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Language Development: Overview

E Lieven, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

All over the world, children learn to talk on a roughly equivalent timetable. They do so by learning the language or languages of their environment. There is considerable debate over what cognitive, social, or specifically linguistic, innate capacities they bring to language leaning. This article begins with a brief timetable of development and then focuses in turn on the major aspects of language learning in terms of infancy, learning words, learning morphology, early grammar, later grammar, and the learning of pragmatic and metalinguistic skills. It concludes with some brief reflections on atypical development. The relevant theoretical issues are covered as they arise in each section and are considered again in the last section on learnability and constituency.

During infancy, children develop a wide range of cognitive and social skills together with a developing ability to segment the speechstream into meaningful units. They usually produce their first recognizable words somewhere between 10–18 months of age and their first multiword utterances between 14–24 months. By age 3, children are often able to produce quite long utterances and are beginning to be able to combine more than one clause into coordinate and subordinate constructions (e.g., relative clauses, cleft sentences). Between the ages of 4 to 7, there are major advances in children's ability to take the perspective of the listener into account and to produce coherent discourse and narrative sequences. These abilities, as well as the ability to reflect on language as an object of knowledge, develop throughout the school years and are much influenced by the extent of literacy or other complex language (for instance, ritual language) to which children are exposed.

Throughout this developmental timetable, there are major individual differences in the ages at which children reach these points and, in addition, in the balance of skills that a particular child may manifest at a particular point in time. There are also individual differences in how children tackle any of these tasks. This is an important point to remember when considering theories that rely for their confirmation on a particular order of development or on a particular relationship among different skills. It is also important to remember that many children (perhaps most) grow up hearing and, to some extent at least, learning more than one language. The evidence to date is that doing so does not have a significant impact on the developmental timetable for language learning in the early years.

Overview of Development

Infancy

Children are born with the ability to discriminate their mother's voice from that of other women and to discriminate speech from nonspeech, presumably because of their experience in the womb. In the earliest months of life, they seem able to discriminate sounds produced in the languages of the world, but this ability diminishes until, by 8 to10 months, their ability to discriminate between sounds is confined to the sounds of their native language(s).

Experiments with children between 6 to 10 months of age indicate a developing sensitivity to the prosodic indicators of major phrasal units in the speechstream. Thus, 9-month-old infants prefer to listen to speech that is segmented using pauses at major clause boundaries, rather than within clauses, whereas there is no difference in listening preferences for 6-month-olds. Around 7.5 months infants also become able to identify words in the speechstream. Experiments with English-, Japanese-, and French-learning children have shown that children can discriminate words that they have heard before from those that they have not, even when the words were embedded in speech. They can also discriminate highly frequent words in their language from low-frequency words, and words that are typically learned early by children from words that are not typically learned early (Jucszyk, 1997).

Experiments with children about 10 months of age have indicated that they are sensitive to the ordering of words in their language, thus being able to discriminate normal English sentences from ones in which determiners and nouns were reversed (e.g., *kitten the*) or ones in which some grammatical morphemes were replaced by nonsense syllables. Older children (at 18 months but not at 15 months) can discriminate sentences in which the combination of auxiliary and verb was correct (*is running*) from those in which it was not (*can running*). Finally, using simple artificial languages, it has been claimed that infants between 7.5 to 17 months are able to recognize strings with the same ordering rules, but with different 'vocabulary' after a short exposure. However, it seems that this discrimination is possible only when there are patterns of repetition in the 'vocabulary items' (Gomez *et al*., 2000).

These experiments show a clear path of development during the first 12 to 18 months of life. As children's experience with language develops, so do their segmentation, word recognition, and pattern recognition skills. These skills are obviously central to the child's ability to parse the input and to start to connect it to meaning. It is important to note that all these experiments depend on the infant's ability to discriminate one stimulus from another. They do not have to understand or use the stimuli in communication nor connect them to any meaning in the environment.

However, infants do make huge developmental strides in their cognitive and social development during the first 12 months of life. Cognitively, infants (probably from birth) have clear expectations about the ways in which objects will behave, and these expectations develop in sophistication over the first year of life. Before their first birthday, they are able to form categories of objects based both on form and, to some extent, on function (Mandler, 2000).

During the first 6 to 8 months of life, children develop the ability to interact with others, to make demands, and to resist them. At around 8 to 9 months, there is a major 'step change' as the infant starts to understand that others have intentions that may be different from their own and to incorporate this understanding of other minds into their behavior; for instance, imitating the perceived intentions of others and showing objects that they know their interactant has not seen (Carpenter *et al*., 1998). Infants aged 12 to18 months are clearly starting to associate attention sharing, demanding, and assisting others with specific gestures that they use and, also perhaps, with systematic vocalizations. This development is highly correlated with word learning, as it seems to be the beginning of the attempt to match form to meaning.

Thus, by about age 10 to 12 months, infants are ready to put the patterns skills that they have extracted together with their communicative and meaning-inference skills. It is this combination that is the true start of human language learning.

How many of these developing abilities are unique to humans, and how many are shared with the other

great apes or primates? This is obviously a contentious issue, and researchers of different theoretical persuasions have made very different claims. Much more research remains to be done to tease apart the exact nature of the skills and their precise developmental sequence. However, a number of experiments have indicated that many of the pattern recognition skills shown by human infants may be shared by other primates. In contrast, the intention-reading and communicative skills shown by infants in the last trimester of their first year do seem uniquely human, though nonhuman primates show some precursors of these abilities, especially those few who have been reared in a 'human' environment (see Tomasello, 2003).

Early Comprehension and Production

The time when children first start to show signs of comprehension and to start producing words varies. However, because much depends on how comprehension and production are defined, it is difficult to give an exact range of variation. Comprehension of individual words such as 'No' starts very early, and children can use contextual cues to interpret the utterances of those around them without parsing much of what they hear. Although most well-controlled studies of early word learning have found that comprehension is achieved in advance of production and starts early, production is more variable, with some children producing their first words (as reported by parents) at around 10 months, whereas others might not produce more than a few recognizable words before 16 to 18 months (Fenson *et al.*, 1994). For most children, progress in comprehension and in production is highly correlated, but there are reports of some children whose comprehension outstrips their production by much more than the normal extent (Bates *et al.*, 1988).

Studies have shown that, even when infants know a word, it will take 15-month-olds much longer to process it and to look to a matching picture than it will older infants. Thus, 15-month-olds need to hear the whole word before looking to the matching picture, whereas 18- and 24-month-olds process it 150 and 300 msec faster, respectively. These two older groups shift their gaze before the word has ended, using the ongoing phonological information to discriminate the matching picture from a distractor (Fernald *et al.*, 1998). This development of automatization is clearly one of the major processes taking place between the earliest word-meaning mappings and the point where vocabulary learning develops rapidly.

The production of utterances also goes through a long process of automatization and refinement. Initially, infants' utterances can match the adult form quite closely. However, they go through a subsequent stage in which each child produces a wider range of words, most of which are reduced to a phonological 'template.' The nature of this template varies from child to child, though it always bears a phonological and segmental relationship to the particular language being learned. Children vary greatly in how accurately they can produce the phonology of their language and in how long it takes for this accuracy to develop. They may also differ early on in the extent to which they pick up on the major tunes of the language, as some children tend to produce shorter and more well-articulated utterances (for detailed summaries, see Lieven, 1997; Peters, 1997).

Some early words are highly context dependent – for example, Piaget's classic example of his daughter, Jacqueline who used *voua-ou* (wow-wow) to refer to everything that could be seen from the balcony – but it seems to be the case that children also produce relatively context-independent words from early on (e.g., *more* to request a number of items, not just food). Context dependence is similar to 'underextension' in which the child uses the word to refer to a limited set of referents. This contrasts with overextension where the word is used to refer to a wider group of referents than in the adult language (an example is the use of *Daddy* to refer to all men whom the child encounters). Much early word comprehension and production shows both characteristics and initially is not stable (see Clark, 2003).

One of the most striking aspects of very early speech is its phonological inaccuracy. Analysis makes it clear that the phonological errors that children produce are systematic. Individual children drop syllables or substitute a particular sound of their own for sounds in their language (for instance, *Puggle* for *Puddle*) while still being able to hear the difference between their own production repeated to them and the 'real' word. Children will not, in fact, accept a repetition of their version of a word as being the 'real' word. This phenomenon raises interesting issues for the relationship between comprehension and production. There is major theoretical debate, however, concerning how it should be analyzed. The debate is between a 'templatic approach,' which characterizes the process as the child assimilating words to a production template (Vihman, 1996) or an optimality theoretical approach that sees the child as seeking to resolve a set of constraints on production, such as 'faithfulness' (i.e., getting as close to the model as possible) and 'markedness' (Bernhardt and Stemberger, 1998).

A second issue is the extent to which children's communicative behavior in these early stages is already 'linguistic' in the sense of being conventionalized, context free, and combinatorial. Thus, researchers

have suggested that children's early communicative acts (e.g., showing as a precursor of declaratives and demanding as a precursor of imperatives) develop into 'protolinguistic' symbols; that is, each child uses a specific set of sounds and gestures to convey different meanings (Bates, 1976).

Learning a Vocabulary and Developing Meaning

After an often slow start, children's vocabulary grows exponentially, with new words being added at a rate of 9 to 10 words per day between the ages of 2 and 6. In industrialized and urbanized societies, children add about 3000 words per year for each year in school. Vocabulary size is related closely to the amount of Child-Directed Speech (CDS) in the early years and to various measures of family talk and schooling in the later years (Fenson *et al.*, 1994; Hart and Risley, 1995).

For children learning many languages, including English, nouns form the largest single category of words, but children also learn a wide range of words from other categories (e.g., *want, me, no, what*). The extent to which nouns predominate early on varies among children learning the same language and among children learning different languages. Young children, under certain pragmatic conditions, require only a minimal number of exposures to a novel noun and its referent to learn its meaning (called 'fast mapping'; Carey and Bartlett, 1978; Clark, 2003).

One issue concerns when children form categories of the words that they are learning. The answer to this depends, in part, on how a category is defined, but evidence suggests that a category of nouns develops relatively early in many languages; that English-speaking children can substitute the determiner *a* for *the* early (while taking many years to learn the full range of determiners and their scope); and that fully fledged categories of verb and adjective take more time to develop.

When children learn a new word, what meaning do they give it? It could be the meaning the word has in the language that they are learning or a meaning based on their cognitive categorizations of the world. For instance, children the world over might already have developed nonverbal categories of 'in-ness' and 'on-ness' during infancy, and when they learn words that express the relation between objects, they might initially match these words to these pre-existent categories. There has been considerable research on this issue, and it seems that this is not what happens. Instead, children seem to learn the word and its referent together. Thus, English-learning children use the prepositions *in* to refer to one object contained within another and *on* to refer to one object supported by another, irrespective of how tight the fit is between the objects. However, Korean-learning children use the verb *kkita* to refer to one object inside another only if the fit is tight (e.g., a cassette in a box) and for other tight fit relations between objects (e.g., one object stuck to another with Velcro). The verb *nehta* is used to refer to a loose fit, regardless of whether one object is inside another or on top of it. Children do under- and over-generalize, but they seem to do so along the lines of categorization indicated by their language (Bowerman and Choi, 2001).

How does a child know what someone is referring to when that person uses a word? In principle, the speaker could be referring to any part of the scene. This problem of reference was elucidated most clearly by the philosopher, Quine. The general answer is to suggest that children come to word learning with some already pre-given interpretative skills. One group of researchers has suggested that these skills are in the nature of innate constraints; for instance, the child initially assumes that a word applies to the whole object and that a novel word will not apply to an object for which the child already has a word (mutual exclusivity constraint; Markman *et al.*, 2003). Another group suggests that these skills derive from the pragmatics of the situation that the child already knows about. A series of experiments indicating that children pre-verbally know what is relevant to a situation and to the perspective of another and that, simply through using context, they can find the referent for a word they have never previously seen paired with the referent, suggest that the latter explanation is more likely to be correct (for this debate, see Clark, 2003; Tomasello, 2003).

Another major debate in the literature is over the status of nouns as the first category to be learned. Gentner (1982) has claimed that nouns are universally easier to learn and that they initiate the process of category learning. She argued that this occurs not only because the use of nouns tends to be very frequent in CDS but also because their reference is more transparent – to concrete, imageable objects – and children already have developed a considerable knowledge of objects and their behavior pre-verbally. In opposition to this theory, researchers have argued that children learn a range of words, not just nouns, from the beginning and that there are languages, such as Korean, in which the proportion of nouns in the lexicon does not exceed the proportion of verbs (more or less broadly defined). This issue has not been resolved: on the one hand, it *is* easier in many languages to learn many object words; on the other hand, children are also building up other categories of their language from the beginning. Developing categories

helps the child segment the other words they hear, and the relative growth of these categories depends on the characteristics of the language being learned and the way it is used in CDS.

Learning Grammar

Learning Morphology

Inflections change the grammatical meaning of words. Languages differ greatly in the amount and kind of inflectional morphology that they show. English has very little inflectional morphology (plural *–s* and past tense *–ed* are two examples). Free morphemes also mark grammatical meanings in languages. For instance, in English, *he* indicates the nominative masculine pronoun (subject argument), whereas *him* marks the accusative masculine pronoun (direct or indirect object argument). The English pronoun system shows irregularity: each pronoun in the English paradigm changes somewhat differently between nominative, accusative, and genitive (e.g., *he, him, his, we, us, our*). In addition, multiple meanings are encoded in one morpheme: number, case, and gender. Other languages encode meaning much more extensively and systematically with both inflectional and free morphemes. Inflections can mark either a local meaning (e.g., plural on a noun in English) or a relational meaning (e.g., plural on a verb to agree with the subject or object; a case marker on a noun as a function of its syntactic role). In either case, productive inflectional marking involves constituency: the ability to understand how plurality is marked on the whole noun phrase within the language being learned and how the noun phrase is coordinated with marking on the verb phrase. Thus, in some languages, determiners, adjectives, and nouns are all marked for plurality and/or case and/or gender, in others not; in some languages there is both subject and object marking on the verb and/or its auxiliaries and in others not.

Children may start by rote learning some frequent words together with their inflections while omitting nonsalient inflections (omission errors). Later, children may over-generalize and use incorrect forms (errors of commission). For instance, in English, children leave out tense markers (*It go there* for *It goes there*), over-regularize past tense marking (*goed* for *went*), and use incorrect forms (*I think her was crying for me*). In languages in which all words in a class carry an inflection, the child may initially use only one inflection and over-generalize it to all members of that class.

A central question is when children become productive with morphology. Researchers from different theoretical persuasions tend to interpret the data in predictably different ways. Those arguing for early, abstract knowledge point to the fact that children learning highly inflected languages produce words with inflectional marking from the beginning, usually accurately. Those who emphasize that the abstract representations underlying inflectional morphology are learned point to the potentially rote-learned nature of early inflectional marking and the limited range of items with which particular inflections are used.

There have been many different ways of defining productivity in naturalistic corpora: for instance, percentage provision in obligatory contexts, use of the same inflection on a number of members of the class, or use of different inflections on the same word. Inevitably, these measures yield different results, depending on how stringent the criteria are and how good the sampling is (Tomasello and Stahl, 2004). Methods are being developed that control for the range of forms in the child's lexicon and then compare the degree of productivity between the child's system at different developmental points and between the child's system and the adult's. For two children learning Spanish, a language with rich inflectional morphology on verbs, this method has shown that productivity develops even after the child can provide all the forms and that the children's range of inflectional provision on the same verbs as their parents, even when the range of inflections is controlled for, is still significantly different at age 2.6 (Aguado-Orea, 2004).

How quickly children learn the morphology of their language seems to depend on the following factors and the interaction among them: type frequency (how many different lexemes are inflected in the same way) and token frequency (the relative frequency of different surface forms) in the input; salience (can they be heard?); transparency of meaning (is the semantics accessible?); formal complexity (is one meaning or more encoded?); and the regularity and distributional consistency of the inflectional paradigm (see Slobin,1985; Peters, 1997 for summaries). In such languages as Turkish, in which suffixes are added in a consistent order and with consistent form to indicate local meaning (e.g., plural, location, possessive), children seem to be at least partially productive relatively early. Other languages present more difficulty – those in which the morphemes are: (1) portmanteau (more than one meaning is combined in one form; e.g., the nominative for 'water' in Russian is *vodá*; the dative plural form is *vodám*); (2) distributed (e.g., marked with a free form and an inflection, Serbo-Croatian locative markers); and/or (3) in complex and partial paradigms (e.g., Polish case endings).

One sure way to know that children have a productive system is to test for their ability to mark words that they have never heard before ('nonce' words). Otherwise, one can never know whether each word and its accompanying inflection have been learned from the input on a one-by-one basis. In Berko's classic 'wug test,' children are first introduced to a novel creature called *a wug*, and then another of these creatures is produced. The child is then asked, *Now we have two – ?* We know that children have productive plural morphology if they answer *wugs*.

This method can be extended to other word classes. For instance, experiments with novel verbs in English suggest that productive past tense morphology for verbs develops somewhat later than does plural morphology for nouns. Note that this is also a way of determining what type of category is represented in the child's system and its level of abstraction (for instance, action verbs only or all verbs or concrete nouns only or all nouns). Nonce experiments have not been conducted in many languages other than English, but their wider use would certainly help clarify some very complex issues in the learning of inflectional morphology. However, they are not easy to conduct with children younger than age 2, and children learning some languages may be partially productive before this age.

Because inflectional morphology can be extremely complex and children seem to demonstrate early sensitivity and productivity, it is often used as a testing ground for debates about whether children have very early abstract linguistic representations. An example is the extensive debate on past tense marking in English. Children start by producing a small number of forms (many of them irregular) and subsequently start to over-generalize the regular *–ed* marker to irregular verbs (e.g., '*runned*' rather than '*ran*'). Children concurrently use the correct form and may continue to over-regularize some forms for many years. Proponents of early abstract representations argue that, once children have learned the past tense rule, they seek to apply it to all new forms that they learn and stop doing so only when they learn the new irregular form that 'blocks' the application of the rule. This model is called the 'dual route model': one route for regulars and one for irregulars. The claim is that this learning occurs even in languages, unlike English, for which the rule is not the most frequent form (i.e., is a 'minority default' rule). Challenges to this position come from 'single-route models' that claim: (1) the developmental pattern of marking can be closely modeled in connectionist networks that have only one (not two) mechanisms (Plunkett and Juola, 1999); (2) these networks can also model the development of marking in languages in which the 'default' marking is not the most frequent; (3) detailed studies of children's marking in languages either with a 'default' (e.g., German plurals; Köpcke, 1998) or with no default (e.g., the Polish genitive; Dąbrowska, 2004) show a long process of development during which children over-generalize a variety of markers, depending on such factors as frequency and phonological similarity, before arriving at the adult system; and (4) the fact that over-generalizations continue for a long time after the child has learned the correct form does not suggest that there are two entirely separate processes involved (Maratsos, 2000).

As well as being a potential window on the nature of children's underlying syntactic abstractions, inflectional morphology can also provide a window on the development of children's underlying semantic representations. An example of this is the 'aspect before tense' debate. Here, the issue is whether children are initially sensitive only to the aspectual features of situations and their marking on verbs (e.g., punctual or durative events: *hit* vs. *singing)* or also to the temporal features (past vs. present events: *sit* vs. *sat*; Weist *et al.*, 2004). Because languages differ greatly in how these features are coded on verbs, cross-linguistic comparison of children's development has been essential in this debate. Methodological problems and the complexity and interrelatedness of the tense and aspect systems in different languages mean that we do not yet have a final answer to this issue.

Early Syntactic Development

Children's first utterances containing more than one word appear between 18 to 24 months of age. Almost all researchers agree that, in the early stages, some utterances are rote learned as a whole (e.g, *what's that?*), and others may be slot-and-frame patterns (e.g., *where's X gone?* or *more X*, where X denotes a range of referents). However, there is disagreement as to the extent of these low-scope patterns: what part they play, if any, in children's developing linguistic representations; and how utterances that are considered not to derive from them should be represented (Lieven *et al.*, 2003). For instance, when it is suggested that the child is using rules for the combination of underlying categories, the hypothesized categories can be very varied. One suggestion would be semantic categories; for instance 'agent' and 'action verb' to generate an utterance like *Lion swim*. However, a different researcher might analyze the same utterance in terms of syntactic relations, such as 'subject' and 'intransitive verb.' In the case of any particular utterance, these alternatives cannot be distinguished: A corpus of utterances (the larger, the more reliable) must be analyzed together with clear definitions of

productivity before it is possible to suggest whether the utterance is likely to have been generated productively and on the basis of what linguistic representations. As noted for morphology, naturalistic data never allow one to be completely certain that an utterance is productive.

Many of children's early utterances are missing features that are provided in adult speech: subjects are frequently omitted, as are function words (e.g., auxiliaries, complementizers, prepositions). Utterances often lack finiteness marking (e.g., no third person *–s* on main verbs in English; nonfinite for finite verbs in Dutch and German).

Children's utterances also reflect features of the input very closely. Thus, English-speaking children's early verbs are those that occur most frequently in the input, children mark verbs in accordance with the most frequent marking on those same verbs in the input, and they use verbs in the argument structures that their mothers use most frequently. In fact, whatever system one looks at, there are strong correlations with frequency in the input. This is not, however, the only factor affecting the child's use: as with phonology and semantics, complexity and salience also play a role, together with, most importantly, what the child wants to talk about.

None of these facts are in serious dispute in the literature; however, their interpretation certainly is. The major divide is between those who interpret them as indicating that the child has early abstract and, specifically, linguistic knowledge (for some researchers, innate) and those who argue that abstraction develops throughout the process of learning language. Clearly, even though children's utterances show a great deal of lexical specificity and partial marking, they could still reflect underlying abstract linguistic knowledge, limited by these four factors:

1. lexical learning of the forms of the language
2. learning the syntactic features particular to the language
3. processing constraints on production (e.g., a limit on the length of what the child can produce)
4. late biological maturation of some part of the system that underlies the abstraction.

Each of these factors is briefly considered below.

In addition, all theories need to account for the patterns of errors that children show. Those maintaining the existence of innate linguistic knowledge must answer this question: If children have innate grammar, why do they make errors that seem to reflect the lack of knowledge of fundamental linguistic systems, such as tense, agreement, and the provision of arguments? Those maintaining that abstractions are constructed must determine how the interaction between the child's current system and the input explains the pattern of errors.

In the case of (1) above, it is obvious that, whatever the underlying system, children have to learn the specific forms of their native language. The clear implication is that claims to underlying structure or the lack of it should not be made until it is established that the child is able to fully comprehend or produce the forms reflecting the hypothesized abstraction.

Within nativist linguistic approaches, one solution to the issue of how children use the hypothesized Universal Grammar (UG) to work out the syntactic particularities of their input language (2 above) is to suggest that they have to set a range of parameters as the result of hearing (a small number of) utterances. Within this literature, there are major debates on the number of parameters, whether or not they are initially set, and how many settings there can be (one, two, or more). An example is to hypothesize a 'head direction parameter' that determines how children identify the input language as being 'left' or 'right branching.' In principle, children then know how to order words across a range of phrasal structures (e.g., noun phrases, prepositional phrases, and verb phrases). Alternative constructivist accounts would suggest that children do this on the basis of the particular strings that they learn from the input, from which word-order patterns are subsequently abstracted in conjunction with the learning of word classes. This hypothesis would make it easier to account for the many instances of inconsistency of head direction in languages. The success of the Principles and Parameters approach in its own terms depends on the number of parameters being relatively small and on agreement among researchers as to how the specified settings can account for the range of relevant phenomena in language development (Fodor, 2001). At the present time, it is not clear that either of these conditions can be met.

In the case of processing constraints (3 above), there clearly are length constraints on what the child produces. Probably, the single most obvious aspect to the lay observer of children's developing language is that children's utterances get longer as they grow older. However, is this an output limitation imposed on a much fuller underlying abstract representation (Valian, 1991), or does it reflect what the child has actually learned up to this point? For instance, if children are processing the input by using already identified strings as the basis for building new strings, doing so would also yield increasingly long utterances over time (Elman *et al.*, 1997). In addition, the way in which patterns were added would mean that the distribution of marking would also change over

time. Research incorporating this type of learning mechanism has been successful at modeling children's patterns of finiteness marking not only in English but also in Dutch and Spanish (Gobet *et al.*, 2004).

An alternative linguistic nativist approach is to hypothesize that, although UG is innate, some parts of the system are on a later maturational timetable, which can account for some of the early error patterns shown by children (4 above). Two well-known accounts that use this approach are Borer and Wexler's attempt to explain the late use of full eventive passives by English-speaking children and Wexler's Agreement-Tense Omission Model (ATOM). In the first, the authors suggest that children are late with eventive passives because 'argument-linking chains' are a late biological maturation (Wexler, 2002). This theory cannot account for the fact that full passives emerge early in some languages (for instance in Sesotho; Demuth, 1992).

The ATOM model (of which the Optional Infinitive hypothesis for typically developing children and the Extended Optional Infinitive hypothesis for children with SLI are earlier versions; Wexler, 1998) predicts that, because pre-maturation children are subject to 'the unique checking constraint,' they will only be able to check either for tense or for agreement. This constraint is intended to account for patterns of incorrect finiteness marking found in young children's speech across a range of languages. One aspect of this model concerns agreement marking. Because, in the model, children can only check for either tense or agreement, a pattern of errors is predicted that, in English, sometimes results in non-nominative pronouns appearing in subject position (e.g., *me* for *I* errors or *her* for *she* errors). The only error predicted *not* to occur at levels greater than noise is the use of a non-nominative pronoun (e.g., *me, him, her, them*) with a finite verb that agrees with the subject (e.g., *Me am going, Her wants that*), because this would result from both tense and agreement having been checked. However, Pine *et al.* (2005) have shown that if agreement rates are broken down by the specific pronoun, errors with *her* in subject position and an agreeing verb occur too often to be disregarded as noise. One implication of this analysis is that it is important to analyze errors in terms of the particular form, rather than to sum across a category defined by the adult system, because the child's system may not be operating at this level of abstraction.

The other main theoretical approach to children's syntactic development argues that grammatical abstraction emerges from interaction between the input and innate learning mechanisms and that these are *not* restricted to the domain of syntax. Constructivist approaches maintain that children start by learning low-scope constructions based around specific words or morphemes. These constructions become more complex, and abstractions (for instance, of tense, agreement, subject, and transitive) build up. Initially, a child may have no understanding of the internal structure of a construction (e.g., *what's that?*), but uses it as a whole with a specific meaning. As development proceeds, functional distributional analysis based on the relation between a form and (child-identified) functions leads to representations of constructions developing internal structure. Patterns of relationships build up between constructions and their parts, in a process of increasing complexity and schematization (Table 1).

One critical aspect of this theory is that, once a slot develops in a construction, it will be paired with a meaning: thus, a 'noun phrase' slot always denotes a referent. In time, the child will learn to refer in increasingly complex ways; for instance, in English with a range of determiners and adjectives. Constituency thus develops hand in hand with the function of the constituent in the construction and becomes increasingly schematic (Dąbrowska, 2004).

Tomasello (2003) provided the most comprehensive statement of this position to date. He suggested that, rather than having to postulate innate syntactic categories or linking rules, it is possible to account for the development of abstract categories and constructions on the basis of general communicative and cognitive processes, such as intention reading, analogy making, and distributional analysis. The critical aspect of this approach is that utterances have meanings as a whole and that, for children to be able to work out

Table 1 Examples of different types of constructions and their meanings

Form	*Meaning*	*Level of abstraction*
What's that?	Requesting a name	Rote-learned
It's a <Noun>[1]	Naming <referent>	Slot-and-frame
Double object construction: <Noun> <Verb> <Noun> <Noun> *Mary gave John the ball*	Agent-Verb of transfer-Recipient-Transferred Object	Schematic

[1]<> denotes an open slot.

what role a word or inflection is playing in an utterance, they have to know, first, what the whole utterance means and then, in a process that Tomasello calls 'blame assignment,' identify the part of the meaning for which the particular form is responsible. In this approach, abstract constructions develop through analogies based on semantic similarity between the meanings of different item-based constructions; for instance, *A hits B*, *X loves Y*, *C pushes D* may give rise to the transitive construction and its syntactic roles.

Tomasello's (1992) 'verb island hypothesis' was an early example of such an approach. He claimed that children initially build up constructions around individual verbs, rather than having more general and abstract categories, such as subject, direct object, and transitive verb, from the beginning. Thus, a child who knows the verb *hit* may have a slot before the verb for the 'hitter' and one after for the 'hittee' without having the abstract representation of a transitive construction. A wide range of production experiments that test English-speaking children's ability to use novel verbs in transitive constructions supports this claim (see Tomasello, 2003). Although most children aged just over 2 years old are already using verbs they know in some two-argument constructions, the ability to demonstrate this knowledge with a verb they have never heard before develops between the ages of 2 and 3 and can be affected strongly by the experimental method employed.

The verb island hypothesis has been challenged by studies using the preferential looking paradigm. They suggest that children can discriminate between a transitive utterance that matches a scene they are looking at and one in which the argument roles are reversed at younger ages than those shown for success in production experiments. Some researchers have suggested that this indicates that children are innately equipped either with a notion of subject or with rules that link the notion of agent to subject. However, it seems difficult to argue for an innate notion of subject, because subject is not a universally identical category across languages (Croft, 2001).

Other researchers, less contentiously, suggest that children are already sensitive to the number of arguments in an utterance and their relationship to a causative scene with two actors and that this allows them to make the preferential-looking discrimination (see the debate involving Fisher and Abbot-Smith and Tomasello in *Cognition*, following Tomasello's (2000) article). Because children are sensitive pre-verbally to causation and many already know how to name people and objects by the time they take part in preferential-looking studies, this finding seems plausible – particularly because there seems to be a correlation between the child's vocabulary level and success in these tasks.

Children's avoidance of using ungrammatical transitives and intransitives in production experiments also suggests earlier sensitivity to some aspects of verb argument structure. In addition, experiments show that English-speaking children manage to use the transitive construction with a novel verb somewhat earlier when case-marked pronouns, rather than nouns, are used as arguments. It may be that languages, such as German, with relatively clear case-marking of argument roles, also assist children in schematizing these roles somewhat earlier. Pine *et al.* (1998) have argued for patterns building up not only around verbs but also around other high-frequency markers, such as *I* + *Verb* or *Verb* + *it*. Thus, the child, as well as building up a 'transitive verb' category, would, at the same time, be learning that *I* and other frequent referents in first position can be in a range of semantic roles in relation to the verb. Childers and Tomasello found supporting evidence for this suggestion (see Tomasello, 2003). Thus, more recent constructivist accounts suggest that the abstract transitive construction builds up from a number of different sources: pre-verbal knowledge of causality, the ability to match arguments in an utterance to referents in the environment, the development of other lexically specific constructions around pronouns, and high-frequency items. The combination of these factors may result in the child being able to perform correctly in some tasks using less fully specified representations than would be required for others (e.g., using a novel verb that has never been heard before in a transitive construction).

From a constructivist perspective, there is initially no necessary relation in the child's system between one construction and another; for instance, between a declarative and a *wh*-question that would be related in the adult system as would be maintained in any analysis based on one or other generativist theory of island constraints (e.g., movement, gaps or checking). However, such relationships do develop. This can be seen from children's increasing conversational flexibility as they question previously mentioned constituents, manipulate topic and focus, and, in English, expand contracted auxiliaries, insert DO-support when rephrasing a previous utterance, and so on. Many experimental studies also show that children become increasingly able to hear a nonce form in one construction (for instance, an active) and to transform it into another (a passive). For linguistic nativists, this should be a relatively automatic outcome of children's abstract linguistic representations.

However, within constructivist approaches, these relations are seen as being learned. This learning

occurs in part through the identification of the same meaning-based categories in different constructions and in part through relating the overall meanings of constructions to each other. For instance, the simple active statement, *I want a banana,* communicates something different from the cleft: *It's a banana I want*. Children's over-generalizations of constructions are explained relatively easily within this framework: For instance, when a child says *Don't giggle me* (meaning *Don't make me giggle*), she has analogized *giggle* as having causative meaning and therefore placed it into a causative transitive construction. There are, however, considerable problems both for linguistic nativists and construction-based accounts in explaining how children cut back from such over-generalizations (Bowerman, 1996; Tomasello, 2003).

Later Syntactic Development

As children's language develops, major changes occur at both clausal and sentential levels. Noun phrases and verb phrases increase in complexity: for instance, although English-speaking children use *a* and *the* early on, it may take many years before they can operate with more complex determiners and their scope (*some*, *every,* and *each*). Likewise, children may be able to use some auxiliaries (e.g., *I'm X-ing*, *Can I Y?*) and verb complement structures (e.g., *I want to play out*) from early on, but the full development of complex verb phrases takes considerable time. At the sentential level, although English-speaking children produce many questions between the ages of 2 and 3, initially most of these are with contracted copulas (*What's that?*, *Where's X?*) or contracted auxiliaries (*What's Mummy X-ing?*, *Where's Y gone?*). Some questions with subject-auxiliary inversion (*Can I X?*, *Are you Y-ing?*) also start appearing during this period, but it is not until approaching age 3 and older that children start to show considerable flexibility in the range of subjects, auxiliaries, and *wh*-words that they can use in inverted *yes/no-* and *wh-* questions. Clause coordination and subordination (e.g., complement structures, causatives, relative clauses) also develop over a considerable time period – both when these structures start to appear and when they increase in internal complexity.

In principle, it is rather difficult for linguistic nativist theories to explain this slow and somewhat patchy development of complex syntax and the accompanying errors that children make. Once the lexical forms are learned, why should children make uninversion errors (*Where she is going?*) or find some embedded relatives easier than others? Linguistic nativist explanations of children's later syntactic development all start from the claim that children could not learn the abstract basis of these constructions because the constituents involved could not be abstracted from a surface analysis of the input. Errors are accounted for in two ways: (1) they arise from the particularities of the language being learned and not from the absence of the abstract representations of Universal Grammar; or (2) children have full competence and errors arise from faulty methodologies (see O'Grady, 1997, for a detailed coverage of explanations from within a broadly UG framework). In constructivist accounts, complex constructions, such as *wh*-questions or relative clauses, begin as item-based or with simpler structures that then build toward greater complexity and schematicity (Tomasello, 2003).

Uninversion errors in English-speaking children's *wh*-questions have given rise to several different linguistic nativist accounts. For example, de Villiers has proposed that questioning arguments is easier than questioning adjuncts. An alternative account, related to the particularities of English (Santelmann *et al.,* 2002), suggested that the errors in children's inversion are explained by the fact that only main verb BE can invert (unlike in German where all main verbs can invert in questions) and DO-support is also unique. Recent constructivist accounts have explained inversion errors in terms of the relative frequency of *wh* + auxiliary combinations in the input. Thus, Rowland and Pine (2000) suggested that children are learning correct inversion from high-frequency combinations of a *wh*-word plus a specific form of the auxiliary and that uninversion errors occur when they have not yet learned the correct combination and produce a 'groping pattern' by putting together a known *wh*-word and a known declarative.

However, the overriding argument, from the linguistic nativist position, against the possibility of learning syntax is that children can deal with complex constructions that could not have been learned from the input. An example is extraction from embedded clauses in *wh*-questions: *Who do you think John likes?* In UG accounts (see, for instance, Crain and Thornton, 1998; Drozd, 2004), children operate with abstract formalisms that relate the object of the embedded clause first to the object of *you think* and from there to the position at the front of the sentence. These formalisms could not, it is argued, be learned from the sequential probabilities of strings on the surface of the input; in addition, the structures are rare to nonexistent in the input and therefore could not be learned as a whole. Whether this latter point is the case awaits much denser sampling of the input, but it should be noted that this type of extraction is not possible in German and that a much wider range of extraction occurs in Italian. This considerable cross-linguistic variation therefore requires, in UG

terms, a complex parametric account and, from the point of view of the language learner, close attention to the particularities of the language.

From a constructivist point of view, children solve these tasks by building up their knowledge of constituency and using already established form-meaning mappings to identify potential constituents in novel constructions. Thus, although children may not have had previous experience with the type of sentence in the Crain and Thornton experiments, they will already know constructions that identify the matrix *wh*-clause as a constituent asking for an act of reference, thus allowing them to attempt to identify the referent of the embedded relative. For instance, English-speaking children's early relative clauses tend not to be restricted (i.e., adding more information about a referent: *The cow that the dog bit ran away*), but presentational (i.e., introducing a topic: *That's the cow that goes there*). Presentational relatives do not involve embedding one clause within another; the main clause is usually a copula (one of the earliest constructions that English-speaking children learn), and the relative clause is not presupposed information but contains the new information to be conveyed. Diessel and Tomasello suggested that all these factors make these constructions easier to produce and also make them the basis for the development of more complex relative clause structures. Diessel (2003) has similar accounts for the development of a number of other constructions in English-speaking children's development. The idea that already existing constituents can be used to work out the meaning of a novel construction is supported by a modeling study (Morris *et al.,* 2000) in which a connectionist network was shown to generalize correctly to previously unlearned constructions on the basis of having learned a variety of simpler constructions.

Developing Pragmatic and Metalinguistic Skills

Children are immersed in communicative interaction with others from infancy, but there are many aspects that take years to develop. Coordinating reference across speaker and listener roles involves manipulating and understanding given and new information, deictic and anaphoric pronouns, temporal information, and so on. In most of the cultures studied, these skills develop initially in conversations with others, and children's attempts to narrate sequences of events start to develop slightly later. Both conversation and narrative require the ability to ground utterances and to refer to referents in ways that require complex cognitive, communicative, and linguistic skills. Children also have to learn to adjust their speech to the genre of the task (conversation, personal narrative, reporting, arguing) and to fit the social context in which they are communicating (for instance, levels of politeness and formality; Slobin *et al.,* 1996).

Conversation

Early conversations with young children typically show a great deal of scaffolding. Thus, background and setting and the identification of referents are provided by the child's interlocutor. Around the age of 2, children are more fluent participants when the conversation is highly 'scripted' around routine activities and when they can join in a multiparty conversation at moments that they choose. Between the ages of 2.6 to 3.0, the first, more subtle, discourse particles start to be used (for instance, in English, *now* and *just*), but their range and presence continue developing up to and beyond the school years. Topic continuity in terms of responding to questions and maintaining the topic over a number of turns also improves radically between the ages of 2 and 4. Clarification requests by children and children's responses to them show clear development as well: Children respond to clarification requests with more nuanced answers as they get older, and they also make more of them, though even at the age of 7, children in a referential communication task do not make clarification requests either as much or in as focused a way as is required by the task (Lloyd, 1991, cited in Tomasello, 2003). Children's rhetorical skills develop throughout the school years, with the ability to bring arguments to bear, to return to a conversational topic, and to introduce new topics in an appropriate way all taking many years to perfect.

Narrative

Children's early narratives tend to be a set of short utterances with no attempt at cohesion among them. For a child to be able to narrate an event to another who was not present requires taking into account the hearer's lack of knowledge of the timing of the event, its sequence, and the participants. This is a complex task in itself, and children also have to learn to coordinate sequences of utterances to keep track of referents and events such that, for instance, already referred-to participants are referred to in one way, and novel ones in another. Two major summaries of studies that have looked at the development of these skills within and across cultures and languages are Berman and Slobin (1994) and Hickmann (2003).

Once children start being able to produce some coordination between utterances in a narrative, they often use very repetitive devices: for instance, maintaining reference to the same referent as thematic

subject throughout the story (e.g., using *He* at the beginning of every utterance) or using *and then* at the beginning of every utterance to coordinate the action. Clearly, the development of narrative abilities is based on the development of a range of skills: Children must be able to take into account the perspective of the listener in terms of what the listener does and does not know. They must also know the linguistic devices of the language that coordinate clauses within utterances (e.g., temporal sequencing, subordination) and across utterances (e.g., the use of pronouns for anaphoric reference), and they must know how their language encodes perspectives; for instance, in English, manner of motion tends to be encoded in the verb, whereas in Spanish it tends to be encoded in adverbials.

Metalinguistic Skills

Children gradually become able to consciously reflect on language, to correct their own and others' utterances, and to notice features of language at all levels: Rhyming relationships, the explanation of metaphors and idioms, and grammaticality judgments. Karmiloff-Smith (1994) has incorporated language development and metalinguistic awareness into her general theory of the development of cognitive skills. In this approach, the early period of language learning is concerned with skill automatization: children have to learn the forms of the language and to use them relatively effortlessly. Once language becomes relatively fluent and automatic, it can become an object of reflection.

Karmiloff-Smith also discussed children's increasing awareness of the plurifunctionality of forms. She sees metacognition as going through several stages in which initially awareness is implicit and only later, as a result of 'representational redescription,' does it become available to conscious reflection.

For many children, the process of moving to conscious awareness of the forms of language and how they fit together is almost certainly aided by learning to read and write (Ravid and Tolchinsky, 2002). Miller and Weinert (1998) give a detailed cross-linguistic account of the ways in which oral and written language vary and the implications of this variation for theories of linguistic competence. For instance, they argue that many of the structures that linguists are concerned with can only be found in written texts and thus that children only learn them during the school years. Competence is, therefore, still developing, rather than being either innate or language development being 'all over by 3.0.' How rapidly these skills develop and how far children get with them are related to the complexity of the language that they hear at home and at school and to levels of literacy (Hart & Risley, 1995; Huttenlocher *et al.*, 2002).

Clearly, literacy cannot be the only way in which speakers become aware of language as an object of reflection. Pre-literate children already show some metacognitive awareness of aspects of language as indicated by Karmiloff-Smith; for instance, they can sometimes correct ungrammatical utterances in naturalistic and experimental situations. There must be many aspects of oral interactions that also afford this ability; for instance, argumentation, speech making, traditions of oral narrative, and the learning of complex ritual language are all likely to be media through which speakers and listeners come to be able to reflect on linguistic structure and its meaning. The important point is that these genres may contain much more complex language than children are likely to learn early on. Thus, language competence, often in the structures in which linguists are most interested, continues to develop over many years.

Atypical Development

Some children grow up in situations that are radically different from those in which typically developing children learn an oral language. The study of these children's atypical development often throws light on the processes involved in language learning and their inter-relationships, though caution should be exercised because one has to see the child and his or her situation as a whole. It is therefore impossible to treat these cases as controlled experiments in which only one variable is changed.

First, from the study of children who grow up from birth in a home where the language used is one of the sign languages of the world, it is clear that these children go through the normal stages of language development on the same timetable as children learning oral languages. Sign languages differ from oral languages not only in the obvious dimension of the medium but also, as a result, in the degree of simultaneity of signs and in the ways in which the face and hands are used grammatically and suprasegmentally. Thus, comparisons between the ways in which children learn the morphology, syntax, and pragmatics of oral and sign language can be extremely illuminating.

There are two groups of children whose nontypical development has been of particular interest to the study of language development: children whose language seems relatively poor by comparison with their nonverbal cognitive levels (children with SLI) and children with Williams's syndrome, whose language seems relatively advanced compared to their very low level of nonverbal cognitive development. Researchers coming from a more linguistic nativist background have claimed that these two syndromes

are evidence for an innate basis to grammatical development (compromised in SLI, preserved in Williams's syndrome) that is separate from more general cognitive development. In the case of SLI, the issue is the nature of the biological compromise. Most children with SLI have a range of problems with language, some of which may be more typical earlier and some later. Articulatory and phonological problems, together with delayed inflectional marking, are typical early problems that often resolve, leaving apparent grammar-only problems later on. There is certainly no agreement in the field that the pattern of impairment in SLI children indicates the presence of an innate module for syntax (Leonard, 1998), though some have made claims to this effect (Rice and Wexler, 1996).

In the case of Williams's syndrome, it is clear that these children also suffer from a wide range of problems with language and that none of them ever reach the language levels of age-matched, typically developing controls. Karmiloff-Smith *et al.* (2003) emphasized a developmental model for these children that suggests that, although language development is atypical from the outset, the problems that children demonstrate change with development and depend on the strategies for producing language that they have developed at earlier stages in the absence of the processes available to typically developing children. Here, too, then, there seems no clear evidence for a specific innate module for syntax.

Learnability and Constituency

The field of language acquisition has been dominated until recently by the so-called learnability issue; namely, that children cannot learn correct syntax from only positive evidence (the so-called poverty of the stimulus argument). Chomsky's various versions of a postulated innate Universal Grammar were attempts to provide these constraints, and the various nativist proposals outlined above aimed to show how these constraints explain different aspects of language development.

Several solutions have been proposed, all of which involve changing the premises of the learnability problem in one way or the other, usually to make the generation of sentences in the language probabilistic, rather than all or nothing (see MacWhinney, 2004 and commentaries). Although the leap from the higher reaches of statistical theory to the details of children's language development is rather large, this solution actually accords quite well both with constructivist approaches to language learning that emphasize the learning of the distributional probabilities in the input and to various attempts to model computationally how distributional probabilities might lead to phrasal learning (Elman *et al.*, 1997). Despite not incorporating any model of semantics, these attempts have been quite successful at detecting distributional regularities in the target language that could form one basis for the establishment of categories and of syntagmatic learning (however, see Chang, 2002).

However, language learning must go beyond the mere learning of immediately sequential probabilities between words. Simply calculating the transitional probability between one word and the next will ignore constituency and produce ungrammatical sentences. This was the basis for Chomsky's 1957 attack on the behaviorist theory of language development. Sentences involve constituents; the subject noun phrase, however long it is, agrees with the main verb, regardless of how many subordinate clauses occur in between; the relationship between an inverted question and its declarative version involves the relationship between the *wh*-word and the whole questioned constituent, independent of the length of the constituent or what occurs between it and the main verb. Thus in *The boy wearing a green hat who I saw yesterday in the park is very nice*, the subject NP (*The boy*) must agree with the main verb (*is*). The relationship between *Is the boy who is wearing a green hat nice?* and *The boy who is wearing a green hat is nice* is that the first *Is* in the question parallels the second *is* in the declarative; otherwise, we would have *Is the boy who wearing a green hat is nice?*

From a constructivist point of view, the crucial extra ingredient is that children are intention readers and meaning makers and that they learn about constituency by building up increasingly complex paradigmatic slots that connect form to meaning. Thus, a child who has heard and used literally hundreds of thousands of copula sentences of the form – *The boy's nice*; *The bus is red*; *They're the ones I want; They are really really good*; *The ones over there are the ones I want*; *The boy wearing a green hat is nice* – will know that *the boy wearing a green hat* refers to a particular object or person. This learned structural knowledge of constituency is then used to parse and produce the more complex embedded structures (see Lewis and Elman, 2001, for an attempt to model the learning of distance dependencies and constituency).

Conclusion

Humans have developed language and it has a biological basis. Yet, precisely what this basis is (or, more likely, bases are) still needs a great deal of precise specification. For instance, localization of language in the brains of adults is much more determined

than it is in children: Children who have early damage to the areas of the brain that subsume language in adults can learn language to normal levels and will have language represented in other parts of the brain as adults. Thus, it seems that language modularity, and the relative independence of syntax and semantics that characterizes the results of some experiments with adults, may be an outcome of development, rather than being pre-given. Chomsky's insistence on a separation between syntax and meaning, as well as the claim that syntax is essentially unlearnable and therefore that there must be an innate module for grammar, has ultimately had a negative impact on the scientific study of how children learn to talk. However, many of the issues raised by researchers working within this tradition, especially with regard to the development of more complex syntax, present challenges that have not yet been met fully by those who suggest that, whatever else is innate, syntax is learned through the application of general cognitive skills to the communicative tasks set for children by those around them.

Both positions face a number of challenges. In both, there is a need for greater specification of the processes involved so that proposals can be tested empirically. The challenge to linguistic nativists is to specify in advance the postulated performance limitations and late maturing processes precisely enough so that, rather than invoking them on an *ad hoc* basis to deal with counter-evidence, they can be used to make falsifiable predictions. In addition, these accounts often lack any notion of development: how does what a child is doing at one stage affect what happens next? Finally, because there are input effects at all levels of language acquisition, such theories tend to under-theorize the role of the input, not just in the quantity required by the child but also in the ways in which its precise characteristics are reflected in the child's system and how this interacts with any hypothesized innate knowledge.

The challenge to constructivists is to specify more precisely the ways in which the cognitive and communicative development of the child and the distributional information in the input interact to generate the patterns of learning and of errors and to test this with a wider range of languages and a wider range of input densities and conditions. There is a long way to go, even in the study of English language learning, to say nothing of other languages, in specifying the precise ways in which children expand their inventory of constructions and how they become increasingly schematic.

Children are creative communicators from the start. The question is the basis of this creativity, its scope, and how it develops.

See also: Bilingual Language Development: Early Years; Brown, Roger William (b. 1925); Bruner, Jerome (b. 1916); CHILDES Database; Chomsky, Noam (b. 1928); Cognitive Linguistics; Constituent Structure; Corpus Linguistics; Developmental Relationship between Language and Cognition; Discourse, Narrative and Pragmatic Development; Formal Models and Language Acquisition; Human Language Processing: Connectionist Models; Infancy: Sensitivity to Linguistic Form; Innate Knowledge; Langacker, Ronald (b. 1942); Language Acquisition Research Methods; Language Development in Blind Children; Language Development in Deaf Children with Hearing Parents; Language Development in School-Age Children, Adolescents, and Adults; Language Development: Morphology; Long-Distance Dependencies; Meaning: Development; Modularity of Mind and Language; Oral Traditions and Spoken Discourse; Phonological Awareness and Literacy; Pragmatics: Optimality Theory; Principles and Parameters Framework of Generative Grammar; Productivity; Quine, Willard van Orman (1908–2000); Relative Clauses; Sign Language: Acquisition; Slobin, Dan Isaac (b. 1939); Social-Cognitive Basis of Language Development; Specific Language Impairment; Syntactic Development; Syntax-Pragmatics Interface: Overview; Variation in First Language Acquisition; Williams Syndrome.

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Language Development: Pre-scientific Studies

R N Campbell, University of Stirling, Stirling, UK

The scientific study of language development may be characterized as involving collection of dated observations linked to general development; the systematic study of such collections by means of type and token counts, tabulation, and so forth; and the development of explanatory accounts grounded in such collections. By the beginning of the 20th century, this sort of apparatus was well established, and works in book form such as Major (1906) and Stern and Stern (1907) presented what are undeniably scientific treatments. However, the foundation of the journal *Pedagogical Seminary* by G. Stanley Hall at Clark University in 1891 provides a more accurate boundary mark: from its foundation onward, the journal featured systematic accounts of aspects of language development.

Early Studies

Reported empirical investigation of language development can probably be dated from the Mughal Akbar the Great's isolation experiment (c. 1578) in which a large number of children were isolated at birth in his palace at Fatehpur Sikri for a period of four years and cared for by unspeaking nurses. According to the three contemporary reports of this experiment, the children did not speak, but may have vocalized. The most explicit account is given in the *Akbarnama*, a life of Akbar prepared by his minister, Sheikh Abu'l Fazl, in the form of an exquisitely illuminated manuscript. Three such manuscripts were produced in the royal workshops. One is located in the Victoria & Albert Museum in London; a second is split between the Chester Beatty Library, Dublin and the British Library; the third is dispersed, with many folios held privately. For printed versions, see Blochmann (1877–86) and Beveridge (1902–1939), who reports the outcome as: "No cry came from that house of silence, nor was any speech heard there. In spite of their four years they had no part of the talisman of speech, and nothing came out except the noise of the dumb." Similar experiments are said to have been carried out at earlier times by the Egyptian Pharaoh Psamtik I in the 7th century B.C., by Emperor Frederick II of Sicily in the 13th century, and by King James IV of Scotland in the late 15th century. However, there are good reasons to doubt the authenticity of all three. For reviews of these early experiments, see Tylor (1878: 79–81), Campbell and Grieve (1982), and Bonvillian *et al.* (1997). It is perhaps remarkable that the first attempt to study language