Tense Over Time: The Longitudinal Course of Tense Acquisition in Children With Specific Language Impairment

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Tense marking in English is relatively late appearing and is especially late for children with Specific Language Impairment (SLI). Little is known about the full course of acquisition for this set of morphemes. Because tense marking is a fundamental property of clause construction, it is central to current theories of morphosyntax and language acquisition. A longitudinal study is reported that encompasses the years of 2:6–8:9 years for typically developing children (N = 43) and 4:6–8:8 years for children with SLI (N = 21). The findings show that a diverse set of morphemes share the property of tense marking; that this set is not mastered until age 4 years in typically developing children and after 7 years for children with SLI; that acquisition shows linear and nonlinear components for both groups, in a typical S-shaped curve; and that nonsyntactic measures are not predictors of growth (including nonverbal intelligence, vocabulary size, and mother’s education), whereas initial MLU does predict rate of acquisition. The findings are consistent with a model of Optional Infinitives (OI) for typically developing children (cf. Wexler, 1994, 1996) and Extended Optional Infinitives (EOI) for children with SLI. This model hypothesizes incomplete specification of features of tense that are represented in the grammar.

KEY WORDS: specific language impairment, grammatical development, grammatical impairment, morphosyntax

A critical clinical issue is the identification of a clinical marker, a linguistic form, or principle that can be shown to be characteristic of children with specific language impairment (SLD). The study reported here is part of a programmatic attempt to identify such a clinical marker. In this line of investigation, two objectives are moving in tandem: one is to clarify the evidential standards by which a grammatical clinical marker can be determined, and the second is to clarify our understanding of grammatical acquisition in children, whether they are affected or unaffected (control).

Earlier findings identified a particular grammatical deficit in preschool children with SLI (Rice & Wexler, 1996a; Rice, Wexler, & Cleave, 1995) in which the grammatical competencies of affected children seem to shadow those of unaffected children. This deficit is referred to as an “extended optional infinitive” (EOI) period because it seems to be an extended parallel to a period of immature grammar shown by unaffected children, which has come to be known as “optional infinitive” (OI; cf.
Wexler, 1994, 1996). The OI stage appears in a number of languages where overt phonological forms for infinitives allow such usage to be detected. Wexler argued that in English, where the infinitive appears as a bare stem, the OI stage is evident in children’s tendency to sometimes drop the following morphemes: third person singular -s in she walks, past -ed in she walked; copular and auxiliary forms of BE and DO (where BE refers to the citation form of the verb to be collapsing across person/number variants in surface forms; where DO refers to auxiliary do collapsing across do and does). The interpretation is that these morphemes share the grammatical property of tense marking. Optional use of morphemes within this set is attributed, within this framework, to an incomplete specification of grammatical tense in the children’s underlying grammatical representations.

In Rice et al. (1995) we found that this set of morphemes is likely to appear optionally in the grammars of children with SLI at a rate lower than the optionality evident in younger controls at equivalent general language levels. Hence, the period of acquisition is “extended” relative to a control group of young children. Rice and Wexler (1996a) replicated this finding with a second sampling of affected and control children and examined a second definition of “extended” as well, one that compared performance on a set of morphemes thought to be part of an EOI cluster with a set of control morphemes thought to be outside the EOI cluster. As expected, the clinical marker is evident on the morphemes associated with an EOI period but not on morphemes outside this cluster. This is important because it shows that the EOI period is not attributable to a more general pattern of stripping away of affixes or dropping of unstressed “functor” words. In effect, what is “extended” is acquisition of a particular set of morphemes, which in turn is interpreted as an “extended” period of incomplete specification of the linguistic property of tense.

In this study we address an additional, and crucially important, criterion for the identification of an “extended” pattern of acquisition: the expectation that the resolution of an EOI period should be protracted for affected children. In so doing, we provide evidence pertinent to three vital gaps in the literature. One is the long-term outcome of preschool children with SLI who show this clinical marker. How “extended” is the acquisition period? Second, there is surprisingly little documentation of the full course of grammatical acquisition in this domain of the grammar for unaffected children. When do unaffected English-speaking children resolve this period (i.e., arrive at adult-like levels of obligatory use of grammatical tense)? Third, there are no studies that examine the coacquisition of the set of OI-related morphemes over time. Does morphological acquisition in this domain proceed one morpheme at a time, or does acquisition of one morpheme proceed in tandem with others in the set? In examining these questions crucial to the clarification of a possible clinical marker for SLI, we are at the same time dealing with issues central to the broader issues of how children acquire (or don’t acquire) fundamental properties of their grammar.

This is essentially a follow-up study to Rice and Wexler (1996a) in which we follow the children for a period of 4 years, encompassing the full age range of 2;6–8 years of age. The intent is to document the children’s performance on a core set of grammatical measures. In so doing, we provide evidence about the full course of acquisition of the targeted set of morphemes for the control, as well as the affected children, the shape of the growth trajectories, and the extent to which the observed growth curve of the affected children shadows that of the control children. Growth curve modeling is carried out to evaluate group differences and similarities in growth curves, the growth curve trends (i.e., whether linear or quadratic), the contribution of predictor variables to the obtained growth curves, and the extent to which individual morphemes coalesce as a set over time.

In this introduction, we summarize the linguistic rationale for this line of investigation, followed by a concise summary of previous findings. We discuss the need for growth curve data and explicate the relevance of growth curve outcomes for further clarification of an EOI period. In particular we highlight the significance of an expected consistency of outcomes for the set of morphemes involved in tense marking.

The Nature of Morphological Knowledge: Morphosyntax, Finiteness, Tense, and Agreement

In traditional treatments of grammatical morphology, bound verbal morphology is treated as an attachment to lexical stems (words). Investigators approaching child language with a Stem + Affix view in mind have regarded the child’s problem as one of learning each morpheme as a one-by-one task. This is clearly exemplified in the important early work of Brown (1973), who described in detail the acquisition of a set of 14 morphemes in 3 young children in a descriptive framework that continues to exert a strong influence on much contemporary developmental inquiry.

The theoretical framework emerging from contemporary linguistic theory posits a different view, one in which morphology is recognized as intrinsically linked to syntactic principles and processes (cf. Haegeeman, 1994). In this view, surface properties, such as phonological similarity and “free standing” versus “bound” morphology, are differentiated from deeper underlying grammatical representations that govern the formulation of clausal
structures. Morphemes can be grouped according to fundamental grammatical functions that play a crucial role in the generation of sentences.

**Finiteness Marking of Verbal Forms**

The grammatical function of interest here is finiteness marking. Finiteness is an obligatory property of main (root) clauses. Finiteness is marked on verbs, which can appear in finite or nonfinite forms. Finite forms are those marked for tense (TNS) and subject-verb agreement (AGR). In English, the finite distinctions relevant to this study can be seen in the following examples (see Schütze, 1997, for a more detailed consideration of the grammatical properties of finiteness).

(1) a. They walk.
   b. They do not walk.

(2) a. They walked.
   b. She walks.

Examples (1) and (2) show that in English finite lexical verbs can appear as bare stems or as overt affixes. In (1) we can see that the bare stem form carries invisible features for TNS/AGR that become apparent in the grammar when negation is inserted, which in turn triggers the insertion of DO. The "silent morpheme" on the lexical verb is described as a "zero morpheme," which does not get expressed in a phonological form. In (2) we see that present and past tense can appear in surface morphology as an affix on verb stems, but the present tense is evident only on third person singular subjects (henceforth 3rd Sing). Present tense on first and second person singular subjects and plural subjects are "null" or "zero" morphemes that do not appear in root affirmative clauses.

Examples (3) and (4) show that finiteness is determined by sites in the syntax, not by the appearance of a lexical verb, and that each clause has but one finiteness-marked site. Here and elsewhere, we follow the convention of an asterisk (*) to indicate an ungrammatical sentence.

(3) a. She liked to walk.
   b. *She liked to walks.

(4) a. She made him walk.
   b. *She made him walks.

This is important because in order to generate grammatical clauses children must recognize where finiteness appears in a clause and where finiteness is not allowed. Notice also another fundamental grammatical property illustrated in (4): Subjects of finite verbs show nominative case (cf. "she walks"), whereas subjects of nonfinite verbs show non-nominative case (cf. "him walk"). Thus, finiteness is not an isolated property of verbs but also affects other grammatical functions, such as case marking of subjects (cf. Schütze, 1997; Schütze & Wexler, 1966; Wexler, Schütze, & Rice, in press).

Finiteness is also evident on forms of BE and DO, illustrated in (5)–(7). Notice that these verbs do not carry lexicalized semantic information, but instead appear to carry out the grammatical function of finiteness marking.

(5) a. She does/did not walk.
   b. *She does not walks.

(6) a. She is/ was walking.
   b. *She is walks.

(7) She is happy.

The generalization is this: if BE or DO is present as the first (i.e., leftmost) auxiliary verb, as in (5) or (6), or as the main (copula) verb, as in (7), it is finite. As shown in (5)b and (6)b, if these forms appear, finiteness cannot appear elsewhere in the clause.

Finally, surface finite verb forms must show subject-verb agreement. In English, this is apparent in examples (8)a–b which show 3rd Sing agreement, and in (9)a–b, which show BE agreement.

(8) a. I walk.
   b. *I walks.

(9) a. She is happy.
   b. *She are happy.

In this framework, morphemes share an abstract underlying grammatical property of finiteness, which consists of TNS and AGR features, which in turn are associated with certain syntactic locations. In English, finiteness can appear on lexical verbs, but not all lexical verbs are finite, and not all bare stem forms of lexical verbs are nonfinite; furthermore, finiteness can appear as a free-standing morpheme or as an affix on a verb. Note that in English past tense does not show subject/verb agreement (i.e., the choice of past tense form is unaffected by the person/number markings on the subject).

**Children's Optional Infinitives (OI) and Extended Optional Infinitives (EOI)**

An important recent discovery is that young children early on use nonfinite (infinitival) forms as well as finite forms of verbs in grammatical contexts where finite forms are required. The phenomenon is now attested in many, but not all, languages (cf. Wexler 1994, 1996). What is relevant here is Wexler's (1994) prediction that in English a period of incomplete knowledge of finiteness would be evident in children's tendency to drop surface markers of finiteness (i.e., 3rd Sing -s, past -ed, BE, and DO). This period has been referred to as an "optional infinitive" (OI) period. In non-English languages, where the phenomenon was first documented,
infinitival forms often differ phonetically from the finite forms. In a given sample of spontaneous utterances, children sometimes used infinitival forms and sometimes used finite forms of the main verb. Another important property of the OI period postulated by Wexler (1994) is that when children in the OI stage use TNS-marked finite forms, they also show subject-verb agreement—that is, ungrammatical utterances such as those in (8)b and (9)b should appear infrequently, if at all.

**Extended Optional Infinitives as a Clinical Marker of SLI**

Rice et al. (1995) postulated that the grammatical deficits of children with SLI can be regarded as an extended period of the OI stage. For some time, there had been reports that verbal morphology was problematic for children with SLI (cf. Leonard, 1998, for a thorough review), although the evidence was somewhat sketchy as to the particulars of the problem. The EOI model linked the morphological deficits of the children with SLI with the predicted OI period in English, hypothesizing that what was extremely delayed in children with SLI is a grammatical function that is relatively slow to mature in unaffected children (cf. Rice & Wexler, 1996a). The first empirical tests of the English OI/EOI model were carried out in Rice et al. (1995), followed by Rice and Wexler (1996a). The outcomes were strongly supportive of the model(s). The key findings were that, for children with SLI at age 5 years, in the year before kindergarten, each of the EOI-related set of morphemes distinguished the SLI children from younger control children, who were 3 years of age (i.e., omissions in obligatory contexts for 3rd Sing -s, past -ed, BE, and DO were at higher rates for the SLI group than for the controls). In fact, a composite measure of tense marking, with a cutoff of 50%, identified 97% of the affected children (sensitivity) and 98% of the unaffected children (specificity; cf. Rice, 1998). In contrast, control morphemes, such as present progressive -ing (as in she's running), plural -s, and the prepositions, in and on, did not show this delay (cf. Oetting & Rice, 1993; Rice & Oetting, 1993). At the same time, all the children showed strong knowledge of finiteness sites in the syntax; that is, errors such as (3)b, (4)b, (5)b, and (6)b were rare if not nonexistent. They also showed strong subject-verb agreement; that is, errors such as (8)b were nonexistent, and (9)b was infrequent. The interpretation is that the OI/EOI symptomology is attributable to an incomplete specification of tense marking in the children's grammars. We can see that agreement marking is not the source of the difficulty because the regular past tense -ed is included in the group of affected morphemes, and agreement marking is not required for its use in English. The descriptive generalization is that children in an OI/EOI stage tend to drop the surface forms thought to mark tense in the underlying grammar, at the same time that they know fundamental principles and processes for generating clausal structure, including subject/verb agreement. (Note that this conclusion is counter to the interpretation of Claessen, 1991, and Rothweiler & Claessen, 1993, who proposed an “agreement deficit” account of the morphosyntax of German-speaking children. Cf. Poeppel & Wexler, 1993; Rice, Noll, & Grimm, 1997; Verrips & Weissenborn, 1992, for further counter evidence.)

In Schütze and Wexler (1996), an extension of Wexler's OI model is presented. This extension assumes that either tense (TNS) or agreement (AGR) or both is omitted from the representation by the child in the OI stage. The two-feature model is required to account for the facts about case assignment. Essentially, children sometimes make case errors, such as her going. These errors are shown to be related to OI utterances, such that non-nominative subject case may or may not appear in OI clauses, but if overt AGR is evident, nominative subject case should appear. Although we do not have space to go into the details of the model here, we will just point out that all the predictions that we have made in this paper still follow from this AGR/TNS-omission model, including the prediction that the child will not make a mistake in using an agreement morpheme. (The reason is that, if an agreement morpheme is fully specified, it can only be used correctly; if AGR or TNS is missing, an agreement morpheme may not be able to be inserted, but it will never be incorrectly inserted.) Thus, for simplicity's sake in the rest of this paper, we will continue to talk about the “tense omission” model.

**Evidential Limitations: When Does the OI/EOI Period End?**

The results of Rice and Wexler (1996a) show that at 3 years of age unaffected children mark tense (collapsed across all measures of tense) in 56% of obligatory contexts, whereas 5-year-old children mark tense in 91% of contexts. Clearly it is between the ages of 3 and 5 years that the child's optional use of these forms drops away and the adult-like obligatory usage is established, although there are virtually no reports in the literature documenting this important period of change. In Brown's (1973) famous analysis of 3 children, he defined “mastery” as 90% correct in obligatory contexts across three samples separated by variable intervals. At the end of the study, Adam was 3;6, Eve was 2;3, and Sarah was 4;0. Adam and Eve had not mastered 3rd Sing -s, Adam and Sarah had not mastered past -ed; none had mastered BE, DO was not included in the set of morphemes studied. Brown provided no figures or data summaries of the trajectory of development of these
forms. Subsequent cross-sectional studies of unaffected children also focused on the early period, not extending beyond 3;6 (cf. de Villiers & de Villiers, 1973, whose oldest children were 3;4; see also the summary of Lahey, Liebergott, Chenick, Menyuk, & Adams, 1992). In short, we do not know the developmental course of the OI period for unaffected English-speaking children.

There is even less documentation for children with SLI. In the Rice and Wexler (1996a) study, the SLI group at 5 years marked tense in 33% of obligatory contexts (collapsed across all measures of tense). Clearly these children have a long way to go to arrive at the adult-like obligatory use. Some hints of how long this may take are in the literature. In a follow-up of Brown’s approach, Johnston and Schery (1976) studied a nonselective clinical sample of children with language disorders (which would have included children with behavioral or neurological difficulties who would have been excluded under current definitions of SLI), encompassing the age range of 3;0–16;2. Their findings are reported in terms of language levels (indexed by mean length of utterance [MLU]), so the data cannot be interpreted in terms of age levels. At the highest MLU level (i.e., mean of 6.97 morphemes), of the morphemes included in their study that are of interest here, 3rd Sing -s, past -ed, and BE are all on average, in the range of 60%–80% in obligatory contexts. Although age information is not available, it is reasonable to assume that most, if not all, of the children scoring MLUs in the reported range were school age. For past tense acquisition, Marchman and Ellis Weismer (1994) report that school-age children with SLI continue to be more likely to omit past tense than control children. Although these reports provide useful clues to long-term outcomes, the available evidence is insufficient for determination of the developmental outcomes of the EOI period for children with SLI.

**Longitudinal Outcomes: Growth Curves**

If we are to understand the nature of the OI/EOI period, and how this period is resolved as children move toward the adult grammar, growth curve data are needed. These data would consist of individual performance measured over time, which can then be collapsed over children within groups, to determine estimates of individual variation within groups as well as group means. Important precedents for the value of such evidence can be seen from studies of the vocabulary acquisition of young children. Huttenlocher, Haigh, Bryk, Seltzer, and Lyons (1991) examined growth trajectories for vocabulary acquisition during the 14- to 26-month age period. Using hierarchical linear modeling techniques (Bryk & Raudenbush, 1992), they modeled individual growth, representing changes in each child’s observed vocabulary size over time, and the contribution of mothers’ input to their children’s vocabulary acquisition. Individual growth in vocabulary size increased as a quadratic function with age during this age period, showing an accelerated rate of acquisition after an initial period of slow and steady growth. Mother’s input at 16 months of age (whether measured as total number of words or number of different words) predicted rates of vocabulary growth. The conclusion is that the number of learning trials plays an important role in early vocabulary acquisition. The point to highlight here is that growth curve analyses provide a description of the pattern of change over time, and evaluation of potential predictors of change, both of which are urgently needed in studies of morphosyntax.

**Patterns of Growth in Morphosyntax**

The uncharted resolution of the OI/EOI period is a gap of significant theoretical import. Debates about language acquisition rage around the question of how children make the transition from a child grammar to an adult grammar. Current formulations of nativist accounts, such as the maturational account favored by Wexler (1994, 1996; Borer & Wexler, 1987) and Rice and Wexler (1996a) assume nonlinear growth, because accelerated rates of acquisition are expected at the onset of different, internally driven phases of acquisition. In our view, maturational nonlinearity does not entail instantaneous acquisition. Just as physical growth is protracted throughout childhood and is thought to be maturationally driven, so too could certain delayed grammatical processes or principles be protracted in acquisition, with periods of nonlinear change. The nonlinearity and protracted growth assumptions are not unique to nativist accounts. It is also held by current connectionist theorists, such as Elman et al. (1996), who attribute accelerated change to accumulated learning experiences, environmental effects, and/or innate individual differences. Another account, by Keith Nelson (1989), hypothesizes readiness effects within children’s grammars, such that certain areas become “hot” for a child at different times. The differences among the perspectives hinge on the relative weight attributed to innate properties of language, general learning mechanisms, the effects of certain language-related environmental events, and innate individual differences. The maturational perspective of the OI/EOI regards as crucial the biological specification of grammatical properties and the timing of these properties, including a role for individual differences in this timing. Although nonlinear growth is an important theoretical assumption across several theories, relevant empirical evidence for morphosyntactic acquisition has been unavailable. Growth curves will provide needed documentation of the rather surprising length of time that English-speaking children need to resolve the OI period. Without substantiation of the full
course of acquisition and the shape of the growth curve, this period cannot be fully understood. Furthermore, without a sense of the normative pattern of growth, we cannot fully understand the EOI period for children with SLI. The questions are: How long does it take for unaffected children to arrive at obligatory use of tense marking? After 3 years of age does this follow a nonlinear trajectory?

With regard to evaluation of an EOI period as a clinical marker of SLI, it is essential to determine the time course of the “extended” delay in resolution of the OI period. How extended is the acquisition period for affected children? Does the shape of the acquisition curve for the affected children parallel that of the unaffected children, suggesting similar change mechanisms at work although with a greatly protracted time course? Is it the case that the SLI group lags behind the control group consistently across time, or does the SLI group suddenly “catch up”? (as is suggested in the literature for “late talkers”: cf. Nippold & Schwartz, 1996; Paul, 1996).

The previous questions could be asked of each of the verbal morphemes of interest, in turn. Of more interest, however, is the interpretation provided by the OI/EOI, that the morphemes share a common underlying grammatical property, that of tense marking. Important support for this interpretation comes from the previous findings (Rice & Waxler, 1996a; Rice et al., 1995) that each morpheme in the set of affected morphemes is affected in the SLI group. Two strong predictions can be made for change over time. One is that, because the underlying linguistic function of tense marking unifies the set of morphemes, and this representation must change if the OI/EOI period is to be resolved, change across the morphemes should be highly associated, happening in tandem across the set of individual surface forms. The prediction is that growth curves for individual morphemes should be highly similar to each other and to a composite measure. Note that this prediction is strong and readily disconfirmable. Given the protracted period of acquisition of children with SLI, there will be greater opportunity for the morphemes within the tense marking set to diverge and follow different paths to acquisition.

A second prediction is that over time individual morphemes should continue to differentiate the affected group from the younger language equivalent control group. In other words, the prediction is that one of the set of morphemes does not race ahead and close the gap, leaving the other morphemes trailing behind, relative to the controls.

**Predictors of Change in Morphosyntax**

Little is known about the predictors of change in morphosyntax, as a general phenomenon, and virtually nothing is known about the OI/EOI period. The question is: At the outset of the study, what variables predict subsequent growth in tense marking? Our assumption is that resolution of an OI/EOI period is driven by children’s innately guided grammatical mechanisms (cf. Rice & Waxler, 1996b; Waxler, 1994, 1996). Furthermore, the integrity of these mechanisms varies across children, such that the children with SLI vary from unaffected children (who also show some variations in age of acquisition, within a “normative range”). Under this model, syntactic and morphosyntactic development should be related. This leads to the prediction that youngsters with higher MLUs at the outset of the study should show faster rates of acquisition of tense marking, independent of group status. Beginning with the work of Brown (1973) it is widely accepted that, in unaffected children, morphological development is associated with utterance length. It is also well known that preschool children with SLI are likely to show lower-than-expected MLU values. Recall that the children in the SLI group in Rice and Waxler (1996a), and Rice et al. (1995) were at MLU levels (about 3.5) similar to children 2 years younger. The expectation is that MLU is likely to increase during the time of change in the OI/EOI grammars. Although the MLU clearly has descriptive value, and has proven to be both valid and reliable in studies of children with SLI (cf. Rice & Waxler, 1996a), it is a rather gross measure of emerging syntactic competence, without a precise interpretation. Our assumption is that MLU, in the range of values of the children studied here, captures an emerging ability to expand clausal constituents (such as inserted adverbial or adjectival phrases) or to combine clauses (such as relative clauses), as well as emerging use of morphemes. These abilities surely build on underlying grammatical representations as well as maturing cognitive abilities related to oral language production.

As is clear from the work of Huttenlocher et al. (1991), we also need to consider possible predictors outside the realm of syntax. Lexical growth plays an important role in alternative models of the adult grammar (cf. Bresnan, 1982; Langacker, 1987) and children’s syntactic acquisition. For example, Marchman and Bates (1994) report that at the earliest stages of language acquisition (ages 1;4–2;6) the size of children’s verb vocabularies predicts correct usage of irregular past tense forms, which they interpret as support of a model which posits that lexical and grammatical growth are “paced by similar, if not identical, mechanisms” (p. 365). One should note, however, that Marchman and Bates, unlike Huttenlocher et al., carry out a cross-sectional study, not a longitudinal one, where the relation of vocabulary and grammar is determined by collapsing evidence across the children’s ages. What is of interest here is the model of undifferentiated mechanisms
underlying vocabulary and grammatical development. This leads to the prediction that children with larger vocabularies will show faster subsequent morphosyntactic acquisition. In contrast, our prediction is the opposite, that initial vocabulary levels should not predict subsequent acquisition of tense marking.

As shown by Huttenlocher et al. (1991), models of vocabulary growth implicate input variations (maternal behaviors) as predictive of change. Maternal education is an indirect indicator of such variations. Entwistle and Astone (1994) regard mother’s education as the preferred index of “human capital” in the home when considering environmental contributions to young children’s development. More specifically, mother’s education is known to be associated with the amount of talking to children (cf. Hart & Risley, 1985, p. 32; Hoff-Ginsberg, 1994; Wellis, 1985), which in turn is predictive of children’s vocabulary development (cf. Huttenlocher et al., 1991) and positively associated with a number of language indices in the first 3 years, including verb tenses (Hart & Risley, 1985). Furthermore, mother’s education is reported to be a predictor of language impairment. For example, LaBenn and LaBenn (1980) document language outcomes of a national sample of 20,137 children, followed from birth to age 8 years, and report that mother’s education predicted failure at age 8 on language comprehension testing. More recently, Tomblin (1996) found that mother’s education is a significant risk factor for SLI. Furthermore, Tomblin et al. (1997) observed that ethnicity as a risk factor is confounded with parental education. Thus, mother’s education has important precedents in the literature as a predictor of children’s language outcomes, and its relation to the condition of SLI needs to be clarified. Because the nativist model of morphosyntax evaluated here does not posit a primary effect for input frequency, independent of other grammatical considerations, the expectation is that mother’s educational levels will not predict their children’s subsequent acquisition of tense marking.

As with the evaluation of the shape of the growth curves, investigation of predictors of change can be considered at the level of individual morphemes or, more interestingly, at the level of the underlying grammatical function of tense marking. It is expected that the predictor equations will be highly similar across the individual members of the set of morphemes, and each should be very similar to a predictor equation for a composite measure. This constitutes a very strong test of the assumption that change in the OI/EIO period is driven by change in underlying grammatical representations in tense marking that in turn are not associated with lexical acquisition in general or general patterns of environmental input.

### Method

#### Participants

This study is, by and large, the outcome study of the children first described as Study 2 in Rice and Wexler (1996a), with only minor adjustments for children who dropped out after the first round of testing and for children added after the first round. Three groups of children were recruited: (a) children with SLI, (b) an age-matched control group (henceforth, the N group because the children were about 5 years of age), and (c) a younger, language-matched control group (henceforth, the Y group because they were about 3 years of age). All children were from monolingual English-speaking homes. Speakers of Black English were excluded.

#### Initial Status

The SLI group met the following inclusionary criteria: (a) identified as SLI and receiving intervention from certified speech-language pathologists in the year prior to kindergarten enrollment (ages 4;5–5;0); (b) receptive language performance one or more standard deviations below the mean on the Peabody Picture Vocabulary Test-Revised (PPVT–R; Dunn & Dunn, 1981); and (c) mean length of utterance one standard deviation or more below age expectations, according to the age norms of Leadholm and Miller (1993). In addition, the Test of Language Development–Primary (TOLD–P:2; Newcomer & Hammill, 1988) was administered to each child. All but 2 children were one standard deviation or more below the mean on the five-subtest language quotient, where the mean is 100 and one standard deviation is 15. One child who had a standard score of 88 was included, as well as another with a standard score of 93, because they met the other criteria. In addition, these children met the following exclusionary criteria: (a) none had been identified as having behavioral or social impairments, and (b) their speech-language pathologists reported their social development to be within normative expectations. Also, their intellectual functioning was above clinical levels of intellectual impairment. All subjects scored an age deviation score of 85 or above on the Columbia Mental Maturity Scale (CMMS; Burgemeister, Blum, & Lorge, 1972), and they passed a hearing screening at 25 dB (30 dB in noise environments) at 1, 2, and 4000 Hz.

In the first year, 21 children with SLI were recruited into the study, 14 boys and 7 girls. The group means and standard deviations were as follows: PPVT standard score, 72; MLU, 3.49; TOLD–P:2 five-subtest language quotient, 76; CMMS, 94. Information about mother’s education was elicited by asking mothers the highest level of formal education completed. On a scale where 1 = some high school and 5 = some

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graduate work, the mean for the SLI group was 2.5. They were distributed across the entire range; 16 were high school graduates or above.

It is important to note that this group of children can be thought of as children with language problems who are not primarily speech impaired. Children with multiple and severe articulation errors were not included. The Goldman Fristoe Test of Articulation (GFTA; Goldman & Fristoe, 1988) was administered. All children passed a phonological screening consisting of nonimitated production of five monosyllabic words in each of four phonetic contexts: final -s, -z, -t, or -d. In order to pass, children needed accurate production of the target sounds or a phonologically consistent approximation. Children with consistently produced (i.e., intelligible) mispronunciations of /s/, /sh/, /ch/, /r/, and /l/ are included. At Round 1, only 3 children scored GFTA standard scores below 10; and 4 were between 10 and 15. The children's speech sound errors were limited to interdental productions of the sibilians, only a few instances of lateral emission of sibilians, and w/r and w/l substitutions. There has been, based on clinical populations, a widespread belief that children's phonological disorders and language disorders are likely to co-occur. Yet a recent epidemiology study (Tomblin, 1996) shows that only 25% of language impaired children have speech sound disorders. The sample of children followed in this study can be regarded as primarily language impaired.

Children in the 5N and 3N groups were drawn from preschool attendance centers in the same residential areas as the children in the SLI group. These children were regarded as "normally developing" by their classroom teachers, passed the hearing screening, and had scores on the PPVT-R and the TOLD-P2 in the normal to high normal range. The children in the 3N group had MLU values that were within ±1 SD of the mean expected for age. In order to ensure equivalent levels across the two groups, each subject in the MLU group was within .10 morphemes of at least 1 child in the SLI group. The CMMS was administered to the children in the 5N group at the outset of the study. Children in the 3N group were too young to receive the CMMS at the time of the initial measures. At age 4 years, they were tested on the CMMS, which is used here as an estimate of their intellectual functioning at age 3 years.

In the first year, 23 5N children were recruited, 11 boys and 12 girls. The group means and standard deviations are as follows: Age, 59 months (4.11); PPVT standard score, 108 (3); MLU, 4.18 (.58); TOLD-P2, 112 (09); CMMS, 107 (10). The mean level of mother's education was 4.1. All were high school graduates or above.

In the first year, 20 3N children were recruited, 10 boys and 10 girls. The group means and standard deviations are as follows: Age, 36 months (3.9); PPVT standard score, 101 (9); MLU, 3.66 (.58); Test of Early Language Development (TELD; Hresko, Reid, & Hammill, 1991), 130 (8); note that in subsequent rounds, this group's TOLD-P2 scores are 107 at Round 3 and 112 at Round 5, leading us to believe that the TELD at Round 1 is an underestimate); CMMS, 110 (9). The mean level of mother's education was 4.5. All were high school graduates or above.

**Outcome Status**

The SLI group, collectively, continued to show limited language acquisition at the end of the study. The group means on the descriptive measures are as follows (with standard deviations in parentheses): PPVT-R standard score, 85 (11); MLU 4.85 (.84); TOLD-P2 five-subtest language quotient, 79 (8); CMMS, 99 (12). For the PPVT-R data, 11 children were at a score of 85 or less; for the TOLD-P2, 16 were at 85 or less; for the CMMS, only 1 child was below 85, with a score of 83. Only 1 child had scores for both the PPVT-R and the TOLD-P2 tests above 85, and this child did not perform well on the measures of tense marking. Thus, this group of children identified as SLI in the preschool years continue to show significant language impairments, relative to age expectations, at age 8 years. At the same time, their nonverbal intelligence is well within normal range.

The 3N group means and standard deviations at the end of the study are as follows: PPVT-R, 118 (10); MLU 4.86 (.52); TOLD-P2, 108 (9); CMMS, 117 (13). The standardized test battery was not administered to the 5N group at the last round of measurement. The means and standard deviations from the previous year's outcomes are as follows: PPVT-R, 116 (9); TOLD-P2, 108 (9); CMMS, 115 (14). The last MLU measurement was at Round 3 for this group, 4.57 (.79). The control groups of children at the end of the study perform overall in the normal to high normal range on the standardized tests.

**Procedures**

**Times of Measurement**

The children were tested at 6-month intervals, once in the fall semester and again in the spring semester, for a total of seven rounds of data collection, encompassing the ages of 2;6–8;9 years. The SLI group age range was 4;5–8;9 years. Data collection was carried out in the children's school attendance centers. Over the course of the study, 63 different attendance centers participated.

**Measures**

The measures reported here are replications of the measures used in Rice and Wexler (1996a). This included
measures of morpheme use in obligatory contexts derived from transcriptions of spontaneous samples and experimental elicitation probes. Spontaneous sampling yielded measures of 3rd Sing -s, past -ed, and BE. (In the analyses reported here, BE data are collapsed across copula and auxiliary contexts because the findings are highly similar, whether from spontaneous or elicited measures.) In order to maximize the likelihood of utterances relevant for the planned analyses, more than 200 utterances were elicited for each group per round. The group means for number of complete and intelligible utterances were as follows: SLI group means range from 238–279 per round; 3N group, 245–240; 5N group, 237–243 for the three rounds of spontaneous sampling. This yielded mean frequencies of obligatory contexts at or exceeding 10 uses for each of the target morphemes, per group (and the group means are very similar), per round, except past -ed, which is more difficult to elicit in spontaneous speech because of children’s preference for irregular verbs. Experimental probes were included in order to ensure a suitable database for each of the morphemes, and to elicit the use of BE in affirmative contexts with different subjects (i.e., first and third person, singular and plural), in questions as well as declarative sentences, and to elicit DO in questions because it is rare in children’s spontaneous utterances as an auxiliary in affirmative declarative sentences. The experimental probes for 3rd Sing -s (total of 12 items) and past -ed (total of 11 items) involved asking children to tell, for example, what a teacher does (e.g., “She helps children”) and to describe a completed action (e.g., “He raked the leaves”). BE and DO were elicited in an interactive puppet task in which participants were told that people cannot understand animals, but a certain puppet could. Children were encouraged to ask about the animals, for example, “Is he cold?” or “Are they hungry?” or to describe them, such as “He is furry.” In this way, copular and auxiliary forms of BE were elicited in declaratives and questions, across person/number markings of subjects, and DO was elicited in questions, as in “Does he want a cookie?” Mean frequencies for total attempts for each of the morphemes in the probes exceeded 10 instances for each morpheme for each group for each round, and the means across groups are very similar. As expected, the frequencies are largest for BE (in probes, means of 40–49 for SLI; 34–44 for 3N; 39–42 for 5N; in spontaneous, means of 64–71 for SLI; 64–71 for 3N; 63–71 for 5N).Collapsed across all morpheme measures, the mean frequencies per group per round is 154–191, and again is similar across groups. The same measures were administered at each round of data collection. Thus, for each round, there are a possible total of seven measures of grammatical tense. Because of ceiling effects, the experimental probes for 3rd Sing -s, BE and DO were not administered beyond Round 5 for the control children.

Reliability

Reliability of measurement was monitored throughout the study. Transcription coding followed a written protocol to which the transcriber/coders were trained to 85% agreement or better with trained coders before carrying out coding. All transcripts were checked by second and third transcriber/coders for possible errors; any detected disagreements were resolved by consensus agreement. Interrater agreement, assessed over rounds, is at 90% or better for utterance boundaries (92%), morpheme transcription (96%), morpheme coding (94%), and morpheme counting (97%). Pairwise monitoring across six different coders found consistently high levels of agreement. For the experimental probes, all examiners were carefully trained to criterion levels of 90% agreement or better with trained examiners before participating in data collection. The integrity of data collection procedures was monitored via visits from second examiners and audio and video records. If differences in procedures across examiners became apparent, they were discussed and resolved. Further monitoring was carried out in group scoring procedures for probe data protocols, in which multiple scorers, including the examiners, scored response forms. Beginning in Round 2, for each of the measures reported here, 10% of the sample was randomly selected for interexaminer reliability checks. The overall rates of interexaminer agreement are 99% for 3rd Sing -s, 98% for past tense -ed, and 88% for BE/DO. Again, pairwise monitoring shows consistently high levels of agreement across different examiners, across the course of the study. Data entry was routinely checked by a second data entry clerk for possible errors at this point. Agreement between initial entry and subsequent checks are at 90% for these measures.

Observed Growth Curves

Group means at each time of measurement for each of the seven measures of tense marking are reported in Figures 1–7. In these figures, the mean percentage correct in obligatory contexts is plotted for each measure, as a function of age, which is the mean age of the group at the time of assessment. Reading from the left of the figure, one sees the younger control children, whose line joins with the older control children at age 5 years. This upper line constitutes the picture of emerging use of the measured morphemes in unaffected children. The lower line on the right-hand side is the mean performance at each round of the SLI group, for average ages 5–8 years.

Because of the observed similarities across the measures, a Composite Tense (CTNS) variable was computed, calculated as the arithmetic mean of the total set of measures. This is reported in Figure 8. The group
Table 1. Composite tense percentage correct in obligatory contexts per group per round of measurement.

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Means and standard deviations for each round for each group are reported in Table 1.

In comparison, longitudinal data for a control morpheme outside the EOI group is provided in Figure 9. The control morpheme is regular plural -s, reported as percentage correct in obligatory contexts in spontaneous samples. Group means for each available round are plotted in the figure.

Descriptively, it is clear that, for the control children, for each EOI measure, the time between 3 and 4 years of age is when obligatory use of tense marking is established. During this period, CTNS moves from 50% to 90%+. Beyond 4 years of age, performance is stable, around 95%. For the 5N group, there is no meaningful variation throughout the sampling period. In contrast, for the children in the SLI group, mean performance is still below expected levels at 8 years of age (a mean of 89% for the SLI group compared to 98% for the younger controls). The comparison morpheme of -s plural shows a strikingly different picture. The SLI group means are at high levels (above 90%) throughout.

Continuance of Tense Marking as a Group Difference Over Time, Over Measures

The group mean data show a remarkably protracted period of development for the affected group of children, suggesting that tense marking continues as a clinical marker beyond the preschool levels of development. To evaluate whether over time the individual morphemes continue to differentiate the affected group from the younger language equivalent group, a series of univariate ANOVAs were carried out, with Group as a between factor (SLI, 3N) and Time as a within factor (seven rounds). These analyses showed that for each of the seven measures, there was a significant group effect, \( p < .01 \), for all measures and a significant time effect, \( p < .001 \), for all measures. Only spontaneous BE showed a significant Group \( \times \) Time interaction; all others had \( p > .05 \). For each measure at each time, t tests were carried out to see if the SLI group was below the control groups in level of obligatory tense marking.

Table 2 reports the obtained significance levels; eta square values; and Cohen's (1988) \( f \) estimate of effect size, where an \( f \) value of .10 is interpreted as small, .25 as medium, and .40 as large. When compared to their age controls, the observed difference for the SLI group exceeds a large effect size for every measure at every time. When compared to their younger controls, of the 50 observed differences for the SLI group, 37 exceed large effects, 11 exceed medium effects, 1 is small, and 1 is nonexistent. There was no apparent reason for the two small group differences, which are most probably attributable to unknown sampling variation. The big conclusion is that in this domain of morphosyntax, there are very robust differences between the affected children and their age controls throughout the period of measurement. Furthermore, when the affected group is compared to the younger control children, the effects sizes are mostly large in magnitude but occasionally and nonsystematically drop into the medium effects range. Considering the relatively small sample size for calculating effects sizes, this constitutes very strong evidence that the SLI group lags behind each of the control groups throughout this time frame.

Growth Curve Modeling

Growth curve modeling was carried out with the 3N and the SLI group to answer these questions: (a) Do children grow linearly in their use of grammatical tense? (b) Do children grow nonlinearly in their use of grammatical tense? (c) Are there individual differences in the rate and type of growth? (d) Are there group differences (between the SLI and 3N children) in the rate and type of growth? (e) Are there individual and group differences...
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in growth after covarying out individual differences at the cutset due to nonverbal intelligence (CMMS), comprehension vocabulary (PPVT-R), mother's education, or MLU? and (f) How much variance is accounted for by the initial predictors? The lack of variation in the longitudinal performance of the 3N group ruled out growth modeling in this control group.

Modeling was carried out by hierarchical linear modeling (HLM) procedures (Bryk & Raudenbush, 1992; Bryk, Raudenbush, & Congdon, 1994), for each of the individual measures and CTNS. HLM is a mixed model analysis, where predictor covariates are considered as fixed variables, and the children's growth over time (both linear and nonlinear) are random effects. As random effects, a different linear and nonlinear regression coefficient is obtained for each child. It is these regression coefficients that provide information concerning the rate of change of each child. Further, variability among children's regression coefficients provides information concerning individual differences in rate of change. The findings for CTNS are reported here because this model held for each of the individual measures, with only a few and very minor individual exceptions. Plural -s was not modeled because of the lack of variation within groups and across time.

Four nested models were evaluated: Model 1 examined whether the four covariates (mother's education, child CMMS, PPVT-R, and MLU) were significantly related to CTNS over time; Model 2 added to Model 1 a linear growth term in order to determine whether, on the average, children (regardless of group membership) changed linearly across time; Model 3 added to Model 2 a nonlinear (quadratic) growth term in order to determine whether, on average, children (regardless of group membership) changed nonlinearly over time; Model 4 added to Model 3 two interaction terms. One term represented the interaction between group membership and linear growth; the second, the interaction between group membership and nonlinear growth. The significance of either term would indicate that the groups grew differently. For example, perhaps the 3N group experienced nonlinear growth, whereas nonlinear growth was absent for the SLI group.

The outcomes are summarized in Table 3, which reports coefficients and standard errors (in parentheses) for each term. With regard to Model 1, the initial predictor variables collectively accounted for a very small proportion of the subsequent individual variation in acquisition of tense marking, less than .01 overall. Out of the predictor set, only MLU reached statistical significance. (MLU’s predictor status is the same whether measured in morphemes [the measure reported here] or words, with one minor exception. For spontaneous past -ed, MLU-word is a significant predictor, whereas MLU-morph is not.) No other predictors reached significance, an observation that holds for each measure except spontaneous BE, where a weak but statistically significant contribution of PPVT was noted. As expected, for each measure, there were group differences at the outset. Also as expected, correlations between initial status (the intercept) and subsequent growth (the slope) showed a negative association (an average of -.5) because children who start the lowest have the most room to grow.

Tests of Models 2 and 3 showed that both linear and nonlinear change was apparent over time. This finding hold for CTNS and for each individual measure, as well. For CTNS, the proportion of variance accounted for by the linear component was .73, with an additional .14 added by the quadratic nonlinear component. For both the linear and nonlinear components, significant heterogeneity across subjects was obtained, which indicated individual differences in rate of change across subjects. Model 4 showed that the two groups did not differ in their growth pattern. The only measure for which this generalization does not hold is that of probe 3rd Sing-s, which for unknown reasons did show different growth between the two groups. Including Model 3, .87% of the variance in growth of CTNS was accounted for by the modeling, a high degree of obtained fit.

From these findings we know that, over the period...
observed, the change from one 6-month interval to another was not constant. Instead, there were changes in acceleration across times of measurement. Inspection of the individual curves shows slow growth at the beginning (a pattern that is more obvious for some measures than for others), followed by rapid acceleration, and then a final period of leveling off. The leveling period appeared around age 4 years for the control children, somewhere above 90%. The SLI group did not show a stable leveling period at the last time of measurement. One possible explanation for the nonlinear component is that this is attributable to the observed, and expected, ceiling effects for the measure. That is, perhaps the nonlinear change is a matter of the bend in the growth curve as the children reach asymptote. This explanation is weakened by the observation that a nonlinear component also appears in the model of the SLI group, where leveling is only minimally evident. More convincingly, growth modeling carried out for Rounds 1–3 also showed nonlinear effects, at a time when leveling effects were not evident for either group. Our conclusion is that ceiling effects alone are not responsible for the nonlinearity evident in the full growth curve. Even though it may not be equally clear from the graphs for each measure, nonlinearity was likely to be operative at the outset of the observed curves.

Another issue that is noteworthy is that of method of measurement. A familiar, and unanswered, question in the language acquisition literature is whether children's use of grammatical morphemes is "easier" or more accurate in spontaneous utterances than in elicitation tasks, presumably because the elicitation tasks bring additional performance demands. In the analyses presented so far, for those measures for which both spontaneous and elicited indices are available (i.e., 3rd Sing-s, past-ed, and BE), we remind the reader that they show the same results on growth curve models and as clinical markers that differentiate the affected children from unaffected younger controls. A further test is whether, for individual children, spontaneous measures "lead" their performance on experimental probes, such that within a round or across rounds the spontaneous measures predict the probe outcomes. Using structural equation modeling methods (Joreskog & Sorbom, 1993), we carried out lead and lag analyses, testing four models: Spontaneous > Probe, with groups equated; Spontaneous > Probe, with group nonequated; Probe > Spontaneous, groups equated; Probe > Spontaneous, groups nonequated. Full data were available through Round 5 for this analysis. All models were rejected. This means that when considering individual children's data, and the relations between spontaneous and probe measures, there was no support for the idea that spontaneous measures for a given morpheme "lead" probe outcomes, either within or across rounds; furthermore, this outcome appeared for both groups of children.

Discussion

We return here to the questions raised in the introduction. How long does it take for unaffected children to arrive at obligatory use of tense marking? After 3 years of age, does this follow a nonlinear trajectory? For the unaffected children sampled in this study, obligatory marking of grammatical tense is not established until 4 years of age, an age much older than observed for the OI period in French-speaking children (Deprez & Pierce, 1993; Pierce, 1992) and German-speaking children (Clahsen, Penke, & Parodi, 1994; Poepel & Wexler, 1993; Rice, Noll, & Grimm, 1997), although to the best of our knowledge there have not been detailed quantitative longitudinal studies over a large set of children and an extended time course for these languages to compare to our normative results. This is not the place to discuss in detail cross-linguistic differences. There is good reason to believe, however, that differences in rate of OIs and time at which the OI stage appears to end may follow from the morphology of the language and the Schütze and Wexler (1996) AGR/TNS deletion model. The morphological specification of the nonfinite morpheme (the phonetically empty morpheme in English but not necessarily phonetically empty in other languages, e.g., French or German) varies from language to language; thus the nonfinite morpheme will appear in different grammatical contexts that are derivable from AGR or TNS omission. This provides ample room for differential probabilities of nonfinite morphemes appearing in different languages. For example, Wexler, Schaeffer, and Bol (1998) provide a detailed morphological analysis of Dutch which predicts that Dutch should have a lower OI rate than English. The intuitive idea is that the English nonfinite marking (the empty morpheme) occurs whenever AGR or TNS aren't specified, but the Dutch morpheme occurs in only a subset of these contexts. The point is that, for the first time, the OI model allows detailed precise predictions about rates of finiteness marking of particular kinds cross-linguistically.

How extended is the acquisition period for affected children? Does the shape of the acquisition curve for the affected children parallel that of the unaffected children, suggesting similar change mechanisms at work although with a greatly protracted time course? Is it the case that the SLI group lags behind the control group consistently across time or does the SLI group suddenly "catch up"? The results for this clinical group show clearly that the period of ECI can be greatly prolonged in children with SLI. In this group, when the children are well into elementary school they continue to show optional use of tense marking. This is a greatly protracted period of time, for which there is no evidence of an accelerated period of "catch up" during which the affected children close the gap with their unaffected peers. Instead, the
affected group seems to shadow the acquisition curves shown by the unaffected children, in which they follow the same general shape of change, but change is projected over a longer period of time. In short, for these children the criteria of “extended” certainly includes a protracted period of development as well as lower level of performance during the preschool years. Performance in the EOI domain is markedly different from that of control morphemes, such as the plural -s. Even though the morphophonological properties of 3rd Sing -s and plural -s are very similar, and both involve the application of grammatical rules, the former is very protracted in acquisition and the latter shows strong similarities to the control children’s performance, essentially at mastery levels throughout the period studied.

Two issues arise. One is whether this extended period is likely to be observed for a wider sampling of children within the SLI diagnostic category. Keep in mind that the children selected for participation in this study showed an early receptive/expressive language deficit, a profile known for high risk of protracted language impairment (cf. Rice & Hadley, 1995; Thal, Tobias, & Morrison, 1991), because we wanted to follow the pattern of development in children with greater grammatical risk, and this proved to be the outcome. The extent to which other children in the SLI diagnostic category follow this pattern remains to be demonstrated by further evidence. It is most likely that some, but not all, of the children who meet the broader diagnostic criteria for SLI will show an EOI period because the diagnosis can include delays in semantic and pragmatic development, as well as grammatical deficits; and the full relation across these dimensions is unknown (cf. Conti-Ramsden, Botting, & Crutchley, 1997). Therefore, it will be important to be able to further specify which clinical descriptors are associated with an EOI period. It may well be that a subset of children diagnosed as SLI (cf. van der Leij’s “grammatical SLI” case studies [van der Leij & Stollwerck, 1996]) continue to show fundamental grammatical deficits into the adolescent age range, at least some of which are likely to be effects of an earlier EOI period. Let us also note that it may well be possible that an EOI period appears in children who do not fall in the subnormal range on standardized tests and therefore go undetected as SLI. There is one case study of this kind previously reported in the literature (Schuele & Rice, 1996).

The second issue is that these children, as a group, were continuously enrolled in language intervention throughout the observation period (although a few had dropped out of services in the latter rounds of measurement). Thus, this period of protracted development persisted in the face of language intervention. Although there is no way to know if the language intervention targeted these particular forms, it is nevertheless reasonable to assume that children enrolled in intervention participated in regularly scheduled occasions of high levels of adult input that focused on language acquisition. Closely related to this observation is the fact that the grammatical contexts measured here are mostly simple clausal constructions. Thus, the movement toward the adult grammar is evident in the obligatory contexts found in simple clauses. During this age range, unaffected children show advanced grammatical structures in which tense marking appears in questions, tag questions, and relative clause structures. What is unknown is if the affected children are making the transition to these more advanced contexts for tense marking. The overall impression is that change comes very slowly for the affected group, when we consider the simplicity of the observed contexts and the fact that language intervention is provided. For children who are not identified when they are young, and not enrolled in intervention, the outcomes may be even more guarded.

Are growth curves for individual morphemes highly similar to each other and to a composite measure? Over time do individual morphemes continue to differentiate the affected group from the younger language equivalent control group? The findings clearly show that, as expected, the set of morphemes measured here (i.e., 3rd Sing -s, past -ed, BE, and DO) grow together over time. Furthermore, the patterns of change are highly similar across the morphemes. This cohesion in different surface forms we take as a reflection of the common underlying grammatical function of tense marking. In this way, the empirical acquisition evidence validates the linguistic notion of tense marking, a construct drawn independently from contemporary models of adult grammar.

Because the set of morphemes, collectively and individually, differentiates the affected from the younger unaffected children across the 3.5 years of observation, the interpretation is that the source of the difficulty for the unaffected children lies in the underlying grammatical representations of tense marking, as argued by an EOI account (cf. Rice & Wexler, 1996a, 1996b; Rice et al. 1995). These findings are clearly at odds with a “simple delay” account in which affected children are thought to be like younger unaffected children in a more slowly emerging grammar (cf. Lahey et al., 1992; Rice & Wexler, 1996a, 1996b). In this study, the SLI children lag behind the control children for an extended period of time and do not show a delayed “catch up” period in which they close the gap and move on toward the adult grammar in an unaffected way. Instead, the EOI grammatical pattern can persist for a relatively long time. Note that over the extended period of time observed, it certainly would have been possible for subsets of the set of morphemes to “break away” and follow an accelerated course of change, or to lag behind.
Alternative accounts of SLI posit that there are no differences in the underlying grammar; instead, patterns of delayed grammatical acquisition are attributed to breakdowns in input processing due to relative frequency effects, redundancies, perceptual salience, relative duration of morphemes, or pronunciability (cf. Leonard, 1998). Two assumptions are shared by most of the various processing accounts. One is that the underlying grammar is intact and does not differ from that of unaffected children. Affected children follow the same principles and hypotheses, in the same order, as the unaffected children. The other assumption is that the problem of the affected children is attributable to a protracted intake of relevant particulars of the input children receive. The EOI and processing accounts do not differ with regard to the first assumption, with the exception of the relatively constrained domain of tense-feature marking (without ruling out the possibility that other such grammatical markers could be identified). The EOI account attributes the same underlying change mechanism to unaffected and affected properties of the grammar (i.e., biologically driven mechanisms of grammatical growth), where affectedness involves a certain kind of highly specified grammatical optionality that persists for a longer period for affected children. In contrast, the processing models presumably must posit two different mechanisms, one to account for the unaffected properties of the grammar, such as robust underlying general learning mechanisms, and another to account for the observed differences in grammatical performance, such as a deficit in input processing mechanisms. Notice that under these assumptions, affected children must be able to build robust and highly constrained grammatical representations in spite of their inability to detect relevant details of the grammatical input. It is far from clear how this could be accomplished. This is a very complex model of the morphosyntactic limitations of SLI, which does not provide an a priori way to expect similarity in observed growth curves across the different EOI morphemes and consistency in clinical differentiation of the affected group, at the same time that control morphemes such as plural -s are at mastery levels.

Our preference is for the parsimony offered by the EOI assumption of the same underlying mechanism contributing to the younger unaffected children's grammar and the affected children's grammar (i.e., an optionality not allowed in the adult grammar that disappears earlier for the unaffected children for what we assume to be genitic reasons). At the same time, the EOI account does not ignore possible differences within the set of EOI morphemes. Obviously, there are grammatical as well as surface differences involved. For example, some of the measured morphemes appear only as affixes on lexical verbs whereas others appear as freestanding morphemes; BE appears as a copula or an auxiliary, and in either case can move to the front of a sentence to form a question, whereas inflected lexical verbs cannot; DO appears as an auxiliary or, rarely, as a main verb, and, if an auxiliary, it appears before negation in declarative sentences and moves to the front of the sentence for questions; BE in declarative sentences can sometimes be contracted/affixed to the subject noun. These differences are known to young children, whether they be unaffected (cf. Waxler's 1996 hypothesis of "very early parameter setting") or SLI, as Rice and Waxler (1996a) and Rice et al. (1995) have demonstrated. The ways in which these grammatical differences interact with putative processing differences are complex. For example, whereas is can be contracted in declarative sentences, such as "he's happy," is cannot be contracted in yes/no questions, as in "Is he happy?" The fact that children with SLI are more likely to use BE in contractible, as compared to uncontractible, contexts (Cleave & Rice, 1997), is in part related to this grammatical difference.

The point here is twofold. One point is that these grammatical differences could certainly conspire to pull apart the morphemes over time, either acting independently or in interaction with input differences, such as frequency of input or relative duration of morpheme. If operative, they would act to disconfirm the predictions under examination in this study, and in the analyses they do not.

The second point is that the processing theories of which we are aware tend to make empirical predictions that are not supported by the facts. Thus, suppose that there is a problem with the input such that the child cannot analyze it. Then either the child won't learn the relevant morphemes (i.e., they won't be in the child's inventory of morphemes and won't be used) or the child will learn them and use them in the wrong contexts. As we have demonstrated in great detail in this and other papers, both of these possibilities do not hold. Children optionally use the finiteness morphemes, but they almost always use them correctly.

Or consider the facts about subject case as analyzed by Schütze and Waxler (1996) and Schütze (1997). In young children's (unaffected and SLI) utterances, accusative subjects appear with Optional Infinitives, at least in present tense (cf. Loeb and Leonard, 1991; also reported in Waxler, Schütze, & Rice, in press, for the children studied here). That is, they have a grammatical system in which accusative case is allowed in subject position if agreement hasn't been specified on the verb. If nonfinite main verbs appear because of an input processing problem rather than through an effect of the representation of the sentence, why should subject case be dependent on the marking on the verb? Schütze and Waxler's explanation assumes that the root infinitives do not bear AGR in their structure. The grammatical
dependencies of case marking cannot be captured in processing models that we know of, but we are, of course, open to new explanations that take these dependencies into account.

At the outset of the study, what variables predict subsequent growth in tense marking? Do youngsters with higher MLUs at the outset of the study show faster rates of acquisition of tense marking, independent of group status? Do initial vocabulary levels predict subsequent acquisition of tense marking? Do mothers’ educational levels predict their children’s subsequent acquisition of tense marking? Are the predictor equations highly similar across the individual members of the set of morphemes, and is each similar to a predictor equation for a composite measure?

In the outcomes of the children studied here, the assessed predictors accounted, as a combined set, for less than 1% of the total variance. Out of the set, the only significant predictor was a general measure of syntactic development, MLU. The powerful parts of the modeling are the description of the growth curves themselves (i.e., the linear and nonlinear components), which together account for 87% of the total variance. In this way, given the linear and nonlinear effects, there is a high level of prediction of the growth curves for an increased likelihood of marking grammatical tense in obligatory contexts. Knowing the child’s group status, mother’s education, vocabulary score, or MLU at the outset of the study contributes surprisingly little (in the case of MLU) or nothing (for the other predictors) to the model. For all intents and purposes, the trajectory of the acquisition of grammatical tense marking is self-contained, within the scope of the variables assessed here.

What is striking is that the modeling holds for each of the individual morphemes, as well as the collective set of morphemes. This provides further and important evidence of the coherence of the tense marking linguistic function over time, its relative independence from the emerging lexical base, and its persistence as a clinical marker for affected children. One positive clinical implication is that morphosyntactic performance could prove to be a clinical marker of affectedness that is operable across levels of parental education.

Caveats

We reiterate that demonstration of a predicted, extended period of EOI is not a demonstration that an EOI period is the only possible grammatical marker of the condition of SLI. Instead, our expectation is that other grammatical markers could, and probably do, exist. What this early period of investigation provides is carefully specified evidence from a particular grammatical competence that is essential for basic clause construction. The long-term consequences of this early period of grammatical immaturity are not known. Furthermore, demonstration of an EOI period as characteristic of the condition of SLI does not entail the prediction that the condition of SLI resolves, when and if the EOI period resolves. Instead, we expect that the grammatical symptoms evolve as children move more fully into the adult grammar and/or they develop compensatory strategies for dealing with an immature or incomplete form of the adult grammar. Longitudinal outcome evidence is needed in order to track the disappearance of the EOI period, as measured here, and the emergence of new grammatical symptoms.

What Accounts for Grammatical Change?

If less than 1% of the variance is accounted for by the predictor variables, then what accounts for the observed linear and nonlinear growth? Elsewhere, we have suggested maturational mechanisms at work (Rice & Wexler, 1996a; Wexler, 1990, 1994, 1996, in press). Notice that the obtained evidence is consistent with a maturational outcome (i.e., a long period of time before obligatory uses of tense marking are fully activated, similar patterns of growth across the set of morphemes, the lack of influence of the most intuitively plausible and argued-for environmental variable, and apparently different timing mechanisms for the affected children relative to control children). We have argued that the differences in timing mechanisms for the affected children could be attributable to genetic differences in specification of the timing of linguistic properties (cf. Rice & Wexler, 1996b).

To see how plausible the maturational theory is, given the present empirical results, consider an analogy: the theory of height (Wexler, 1990). Suppose it were hypothesized that growth in height were dependent on learning and that the relevant environmental variables that affected the learning of height were input from parents as measured by mother’s education, size of vocabulary, and MLU. Suppose the empirical results showed that these variables accounted for less than 1% of the variance in differential height and that other environmental variables could not be found that were more powerful predictors. In addition, suppose growth was prolonged so that maximal height was only attained after many years. Furthermore, a number of physical features grew together; thus height was very much correlated with growth of arms, say. Furthermore, a small number of children never grew to ordinary height no matter what environmental effects were tried. Given these results, the appropriate scientific conclusion might be that growth in height was maturational. It
seems to us that the case for the maturation of finiteness has the same logic.

Of course, the data reported here do not conclusively reveal the mechanisms for change in a child’s grammar, but they do show that the picture is nicely coherent when change in this part of the grammar occurs. The picture reported here, of change and delayed change, constitutes the clearest evidence to date of the course of morphosyntactic acquisition of English-speaking children, including children with SLI. Although further evidence is needed, these findings can be used as a template for the expected growth outcomes of children in the age range studied. We take the outcomes as clear refutation of overly simplistic assumptions of one-morpheme-at-a-time grammatical growth, even in the case of children with SLI who take a very long time to regard tense marking as an obligatory part of the grammar, even when it is required for the construction of each and every clause.

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