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Early Child Grammars: Qualitative and Quantitative Analysis of Morphosyntactic Production

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Abstract

This article reports on a series of 5 analyses of spontaneous production of verbal inflection (tense and person–number agreement) by 2-year-olds acquiring French as a native language. A formal analysis of the qualitative and quantitative results is developed using the unique resources of Optimality Theory (OT; Prince & Smolensky, 2004). It is argued that acquisition of morphosyntax proceeds via overlapping grammars (rather than through abrupt changes), which OT formalizes in terms of partial rather than total constraint rankings. Initially, economy of structure constraints take priority over faithfulness constraints that demand faithful expression of a speaker's intent, resulting in child production of tense that is comparable in level to that of child-directed speech. Using the independent Predominant Length of Utterance measure of syntactic development proposed in Vainikka, Legendre, and Todorova (1999), production of agreement is shown first to lag behind tense then to compete with tense at an intermediate stage of development. As the child's development progresses, faithfulness constraints become more dominant, and the overall production of tense and agreement becomes adult-like.

Keywords: Linguistics; First-language acquisition; Morphosyntax; Longitudinal and cross-sectional studies of spontaneous production; Stages of syntactic development

1. Introduction

Traditionally, there has been a fundamental difference in focus in the study of language within the field of theoretical linguistics and within cognitive science. By and large, theoretical linguists are committed to exploring qualitative variation among grammars of adults speaking different languages, whereas cognitive scientists have tended to focus on quantitative aspects of their production, comprehension, or both. Similarly, in studies of first language acquisition, linguists typically seek to understand the extent to which the speech of young children is qualitatively different from the adult target, whereas cognitive scientists typically seek to quantify their differences. Optimality Theory (OT; Prince & Smolensky, 2004), by virtue of its avowed goals and its formal structure, makes it possible for the first time to ground a theory of language

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acquisition in a theory of the typological space of possible grammars and at the same time characterize quantitative aspects of developing grammars.

From the perspective of production a linguistic system is fundamentally a delicate balancing act between one extreme—expressing all distinctions that characterize human life—and the opposite extreme—expressing none—to function as a more efficient grammar or computational device. Across languages of the world, important distinctions are realized in more or less complex morphological and syntactic structure. Languages that have poor morphology favor economy: For example, in Vietnamese, temporal information is recovered from the context of an utterance rather than inflectional morphology. Languages with rich morphology are languages that favor expressiveness. In other words, the latter are languages that rank "express important distinctions linguistically" above "be economical." The space of alternative grammars is delimited by the possible alternative resolutions of this conflict and the number of distinctions that may be expressed linguistically. It is this very intuitive idea that OT formalizes and builds on.

OT characterizes grammatical knowledge as a system of universal, violable constraints on well-formed linguistic combinations, ranked into a language-particular hierarchy. Two constraint families—markedness and faithfulness—regulate the balance between expressiveness and economy of structure. Markedness constraints, typically of the form "no structure x," favor economical representations over complex ones, whereas faithfulness constraints ("parse feature f") regulate the extent to which the output of the grammar (e.g., what is expressed) reflects the input to the grammar (e.g., what a speaker seeks to express). The task of a child acquiring a language is to figure out how the conflict between economy and expressiveness is resolved in the particular language he or she is exposed to.

Typically, faithfulness constraints strictly dominate markedness constraints in adult grammars; whereas in early child grammars, the reverse often holds, with markedness constraints dominating faithfulness constraints (resulting in "simplified"—less marked—structures). This is supported by empirical studies of acquisition of phonology (e.g., Demuth, 1995; Gnanadesikan, 1995; Levelt, 1994; Pater & Paradis, 1996; Stemberger & Bernhardt, 1999) and by a formal argument from Smolensky (1996): For unmarked structures to be learnable, the markedness constraints must outrank the faithfulness constraints in the initial state of the grammar. From this perspective, the process of acquisition consists in reranking the constraints such that some faithfulness constraints outrank markedness constraints.

In OT, a strict constraint ranking by definition, yields one optimization for every input; normally, this yields one optimal output.[1] Consider, for example, the sentence, "George pushed me," uttered by a 3-year-old child acquiring English as a native language.

Assume for the sake of discussion that there are only two possible ways of expressing the input (specified in the upper left cell of Tableau 1) in languages of the world. These are instantiated as candidate outputs *a* ("George pushed me") and *b* ("George push me"). Note that each candidate output is favored by one of the constraints listed in the right-most columns. If FAITH dominates *STRUCTURE (as conventionally represented earlier by placing the higher ranked constraint to the left of the lower ranked one), candidate *a* containing the inflectional morpheme *-ed* encoding past tense is evaluated as optimal, compared to candidate *b* (without the *-ed* morpheme). That is, candidate *a* only violates the lower ranked constraint, *STRUCTURE. Candidate *b* is less harmonic than *a* (i.e., fares worse than *a*) because it violates

the higher ranked constraint, FAITH. Tableau 1 is an instantiation of *strict* constraint ranking whereby each optimization returns one and one candidate output only as optimal.[2] It yields a qualitative result regarding which forms are and which forms are not produced at a given age in a given language.

Tableau 1

Input: push (x, y); x = George, y = me; tense = past	FAITH	*STRUCTURE
☞ a. George pushed me		*
b. George push me	*!	

If, however, the two constraints are allowed to *float,* two optimizations result; one shown in Tableau 1 with optimal output candidate *a* and the other in Tableau 2 (where *STRUCTURE dominates FAITH) with optimal output candidate *b.*

Tableau 2

Input: push (x, y); x = George, y = me; tense = past	*STRUCTURE	FAITH
a. George pushed me	*!	
☞ b. George push me		*

Assuming the alternative rankings of *STRUCTURE and FAITH are equiprobable, we can equivalently state that output candidates *a* and *b* are optimal 50% of the time each when the two constraints float. In other words, the corresponding pattern of production is a quantitative one: a 50/50 distribution or optionality of two alternative forms.

Two kinds of general OT learning algorithms have been proposed. On the one hand, Tesar and Smolensky (1998, 2000) focused on learning procedures in the absence of variation and proposed that learning strict domination hierarchies proceeds by demoting markedness constraints. On the other, in the context of some types of variation, Boersma (1997) and Boersma and Hayes (2001) proposed an algorithm for learning partial rankings statistically. To the best of my knowledge, no learning algorithms have been proposed yet that deal with learning partial rankings of the specific type discussed in this article.

To sum up the goals of this article, later I argue:

1. Child grammars obey the same well-formedness constraints as adult grammars; the difference is simply one of constraint reranking, which is the same formal mechanism that underlies cross-linguistic variation.
2. Constraint reranking may result in simpler morphosyntactic structures (e.g., structures that lack inflectional morphology).
3. Early morphosyntactic production consists of both adult-like and nonadult-like forms because the constraint ranking is not fixed yet. Constraints are only partially ranked with respect to one another.
4. The acquisition of morphosyntax proceeds via a sequence of overlapping grammars.

The claim that constraint floating or partial constraint ranking is characteristic of early grammars is elaborated later in the context of several studies of morphosyntactic production in

French native speakers between the ages of 1;8 and 2;6. Two large corpora are analyzed. One is a longitudinal study of three children whose corpora are available from the CHILDES Database (MacWhinney & Snow, 1985). The other is a sample of 22 children (ages 2;0–2;6) from a cross-sectional study provided to myself and my research team by Marie-Thérèse Le Normand (1999). Her corpus is referred to later as the Le Normand corpus.

This article is structured as follows: Section 2 is devoted to general, cross-linguistic background material on morphosyntactic acquisition. Section 3 focuses on the properties of the French inflectional system; in particular, tense and person–number agreement, which children eventually master. Section 4 consists of four studies pertaining to children's developmental course toward mastery of basic tenses and agreement distinctions; based on longitudinal data. An independent measure of syntactic development originally proposed in Vainikka, Legendre, and Todorova (1999) is introduced first, followed by a study of child production of nonadult-like forms. A study of child production of tense and agreement closes the empirical discussion in section 4. Section 5 develops a formal analysis of the generalizations obtained in section 4, including some discussion of predictions made regarding comprehension. Section 6 offers confirming empirical evidence for the general analysis of production, based on a new cross-sectional study. Section 7 summarizes the main claims.

2. A brief cross-linguistic perspective on morphosyntactic development

Research over the last 20 years has revealed a systematic pattern of morphosyntactic development between the ages of 18 to 30 months across languages (Slobin, 1986–1992). For example, once an English-speaking child has reached the "two-word" stage, he or she tends to produce nonadult-like verbal forms like (1) rather than their adult-like counterparts in (2). By the time the child reaches his or her third birthday, utterances of the type in (1) have disappeared altogether. In many languages including Dutch, French, German, Icelandic, and others, toddlers produce both utterances like (1) and (2) at the same stage of development in what appears to be a random pattern (e.g., Phillips, 1995; Wexler, 1994).

(1) a. Geraint push me (Bethan, age 1;9). (Data cited in Radford, 1990, p. 148)
b. Hammer gone (Angharad, age 1;10).
c. Man drive truck (Allison, age 1;10).

(2) a. Geraint pushed me.
b. The hammer is gone.
c. The man drives/is driving a truck.

The examples in (2) are well-formed structures characteristic of adult grammars because they include not only lexical items (e.g., 1 verb, *push*; and 2 nominal arguments, *Geraint* and *me* in [2a]) but also grammatical markers that allow speakers to express finer distinctions such as to the time of the event (the event in [2a] has just happened), whether the participants are identified or not, and so forth. What is lacking in (1) is precisely this kind of grammatical information, otherwise known as *inflectional morphology*: the past-tense inflection *-ed* is missing in (1a) and the auxiliary/copula *is* and the article are missing in (1b); both the third-person singular inflection *-s* and the articles marking (in)definiteness of the nominal referents are missing in (1c).

Table 1
Cross-linguistic sample of optional inflection phenomenon

Language	Reference	Inflection	Optional Inflection	Ages
Catalan	Davidson & Legendre (2003)	Rich in tense and person–number agreement	Yes	1;6–2;8
Chinese (Mandarin)	Legendre, Hagstrom, Chen-Main, Tao, & Smolensky (2004)	No person–number agreement or tense; some aspectual distinctions	Yes	1;9–2;2
German	Clahsen, Penke, & Parodi (1993/1994)	Rich in tense and person–number agreement	Yes	1;8–2;4
Swedish	Josefsson (2002)	Tense marking; no person–number agreement	Yes	1;11–2;5

Languages vary to some extent in the number and kind of overt grammatical markers they make use of, but the phenomenon of simultaneous production of adult-like and nonadult-like verbal forms in toddler speech appears largely independent of a language's morphosyntactic structure, despite claims to the contrary (Wexler, 1998). Table 1 classifies a number of languages along some well-known criteria of richness of their inflectional morphology and reveals the existence of a similar pattern of *optional inflection* roughly in the same age groups (see references for details). It is against this typological background that the acquisition of the French inflectional system is discussed next.

3. The adult spoken French inflectional system: Person–number agreement and tense

Before analyzing young children's production of native French, it is important to know what linguistic system the children will ultimately attain. The fact that young children acquiring French are exposed to the spoken (rather than the written) language matters because the rich system of inflectional suffixes that are characteristic of the spelled language are by and large phonologically silent. Compare the orthographic forms in Table 2, column 2 with the corresponding pronunciations in column 3 in the present-tense paradigm of a regular verb like *danser* ("to dance"). Leaving aside the forms in parentheses, which are extremely rare if not nonexistent in child-directed speech, there is total homophony for all remaining verbal forms of the *-er* (first conjugation) class (i.e., 90% of French verbs; Dietiker, 1978).

In contrast to its impoverished suffixal agreement morphology, French has a rich system of preverbal subject pronouns (see Table 2, column 4). Despite some superficial similarities in positioning, French subject pronouns (*je, tu, il, elle,* etc.) differ in many respects from their English counterparts (*I, you, he, she,* etc.). In particular, they are phonologically weak elements otherwise known as *clitics*: they cannot be stressed, nor can they occur in isolation (as an answer to a question) or be separated from the verb by anything other than another type of clitic (Kayne, 1972). In short, they behave more like prefixes attached to a verbal root than an inde-

Table 2
Spoken French: Inflectional paradigm of *-er* verbs, present tense

Infinitive	*danser*	[dãse]	With subject pronoun
First person sg	*danse*	[dãs]	je danse
Second person sg	*danses*	[dãs]	tu danses
Third person sg	*danse*	[dãs]	il, elle danse
First person pl	*(dansons)*	[dãsõ]	*on danse*[a] *(nous dansons)*
Second person pl or formal	*(dansez)*	[dãse]	(vous dansez)
Third person pl	*dansent*	[dãs]	*ils, elles dansent*

Note. sg = singular; pl = plural.

[a]In Spoken French, *on* originally meaning "one" has come to completely replace nous "we" as the first-person plural subject pronoun. The 2,870 utterances of child-directed speech discussed in section 4.3 contain no instances of *nous* as subject pronoun. Evidence that *on* is properly identified as first-person plural comes from sentences like, "*on prend notre voiture*" ("one takes our car"), where the possessive pronoun must be coreferential with the possessor (or subject). The form of the possessive pronoun *notre* is unambiguously first-person plural. It is the form required with a possessor identified as *nous* in the formal register: "*nous prenons notre voiture*" ("we take our car"). The other *on* with its original unspecified reference meaning "one" requires a third-person possessive adjective "*on prend sa voiture*" ("one takes one's car"); this is extremely rare in child-directed speech and, therefore, ignored here.

pendent lexical item (in English) and are best analyzed as agreement markers (Auger, 1994; Ferdinand, 1996; Jakubowicz & Rigaut, 1997; Legendre, Hagstrom, Vainikka, & Todorova, 2002; Miller, 1992; Pierce, 1992; Roberge, 1990).

In child French, subject clitics emerge early between the ages of 2;0 and 2;3, and they emerge in tensed contexts only (Hamann, Rizzi, & Frauenfelder, 1995; Kaiser, 1994; Legendre et al., 2002; Pierce, 1992). The latter generalization is additional evidence that French subject clitics behave like inflectional elements, at least in child speech.

In addition to quasiprefixal agreement morphology, French marks common nonpresent tenses (past and future) by means of an auxiliary verb preceding the lexical verb rather than suffixal morphology, at least in the spoken register characteristic of child-directed speech. Therefore, the first nonpresent tenses a child is exposed to are the ones listed in Table 3 for danser: periphrastic past tense and future. (All forms of the *danser–dansé* in Table 3 are homophonous: *dãse.*)

Table 3
Spoken French: Inflectional paradigms of nonpresent tenses

	Periphrastic Past Tense	Periphrastic Future Tense
First person sg	*j'ai dansé*	*je vais danser*
Second person sg	*tu as dansé*	*tu vas danser*
Third person sg	*il (masc), elle (fem) a dansé*	*il (masc), elle (fem) va danser*
First person pl	*on a dansé*	*on va danser*
Second person pl or formal	*vous avez dansé*	*vous allez danser*
Third person pl	*ils (masc), elles (fem) ont dansé*	*ils (masc), elles (fem) vont danser*

Note. sg = singular; pl = plural.

Summing up, the child acquiring native French is exposed to a language with rich prefixal distinctions that serve to mark distinctions in person–number as well as tense.[3]

4. The developing French inflectional system: Empirical results

4.1. Default tense and agreement

Previous studies of the acquisition of the French inflectional system (e.g., Ferdinand, 1996; Pierce, 1992) are deficient in at least two respects. One, they characteristically fail to separate the development of tense and that of person–number agreement in French despite the fact that these categories are functionally different and morphologically distinguishable (auxiliary vs. clitic pronoun). Second, they consider that tense and agreement emerge as soon as the child starts using third-person singular forms in the present tense. This is problematic because in young children's speech, present tense is disproportionably used regardless of the temporal properties of the situation described. As shown in (3), in a context where the future tense is called for in French, Grégoire uses the present tense form *mange* (in bold) instead of the future tense form *vais/va manger.* At this point in the corpus, Grégoire has already shown that he knows how to use the future tense.[4]

(3) Situation: Grégoire has been eating toast since the beginning of the recording; while holding a big piece he starts running to the kitchen where his mother is cleaning up some red mess on the floor. The adult recording the session who has been talking to Grégoire for awhile suggests taking the toast back to the kitchen then begs him for the piece of toast at which point Grégoire says:

Mange à la cuisine le pain. (Grégoire, age 2;1)
Eat–present in the kitchen the bread.
"(I) am going to eat the bread in the kitchen" (lit.: "am/is eating").

Similarly, children's third-person singular markings include numerous nonadult-like references to themselves and some to plural referents. In (4a) the subject clitic is missing, but the auxiliary form *va* [va] of the irregular verb *aller* ("to go" as transcribed by the original coder) is a third person of this irregular verb (the correct first person is *vais* [vɛ]).[5] In (4b) the child uses the strong pronoun *moi* to refer to himself but uses the auxiliary form *a* [a] instead of *ai* [e].[6] In (4c) the subject is plural but the auxiliary form is singular *est* [e] instead of plural *sont* [sõ]. Both auxiliaries are irregular in the sense that individual forms differ on the basis of person and number, contrary to the large majority of frequent French verbs examined here. (INF refers to "infinitive" in the gloss, PART to "past participle.")

(4) a. Situation: The child leaves the kitchen to look for his mother

Va voir maman. (Grégoire, age 1;10)
"I *am going to* see mom" (lit.: "[I] **is** going to see-INF").

b. Situation: S is sitting at the dinner table ready to eat. He announces that he has put his lollipop down.

Moi **a** **mis** Titi là. (Stéphane, age 2;7)
"I have put Titi there" (lit.: "I **has** put-PART").

c. Situation: Adult comments that Grégoire's siblings and his father are absent.

Papa et Maman **est parti**. (Grégoire, age 2;0)
"Mother and Father are gone" (lit.: "**is** gone-PART").

In audio recordings without visual support, it is often difficult to interpret a given instance of present tense as genuinely referring to an event occurring at the moment of speech rather than a default use; hence, a conservative approach is called for. Meisel (1990) argued that tense can be said to be acquired only with the emergence of a tense *contrast* (e.g., present vs. past) rather than the mere appearance of the present tense. As the example in (3) shows, the use of present tense needs to be construed as default or underspecified tense rather than true present tense in some cases. Similarly, for person–number agreement, the acquisition of agreement coincides with the emergence of a contrast between two different forms. Highly frequent third-person singular forms are best characterized as instances of default or underspecified agreement.

4.2. Study 1: Measuring morphosyntactic development

To begin to analyze morphosyntactic development, it is important to be able to measure a child's stage of development using a metric that is comparable across children and independent of particular syntactic constructions.

Age only provides a very rough measure of a child's morphosyntactic development. The well-studied transcripts of Adam, Eve, and Sarah (Brown, 1973) show that at age 2;3 Adam's and Sarah's morphosyntactic development is just beginning, whereas Eve has already acquired much of English syntax. In French, Grégoire and Stéphane will be shown to display the same basic morphosyntactic abilities at significantly different ages: 1;9 for Grégoire versus 2;3 for Stéphane. Grégoire, Philippe, and Stéphane display the same advanced morphosyntactic abilities at different ages as well: 2;5, 2;6, and 3;3, respectively. In the Le Normand corpus (Study 5, section 6), the 22 children studied have the same age ranging from 2;0 to 2;6; yet, they are at three different stages of morphosyntactic development.

The mean length of utterance (MLU; Brown 1973) was largely developed to remedy this situation and has become the standard measure of morphosyntactic development among psychologists studying language acquisition. There is, however, no agreement on the unit of measure across users who freely use morphemes (Brown, 1973) or words (e.g., Clahsen, Penke, & Parodi, 1993/1994) as the measuring unit. To be truly useful as a tool for the acquisition of syntax (including word order, null subjects and objects, question formation, etc.), it is necessary to know which MLU ranges correspond to meaningful syntactic stages. However, a study by Klee and Fitzgerald (1985) has conclusively shown that there is no predictable relation between MLU and syntactic complexity.

The arbitrariness problem of establishing MLU cutoff points that do not correspond to meaningful syntactic stages can be obviated by including in the metric a measure of syntactic development that is independent of particular syntactic phenomenon. This step has led to the predominant length of utterance (PLU) metric of Vainikka et al. (1999), which builds on the

MLU and the traditional observations that children go through a one-word stage before a two-word stage, and so forth. The PLU metric, however, looks at the proportions of utterances of different length rather than just the *mean* length. In addition, it incorporates an independent measure of syntactic development, namely the proportion of utterances containing verbs at different stages. Verbs play a central role in (adult) syntax. Moreover, the fact that there is arguably no syntax before verbs appear in child speech supports measuring their rate as part of defining a stage of syntactic development.

Vainikka et al. (1999) provided a specific set of coding guidelines and substantial empirical evidence that the PLU-stages proposed in (5) are motivated cross linguistically. Moreover, this measure has been successfully applied to detailed studies of Catalan (Davidson & Legendre, 2003), Mandarin Chinese (Legendre, Hagstrom, Chen-Main, Tao, & Smolensky, 2004), and Polish (Jarosz, 2003).

(5) Definitions of PLU Stages
Length of utterance:
Stage 1: Predominantly one-word stage
Almost all utterances (90%) are of the one-word sentence type.
Stage 2: Intermediate stage between one-word and two-word stage
The one-word sentence type is still very common (60%–89% of the utterances are of the one word-type).
Stage 3: Two-word stage
The one-word sentence type no longer clearly predominates (i.e., fewer than 60% of all utterances are one-word utterances).
The multiword sentence type (3 words and more) is not the most common one.
Stage 4: Predominantly multiword stage
The multiword sentence type (3 words and more) is the most common one.

Proportion of verbs:
Stage a: At most, 10% of all utterances contain a verb
Stage b: 11% to 60% of all utterances contain a verb
Stage c: More than 60% of all utterances contain a verb

Utterances are simultaneously evaluated for number of words[7] and percentage of verbs. Greater percentages of words correlate with greater proportions of verbs and children do not regress to a smaller percentage of verbs when they produce longer utterances. Hence, only a subset of possible stages (3a, 3b, 3c, etc.) is in fact encountered in normally developing children. They are in succession: 2b, 3b, 4b, and 4c. At this point, we suspect that other stages like 2c, 3a, 3c, and 4a, if they exist at all, would be the result of some particular deficiency.

4.2.1. Materials and participants

The French data come from the CHILDES Database (MacWhinney & Snow, 1985). It consists of separate audio-recorded sessions of spontaneous interaction between 3 monolingual male children acquiring Continental French as a first language and 1 to 3 adults (typically 1 or 2 parents, occasionally an older child plus the person visiting the family home and recording the data).

Table 4
Children's corpora analyzed (CHILDES Database)

Child	Source	Files	Age Range	Total Utterances
Grégoire	Champaud corpus	1–10	1;9–2;5	2,644
Philippe	Suppes, Smith, & Leveillé (1973)	1–3 & 11	2;1–2;2 & 2;6	1,285
Stéphane	Rondal (1985)	1–3; 6a/6f/8a; 25b	2;2–2;3 & 2;6–2;8 & 3;3	1,589

The situations recorded vary from free play to looking at books, eating at the dinner table, using the potty, and so forth. The specifications of the corpora used here are listed in Table 4.[8]

4.2.2. Coding

All files were coded for PLU stage by hand by myself, a native speaker of French. All children's utterances were coded for PLU stages based on the number of words—percentages of one-word utterances, two-word utterances, and multiword utterances (3 words and more)—as well as percentage of verbs.

4.2.3. Discussion

Spontaneous production data in French from three children available through the CHILDES Database at the time of the original study reveals three successive stages of development: PLU Stages 3b, 4b, and 4c. No data is available for PLU Stage 2b (the recordings started too late to capture that stage in French, compared to the Catalan data discussed in Davidson & Legendre, 2003). Data from only 2 children are available at Stage 3b, but they amount to a nonnegligible number of utterances (about 1,500). Discrepancies with respect to age can be seen: At the age Grégoire reaches PLU Stage 4b, Stéphane is still at PLU Stage 3b. Although the more advanced Stage 4c correlates with older age, there can be a significant age gap across children, as is the case for Stéphane. Although higher MLU counts tend to correlate with higher PLU for a given child (see Table 5), significant discrepancies can also be observed. For example, Stéphane's MLU at age 2;2 through ;3 and age 2;6 through 2;8 overlaps (2.1–3 and 1.9–2.6, re-

Table 5
PLU stages—CHILDES corpora

Child Name	Files	Age	PLU Stage	MLU	Total Utterances
Grégoire	1–4	1;9–1;10	3b	1.8	874
	5–7	2;0–2;3	4b	2.0–2.5	732
	8–10	2;5	4c	3.2–4.6	1,038
Stéphane	1–3	2;2–2;3	3b	2.1–3	644
	6a/6f/8a	2;6–2;8	4b	1.9–2.6	688
	25b	3;3	4c	—	257
Philippe	1–3	2;1–2;2	4b	3.0–3.5	898
	11	2;6	4c	—	387

Note. PLU = predominant length of utterance; MLU = mean length of utterance.

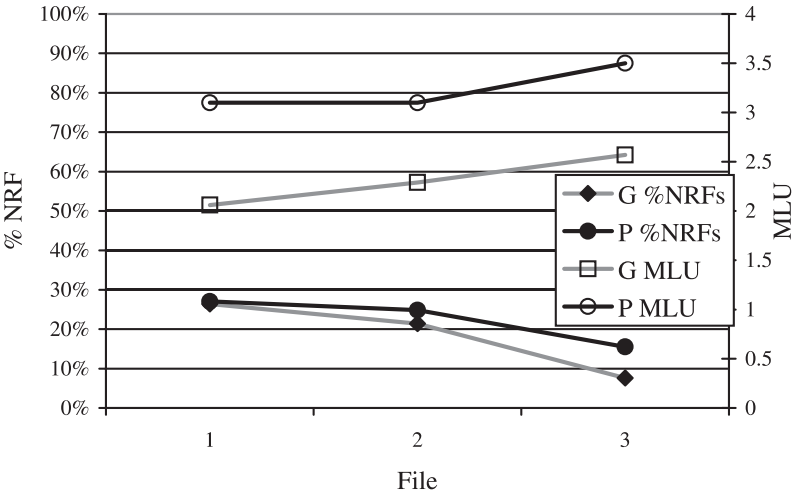

Fig. 1. Production of non-finite root forms at Stage 4b versus mean length of utterances.

spectively). In terms of PLU, he is clearly at two distinct stages of development. At the same PLU Stage 4b, Grégoire and Philippe show distinct MLUs: 2.0–2.5 and 3.0–3.5, respectively.

Anticipating some of the discussion in Section 4.3, Fig. 1 plots the production of nonadult-like verbal forms (non-finite root forms [NRFs]) at Stage 4b for both Grégoire and Philippe's three relevant files (arbitrarily indicated as 1–3), showing in the lower part of the graph that both children produce roughly equivalent proportions of nonadult-like utterances lacking inflection. However, their MLUs (shown in the upper part of the graph) are quite different: Grégoire's ranges from 2 to 2.5, whereas Philippe's ranges from 3 to 3.5 (see Table 5). In PLU terms, however, they are at the same independently measured stage of development: 4b.

I conclude that such distributions provide evidence in favor of a PLU measure over the MLU, at least for the study of morphosyntax.[9]

4.3. Study 2: NRFs in child French

In main ("root") clause contexts, French children produce a mix of adult-like forms and nonadult-like verbal forms that will be referred to as NRFs. *Non-finite* means that the verb lacks the tense, person, and number inflection characteristic of finite verbs. NRFs include infinitive forms and bare participles as exemplified in (6). For 90% of French verbs (i.e., first conjugation verbs), these two forms are phonologically identical. For example [dãse] is the phonetic transcription of both danser ("to dance") and dansé ("danced") as in, "He has danced." It is, therefore, often difficult to make a definitive coding decision. Whether they are identified as infinitives or bare participles makes no difference in this discussion because both are simply counted as NRFs in the relevant contexts.

(6) a. Situation: Grégoire holds a kleenex while starting for the restroom

Cabinets **ouvrir**. (Grégoire, PLU Stage 3b; age 1;9)
Restroom open-INF.
"(I will) open the restroom (door)."

b. Situation: Grégoire and the two adults are speaking about a bird perched on a roof. Mother proposes to wave to the bird and G is asked, "What is the hand doing?" Sometimes the child answers correctly: *la main elle est montée* ("the hand (it) has gone up"; sometimes with an NRF as shown later. The form in phonetics could be either mark a participle (spelled *monté(e)*) or an infinitive (spelled *monter*)

Mõt[e] la main. (Grégoire, PLU Stage 3b; age 1;10)
go up-PART/INF the hand.
"gone/go up the hand."

c. Situation: Stéphane enumerates small objects he is looking for, including a flashlight he claimed earlier was hidden beneath something

Cherch[e] la pim. (Stéphane, PLU Stage 3b; age 2;2)
look-for-PART/INF the flashlight.
"(I am) looking for the flashlight."

4.3.1. Results

The first quantitative result of the overall study of child French concerns NRFs characteristic of an early stage of morphosyntactic development (see Fig. 2). Young French children produce a significant percentage of NRFs at PLU Stage 3b, ranging from 28% to 48%, depending on the child. The proportion is considerably lower at the next stage of development (4b), ranging from 12% to 21%. At Stage 4c, NRFs have almost disappeared altogether with percentages ranging from 1% to 4%. For each child, the production levels differ significantly at different stages (percentage from Table 6): Grégoire (28% vs. 16%), $\chi^2(1, N = 584) = 11.4$, $p < .0008$; (16% vs. 1%), $\chi^2(1, N = 998) = 95.4$, $p < 10^{-21}$; Stéphane (48% vs. 12%), $\chi^2(1, N = 311) = 48.8$, $p < 10^{-11}$; (12% vs. 2%), $\chi^2(1, N = 357) = 12.6$, $p < .0004$; Philippe (21% vs. 4%), $\chi^2(1, N = 736) = 38.2$, $p < 10^{-9}$.

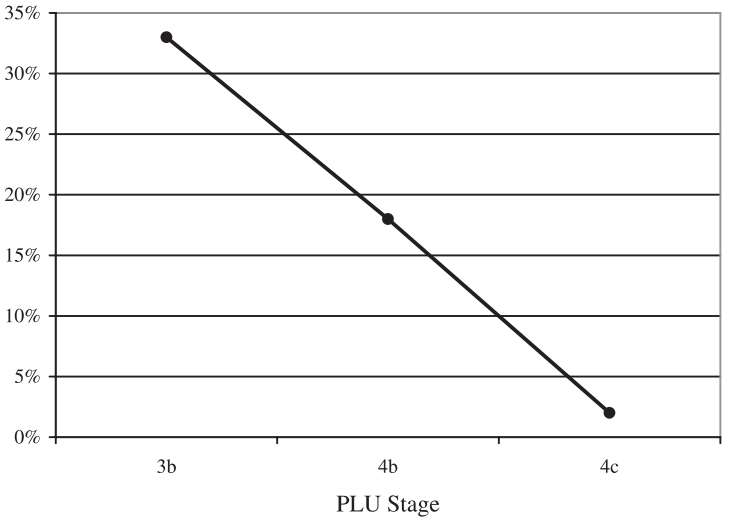

Fig. 2. Average production of non-finite root forms versus predominant length of utterance stages.

Table 6
Proportion of nonfinite root forms of all verbs

Child	Stage 3b	Stage 4b	Stage 4c
Grégoire	28% (82/297)	16% (46/287)	1% (6/711)
Stéphane	48% (51/106)	12% (25/205)	2% (3/152)
Philippe	—	21% (102/476)	4% (11/260)
Weighted average	33% (133/403)	18% (173/968)	2% (20/1123)

4.3.2. Discussion

The fact that NRFs have disappeared by Stage 4c suggests that Stage 4c is adult-like with respect to acquisition of inflection. This is indeed the case, as Stage 4c will be independently shown to be the stage by which both *tense* and *agreement* are productively used at adult-like levels by the three children.

In French, proportions of nonadult-like forms linearly decrease over the three stages of development, from a relatively high average level of 33% at PLU Stage 3b (out of all utterances containing verbs). Although this relatively high proportion of NRFs does not challenge the relevant claims pertaining to French (e.g., Pierce, 1992), the bigger picture of understanding NRFs in child speech cross linguistically in terms of PLU stages surely does.

In romance languages other than French, NRFs may be lower at a similar stage of development stage, but they still appear. This is the case in Catalan (Davidson & Legendre, 2003) based on a study of three children from the CHILDES Database (Pep: 10% NRFs; Gisela: 4% NRFs; Laura: 8% NRFs; all at Stage 3b). Wexler (1998) made the claim that only nonnull subject languages (English, German, Dutch, etc.) exhibit the NRF phenomenon. However, his complementary claim that null subject languages (like Catalan) do not exhibit the NRF phenomenon is not substantiated by our analysis that reveals that at an earlier stage of development (PLU Stage 2b) Pep's utterances containing verbs include 20% of NRFs.[10] Crucially, claims like Wexler's (1998) are not based on an independent measure of syntactic development but rather on a monolithic concept of "optional infinitive stage," which fails to take into consideration the fact that there are clearly identifiable substages of development. For now, I conclude that the difference in NRF percentages across null-subject and nonnull-subject languages is a quantitative rather than a qualitative one.

4.4. Study 3: Tense and agreement in spontaneous child-directed speech

Analyzing the adult speech in naturalistic sessions with a child is crucial for several reasons: (a) to establish whether the child systematically produces tense and agreement markers at the same rate as their adult interlocutors, (b) to evaluate whether children "copy" the adult patterns, and (c) to quantify the child's adult-like target against which the child's production of adult-like forms can be measured.

Samples of adult speech from three child corpora from the CHILDES Database were coded for nonpresent tense and non-3sg (non-third person singular) occurrences and analyzed by myself to establish a baseline of adult production in the same situational contexts. For all children,

the two adult speech samples come from files corresponding to their least advanced and most advanced stages of development; otherwise, they were randomly selected.

As can be expected from spontaneous recordings during home visits, the sessions vary with respect to the activities and events that frame their verbal exchange and the number of adults interacting with the child (typically 2 in Grégoire's and Philippe's sessions vs. 1 in Stéphane's). The files retained for analysis are all files in which the adults and the child typically look at books or themselves or play with toys together; all arguably display a "here-and-now" bias. Eliminated from consideration for the adult count were files that significantly depart from this standard either because a significant portion of the adult speech is devoted to comments from one adult to the other about the child's latest linguistic achievements (e.g., Grégoire's File 3) or because the session recorded after a long summer break is a question–answer session between the adults and the child about his recent summer vacation resulting in a high percentage of past-tense forms (e.g., Philippe's File 11).

4.4.1. Results

As revealed by Table 7, the results pertaining to tense are similar across adults and developmental stages. Despite the here-and-now focus of the sample files, all adults use nonpresent tenses roughly 30% of the time regardless of the developmental stage of their children. The percentage of nonpresent tense at PLU Stage 3b may be somewhat artificially low due to the relatively low percentage from Grégoire's file (23%).

There is more variation in the percentage of non-3sg agreement in adult speech both across adults and across PLU stages. The adults in Philippe's files use a higher percentage of non-third singular forms (52%) versus an average of 41% for the adult speech in Grégoire's file and 38% in Stéphane's file. The percentage of non-3sg agreement at PLU Stage 3b may be artificially low because no data from Philippe is available.

For both Grégoire and Stéphane, adults appear to produce fewer non-third singular forms in later files (PLU Stage 4c) than at Stage 4b for no obvious reason. The distribution of second-person singular forms merits investigation because the situation calls for a child response using a non-third person singular form. However, it is not the proportion of second-person sin-

Table 7
Adult usage of non-3sg and nonpresent tense per child and PLU stage

Adults From File No. and PLU Stage	Nonpresent	Non-3sg
Grégoire 2 3b	23% (95/409)	38 % (156/409)
Grégoire 6 4b	33% (127/384)	55% (210/384)
Grégoire 9 4c	28% (184/659)	35% (231/659)
Stéphane 3 3b	29% (49/166)	41% (68/166)
Stéphane 6f 4b	34% (69/202)	41% (83/202)
Stéphane 25b 4c	31% (61/197)	32% (63/197)
Philippe 3 4b	30% (137/442)	52% (232/442)
Philippe 10 4c	29% (121/411)	53% (218/411)
Weighted average	29% (843/2870)	44% (1,261/2,870)

Note. PLU = predominant length of utterance.

Table 8
Adult usage of second-person singular forms out of all non-3sg

Adults From File No. and PLU Stage	Second-person singular
Grégoire 2 3b	53% (83/156)
Grégoire 6 4b	57% (119/210)
Grégoire 9 4c	64% (150/231)
Stéphane 3 3b	76% (52/68)
Stéphane 6f 4b	59% (49/83)
Stéphane 25b 4c	59% (37/63)
Philippe 3 4b	48% (111/232)
Philippe 10 4b/c	64% (139/218)
Weighted average	59% (740/1,261)

Note. PLU = predominant length of utterance.

gular forms that is responsible for discrepancy across adults. As shown in Table 8, production of second-person singular forms is consistently above 48% of non-third singular forms and averages 59% across all adults. Given that all counts represent only a sample of child-directed speech, *albeit* a substantial one, we may conclude that adults appear to be broadly consistent in the way they interact with their children regardless of their stage of development.

4.4.2. Discussion

There is no evidence from child-directed speech that adult production of nonpresent tense is tied to the particular stage of development of their child. An adult-level percentage of 30% (Table 7) can therefore reasonably be set as an estimation of the tense production target for children acquiring native French and measure their progress toward achieving this goal. Given that young children are able to use tense early (e.g., in French) and agreement early (e.g., Catalan) in appropriate contexts, I assume that children's intentions include specifying tense and person–number agreement on a par with their adult counterparts. This becomes an important part of the formal OT analysis developed in section 5.

In child-directed speech, adult production of agreement (i.e., non-third singular verbal forms) is systematically higher than production of tense (i.e., nonpresent tense). Adult production of non-third singular verbal forms varies across adults, but their production tends to be similar across stages of development for a given child. A target production level of agreement for children can provisionally be set at roughly 45% (Table 7) for the formal analysis.

4.5. Study 4: Longitudinal study of child production of tense and agreement

The child utterances coded for PLU stages in Study 2 were recoded by myself for presence versus absence of markers of tense and subject clitics encoding person–number agreement (see section 3). At the earliest stage of development (PLU Stage 3b), utterances like (7) can be found showing that children are able to produce adult-like nonpresent forms, whereas the focus of the adult–child interaction is the here and now. At the same time, they fail to produce

adult-like agreeing forms (7a, repeated from 4a); they produce NRFs (7b) and use non-adult-like Verb–Object–Subject clausal word order (7b). Both examples are from Grégoire at PLU Stage 3b.

(7) a. Va cherch[e] maman.
Goes look for-PART/INF mom.
"I *am going to* look for mom" (lit.: "[I] is going").
b. Mang[e] salade Adrien.
Eat-PART/INF salad A.
"Adrien is eating salad."

4.5.1. Results

The main qualitative result is that tense and agreement inflection follow independent courses of acquisition in child French. In particular, at the earliest stage available in these corpora (PLU Stage 3b), children already use tense to the same extent as adults in the sense that they make use of nonpresent tenses (periphrastic past and future) on average 35% of the time (Table 9) compared to an average of 30% for adults (Table 7). Overall, the children somewhat exceed their adult counterparts in nonpresent tense production at PLU Stage 3b (see Fig. 3). For each child, the production levels differ significantly at different stages (percentage from Table 9): Grégoire (34% vs. 21%), $\chi^2(1, N = 406) = 9.0$, $p < .003$; (21% vs. 32%), $\chi^2(1, N = 858) = 9.3$, $p < .003$; Stéphane (37% vs. 10%), $\chi^2(1, N = 231) = 22.3$, $p < 10^{-5}$; (10% vs. 25%), $\chi^2(1, N = 314) = 13.9$, $p < .0002$; Philippe (13% vs. 30%), $\chi^2(1, N = 580) = 24.9$, $p < 10^{-6}$.

At the earliest developmental stage (PLU Stage 3b), tense contrasts emerge but agreement markers are practically nonexistent (child, 4% at 3b vs. adult, 39%; Table 7). At PLU Stage 4c, however, agreement markers approach the level of their adult counterparts (child, 36% vs. adult, 40%; Table 7) following a linear path of development. For each child, the production levels differ significantly at different stages (percentage from Table 10): Grégoire (3% vs. 19%),

Table 9
Nonpresent tense inflection (out of verbs marked for any tense)

Child	Stage 3b	Stage 4b	Stage 4c
Grégoire	34% (66/194)	21% (44/212)	32% (205/646)
Stéphane	37% (19/52)	10% (17/179)	25% (34/135)
Philippe	—	13% (44/334)	30% (74/246)
Weighted average	35% (85/246)	15% (105/725)	31% (313/1,027)

Table 10
Verbs with non-3sg agreement inflection (out of verbs marked for any agreement)

Child	Stage 3b	Stage 4b	Stage 4c
Grégoire	3% (5/156)	19% (33/172)	34% (221/649)
Stéphane	5% (2/43)	12% (13/109)	38% (51/133)
Philippe	—	15% (44/303)	40% (98/246)
Weighted average	4% (7/199)	15% (90/584)	36% (370/1,028)

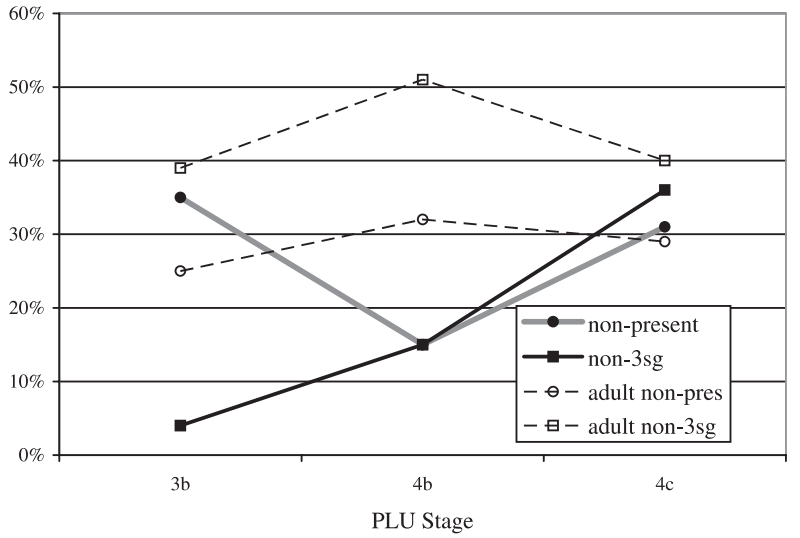

Fig. 3. Comparison of adult versus child production of nonpresent tense and non-3sg agreement.

$\chi^2(1, N = 328) = 20.3, p < 10^{-5}$; (19% vs. 34%), $\chi^2(1, N = 821) = 14.0, p < .0002$; Stéphane (5% vs. 12%), $\chi^2(1, N = 152) = 1.8, p < .02$;[11] (12% vs. 38%), $\chi^2(1, N = 242) = 21.4, p < 10^{-5}$; Philippe (15% vs. 40%), $\chi^2(1, N = 549) = 45.3, p < 10^{-10}$.

The quantitative analysis reveals an even more striking pattern in Table 10. The use of nonpresent tense at the earliest stage (PLU Stage 3b) is adult-like in level but it dips at Stage 4b to return to an adult-like level at the next Stage 4c. The average tense dip is displayed in Fig. 3.

Once average agreement production is plotted along with tense production, another interesting pattern emerges. At PLU Stage 4b, decreasing tense production is down to 15% at the same time that rising agreement production is up to 15%. That such a pattern of agreement would independently occur across three children is unlikely to be an accident.[12]

A second set of results concerns a verb-by-verb analysis of the tense and agreement patterns for Grégoire and Stéphane at the earliest documented stage (3b). Grégoire produces a total of 33 distinct verbs, 17 of which are used once or twice only in the course of four recorded files. Of the remaining 16 used, at least four times each, only 4 are used in a single form. All others (12 verbs) appear in at least two different forms (present tense, past tense, future, NRF). Of these, 6 verbs appear both in a nonpresent tense and either the default present tense or NRF form (*casser,* "break"; *tomber,* "fall"; *tourner,* "turn"; *monter* "go up"; *manger,* "eat"; *voir* "see"). The pattern is strikingly similar for Stéphane. He produces a total of 25 distinct verbs at Stage 3b, 15 of which are used only once or twice. Of the remaining 10 verbs used, at least three times each, only 2 are used in a single form. Six verbs appear both in at least one nonpresent tense and either the present tense or NRF form (*casser,* "break"; *tomber,* "fall"; *chercher,* "look for"; *faire,* "do"; *attraper,* "catch"; *cacher,* "hide").

4.5.2. Discussion

Two alternative hypotheses pertaining to the dip in tense (Fig. 3) readily come to mind. One is that the dip in tense marking at PLU Stage 4b results from a competition with agreement.

The intuitive idea is that resources to express inflectional categories are limited; in particular, they are limited to one up through this stage. This means that at PLU Stage 3b, only a single category, tense is expressed; by Stage 4b, children have realized that there is another category, person–number agreement, but their resources are still limited; leading them to (most of the time) randomly produce one or the other. Alternatively, the dip in tense at PLU Stage 4b is independent of the emergence of agreement and may be due to other particularities of the data.

Recall that the adult tense production is relatively stable across the three PLU stages of development and quite different from the children's profile: 3b, 25%; 4b, 32%; 4c, 29% (see Table 7 and Fig. 3). In fact, adult production of nonpresent tense rises from 25% to 32% between Stages 3b and 4b. At the same time, the child production of tense drops from 35% in average to 15%. There is clearly no immediate mirroring of the adult pattern. Between Stages 4b and 4c, the child production of tense rises from 15% in average to 31%. It is also rather unlikely that the children are mirroring what the adults do at the previous stage, apart from the very general trends revealed in Fig. 3. Specifically, there is both a rise in adult production of non-3sg agreement from Stage 3b to Stage 4b and a rise in child production of non-3sg agreement from Stage 4b to Stage 4c, but the percentages are very different across the two populations. A mirroring explanation would furthermore make the wrong prediction at the next stage: The subsequent adult pattern—a decrease in non-3sg agreement from Stage 4b to Stage 4c—would entail a corresponding decrease in child production of non-3sg agreement later. Such a pattern is definitely not attested in the data, nor can the dip in tense marking be attributed to a special character of the situations depicted in the Stage 4b data: All recorded sessions are equally concerned with the here and now.

To sum up, the hypothesis that child production of tense dips because it is in competition with production of agreement remains the only viable hypothesis of the phenomenon exposed by the PLU stage of development analysis and the quantitative analysis graphed in Fig. 3. It is probably no accident that the rise in child production of agreement at Stage 4b (from an average 4% at Stage 3b to 15% at Stage 4b) coincides with an increase in child-directed speech production of agreement at that very stage (from 39% at Stage 3b to 51% at Stage 4b), resulting in a greater exposure to agreement distinctions in French; but the overall curve of acquisition of tense and agreement we see in Fig. 3 cannot be explained by simply correlating the child production with the adult production.

The verb-by-verb analysis supports the conclusion that the grammar is falling into place by PLU Stage 3b. Although we cannot preclude that linguistic production may involve a lexically based process (e.g., Lieven, Pine, & Baldwin, 1997; Tomasello, 1992, 2000) at earlier stages of development, the grammar of tense marking is operative by the age of 1;9 (Grégoire) and 2;2 (Stéphane). Both Grégoire and Stéphane use half a dozen verbs each in both a tensed form (periphrastic past or future) and a nontensed form (present tense or NRF), which is a pattern that is unexpected if the children are at this stage learning individual verbs with a particular inflection only. The verbs that are used only once or twice by each child simply do not convey any relevant information. They are relatively frequent because the home situations are diverse, and the children move from activity to activity rapidly.

During the acquisition of French, (nonpresent) tense emerges before (non-3sg) agreement. This turns out to be the opposite of what is observed in young Catalan speakers at the same stage: They produce agreement contrasts before tense contrasts (Davidson & Legendre, 2003).

An explanation for the contrasting patterns in French versus Catalan remains to be found (but see footnote 10 for a suggestion).

Finally, the French pattern is a challenge for theories that associate the NRF phenomenon with an early tense deficiency (Wexler, 1994). Clearly, this cannot be the explanation for child French: Despite producing one third of their utterances as NRFs, young native French speakers produce tense roughly at the same level very early on as their adult counterparts.

5. The developing French inflectional system: Formal analysis

5.1. Formal analysis of production

A formal model of child French production needs to capture two basic, intuitive ideas. The first idea is that there are conflicting constraints at play in the child: On the one hand, sentences should show tense and sentences should show agreement; but on the other, sentences should not be so complicated as to realize inflection and sentences should not be so complicated as to realize both tense and agreement. In the OT analysis developed in the following, these statements are formalized as the markedness constraints in (8) and the faithfulness constraints in (9). Although the constraints themselves constitute the universal component of the grammar, the constraint ranking constitutes its language-particular component (i.e., the only component that admits variation).

Evidence that these constraints are universal and operative in adult grammars comes from several sources. First, there are languages that have no inflectional morphology whatsoever (e.g., Vietnamese). In the typological literature, these are referred to as *isolating* languages. Second, languages with rich morphology (e.g., Italian) may resort to nonfinite forms in special contexts such as negative imperatives (e.g., in commands like, "Don't do this!"). Finally, special registers in otherwise morphologically endowed languages tend to be isolating (e.g., newspaper-style headlines commonly include titles of the type, "Bush to run for president again").

To remain *theory-neutral* regarding the representation of inflectional categories in the grammar, the constraints penalizing morphological structure are stated as *AFFIX and *AFFIX^2 and ignore positional issues.[13]

(8) Markedness constraints:
*AFFIX: No affix.
*AFFIX^2: No pair of affixes.

The *AFFIX constraint is violated by any candidate structure that has an affix, be it tense or agreement, in suffix or prefix position with respect to the verb root. *AFFIX is only satisfied by nonfinite verbs, which, by assumption, have no morphological structure realizing tense or agreement features. The *AFFIX^2 constraint[14] is violated by any verbal form with two distinct affixes (i.e., by structures in which both tense and agreement features are realized).

(9) Faithfulness constraints:
PARSET: Parse tense.
PARSEA: Parse agreement.

The faithfulness constraints in (9) limit differences between what is intended by the speaker (the input to optimization) and what is expressed (the output of optimization). They require the output to express all and only the properties of the input and stand in conflict with the markedness constraints in (8) that make demands on the structure of the output. The input to optimization in syntax is routinely assumed to consist of the basic components of an intended utterance (e.g., Grimshaw, 1997; Legendre, Smolensky, & Wilson, 1998; Smolensky, Legendre, & Tesar, 2006). These include lexical items, predicate-argument structure, and inflectional features. For a given input, the grammar generates and evaluates a set of expressions—the output candidate set—consisting of alternative structural realizations of that input. By hypothesis, the input to optimization in child grammars contains the same features as their adult counterpart (see section 4.4).

The second idea the formal analysis needs to capture is that a particular stage of (incomplete) development does not represent a unique total constraint ranking. Rankings coexist and the mixture changes through the course of acquisition. I propose that faithfulness constraints may float over a certain range of the constraint hierarchy determined by markedness constraints penalizing structure as shown in Tableaux's 1 and 2 (see introduction). Formally, this corresponds to a *partial* ordering of constraints; such a grammar determines a *set* of total constraint rankings and predicts not only that we see variation in outputs of the developing grammar but also with what frequency we will see each output (see also Anttila, 1997; Boersma, 1997; Reynolds, 1994).

For the simple inputs relevant to the early child utterances studied here, at every stage of development, there are four possible expressions or *candidates* to be evaluated. For example, given an input containing the features [1sg] (first-person singular) and [past tense], the candidates are as follows: (a) an uninflected verbal form (10a) that precludes parsing any inflectional features, yielding an NRF as output; (b) and (c) a verb form with one affix that parses only one feature, either tense (auxiliary *a*) or agreement (1sg subject clitic *je*), as shown in (10b) and (10c), yielding verbal forms that are either tensed or agreeing but not both; and (d) an adult-like verbal form with two affixes, making it possible to parse both tense (auxiliary *ai*) and agreement (subject clitic *j',* a variant of 1sg *je*) and yielding adult-like verbal forms. The order affix–root mirrors the French order.

(10) Candidate expressions of a [1sg], [past tense] input:

a. [V]	example:	*danser/dansé* (NRF)
	violates:	PARSEA, PARSET
	satisfies:	*AFFIX, *AFFIX^2
	> NEITHER TENSED NOR AGREEING	
b. [affix$_T$ [V]]	example:	*a dansé* (3sg, past)
	violates:	PARSEA, *AFFIX
	satisfies:	PARSET, *AFFIX^2
	> TENSED, NOT AGREEING	
c. [affix$_{Agr}$ [V]]	example:	*je danse* (1sg, present)
	violates:	PARSET, *AFFIX
	satisfies:	PARSEA, *AFFIX^2
	> AGREEING, NOT TENSED	

d. [affix$_{Agr}$ [affix$_{T}$ [V]]] example: *j'ai dansé* (1sg, past)
violates: *AFFIX (twice), *AFFIX^2
satisfies: PARSEA, PARSET
> TENSED AND AGREEING

If a child had a single total constraint ranking at each stage of development, a single type of output would be optimal; which one among the four displayed in (10) that would be depends on the constraint ranking. For example, a total constraint ranking like *AFFIX^2 » PARSET » *AFFIX » PARSEA corresponding say to PLU Stage 3b would result in all child utterances being tensed but not agreeing. All verbal forms would be of the type (10b); that is, a dansé. That is because candidate *b* is optimal as shown in Tableau 3, despite violating *AFFIX and PARSEA, because its competitors fare worse given the constraint ranking. They violate higher ranked constraints: PARSET for candidates *a* and *c* and *AFFIX^2 for candidate *d.* (Recall that constraints are represented from highest [left-most] to lowest [right-most].)

Tableau 3
A total constraint ranking analysis

Input: *danser* (x); x=1sg; tense= past	*AFFIX^2	PARSET	*AFFIX	PARSEA
a. *danser/dansé* (NRF)		*!		*
☞ b. *a dansé* (3sg, past)			*	*
c. *je danse* (1sg, present)		*!	*	
d. *j'ai dansé* (1sg, past)	*!		**	

This, however, does not characterize the observed child language. Children acquiring native French produce a mix of verbal forms, exemplified in (11) for Stage 4b (the first stage at which they produce some forms that are both tensed and agreeing).

(11) a. Marked for both tense and agreement (e.g., periphrastic past tense, 1sg).

Et moi **j'ai roulé** sur moi la belle voiture. (Grégoire, PLU Stage 4b)
"and me I have run all over me the beautiful car."

b. Tensed but not agreeing (e.g., periphrastic future tense, but auxiliary form phonologically ambiguous between 2sg and 3sg of irregular verb in a context calling for 1sg).

[**va**] assis. (Grégoire, PLU Stage 4b)
"are/is going to sit down."

c. Agreeing but not tensed (e.g., 1sg, but present tense in a context clearly calling for past tense).

Je mets le gant. (Grégoire, PLU Stage 4b)
"I put on the glove."

Their apparent optionality is interpreted here as resulting from a *coexistence* of total rankings at a given stage of development. Formally, rankings coexist because some constraints are *partially ranked* with respect to others (Anttila, 1997; Boersma, 1997; Nagy & Reynolds, 1997; Reynolds, 1994). A partial ranking straightforwardly allows us to express the fundamental observation that proportions of alternative verbal forms (e.g., NRF, tensed only, tensed & agree-

ing) change in particular, systematic ways through the course of development. Overall, the stage-by-stage analysis relies on the changing distribution of PARSEA and PARSET with respect to *AFFIX^2 and *AFFIX.

At PLU Stage 3b, PARSET has a higher range than PARSEA. At this stage, PARSEA is ranked so low as to be irrelevant.

(12) *PLU Stage 3b*:

Fixed		*AFFIX^2 » *AFFIX
Floating:	PARSET	———————————
	PARSEA	————

The partial ranking in (12) encodes three total rankings: PARSEA is (strictly) ranked below *AFFIX, but PARSET is partially ranked with respect to *AFFIX^2 and *AFFIX. In some evaluations, PARSET is ranked above *AFFIX^2; and, in others, below. Concretely, this means that the child uses any of the three rankings given later in (12). Two of these rankings yield a tensed verb; one yields an NRF.

(13) *PLU Stage 3b*:

a.	PARSET » *AFFIX^2 » *AFFIX » PARSEA	yields:	tensed
b.	*AFFIX^2 » PARSET » *AFFIX » PARSEA	yields:	tensed
c.	*AFFIX^2 » *AFFIX » PARSET » PARSEA	yields:	NRF

Note that, assuming them to be equally likely (following Reynolds, 1994, and Anttila, 1997), the three rankings in (13) provide an expected proportion of each type of output as well: Twice as many rankings yield tensed verbs as yield NRFs, so we expect to see twice as many tensed verbs as NRFs. In other words, the partial ranking in (13) predicts that 33% of verbs at PLU Stage 3b will be NRFs, whereas 67% of verbs will be tensed (which is 100% of finite verbs). No verbs at Stage 3b will be agreeing (so, of course, no verbs at Stage 3b will be both agreeing and tensed). That is precisely what we saw in the child data (see Table 6): 35% of verbs are NRFs at Stage 3b; all of the finite verbs are tensed and nonagreeing.

At PLU Stage 4b, PARSEA advances to cover the same ground as PARSET; PARSEA, and PARSET are completely symmetrical at this stage.[15] The partial ranking in (14) defines the 12 orderings given in (15).

(14) *PLU Stage 4b*:

Fixed		*AFFIX^2 » *AFFIX
Floating:	PARSET	———————
	PARSEA	———————

(15) *PLU Stage 4b*:

a.	PARSET » PARSEA » *AFFIX^2 » *AFFIX	yields:	tensed and agreeing
b.	PARSEA » PARSET » *AFFIX^2 » *AFFIX	yields:	tensed and agreeing
c.	*AFFIX^2 » *AFFIX » PARSET » PARSEA	yields:	NRF
d.	*AFFIX^2 » *AFFIX » PARSEA » PARSET	yields:	NRF
e.	*AFFIX^2 » PARSET » PARSEA » *AFFIX	yields:	tensed
f.	*AFFIX^2 » PARSEA » PARSET » *AFFIX	yields:	agreeing
g.	PARSET » *AFFIX^2 » PARSEA » *AFFIX	yields:	tensed
h.	PARSEA » *AFFIX^2 » PARSET » *AFFIX	yields:	agreeing

i. PARSET » *AFFIX² » *AFFIX » PARSEA yields: tensed
j. PARSEA » *AFFIX² » *AFFIX » PARSET yields: agreeing
k. *AFFIX² » PARSET » *AFFIX » PARSEA yields: tensed
l. *AFFIX² » PARSEA » *AFFIX » PARSET yields: agreeing

The rankings in (15) yield the following proportions for verbal forms. Two of the 12 rankings (a, b) yield forms that are both tensed and agreeing (17%). Two of the 12 rankings (c, d) yield NRFs (17%). Four of the 12 rankings (e, g, i, k) yield tensed (nonagreeing) forms (33%). Finally, the remaining 4 of 12 rankings (f, h, j, l) yield agreeing (nontensed) forms (33%).

Of inflected verbs, this predicts that 60% (6 out of 10) will be agreeing, and 60% (6 out of 10) will be tensed (this, of course, includes two rankings, a and b, that yield both tense and agreement).

Recall that only nonpresent tense unambiguously indicates presence of tense, and that only non-3sg agreement unambiguously indicates presence of agreement. Based on the observed adult proportions of nonpresent tense (29%) and non-3sg agreement (44%) at Stage 4b, we therefore predict that we will see 17% (60% × 29%) of inflected verbs in the child data showing nonpresent tense and 26% (60% × 44%) of inflected verbs in the child data showing non-3sg agreement.

The attested proportions fare well with the predictions: 18% are NRFs at Stage 4b (vs. predicted 17%), 15% of finite verbs show nonpresent tense morphology (vs. predicted 17%), and 15% of finite verbs showed non-3sg inflection (vs. predicted 26%). The discrepancy between the predicted 26% and the attested 15% points to a limitation in the present partial constraint ranking analysis that may be due to the working assumption that all rankings are equiprobable. This suggests exploring alternative weighted systems of constraint rankings with a particular constraint more likely to appear at the center of its range than near the edges of its range (Boersma, 1997). Finally, at PLU Stage 4c, PARSET and PARSEA, together, come to outrank *AFFIX², at which point tense and agreement are always both realized.

(16) *PLU Stage 4c*:

Fixed		*AFFIX² » *AFFIX
Floating:	PARSET	——
	PARSEA	——

(17) *PLU Stage 4c*:
a. PARSET » PARSEA » *AFFIX² » *AFFIX yields: tensed and agreeing
b. PARSEA » PARSET » *AFFIX² » *AFFIX yields: tensed and agreeing

Both rankings in (17) yield tensed and agreeing forms.[16] The corresponding partial ranking in (16) hence predicts 29% nonpresent (100% Tensed × 29% Observed adult nonpresent) and 44% non-3sg (100% Agreeing × 44% Observed adult non-3sg), as well as 0% NRFs. Once again, the predictions fare reasonably well with the proportions of attested forms: 31% nonpresent, 36% non-3sg, and 2% NRFs. See Figs. 4 through 6 for a visual illustration of the comparison between observed and predicted proportions that include empirical results from the cross-sectional study discussed in section 6.

The OT analysis of morphosyntactic development respects three general principles: (a) In child speech, the initial constraint rankings have markedness constraints outranking faithful-

ness constraints, (b) constraint reranking cannot backtrack; acquisition proceeds by spreading faithfulness constraints *monotonically upward* through the hierarchy, and (c) acquisition proceeds via constraints floating over shifting ranges (i.e., yielding a partial constraint ordering) rather than through abrupt and absolute constraint reranking.

5.2. Predictions regarding comprehension

Although experimental studies pertaining to the early comprehension of tense and agreement are ongoing in collaboration with a psycholinguistics lab in Paris (Barrière et al., 2004; Legendre, 2006; Nazzi, Barrière, Legendre, Nicol, & Long, 2004), it is worth formulating what predictions the present OT analysis makes regarding comprehension.

As discussed in Smolensky (1996), an OT grammar is inherently bidirectional. The production direction (discussed earlier) goes from a given interpretation (input) to an optimal expression (output), whereas the comprehension direction goes from a given expression (input) to an optimal interpretation (output). Therefore, a constraint ranking based on production makes predictions about the reverse direction as demonstrated later.

In their original formulation, Prince and Smolensky (2004) identified two kinds of faithfulness constraints: (a) PARSE constraints requiring that if an interpretation has a feature F_x, then the expression must contain F_x; (b) FILL constraints requiring that if an expression has a feature F_y, then the interpretation must contain F_y. Recall that PARSE constraints were discussed in the context of an analysis of (spontaneous) production. In comprehension-directed optimization, PARSE constraints are vacuously satisfied (they do not play a role), but FILL constraints are active, as shown in Tableau 4.

Tableau 4
Comprehension of child tense and agreement

Input/expression: [AgrP ils3PL [TP sontPAST partis]] → ?	*AF^2	PARSET	PARSEAGR	*AF	FILLT	FILLAGR
a. partir(x)	*			**	*!	*
b. partir(x), T=PAST	*			**		*!
c. partir(x), x=3PL	*			**	*!	
→ d. partir(x), x=3PL,T=PAST	*			**		

The expression is held constant across candidates, and each candidate in Tableau 4 is best seen as a combination of an expression (see input) paired with the interpretation listed under a through d. This, in turn, means that all candidates equally violate *AFFIX^2 and *AFFIX. In addition, PARSET and PARSEAGR are vacuously satisfied by candidates *a* and *c* and *a* and *b,* respectively. The decision regarding the optimal candidate interpretation therefore falls to FILLT, a constraint requiring that if an expression has a T feature (e.g., Past), then the interpretation must contain that feature (Prince & Smolensky, 2004). Similarly, FILLAGR requires that an Agr feature in the expression (e.g., 3pl) have a corresponding feature in the interpretation. Interpretations a and c violate FILLT because the expression contains a T head, but there is no corresponding T feature in the interpretation. Interpretations a and b violate FILLAGR in a similar fashion. In fact, the only inter-

pretation in Tableau 4 that satisfies both FILLT and FILLAGR is d. The fact that candidate *d* is optimal under any ranking means that good comprehension is predicted as early as Stage 3b.

What role, if any, does the constraint floating responsible for the production pattern play in comprehension? None, as can be derived from Tableau 4. Two of the four constraints active in production are vacuously satisfied in comprehension and two more are equally violated by all candidates. The two active constraints (FILL) are satisfied; hence, their relative ranking is also irrelevant. Good comprehension is predicted, regardless of constraint floating.

Although the pattern predicted is of the sort commonly reported in the literature (e.g., Bates, 1993; Bishop, 1997; Clark & Hecht, 1983; Naigles, 2002)—good comprehension paired with imperfect production early on—it remains to be seen whether the pattern is confirmed by forthcoming experimental results.

6. Study 5: Cross-sectional study of child production of tense and agreement

This last section discusses empirical evidence from a separate set of situations involving monolingual children acquiring native Continental French. The Le Normand corpus (see Table 11) is a large cross-sectional corpus of relatively short recordings of spontaneous speech produced during symbolic play, in the same standard situation with the same characters, and videotaped by the same observer (for further details, see Parisse & Le Normand, 2000). A sample of 22 randomly selected children from that corpus in the age range 2;0 through 2;6 was analyzed following the procedures described under sections 3 and 4.[17]

In the Le Normand corpus, adults do not verbally interact with the child at play, resulting in quasimonologues. This corpus contrasts with the CHILDES Database corpora discussed earlier and best described as dialogues or question–answer sessions pertaining mostly to toys, objects, or people present during recordings. This difference, paired with the conclusions reached earlier, make several verifiable predictions:

1. If a relatively high proportion of NRF production followed by its linear decrease is characteristic of the grammar of child French rather than particular circumstances of production, then we expect children from the Le Normand corpus to show percentages of NRFs comparable to the three children investigated earlier.
2. If nonpresent tense production is independent of the here-and-now situations at hand, as argued earlier for both adults and children, then we expect children from the Le Normand corpus to produce an equally high percentage of nontensed verbal forms at PLU Stage 3b.

Table 11
Le Normand corpus (1999)

Predominant Length of Utterance Stage	Number of Children	Age Range
3b	14	2;0–2;6
4b	2	2;0–2;6
4c	6	2;3–2;6

3. If the analysis in terms of a competition between tense and agreement is on the right track, then we expect the children from the Le Normand corpus to exhibit a dip in tense production as well as some rise in agreement production at PLU Stage 4b.

4. Given the difference in discourse type (quasimonologue in Le Normand corpora vs. CHILDES dialogues requiring more first-person singular answers from the children), we do not expect the children from Le Normand corpora to necessarily produce as high a percentage of non-3sg agreement as their CHILDES counterparts.

5. Finally, we expect children from the Le Normand corpus to approximate adult-level production of tense at PLU Stage 4c.

6.1. Results

For the Le Normand corpus, results are given as an average percentage at Stage 3b (the range is small across participants) but as individual percentages for the 2 children identified at Stage 4b and the 4 children identified at Stage 4c when significant variation is exhibited (as is the case for agreement). Tables 12 through 14 compare the production of NRFs, nonpresent tense, and non-3sg agreement across the three available populations.

The trends displayed in Tables 12 through 14 confirm the general predictions of the analysis. With respect to NRFs (Table 12), children from the Le Normand corpus exhibit the same phenomenon as their CHILDES Database counterparts. In fact, the proportions are remarkably similar.

The same can be said about their production of nonpresent tense (Table 13). Children from the Le Normand corpus are at the very same level of production as the adults in the CHILDES Database and comparable; a bit lower than the children from the CHILDES Database. Even

Table 12
Average production of nonfinite root forms

Predominant Length of Utterance Stage	Le Normand Corpus (%)	CHILDES (%)
3b	34	33
4b	11–17	18
4c	5	2

Table 13
Average production of nonpresent tense

Predominant Length of Utterance Stage	Le Normand Corpus (%)	CHILDES (%)	Adult (%)
3b	26	35	25
4b	11–19	15	32
4c	40	31	29

Table 14
Average production of non-3sg agreement

Predominant Length of Utterance Stage	Le Normand Corpus (%)	CHILDES (%)	Adult (%)
3b	0	4	39
4b	9–14	15	51
4c	3–10–14–21	36	40

more striking is the dip in tense production at PLU Stage 4b. It is found in both child corpora to comparable proportions.

The production of non-3sg agreement is also comparable across the two child populations at PLU Stages 3b and 4b, but production at Stage 4c differs. Children from the Le Normand corpus produce many fewer non-3sg forms than their CHILDES counterparts. This makes sense in light of the difference between the two child corpora and does not entail that the children from the Le Normand corpus are less advanced with respect to acquisition of agreement than their CHILDES counterparts at Stage 4b. Recall that the latter are engaged in question–answer sessions that prod them to use first-person forms and to some extent ask questions of their own, using second-person forms. The former are engaged in symbolic play and verbal monologues with more opportunities to comment on the objects they play with than their own actions and feelings. There is also no opportunity for asking questions from adults using second-person forms. Therefore, the proportion of first- and second-person inputs is plausibly considerably reduced and may not reflect the true competence of the relevant children.

To sum up, the detailed study of two kinds of spontaneous speech corpora reveal that the circumstances of and activities carried out during recordings are reflected in the children's production of agreement but not tense. Figs. 4 through 6 display the predicted versus observed re-

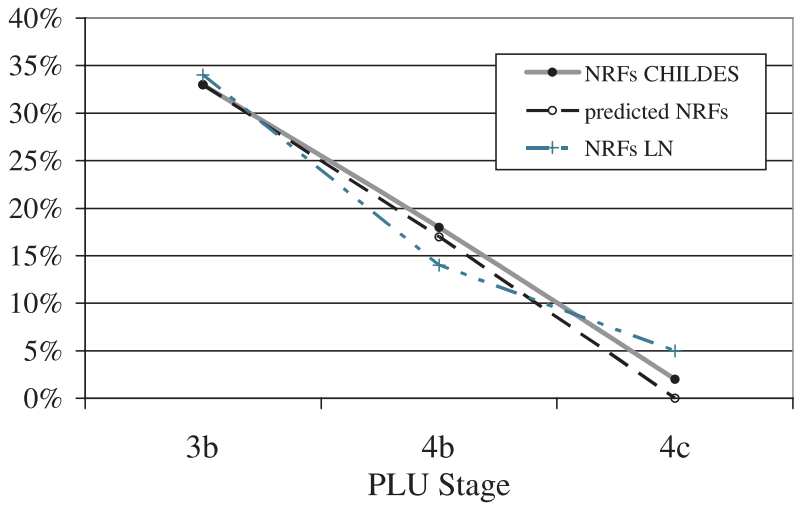

Fig. 4. Observed versus predicted production of non-finite root forms.

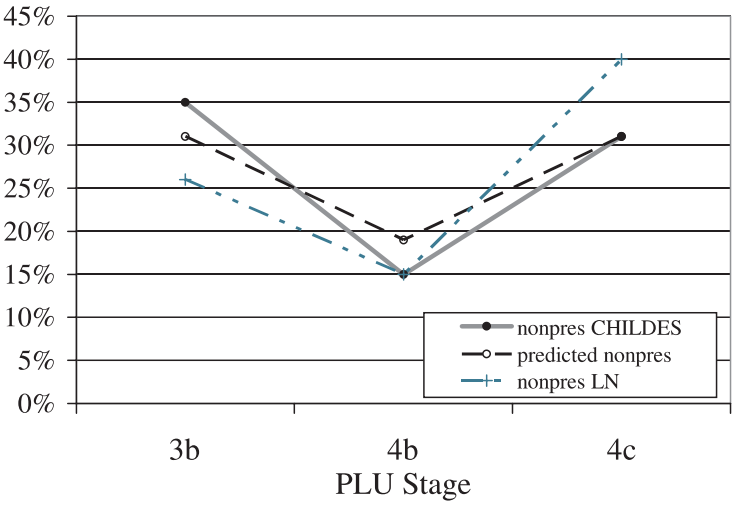

Fig. 5. Observed versus predicted production of nonpresent tense.

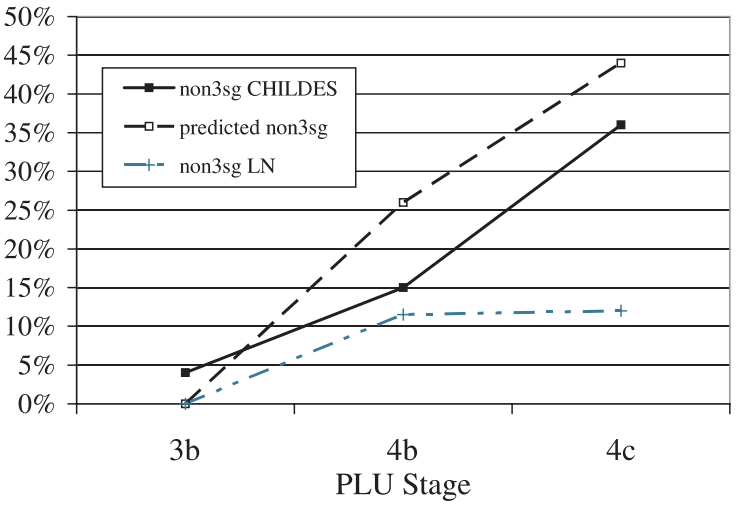

Fig. 6. Observed versus predicted production of non-third singular agreement.

sults for NRFs and for nonpresent tense and non-third singular agreement markings, respectively, for all child populations.

7. Conclusion

A detailed study of morphosyntactic development in children acquiring native French reveals that their tense and agreement production reflects separate courses of acquisition,

whereas their production of nonadult-like forms steadily decreases as their utterances become longer and richer. Nonpresent tense production precedes non-3sg agreement production early on but suffers a characteristic dip at the intermediate stage of development where tense is argued to compete with agreement. The pattern is robust across the 25 children investigated despite some differences in production of agreement tentatively hypothesized to be related to the nature of the corpora themselves.

Quantitatively speaking, children's production of nonpresent tense starts and ends roughly at adult-like levels, but their development does not mirror adult production overall. A formal analysis grounded in universal constraints present in adult grammars, but exploiting OT's characterization of grammars as derived from alternative constraint rankings is successful in capturing both qualitative and quantitative aspects of the morphosyntactic development that takes place in 2-year-olds. Specifically, the pattern of development of verbal inflection in French results from economy of structure constraints taking priority over faithfulness constraints initially. Then the faithfulness constraints become more dominant as the child's development progresses. Overall, acquisition proceeds via overlapping grammars rather than through abrupt changes.

The floating range of partially ranked constraints delimits the relative proportions of alternative optimal outputs. Partial ranking, therefore, provides a mechanism for fully integrating qualitative and quantitative factors into a single, formal model of linguistic variation including the rampant variation observed in language development.

Notes

1. See Smolensky (this volume) for an explanation of Optimality Theory (OT) tableaux; and Smolensky, Legendre, and Tesar (2006) for a comprehensive introduction to OT.
2. In fact, FAITH and *STRUCTURE are themselves families of constraints to be relativized to individual categories (tense, agreement), as discussed in section 5.
3. In this analysis, person and number are treated as a single inflectional category and, therefore, referred to as "agreement." This is a shortcut that shall be eliminated in future studies.
4. The hypothesis that early past tense might actually have more of an aspectual value distinguishing completed from noncompleted events (Antinucci & Miller, 1976) is ignored here. The focus is on tense *marking,* not its actual temporal properties.
5. *Aller* ("to go") is one of the few verbs in French whose individual forms are distinct, based on person and number.
6. It is hard to conceive of this as a mere phonetic mistake because Stéphane does not seem to have any problem with the vowel [e].
7. As defined in (5), the predominant length of utterance metric will not characterize polysynthetic languages (e.g., Eskimo languages) in which one sentence equals one word. For those languages, the morpheme is probably the unit of choice.
8. The study was originally based on Grégoire's entire spontaneous speech corpora of 10 files. Some sampling from the other two children's data was subsequently added targeting the stages of development identified in Grégoire's data, in particular his earlier two

predominant length of utterance stages, 3b and 4b. It quickly transpired that Philippe is at a more advanced stage of development than Grégoire, making his data less critical here. Stéphane's corpus is transcribed phonologically, and he exhibits certain phonological problems that make analysis difficult. These considerations led to some discontinuity in the analyzed files from Philippe and Stéphane without, I believe, introducing significant biases in the data.

9. Mean length of utterances are incomplete for Stéphane and Philippe; hence, it is not possible to carry out a fuller comparison at this time.
10. It is not substantiated by this analysis of French as a null-subject language because subject clitic pronouns are construed as prefixal agreement markers. The fact that French children do produce a higher percentage of non-finite root forms than their Catalan counterparts could be due to a difference in morphological structure (e.g., prefixation in French vs. suffixation in Catalan).
11. The very small number of agreeing utterances is smaller than five (i.e., 2); hence, the result for the change from Stage 3b to 4b is not significant.
12. Philippe's production of tense and agreement at predominant length of utterance Stage 3b are missing because his corpus does not include files recorded at an earlier age. Noteworthy is the fact that his production of agreement at Stage 4b is 15%; not 3% or 30%.
13. Inflectional morphology has been argued to have a syntactic status similar to that of lexical categories, albeit in the form of *functional projections* erected above the lexical projection of verbs (for an implementation using constraints *F, "no functional head," and *F^2, "no pair of functional heads," see Legendre, Hagstom, Vainikka, & Todorova, 2002). Nothing in the formal analysis hinges on this; hence, the text adopts the neutral but formally equivalent constraints *AFFIX and *AFFIX^2.
14. *AFFIX^2 is not a basic constraint but rather the result of applying a general operation of Optimality Theory, local conjunction, to two instances of *AFFIX (*AFFIX^2 ≡ *AFFIX &*AFFIX). A self-conjunction such as *AFFIX^2 is a constraint formed from two (identical) more basic constraints; by definition, it is violated in any candidate containing two distinct violations of *AFFIX. *AFFIX^2 is necessarily ranked above *AFFIX because they are part of a *power hierarchy* (Smolensky, 1995). This formalizes the intuition we wish to capture: that having two affixes is more costly in terms of structure than having one (and not simply by virtue of having two violations of *AFFIX, but qualitatively worse for having two *simultaneous* violations of *AFFIX in the same domain). See Smolensky (1995); Smolensky, Legendre, and Tesar (2006); and Legendre, Raymond, and Smolensky (2006) for further discussion of local conjunction.
15. Given that agreement is more common in the child-directed speech than tense with the reverse being the case in the children's speech, a reviewer asks what triggers later promotion of PARSEA than PARSET. Obviously, it cannot be frequencies in the adult input as shown in French, nor can it be the communicative content of tense (which could be considered higher than that of agreement which amounts to redundant information). In Catalan (another romance language,) the reverse pattern—agreement first, tense later—holds. As suggested in footnote 10, the positioning of the inflection (prefixal in French, suffixal in Catalan) merits further examination.

16. As pointed out by a reviewer, the claim that Stage 4b is essentially the adult ranking entails that adults have two alternative constraint rankings as well, yielding the same outcome. In fact, this is relatively commonplace in adult grammars because the number of constraint rankings is typically much larger than the number of grammars (patterns) they determine. This can be verified by computing factorial typologies. However, there is a difference between partial ranking in adult and child grammars. The extent of partial constraint ranking is greater in child grammars, resulting in a pattern of different surface structures. In other words, not every partial constraint ranking yields different alternative surface structures.
17. The difference in numbers of children representing each stage in the Le Normand corpus is incidental, due simply to the data made available to me by the original collector. The data was originally collected for a different purpose.

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