Chapter 8 in

A PHENOTYPE OF
SPECIFIC LANGUAGE IMPAIRMENT:
EXTENDED OPTIONAL INFINITIVES

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The search for genetic contributions to language acquisition has recently focused on children with specific language impairment (SLI). These are children whose language development is significantly delayed or incompletely developed, even though the putative prerequisite abilities, in the areas of hearing, cognition, psychosocial development, and neuromotor functioning, seem to be in place. What is interesting about these children is that they seem to demonstrate variation where none would be expected. By the age of 5 years, grammatical fundamentals are well in place for most children. Yet, children with SLI are well behind their age peers in certain key areas of grammatical development.

The reasons for this variation are unknown. Attempts to attribute the children's grammatical problems to variations in linguistic input or parental interactions have proven inconclusive. Attention has shifted from environmental factors to genetic influences with the recent discovery that the condition of SLI is quite likely to aggregate in families and to be highly concordant in monozygotic twins (see Bishop, North, & Donlan, 1995; Crago & Allen, Gilger, and Tomblin, this volume). These findings, among others, suggest the possibility that a condition characterized by variation in language aptitude is heritable. The clear implication is that it should be possible, in principle at least, to identify the genes that contribute to this inheritance.

The search for genetic contributions to higher cognitive processes, however, depends on a clear understanding of the trait that is being passed on, and the behavioral manifestations of that trait (i.e., the behavioral phenotype; see Brzustowisch, Gilger, Pennington, and Smith, this volume; Lander & Schork, 1994). Procedurally, it must be possible to sort the population into those individuals
with the trait versus those without it. Individuals with the trait who are overlooked by the procedure are cases that will contribute to error in analyses. Accurate identification of affected individuals is essential, and identification depends upon the definition of the trait. At another level, an understanding of the trait is crucial for interpretation of possible genetic contributions and related effects on the central nervous system (CNS) and cortical structures (cf. Plante & Poeppel, this volume). It is important to know which aspects of language acquisition are influenced by genetic encoding and the ways in which that influence plays out. The chain of influence will involve RNA, enzymes, structures and functions of the CNS, linguistic representations, and environmental influences. To sort out the genetic etiology and intervening processes, it is essential to have a clear model of the linguistic end state.

Central to the genetics issue, then, is the question of how to characterize the condition of SLI. In this chapter, we report on recent advances in our understanding of the linguistic qualities of SLI. We draw upon theoretical developments in normative language acquisition to formulate predictions for the grammars of children with SLI. The area of interest is that of morphosyntax, an area known to be problematic for these children. For example, it is well-known that young children with SLI typically demonstrate a protracted period of acquisition of verbal morphology. The work described here (a) contributes an account of this symptom in a way that places the problem in the linguistic domain (related psychological processes, such as auditory processing or memory, are not primary explanatory factors), (b) predicts related grammatical symptoms, (c) accounts for what the children know about grammar as well as don’t know, and (d) shows the ways in which the grammar of affected individuals compares to those of unaffected individuals.

The phenomenon of interest is that of an extended optional infinitive (EOI) stage of morphosyntax in children with SLI. Theoretical underpinnings of this model can be found in Wexler (1994) and his chapter in this volume. Detailed empirical evidence is reported in Rice, Wexler, and Cleave (1994) and Rice and Wexler (In preparation). In this chapter we review the relevant linguistic developments, specify particular predictions, and summarize the evidence in support of an EOI stage of SLI. We then turn to interpretive issues. One is the way in which this stage enhances our understanding of what constitutes a delay of language. We explore possible reasons for an EOI and conclude that fully satisfactory explanations have yet to be worked out. Finally, we discuss the implications of an EOI stage for specification of a phenotype of SLI.

ACQUISITION OF MORPHOSYNTAX IN NORMALLY DEVELOPING CHILDREN: OPTIONAL INFINITIVE STAGE (OI)

Theories of the knowledge of verbal inflection in young children have been greatly revised in recent years. A crucial new insight is that inflection is intimately related to syntax, hence the terminology *morphosyntax*. In particular, inflection can be seen as the phonetic instantiation of inflectional categories that have their own reality in the *structural representation* (the phrase-marker) of a sentence (see Wexler, this volume). Thus, for example, there is a category of tense (TNS) and a category of agreement (AGR) which show up in the representation of a sentence. Categories like TNS and AGR are called *functional categories* because they are involved in the formal structure of a sentence, as opposed to *lexical categories* like nouns (N) or verbs (V).

Verbs can be marked for tense and agreement. If so, they are +finite. Nonfinite forms, or infinitival forms, are −finite. In (1) the verb *talk* is finite, as indicated by the third person singular prefix -s. Similarly, in (2) *talk* is finite because of the past tense marking.

(1) The scientist *talks*.
(2) The scientist *talked*.

In (3), *talk* is nonfinite, as in (4), and neither of these contexts can a tense marker be inserted (as indicated by the *, a conventional symbol for an ungrammatical structure).

(3) The scientist likes to *talk*/*talks*/*talked*.
(4) The scientist made the student *talk*/*talks*/*talked*.

Other languages, such as French, are more consistent in overtly marking finiteness on verbs; that is, the infinitival form shows up less frequently as a finite form. For example, the verb *parler* (*talk*) appears in an infinitival form, *parlier*, and in finite forms marked for person and number and tense (e.g., *parle* for first and third person singular, present tense; *parles* for second person singular).

The crucial observation is that +finite verbs obey certain syntactic principles. This can be clearly demonstrated with regard to placement of the negative particle, *pas*, in French. Nonfinite verbs follow *pas* in what is thought to be the base position (5).

(5) Elle ne peut pas *parler*.
She cannot talk [-finite].

In contrast, finite verbs move or raise to the left of *pas*, as in (6).

(6) Elle ne *parle* pas.
She does not talk [+finite].

Syntactic phenomena, such as these, attested to across multiple languages (cf. Wexler, 1994, this volume) show the existence of functional maximal projections in the phrase structures of clauses. Two such projections are the gran-
matical categories of TNS and AGT. Among their functions is that they serve as landing sites for the movement of verbs around the negative marker in French.

The notion of morphosyntax and functional maximal projections in the phrase structure contributes several important insights to our understanding of the grammar of children with SLI. First, it forms the basis for a new model of children’s acquisition of morphosyntax, leading to the identification of the optional infinitive stage (OI) (cf. Wexler, 1994, this volume). Second, it provides a formulation of English verbal morphology that captures ways in which different surface morphemes carry out common grammatical functions, thereby allowing for evaluation of a cluster of morphemes and avoiding the analytic problems of a one-morpheme-at-a-time piecemeal approach. Third, it allows for an interpretation of the commonly attested bare forms of verbs in which grammatical morphemes seem to be omitted. This interpretation also explains why, when the forms do appear, they are very likely to be used accurately. Finally, it allows for a rather precise way of characterizing what the children do not know about morphosyntax.

Optional Infinitive Stage

Wexler (1994; this chapter) has shown that there is a stage in the development of young nonimpaired children in which they do not obligatorily mark tense in main clauses but in which they know, nevertheless, the grammatical properties of finiteness. This is known as the optional infinitive stage. In non-English languages young children sometimes use infinitival forms of verbs where they should use finite forms. For example, samples from French-speaking children yield declarative utterances in which the main verb is an infinitive such as:

(7) Voir l’auto papa.
    See [-finite] the car of daddy.

During the same stage of infinitival use, the children show that they know about the related linguistic processes that apply to finite verbs. For example, in French (see Pierce, 1992; Weissenborn, 1994) even very young children know that finite verbs precede the negative marker, pas, as in utterances such as (8):

(8) Il est pas mort.
    He is [+finite] not dead.

and that nonfinite verbs follow pas, as in utterances such as (9):

(9) Pas manger la poupee.
    Not eat [-finite] the doll.

The interpretation is that French-speaking children know that verbs raise, or move to precede the negative marker, if the verbs are marked +finite, that is, if they are marked for tense and agreement features. What children do not seem to know is that such features must be marked on the main verb of a clause. That is, they sometimes choose an infinitive, in which case the finite features are not registered and the related processes do not appear. At the same time, children do seem to know that finite verbs, when used, must show agreement and tense and that they must appear in certain positions in the clause.

What is interesting is that young normally developing children in an OI stage do not, at the initial emergence of their grammar, seem to honor an important principle of their morphosyntax. Some time elapses before they begin to consistently use finite forms in main clauses even though they, early on, show that they understand related underlying principles. Wexler concluded that they are relatively late in marking tense where tense marking should appear. This is somewhat surprising in that tense is a fundamental requirement of a fully formed clause in adult grammar.

Predictions for English Morphology

The relevance of the infinitival stage in French- and German-speaking children for our understanding of the acquisition of English was pointed out by Wexler (1994). He argued that in utterances such as (10) and (11) the bare stem form of lexical verbs, such as talk, can be interpreted as infinitival forms.

(10) *The scientist talks.
    [The scientist talks.]

(11) *Yesterday, the scientist talks.
    [Yesterday, the scientist talked.]

Thus, in English, the OI stage could be revealed by children’s optional use of -s and -ed as markers of present and past tense on lexical verbs.

In English, finiteness is also marked on nonlexical verbs (i.e., those that do not contribute semantic information). Do and be forms function in this way, as illustrated in (12) and (13):^1

(12) Do/did you want something?
(13) Is/was the scientist happy?

These linguistic facts lead to the prediction that English-speaking children in an OI stage of development should show optional use of the set of morphemes that mark finiteness. More specifically, they should show omissions of -s, -ed, be

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^1 BE and DO (all caps) are used here to denote the citation form of the set of BE and DO verbs of interest in this discussion. This would include the phonological variants, that is, am, are, is, do, does. For BE it includes the grammatical classes of copula (e.g., “he is happy”) and auxiliary verbs (e.g., “she is running”). For DO it includes the auxiliary form of the verb but excludes main verb contexts (e.g., “you do it.”).
and do forms in contexts where these forms are obligatory in the adult grammar. More precisely, in the linguistic framework adopted here, children in an OI stage have a grammar that allows optional use of a finite or nonfinite version of a given form, F, in linguistic contexts where the adult grammar specifies a finite version of the form. The children's grammar allows an option not allowed in the adult grammar. Use of a nonfinite form is an allowable option in the child grammar and, in that sense, is not an omission or error. To avoid excessive wordiness, we use terms like omissions, errors, and correct use here, to mean with regard to the adult grammar. The reader should keep in mind that these are not viewed as ungrammatical within an OI child grammar.

Note that the predicted set of affected morphemes includes different ways to phonetically and morphologically represent finiteness: -s and -ed are affixes; be and do are free-standing morphemes that can appear in different positions within a sentence and have different forms, depending on person, number, and tense (e.g., am, is, are; do, does). The point is that they are not defined by their surface properties. They are, instead, defined by whether or not they carry markings of tense and agreement and, if so, the word order rules that apply. Notice also that the notions of tense and agreement are formal grammatical notions. Tense is not the same as a child's notion of time. Tense can be marked as present or past. Children can know about presentness and pastness but not know about the need to mark grammatical tense in sentences. The distinction is especially evident in constructions with do, as in (12), where the marker of present/past tense appears on a grammatical form that does not contribute to the meaning of the sentence.

Further predictions of the OI stage are that children who omit -s, -ed, be and do will, at the same time, know that if they use the targeted forms, certain constraints apply. Thus, the way in which their usage will differ from that of the adult grammar will be in the omission of finiteness, not in overt errors of agreement. It is predicted that, if the forms appear, they will show correct agreement. This is most evident in the be forms of English, where person and number agreement show on different forms (e.g., I am, you are, he is).

MORPHOSYNTAX OF CHILDREN WITH SLI: EXTENDED OPTIONAL INFINITIVE

For some time, it has been reported in the literature that one way in which the grammar of English-speaking children with SLI differs from that of control children is in a lower likelihood that they will use certain grammatical forms in contexts where those forms are obligated in the adult grammars. This is well documented for -s, -ed, and, to a lesser extent, be forms (Bishop, 1992; Leonard, 1989; Rice, 1991). The OI account raises the possibility that these facts are part of the same underlying phenomenon, that of an EOI stage in the morphosyntax of children with SLI. If children with SLI are adhering to the linguistic constraints that guide normative acquisition of morphosyntax, then we would expect that they, too, would demonstrate an OI stage. What would distinguish them would be (a) a later-than-expected emergence (i.e., first uses) of the targeted grammatical forms; (b) once finiteness emerges, a later-than-expected optional use of nonfinite forms in contexts where the adult grammar requires finiteness; and (c) a longer-than-expected period of OI, perhaps into adulthood.

In this chapter, we discuss (b) and (c). Although it is generally presumed that (a) is an accurate characterization, there is surprisingly little direct evidence available about emergence of grammatical forms. Hadley and Rice (in press) studied the emergence of be and do and document a late onset for children with SLI. With regard to (b), predictions that apply to -s, -ed, be, and do are as follows:

1. For -s and -ed markings on lexical verbs, bare stems (i.e., the nonfinite forms of the verb) may optionally be used where inflected forms are required.
2. For -s, in contexts other than third person singular, there will be no overt marking. That is, *they walks is predicted to not be a productive error.
3. -ed will be restricted to past tense contexts.
4. Auxiliary and main verb be may be omitted.
5. Auxiliary do may be omitted.
6. When be and do forms are used in contexts where the adult grammar requires a finite form, children will give correct agreeing forms.

These predictions were tested in a recent study (Rice, Wexler, & Cleave, 1994). The participants included 18 children with SLI with a mean age of 5 years.

The use of nonfinite forms of be in contexts where allowed in the adult grammar are not ruled out within an OI or EOI stage. These are contexts, such as infinitival complements (e.g., "I want to be happy."), verb phrases containing modal (e.g., "I will be happy."), and imperatives (e.g., "Be happy."). What should not appear are nonfinite forms of be in grammatical (contexts which require finiteness; for example, we do not expect forms like "She be happy." In fact, as Wexler (1991) pointed out, it is a general property of the OI stage cross-linguistically that auxiliaries do not appear as nonfinite forms in contexts where adult grammar requires that they be finite. The prediction is that the OI and EOI stage of English follow this pattern.

At the same time, it is recognized that some dialectal variants of English allow main verb uses of be, and may also allow other surface features similar to those of the OI stage, such as omission of third singular -s on lexical verbs. The specific details of how an OI stage may be manifest in dialectal variants of English have yet to be worked out.

Since the writing of this chapter, the findings of Rice, Wexler, and Cleave (1995) have been replicated in Rice and Wexler's work (in preparation), which investigated a separate second sample of children with SLI and nonaffected children in two control groups, one matched for chronological age and the second for mean length of utterance. Because the findings across the two studies are very similar, the details reported in this chapter can be considered illustrative of the findings for Rice and Wexler (in preparation), as well. Rice and Wexler go on to present evidence of distributional nonoverlap of the children with SLI and their age peers on the targeted morphemes, and develop further arguments for tense as a clausal marker.
assume the morphemes could be applied in contexts not allowed in the adult grammar. They did not say things like (18) or (19).

(18) *You walks.
(19) *Yesterday he walks.

The EOI predicts that when children choose to use a be form, they will select the form that goes with the person and number of the subject. Thus, children will generate utterances such as those in (20) but not those in (21).

(20) She is happy / you are happy.
(21) *She are happy / *you is happy.

This prediction was upheld, perhaps most surprisingly for the children in the SLI group. Even though they omitted be forms at an average rate of 55%, in the 45% of the utterances in which an overt form of be did occur, it was highly likely to be the right choice, with accuracy over 90%. This shows that these children, who demonstrate such striking limitations in their morphosyntax relative to children a full two years younger, nevertheless know some important properties of English grammar. The be form of English is an unambiguous context in which to observe agreement. What these findings suggest is that the SLI children, by the age of those children studied here, do show consistent marking of agreement, at the same time that they do not show consistent marking of tense.

EXTENDED DEVELOPMENT THEORY OF SLI: IN WHAT WAY IS GRAMMAR DELAYED?

The Logic of How to Determine Delay

The EOI can be regarded as one form of an extended development theory (EDT) of SLI. The EDT can be compared to the notion of delayed language that has been in the literature for some time. “Delay” carries with it several notions. One is the idea that, typically, language emerges at a later age for children with SLI.
than for nonimpaired children. This observation raises the possibility of a methodological refinement, in which there are two control groups, one matched for chronological age and the other for general language development (for preschool children, this is usually the mean length of utterance). This design, as employed in the study previously described, allows for determination of whether or not certain aspects of the grammatical systems of children with SLI lag behind their general language development, that is, if there is a difference beyond the delayed emergence of grammar relative to age peers (recall that these children are clinically identified because they do not show the grammatical competencies of their age peers). In the logic of the language-control group design, no differences between the SLI group and the language control group are taken as evidence that the grammar of SLI children does not differ from normally developing children in any way other than delayed emergence. More specifically, when the two groups do not differ on targeted grammatical morphemes, it is said that SLI children do not have “extraordinary difficulty” learning grammatical morphemes (Lahey, Liebergott, Chesnick, Menyuk, & Adams, 1992). On the other hand, if differences are found between the SLI group and the language control group, they are taken as evidence for ways in which the grammar of children with SLI is different from younger nonimpaired children. More specifically, it is evidence that certain grammatical morphemes are extraordinarily difficult for children with SLI (e.g., Leonard, 1989; Rice & Oetting, 1993; Watkins & Rice, 1991).

**Interpretation of Grammatical Differences Not Accounted for by a Delay**

A finding of a difference reveals a more interesting problem than a simple delayed onset of language acquisition. The problem is how to account for the fact that some aspects of the grammar of children with SLI pose selective and extraordinary difficulty, and how to characterize these difficulties in terms of the grammar and language acquisition mechanisms of nonaffected children. Leonard (1989) invoked surface properties of the grammar as an explanatory construct, proposing that the grammatical morphemes that differentiate children with SLI from language-control children are ones that are unstressed and phonetically unsalient. This interpretation has been challenged by evidence that forms similar in surface structure, but different in underlying grammatical function, do not pattern together in differentiating children with SLI from their controls (Rice & Oetting, 1993; Watkins & Rice, 1991).

**Delay as Something to Be Outgrown**

Another aspect of the notion of delay is the assumption that children will outgrow their initial symptomology. Presumably, whatever factors that account for the initial extended period of time before the children’s language emerges can be overcome or are no longer operative and then language acquisition can proceed unhampered. Recent studies of children with delays in expressive language only, sometimes referred to as late talkers or specific expressive language delay (SLED), suggested that about half of the children with this diagnosis as preschoolers may catch up with their nonimpaired peers by age 4 years (cf. Paul & Allforde, 1993). Notice that the children in the study reported here were children whose receptive language milestones, as well as expressive language, were significantly below age expectations. Children with such receptive limitations are less likely to outgrow their initial language impairment (cf. Thal, Tobias, & Morrison, 1991), perhaps because their underlying linguistic representations are less fully developed than those of children who perform within normative range on receptive tests.

Recent evidence suggests that affected individuals may not, in fact, outgrow the kinds of grammatical differences evident during the preschool years. Two recent studies—Marchman and Weismer (1994) and Oetting, Horrohov, and Costanza (1995)—reported that children with SLI (defined according to criteria similar to the ones used in Rice, Wexler, & Cleave, 1994), who were 7 to 9 years old, performed below their comparison groups on an elicitation task of tense marking. The children with SLI were distinctive for their overuse of zero-marked stems. This kind of error was observed for regular and irregular past tense forms. Tomblin (1994) reported that in a sample of young adults with a positive history for childhood language disorders, their spontaneous samples yielded more errors with tense marking than did samples from control subjects. In a detailed case study report of affected adults in a family with a high incidence of language disorders, Ullman and Gopnik (1994) documented that these individuals had not mastered tense marking on either regular or irregular verbs. The conclusion is that tense-marking, in particular, may remain as a way in which the grammar of affected persons does not fully approximate the expected adult levels of performance.

**Accounts of Deviant Language**

Some investigators following models of normative language acquisition have concluded that the grammars of individuals with SLI are different from those of nonimpaired speakers. Clahsen (1989, 1991) argued that German-speaking children with SLI are missing agreement relationships whereas Grimm and Weinert (1990) identified the problem as one of word order rules. Gopnik and Crago (1991) proposed a missing features model of SLI, in which affected individuals are thought to be missing features of the systems that guide the morphological acquisition of nonimpaired children, including features of number, tense, agreement, gender, aspect, animacy, person, and mass/count (cf. Oetting & Rice, 1993, and Rice & Oetting, 1993 for evidence that the number feature, counter to the predictions of the missing features model, is available to children with SLI).
EOI AS EXTENDED DEVELOPMENT OF LANGUAGE

What is needed is a way to capture how the grammar of children affected with SLI can be delayed in emergence, show selective ways in which certain grammatical morphemes differentiate the performance of children with SLI from language-level-control children, and, at the same time, maintain strong parallels with the grammars of nonaffected children. This account should also accurately predict long-term outcomes.

Under an EOI account, impairment can be thought of as having three manifestations. One is a later-than-expected emergence of the targeted grammatical forms. In this sense, language is delayed. The second manifestation is evident in the period after emergence, when there is a lower-than-expected optional use of finite forms in contexts where the adult grammar requires finiteness. In this sense, certain grammatical forms are extraordinarily difficult. At the same time, there are deep underlying similarities between children with SLI and their nonimpaired peers in that both groups adhere to the linguistic principles that guide normative acquisition of morphosyntax. The third manifestation is an extended period of time in which an optional use of finite forms is evident. In the EOI account, the variation evident in SLI is attributable to a long, drawn-out period of development for certain very specific linguistic principles, principles that appear late in the morphosyntax of nonimpaired children, and that apply to a specific set of surface morphemes. In this way, normative and non-normative variations are linked.

Within this view, language acquisition could be likened to a train. At the outset, the train is at the station with a certain configuration of engines, cars, potential for acceleration, and tracks for guidance. For most children, the train leaves the station at a particular time, with the cars in alignment and the coupling between them carefully synchronized. In the case of children with SLI, the train seems to depart later. Yet the train follows the same physical laws and constraints that govern the functioning of the train of non-SLI children. On closer inspection, it is apparent that the coupling of the cars for the children with SLI is not the same as for the other children. Instead of tight coupling, some cars are attached in a more elastic way, as if made of material like a bungee cord. This allows for the train to maintain its configuration, but some cars fall behind the momentum of others. Thus, the SLI children's morphosyntax can be characterized as having a delayed emergence, an extended period of development, adherence to the same principles as the morphosyntax of non-SLI children, and at the same time a general configuration not quite the same as the other children by virtue of the fact that not all aspects of the linguistic system are fully synchronized. What is not known is whether or not the language train of the individuals with SLI ever comes to fully align in the same way as the train of nonaffected individuals.

To summarize, 5-year-old children with SLI, who optionally mark tense in contexts where the adult grammar requires tense, share linguistic characteristics that also apply to much younger children. An EOI is not deviant in the sense of "abnormal" or "missing" principles or structures that are attested to in younger children. At the same time, an EOI is unlike normative acquisition in a lower-than-expected use of finite forms over an extended period of time. There is an extended development of the acquisition of tense. The full duration of this period is not known. The recent reports of adults with SLI who demonstrate less-than-expected use of tense markers suggest that the period may persist into adulthood.

POSSIBLE REASONS FOR THE EOI

Explanations have been put forward for grammatical limitations of SLI of the kind described here. Possible explanations fall into two broad categories. One category carries the theme of missing components of the grammar. In a sense, this category of explanations regards the grammar of children with SLI, the underlying linguistic representations, as deviant in some way. This category focuses on linguistic structures or processes. Examples of this category are the missing features account of Gopnik and Crago (1991) and the missing agreement account of Cahen (1989). Another category of explanations focuses on psychological processing mechanisms thought to be at least somewhat independent of linguistic representation. On models of this sort, observed differences in grammatical forms are attributable to problems in processing the input language in a way that restricts a child's ability to fill out linguistic representations or to problems with capacity constraints. This line of explanation emphasizes the surface properties of grammatical forms, such as salience, patterns of stress, and frequency of input. Examples of this category are Bishop (1992), Leonard (1989), Johnston (1994), and Tallal, Stark, Kallman, and Mellits (1990).

Explanations from either of these two camps, at least as currently formulated, encounter significant obstacles when applied to the phenomena associated with EOI. With regard to missing components of morphosyntax, it is obvious from available evidence that any missing elements must be quite constrained and are constrained in the same way that younger, normally developing children's language is constrained. It is imperative that this issue be examined from a highly specified model of the adult grammar. What can seem to be missing, such as agreement, may instead be confounded with other dimensions. An example is the observation that English-speaking SLI children tend to use a bare stem form of the verb in contexts that require -s (in utterances such as I, previously mentioned). One possible interpretation is that this phenomenon is attributable to missing agreement (an interpretation examined in Rice, 1994). What now seems to be operative is a limitation in tense-marking that is also marked by the third person singular present tense -s morpheme. Another contribution of a highly specified model of the adult grammar is that it can identify contexts where agreement is unambiguously marked. In English, be offers such a context.
When examined for evidence of agreement (Hadley & Rice, in preparation; Rice, Waxler, & Cleave, 1995), the incorrect form choice predicted by a missing agreement account is not evident.

If there is a candidate for a missing element of the morphosyntax at some early and perhaps later stages, it might be knowledge of the need to mark tense in a main clause. But much more work needs to be done to flesh out what this may mean. It may be attributable to underspecification of tense features, or limited mechanisms for movement of the verb to the functional category of INFL, or other, as yet unspecified, factors (cf. Waxler, 1994 for the original discussion of possible analyses of the OI stage in normally developing children. Also see Hyams, 1994; Rizzi, 1994). A more complete understanding will require evidence from cross-linguistic studies that allow for observation of different parts of the finiteness marking systems of the grammar. The EOI stage manifestations depend upon the particular linguistic properties of a given language (cf. Crago & Allen, this volume; Leonard, this volume; Waxler, 1994, this volume). Further evidence from particular contexts of English will also continue to play an important role in the search for illumination.

Processing or limited capacity accounts also encounter challenges when applied to the phenomena of the EOI. At the outset, it is evident that children with SLI do not make haphazard mistakes. They do not misapply morphemes across lexical or grammatical categories, nor do they formulate odd word orders. Any processing or limited capacity account must be able to capture the fact that performance is constrained by underlying linguistic structures and processes (cf. Leonard, this volume, who stipulates that the underlying linguistic representations for children with SLI do not differ from those of nonimpaired children, a position similar in that respect to that of the EDT previously sketched out).

Linguistically constrained processing accounts seem to be best suited to accounting for omissions of expected surface forms. Intuitively, there is something quite appealing about the notion that the missing forms characteristic of English-speaking children with SLI correspond to the small, unstressed parts of the surface grammar and are, therefore, missing because they are small, unstressed forms. This characterization has been in the literature from the beginning. There are some important caveats that apply, however. One is that the salience account is empty unless there is an independent definition of salience. If there is not, then there is no way to disprove a salience theory; one simply defines elements that are omitted to have low salience. Second, a low salience account makes overly broad predictions. For example, surface properties alone would predict that different morphemes that share the same surface form should be equally vulnerable. One such example is Leonard’s (this volume) prediction that regular plural -s should be vulnerable for English-speaking children with SLI, as well as -s to mark third person singular present tense on verbs. This prediction is not upheld, however, in studies of SLI children’s use of plurals (cf. Oetting & Rice, 1993; Rice, 1994; Rice & Oetting, 1993). In these studies, plural usage is surprisingly robust in samples of SLI children, with levels of accuracy at or near mastery in spontaneous speech, whereas the -s verbal inflection is at low levels of accuracy. The point to be emphasized here is that a salience or processing account of the obtained evidence for -s, ed, be, and do would also predict bare forms of the noun where regular plural -s is required, a prediction that does not hold for the children in the study reported here. In a parallel vein, Watkins and Rice (1991) showed that children with SLI were more likely to omit forms such as in and on when they were used as particles than when they were used as prepositions, a difference not predicted by a surface processing account.

Further counterevidence is found in recent reports that irregular past tense forms are also vulnerable for affected individuals (cf. Marchman & Weismer, 1994; Oetting et al., 1995; Ullman & Gopnik, 1994). On low-salience accounts, the regular past tense suffix -ed is usually regarded as low salient whereas the stem-internal changes of irregular verbs, such as ride/rode, are not. If both categories of verbs are likely to be missing tense-marking, then the explanation must shift from that of the surface phonetics to the underlying grammatical function.

Equally problematic for a processing account, however, is the new finding that agreement is evident for be. The available models of processing limitations (e.g., Bishop, 1994; Gathercole & Baddeley, 1990; Leonard, 1989; Tallal & Stark, 1981) focus on the input available to a child: Perhaps the original phonetic form is not detected in the input or, if detected, is sufficiently demanding to create a processing load that exceeds a youngster’s capacity, or jeopardizes a child’s ability to recognize and place a grammatical form in the appropriate paradigm, such that sufficient instances of verb +ed, for example, are not entered into a past tense paradigm to establish a general rule. Under these scenarios, memory of stored forms is vulnerable, as is the formulation of full paradigms (i.e., knowledge of the morphological forms that mark the grammatical distinction).

A processing account would readily predict the fact that the SLI children in the study previously described, as a group, omitted be forms in 55% of the contexts where they were required. On this kind of explanation, these small, unstressed forms would not be detected in the input or, if detected, would require additional instances or redundancy of use before they would finally be entered into a grammatical paradigm. One would predict, then, during the period of high probability of omission, confusion about which surface forms appear with which grammatical subjects, a confusion reflective of an incomplete or inaccurate paradigm, and/or limited memory of the surface forms of the morphemes. What would not be predicted is the highly consistent choice of correct forms of be in the 45% of the contexts in which be could appear, as observed in the study reported here. This high level of accuracy suggests that the forms of

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4Current analyses underway in our lab also show that irregular past tense forms are affected. In our data, children with SLI are much more likely to use a bare stem form than are the nonaffected children, a tendency that persists from the preschool years into elementary school.
be are available in the linguistic representations, hence, they have passed through the input mechanisms and entered the grammar. There does not seem to be any obvious way to predict that input processing limitations will lead to a high rate of omissions of a set of different surface forms that are also used with a high degree of accuracy when they do appear. Accurate use implies underlying representations and sufficient memory for recall.

Exactly the same point can be made with regard to regular third person singular -s. If -s is nonsalient and, thus, not entered correctly into a paradigm, if it appears at all, it should appear randomly with regard to subjects. However, we have already seen that -s is almost always used correctly, that is, with third person singular subjects, and almost never with other subjects. This consistent pattern of use of -s indicates that its grammatical properties are known, counter to the salience hypothesis.

We conclude that neither of the two kinds of available explanations of the limited morphosyntax of children with SLI offers an immediate and compelling explanation of the observed phenomena of the EOI stage. Waxler (1994) commented on the possibility of a maturational mechanism at work in the OI stage of young nonimpaired children, such that a part of the grammar that necessitates tense in main clauses would not be available early on, but would “kick in” at some later time, probably around 3 years of age. Clearly, the tense-marking system is fully operative by 5 years of age. This implies that, for children with SLI, there may be a problem with the activation of a time-referenced onset switch of some sort in the grammar. This onset switch may be set late, or may be only partially operational once activated, or may never be switched on. Answers to these possibilities will depend upon the collection of evidence that documents the longitudinal trajectory of the EOI stage of SLI, and its ultimate resolution or outcome. That is the direction of our current investigations of the EOI stage.

**Implications for a Phenotype of SLI**

In the previous sections of this chapter, we described an EOI stage that is likely to be characteristic of English-speaking children with SLI. Now we consider the implications of this finding for the specification of a phenotype for genetic contributions to language acquisition. We examine several properties that enhance the promise of candidate phenotypes of language acquisition and use the EOI as an illustration of issues that arise.

**Variation Appears Where Variation Is Not Expected**

As noted at the outset, a good phenotype is one that demonstrates variation across individuals, and allows for grouping of individuals on the basis of the behaviors associated with the phenotype. In the case of the EOI, variation appears where, for theoretical and empirical reasons, variation is not expected. Tense-marking should not be optional in individuals over 5 years of age. It is a fundamental property of the grammar that must be in place for the formulation of sentences. So, speakers should know this property of the grammar. If there is a grammatical trait that is characteristic of the general population that is not evident in some individuals, that variation could plausibly be attributable to inherited variations.

A closely related point is that the obtained variations constitute extreme values. The accuracy of tense-marking of children with SLI is far below the expected levels of the general population, at the age levels observed (available evidence is strongest for the period of 2–7 years). This means that a distributional analysis of children’s accuracy of tense-marking at age 5 years would show that most children would fail in the uppermost levels whereas there would be a group of children who would still cluster at the lower end of accuracy. Although such normative information from a randomly drawn sample is not yet available, the evidence from our experimental studies of group differences provides evidence of this distribution (Rice & Waxler, in preparation). If it turns out that an EOI stage is distributionally distinct, that would be relevant to attempts to determine if the condition is also etiologically distinct (cf. attempts to demonstrate that the genes that contribute to reading disabilities are the same as those contributing to variations in reading at higher levels of ability; Gilger, this volume; Gilger, Borecki, Smith, Defries, & Pennington, 1994; Leidy & Pennington, this volume; Shaywitz, Escobar, Shaywitz, Fletcher, & Makuc, 1992; Smith, this volume). What is at issue is whether or not the individual variation evident in EOI is attributable to the same etiological factors as the variation evident in the OI stage of development. Is there one gene or cluster of genes that influences grammatical ability that causes variation across individuals, and the condition of SLI is but the bottom tail of this variation (cf. Leonard, 1990)? Or is the variation not a matter of one distribution, but two overlapping distributions, such that the clump at the bottom of the distribution of children in an EOI stage is attributable to a different etiology? These are fundamentally important questions that are on the immediate horizon, just within view. If answers are to be found, there must be a way to identify individuals in an EOI stage, and there must be an understanding of the trait involved, and how this trait may or may not be considered to be part of the normative distribution and expected linguistic competencies.

**Variations in Observed Behavior Are Interpretable in Terms of Higher Order Cognitive Representations**

What differentiates the genetics of higher cognitive abilities in humans from the behaviors of animals is the postulation of underlying representational mechanisms that account for why linguistic behaviors, for example, show the constraint:
that they do and the observed patterns of contingency relationships in the surface structures. So the challenge is to do more than just link behaviors or surface markers with genes. The full task is to show relationships in a way that corresponds to the underlying grammar. Perhaps it will be possible to demonstrate that tense-marking is associated with familial aggregations of affectedness that correspond to known patterns of genetic transmission and that the affected family members show characteristic allelic variations. That would be a major advancement in what we know, without any doubt. But what would make it really interesting would be the way in which such a demonstrated association could contribute to our understanding of human linguistic capacities. In the case of EOI, tense-marking is not defined in terms of a particular surface instantiation of tense-marking, such as the -s or -ed suffix, although this may turn out to be an efficient way to measure it. Instead, the theoretical framework provides an account of how tense-marking is integrated into the grammatical system. The point is that clinical markers, at best, should have an associated interpretive framework that allows for full explication of the possible genetic contribution.

The Observed Variation May Be Quite Localized

Language can be defined in ways that highlight general characteristics or that delineate carefully differentiated subparts. The best examples of general characteristics are to be found in the normative, omnibus tests of language acquisition. There is usually relatively gross differentiation of what constitutes language. Often the tests are organized according to performance modality (i.e., receptive vs. expressive and test in broadly defined areas of vocabulary and grammar). In contrast, for example, in theoretical terms, morphosyntax can be partitioned from other parts of the linguistic system and further subdivided into phenomena, such as finiteness-marking.

Almost all of what we know about the condition of SLI is at the level of general milestones of language acquisition. Conventional means of clinical identification rely heavily on normative assessment with omnibus tests of language performance. Although the limitations of this procedure are frequently noted, it remains a mainstay of clinical practice. Therefore, any identification of affected individuals is likely to rely on such methods.

What remains obscured by such an approach is the possibility of localized variations in certain areas of the grammar. If these areas are tested only sporadically in the standardized tests, and if other areas of language acquisition are not problematic, individuals may be considered unaffected when in fact there are interesting variations.

There is evidence that an EOI stage may not be detected by a conventional language test. A case study underway (Schuele, 1992, 1995) documented such a possibility with a young girl, AM, age 6½ years at first assessment. This child was interesting because she demonstrated selective impairments of morphosyn-
What these arguments suggest is that it is probably overly restrictive to define an SLI phenotype too narrowly. But some caution is necessary. On the one hand, it is quite possible that certain kinds of linguistic knowledge may be relatively independent of general cognitive estimates (cf. the case of AM, observations of children with Williams Syndrome). On the other hand, it is also the case that deficits in general cognitive abilities are known to correlate highly with general measures of language impairment. And the etiology of pervasive developmental delay is likely to be distinct from the etiology of more selective impairment in the speech and language systems.

To return to the example of the EOI, what is not known is how much of the cognitive prerequisites must be in place to support the morphosyntactic system. Presumably, certain fundamentals must be present such as memory, ability to process incoming speech, basic categorization abilities, and fundamental conceptual development. Minimal levels of these fundamentals may suffice. A Wexler (1994) pointed out, very young children (under 2 years of age) have a wide variety of morphosyntactic abilities; children at this age would not usually be characterized as having a particularly large measure of conceptual development. So, the question is how to define the level of cognitive performance that is essential for grammatical acquisition. It seems that the current experimental standards are probably too conservative; evidence suggests that SLI is detectable at even lower levels of conceptual performance, and the minimal conceptual levels necessary for morphosyntactic development may be quite low. Adjustments in the definition of SLI with regard to cognitive levels are quite likely and in need of further evaluation.

Evidence of Affectedness Is Likely to Be Time-Referenced

There are two senses in which time-referencing applies to the possible phenotype of SLI. One is that the surface manifestation of the grammatical difference is likely to change with age. Young children could be identified by an EOI stage. Presumably, this stage will not be as apparent in older individuals, although little is known of how this stage plays out over time. So, there is the empirical issue of how to evaluate grammatical competence in a way that captures age-referenced grammatical expectations and, at the same time, captures interesting individual variations in ability. The second sense of time-referencing bears on the trait itself. The trait may change over time. There are several possibilities. One is that an underlying representation for the obligatoriness of tense is not available early on but comes on-line at a certain time for nonaffected individuals, say around 3 years, but does not ever come on-line for other individuals, or, does so at a much later time, say around 7 years. If obligatory TNS is late, or incompletely specified somehow, it is certainly possible for individuals to develop compensatory strategies, such that their grammatical performance could stay within the range of what they can manage. As in the case of reading disabilities, individuals could be difficult to detect because they compensate. In the case of EOI, for a compensated individual, tense-marking may be nonoptional in highly familiar contexts, or in grammatically simple configurations, but not in more demanding linguistic contexts. What will be needed to sort out these possibilities are careful empirical investigations that provide the necessary descriptive information. In short, much more needs to be known about the clinical manifestations of an EOI stage and how it changes over time.

CONCLUDING REMARKS

In this chapter, we have shown that the condition of SLI can be characterized in young children as an extended optional infinitive (EOI) stage of morphosyntax. The EOI is detectable because of the observed OI stage of normative variation which is, in turn, derived from current theoretical models of adult grammar. The fundamental question is whether or not the EOI stage, and the related OI stage, could be linked to possible variations in genetic mechanisms underlying linguistic representations. Answers to this question are not now available. At the same time, we know that any answers will depend upon the specification of a phenotype. Such specification subdivides into two issues: One is the ability to identify affected individuals and the second is an understanding of the underlying trait.

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