesis, the interpretation is that he now no longer needs to supply the CP with Swedish material. We can note that he no longer has intra-sentential mixing, except for some rare occurrences of single lexical items. (As mentioned above, we consider such mixings as being of another type, which may continue though the entire lifespan).

In summary, in Lukas's production in Italian we have seen a departure from Italian single N in the mixed utterances. Later we found Italian DP, later still VP and PP, and last (probably) IP, which were combined with Swedish lexical elements representing higher categories

[3] The 3sg form *chiude* is used by Lukas in reference to 2sg (e.g. *chiudi*), so it is not finite. However, it is in the typical Swedish V2 position and used together with a 2sg pronoun. Hence, we propose that the verb is not left in its base position, but an uninflected verb from the Italian VP is moved up to the Swedish C. In (8), the verb does not have the Swedish present tense ending *-er*, as in the similar sentences (10b, c).

[4] We follow Grimshaw (1994) in assuming that only a clause with clear C elements (subordination or C-elements, topicalization) has features matched for C. Although, (10d) could be interpreted as if the verb and the stressed subject pronoun had moved to the CP layer, we are not sure about this since the clitic pronoun, which would be required in that case, (*l'accendo IO, questo motore*), is missing from Lukas's utterance.

Table 5. *PAUL: Swedish constituents in PURE SWEDISH utterances in the recordings with the Swedish interlocutor.*

Child, rec, age, MLU	V	N	DP	PP	IP	CP
P1 2;9 1.8	2	12	7	1	1 + 5 cop	–
P2 3;1 3.2	–	16	22	–	6 + SVfX	–
P3 3;5 2.8	–	–	17	2	+	4
P4 3;9 3.3			+	+	+	1
P5 4;1 4.1			+	+	+	12

Legend: see Table 2.
SVfX: subject + finite verb + complement.

Table 6. *PAUL: French constituents in PURE FRENCH utterances in the recordings with the French interlocutor.*

Child, rec, age, MLU	A	V	N	DP	PP	VP	IP	CP
P1 2;9 1.3	2	3	6	9	–	–	– +2cop	–
P2 3;1 1.4	1	2	12	13	1	–	–	–
P3 3;5 1.7	4	1	6	4	4	–	– +2Vf	–
P4 3;9 1.3	–	2	1	–	–	–	–	–
P5 4;1 1.7	–	1	1	2	4	–	–	–

A = isolated adjectives or adverbs, V = bare verbs, N bare nouns.
DP = French D + N(P), PP = French P + DP.
VP = bare main verb + complement, without subject clitic.
IP = French auxiliary or modal verb + VP (other indications of. finiteness, e.g. copula, subject + finite verb = Vf).
CP = subordinate clauses with subordinators.

Table 7. *PAUL: French constituents in MIXED Swedish-French utterances in the recordings with the French interlocutor.*

Child, rec, age	A	V	N	DP	PP	VP	IP
P1 2;9		1	2	–	–	–	–
P2 3;1	6	1	4	2	–	–	–
P3 3;5	–	2	–	–	1	–	–
P4 3;9	–	1	2	–	–	–	–
P5 4;1	–	–	3	–	1	–	–

Legend: see Table 4.

to 'fill gaps' in the structure when speaking Italian. In the end, when he has clear evidence of CP in both languages, he ceases to use intra-sentential mixing of this type.

Lukas's data show some important facts related to the Ivy Hypothesis. The Italian parts of the mixed utterances and the pure Italian utterances develop in parallel, from the production of simple lexical constituents to complex ones. The recordings which contain Italian DPs also contain Ns in this language; the recordings that contain VPs also contain DPs and Ns; the recordings that contain IPs, as well as those containing CPs, also contain all the other constituents in Italian, just mentioned. The hierarchy of constituents is not reversible (as shown hypothetically in example (2) above) in any of the recordings. What Lukas produces in his Weaker Language, Italian, as part of a mixed utterance always reflects what he is capable of producing in Italian, judging from his Italian monolingual utterances in the same recordings.

The Swedish-French children

PAUL's Swedish develops much further and more rapidly than his French: articles and auxiliaries/modals (i.e. DP and IP) in Swedish are present at the age of 2;9 (Swedish MLU 1.8) and are used frequently and productively from about 3;1. Subordinators (clear evidence of CP) are present in Swedish from 3;5 (see Table 5). In his pure French utterances (see Table 6), DPs are present and productive at about the same time as in Swedish (2;9), but in Swedish he has earlier a greater proportion of DPs than of bare Ns (which is also a sign of development). Evidence for French IPs hardly occurs, except at 3;5, where Paul uses two finite verbs with subject clitics. He never has French CPs in the form of subordinate clauses or question words.

The development of the pure French utterances can be compared to the French constituents used in the mixed utterances (see Table 7). In the mixed utterances, we find first bare lexical items from French combined with a word in Swedish, (14a, b) below; later, from the age of 3;1, we see a combination of Swedish IP or CP with a bare French N or DP, (14c–e); and later still, with a PP, (14f, g), if we consider *du* as P + D.[5] We find the same gradual (pattern of) development as in the pure French utterances, namely V/N > DP > PP (even if the occurrences are too rare to be considered real evidence).

(14) a. **där** (i) assis 'There/seated.' (Paul, 2;9)
b. voiture **titta** 'Car/look.' (Paul, 2;9)
c. pomme, **heter den** 'Apple,/it is called.' (Paul, 3;1)
d. **jag ritar** (un trompe) 'I draw/a trunk.' (Paul, 3;1)
e. **heter det** ma queue? 'Is it called/my tail?' (Paul, 3;1)
f. du fil, **jag tappat** 'Thread,/I lost.' (Paul, 3;5)
g. **han går under** sous l'eau 'He goes under/under the water.' (Paul, 4;1)

[5] We analyze *pomme* in (14c) as base-generated in VP (*den heter pomme*) moved to a Swedish CP, because of the inversion.

Table 8. *LÉO: Swedish constituents in* PURE SWEDISH *utterances in the recordings with the Swedish interlocutor.*

Child, rec, age, MLU	V	N	DP	PP	IP	CP
L1 1;10 1.8	10	24	22	–	– +3SVfX	–
L2 2;2 2.4	–	33	41	8	7 +cop	–
L3 2;6 3.4	–	13	42	20	8	2
L4 2;9 3.2			+	+	+	4
L5 3;2 2.8			+	+	+	6

Legend: see Tables 2 and 5.

Table 9. *LÉO, French constituents in* PURE FRENCH *utterances in the recordings with the French interlocutor.*

Child, rec, age, MLU	A	V	N	DP	PP	VP	IP	CP
L1 1;10 1.1	1	2	1	1	–	1	–	–
L2 2;2 1.2	1	–	3	1	1	2	–	–
L3 2;6 2.0	3	2	13	21	3	–	– +4 cop, 1 Vf	–
L4 2;10 1.0	–	–	6	1	–		–	–
L5 3;2 1.5	2	2	8	4	–	1	1 +1 cop, 1 Vf	1
L6 3;7 2.0	2	–	3	8	2	1	2 +5 Vf	–
L7 3;10 1.4	1	2	61	21	2	2	– +2 Vf	–

Legend: see Table 6.

In the corpus of all mixed utterances we find only two counterexamples to the Ivy Hypothesis (see example (3) above), where a higher element from French is combined with a lexical item from Swedish: *une* ***bil*** 'a (Fr)/ car (Sw)', and *dans* ***buss*** 'in (Fr)/ bus (Sw)'.

In these data, it could have been possible to consider (14c) as an insertion of a single N, and (14d, e) as insertions of DP; recall, however, the discussion concerning the examples (8) and (10) above on possible insertion of functional elements.

LÉO's Swedish developed as in a typical monolingual Swedish child (see Table 8). His French structures are clearly less developed (see Table 9): using as criterion of development a greater proportion of DPs than of bare Ns, we note that this is the case much earlier in Swedish (2;2) than in French (2;6 and again 3;7). Evidence for IP appears considerably later in French (see Table 9): Léo never uses French auxiliaries and modals+VP, but at 2;6 he has several occurrences of subject clitic with a finite verb. In his Swedish, structures with a subject pronoun+finite verb occur eight months earlier. There is only one French WH-word, which occurs seven months later than a word of that type in Swedish. From 3;2, after a month in France, Léo has rather complex French sentences and speaks generally more French (cf. Figure 4c above).

Table 10. *LÉO: French constituents in* MIXED *Swedish-French utterances in the recordings with the French interlocutor.*

Child, rec, age	A	V	N	DP	PP	VP	IP
L1 1;10	–	–	2	–	–	–	–
L2 2;2	–	–	12	–	–	–	–
L3 2;6	–	–	16	(1)	(1)	1	–
L4 2;10	–	–	–	–	–	–	–
L5 3;2	–	–	–	–	–	–	–
L6 3;7	–	–	1	2	–	–	–
L7 3;10	–	(1)	–	3	–	–	–

Legend, see Table 4.

In Léo's mixed utterances, the French part consists mostly of bare lexical items, but also of the more complex combination of elements, which are also found in his pure French utterances (see Table 10). In the earliest mixed utterances, bare French Ns are combined with the (higher) rest of the sentence in Swedish (15a–c). Since the Swedish suffixed article is the head of DP, and the N is raised to it (Delsing, 1993), both (15a) and (15b) are instances of what is illustrated in Figure 1a above. Later, we find an entire VP (including PP/DP, (15d)); we also find a French DPs combined with a Swedish finite verb, i.e. IP – or at least a category higher than DP – as in (15f), a preposition, as in (15g), and with a conjunction, (15e).

(15) a. **där** bouch-**en** 'There/mouth- /the.' (Léo, 1;10)
b. **det är en** dame 'That is a/lady.' (Léo, 2;2)
c. **det är** soleil 'That is/sun.' (Léo, 2;6)
d. **jag** dormir dans la fauteuil 'I/sleep in the chair.' (Léo, 2;6)
e. les vaches (**och**) les cheveaux 'The cows/and/the horses.' (Léo, 3;7)
f. (**kast**) les pierres 'Throw/the stones.' (Léo, 3;10)
g. **på** les p- **hoppar på** les pierres 'On/the st-, /jump on/ the stones.' (Léo, 3;10)

Although mixed utterances are rare, they are compatible with the Ivy Hypothesis in the sense that the French constituents gradually grow (N > DP > VP) and the Swedish parts are of higher levels. This accounts for the facts in a more uniform way than considering (15a–c) as N-insertion, (15f, g) as DP-insertion, and (15d, e) as insertion of a functional element.

In Léo's corpus, there are no instances in which a higher element from French is combined with a lower word or phrase from Swedish, i.e. no counterexamples to the Ivy Hypothesis.

Table 11. *ALEX: mixing patterns with French interlocutor according to diary data.*

1) Age	2) Pure French utterance	3) Swedish HC + French N/A/V	4) French HC + Swedish N/A/V	5) Swedish HC + French Phrase (DP/VP/...)	6) French HC + Swedish Phrase	7) Undecided
1;11–2;5	6	61	1	9	–	1
2;6–3;6	10	30	–	29 (13/6)	1	3
3;6–4;0	9	31	–	43 (21/25)	1	9

HC = higher syntactic category, N/A/V lower, single content word.
Phrase = lower phrase.

In the three children, Lukas, Paul and Léo, the clearly less developed syntactic structure in their Weaker Language (compare Table 3 with Table 2, Table 6 with Table 5, and Table 9 with Table 8), can be well accounted for in a lexicalist framework, which takes into account the amount of input in each language (cf. point (vi) of the Introduction).

ALEX'S Swedish developed early. He had IP productively from about 1;11, and CP from 2;2, when he used many different kinds of subordinate phrases (Engelmark, 1996). His development of French is less clear and data are rare, but some cases are observed at the ages indicated below. We do not know, however, how productive they are.

(16) Evidence of the earliest use of complex syntactic constituents in Alex's Swedish and French.

	Swedish	French
DP	1;11	2;6
IP	1;11	2;8
CP	2;2	2;10

In these data, we have not been able to quantify the pure French or pure Swedish utterances since the diary essentially consists of mixed utterances. We have therefore counted for these data those mixed utterances that (see Table 11):

- are compatible with the Ivy Hypothesis, combining a higher Swedish constituent with a French single content word (column 3);
- support the hypothesis, combining a higher Swedish constituent with a French lower phrase (column 5); and
- are counterexamples of the hypothesis, where inversely a higher French constituent is combined with a Swedish content word or a lower phrase (columns 4 and 6).

We note that the mixing is clearly unidirectional, thus supporting the Ivy Hypothesis. Typical illustrative examples will be shown and discussed below. There are extremely few counterexamples.

In most cases of these diary data, we find quite long stretches of Swedish with one (lower) lexical item in French, such as in (17). Often, the French nouns are combined with the Swedish suffixed determiner, such as in (17a). (We consistently use boldface for items that are not in the context language, in spite of the fact that we are essentially discussing the French constituents for the moment.)

(17) a. **Alex vill ha** marteau-**en**, **mammas**
'Alex wants/ hammer/-DEF, mother's/
marteau (Alex, 1;11)
hammer.'

b. **du får inte** bouger (Alex, 3;7)
'You may not/ move.'

There is, however, a clear development of the mixed utterances, in the sense that the French parts of the utterances increasingly consist of phrases, and not only of single content words. DPs, as in (18), for example, became frequent during the period 2;6–3;6 (cf. Table 11, column 5).

(18) a. **titta på** le rasoir! (Alex, 2;6)
'Look at/ the razor.'

b. **lyssna på** les écouteurs (Alex, 2;9)
'Listen to/ the headphones.'

From this period and up to age 4;0, there is also an increasing number of French VPs combined with a Swedish IP or CP (cf. Table 11, column 5):[6]

[6] An anonymous reviewer suggested that the short form of the verb *démonte* may suggest that the French part is an IP, not a VP. However, that would create problems with the auxiliary verb *ska*, also in IP. Another possibility would be to consider jag *ska* as occupying the CP surface position. If then *démonte* is in IP, it would still be a lower constituent than the Swedish one.

Table 12. *ALICE: mixing patterns in the first recording in Sweden (Swedish interlocutor).*

1) Age	2) Swedish HC (etc.) + French N/A/V	3) French HC + Swedish N/A/V	4) Swedish HC + French Phrase	4) French HC + Swedish Phrase IP/VP	C/IP	5) Undecided
3;2	–	9	–	6	4	2

Legend: see Table 11.

(19) a. **jag ska** démonte la table, **jag ska**
'I shall/ dismantle the table,/ I shall/
démonte la table, pappa! (Alex 2;9)
dismantle the table, daddy!'
b. **jag har** emmené les jouets **dit** (Alex 2;9)
'I have/ taken the toys/ there.'

There is one case that quite clearly represents Figure 1d above, illustrating the predictions of the Ivy Hypothesis, a Swedish C combined with two French IPs:

(20) det är ju tur att **le lapin a rêvé** att
'It is lucky that/ the rabbit dreamed/ that/
le loup a mangé le lapin (Alex 3;7)
the wolf ate the rabbit.'

When ALICE had just come to Sweden from France at age 3;2, her mixed utterances showed a tendency toward a mirror image of the other children studied here: the higher layers are in French and the lower layers are in Swedish (see Table 12). In the recordings, it can be observed that she has lexically instantiated IP and CP in her pure French utterances. In Swedish, there are still no subordinate clauses (i.e. no direct evidence of CP), but there are some cases of IP. Persson (2001) analyzed this recording and found: French MLU 2.9, Swedish MLU 2.6; French Upper Bound 10, and Swedish Upper Bound 5. This shows that French is still the Stronger Language at this point.

In her mixed utterances in the Swedish context, Alice uses only higher elements from the Stronger Language French combined with single words or lower phrases from Swedish (see Table 12, columns 3 and 5), and no occurrences of mixing in the other direction (see Table 12, columns 2 and 4). As the Ivy Hypothesis predicts, there are also complex Swedish phrases – not only single items – combined with portions of higher-level structure from French. In (21), we have examples of French higher syntactic portions and Swedish lower ones in the Swedish interaction:

(21) a. **le** flygplan, . . . 'The/airplane.' D/N
b. **je veux** en bila; en bil. 'I want/a cars; a car.' IP/DP
c. **et ça, il va pas** komma in 'And that, he will not/ come in.' IP/VP
d. **parce que après**, han kan bitas 'Because later,/he can bite.' CP/IP
e. **parce que** det gör ont där 'Because/it hurts there.' CP/IP

The diary data from Alex and Alice, though not exhaustive and not quantifiable, are mirror images of each other, as the Ivy Hypothesis predicts.

Discussion and conclusions

The bilingual syntactic development of the children studied here can be summarized as follows.

1. One language was generally clearly weaker: Italian in Lukas, French in Paul, Léo and Alex, and temporarily Swedish in Alice. Not only the general production and use but also MLUs in both languages were clearly different. There was a difference of about 1.0 throughout the development in the cases we have been able to quantify over time (Lukas, Paul, Léo), a difference supported by criteria involving Upper Bound and word types.
2. The Stronger Language in all children developed rapidly, and the higher categories were lexically instantiated in the order DP, PP/VP, IP and CP, with CP apparently well-acquired in most cases before the age of 3;5, just like in most monolingual children.
3. In their Weaker Language, the development followed the same order, but the lexical realization of higher categories was considerably delayed (which is equivalent to a clear difference in syntactic development at each sampling point).
4. Practically all mixed utterances produced by these children during the period studied were such that the 'missing' elements – which represent portions of higher syntactic structure – were 'replaced by' their

counterparts in the Stronger Language. This was independent of whether the Stronger Language was Swedish or French.

We therefore interpret our data as supporting the Ivy Hypothesis, such as presented in the introduction and illustrated in Figure 1.

The general difference between the two languages of the children studied here turned out to be more important than in most previous studies on uneven development, where the difference is less evident (cf. Figure 5 and associated discussion). With less difference in syntactic development in the two languages, bidirectional mixing may occur, at least occasionally. We suppose that if the higher layers of the Weaker Language are already well acquired and easily accessible, which is the case in the studies mentioned but not in our data, then they may also be used in the other language and combined with lexical elements of the Stronger Language.[7]

We considered earlier (in section 'Elements combined in code-mixing') whether our data could be accounted for by the principles summarized in Muysken (2000) for adult bilinguals, such as insertion or the functional element effect. If we could assume that it was only and consistently the Stronger Language (as defined here) that corresponded to the Matrix Language or Base Language (Muysken, 2000), then this could possibly have been the case. First, examples like (4), (15a–c) and (17a) above could be considered as insertions of a bare noun. However, this would be only a partial account for the data presented here, since rather few utterances are of this type. Second, if we could consider as insertion (cf. Myers-Scotton, 1997) any kind of unique and single constituent, of whatever complexity (DP, PP, VP, even IP), inserted as an Embedded Language Island from the Weaker Language into the Stronger Language, as analyzed in the MLF model, then our data seem, at first sight, compatible with such a view. However, insertion is said to be subject to congruence (Muysken, 2000, pp. 17–18). This gives us a problem if we considered an Italian IP as inserted into a Swedish CP position (examples (8) and (10)) or a Swedish IP inserted into a French CP position (examples (21d, e)), since here the structures are not equivalent in Swedish and Romance. These empirical problems, in combination with the difficulties with equating the Matrix Language with the Stronger Language in our sense (as mentioned above), and in combination with the fact that the MLF applies to two developed languages, make us consider the MLF as different from the Ivy Hypothesis and less apt to serve as a model for the type of data presented here.

We find utterances in our data which, at first sight, could be taken as evidence for the Functional Element Effect (Muysken, 2000, p. 154).[8] These are cases in which, for example, the subject pronoun+auxiliary is in the Stronger Language and the VP is in the Weaker Language (cf. examples (6b), (19) and (21c)), or a complementizer is in the Stronger Language and the rest of the sentence in the Weaker Language (cf. (20) and (21e)). However, we reject this for several reasons:

- If functional elements of any level could be inserted, then we could also expect articles in lower layers to be in Swedish and not in Italian in, for example, (6) and (10), and many other of Lukas's utterances. This is not the case except when D is the highest category, as in (4).
- Adverbs like *då* 'then' in (8), *nu* 'now' in (10a–c) and *après* 'after' in (21d) are generated in very high positions (see Schlyter, forthcoming), probably in the CP layer. Nevertheless, they are lexical elements (according to Cinque (1999), they are XPs generated in the Spec of a functional category). This means that in the examples mentioned, not only functional elements are inserted, but the entire CP layer is lexically instantiated in the Stronger Language.[9]
- In many cases, there would be no possibility to decide whether the insertion or the Functional Elements Effect is the relevant principle, since either would be possible. The Ivy Hypothesis, on the other hand, can account for such data in a uniform way.

We further claim that the Ivy Hypothesis would be more economical and general than the two principles just mentioned together in accounting for the data we have studied here, not only because it replaces two principles with one, but also because it simultaneously takes into consideration the syntactic development in both languages.

The empirical evidence considered above is not altogether incompatible with other generalizations of code-mixing patterns that have been proposed for code-mixing in children, but there are differences. The Bilingual Bootstrapping Hypothesis (Gawlitzek-Maiwald and Tracy, 1996; Gawlitzek-Maiwald, 2001, 2003) seems to account well for parts of our data (examples (6b), (19) and possibly also (21e)). However, in the children studied

[7] We cannot explain why such bidirectional mixings occur; we can only speculate that their occurrence has possibly to do with higher and/or functional elements being stored in long-time memory, whereas lexical phrases (possibly along with their low-level functional elements) are more attached to the actual situation, often picked up from the interlocutor's speech. Such a view could account for both the Ivy Hypothesis and other approaches. However, a serious discussion of this would need a separate study.

[8] A similar proposal was made by one of the anonymous reviewers.

[9] One may argue that also such short adverbs are functional elements, and ask for more evident examples in form of clearly lexical adverbs of the type 'naturally', 'evidently', etc. However, such adverbs appear extremely late in child language (Schlyter, forthcoming), well after the development outlined here.

by these authors, this kind of mixing does not occur in the entire development. Rather, the authors explicitly constrain Bilingual Bootstrapping to the CP/IP layers. A similar view is held by Paradis and Genesee (1996) for the IP, acquired earlier in French than in English, which may lead to code-mixing in the specific IP domain. However, in all these studies there does not seem to be a general and continuous distinction, as there is in our study, between the proficiency in the two languages. In the studies by Gawlitzek-Maiwald and colleague, no evidence is given for a more general developmental level of each language, and the children studied in Paradis and Genesee (1996) have a similar general level of development in both languages.

Moreover, the authors of the Bootstrapping Hypothesis reject a lexicalist view of acquisition, whereas for the Ivy Hypothesis, lexical acquisition and structure building is crucial (see below). An uneven bilingual development of this kind, with clear differences in the structural development of each language, as well as the mixing pattern which we claim follows from it, fits well into a framework of a Lexicalist theory of language acquisition. We agree with Paradis and Genesee (1996, p. 21) that data like ours are 'compatible with some structure-building approach; thus, they do not appear compatible with the strong continuity hypothesis' but we don't agree with their criticism of lexical learning, when they argue that vocabulary and syntax must be kept apart (p. 20): 'It is clear that the amount of input exerts a stronger influence on vocabulary growth than on syntactic development.' In our data, we find in one and the same language a lack of input and exposure, a very small vocabulary and a delayed development of syntax specific to the language in question. The code-mixing pattern where this Weaker Language, so to speak, 'clings on the tree structure' of the Stronger Language, at a time when both languages are continuously growing, is, in our view, a reflection of what happens when the child tries to supply with items from the Stronger Language that what is not yet developed in the Weaker Language. In this way, the Ivy Hypothesis not only accounts for code-mixing but also puts it in a theoretical frame together with language acquisition.

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