6

Input and the Acquisition of Language: Three Questions

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What is the role of input in the language acquisition process? Obviously, infants spoken to in a given language reliably become children who speak that language, demonstrating in a general way that input must affect language development. But questions concerning the role of input go beyond this obvious level and lie ultimately at the heart of the language acquisition process itself. Three central questions are: (1) What is the nature of the input, and what information about the grammar can the child extract from it? (2) Does input control either the sequence in which or the speed with which children construct the grammar? (3) Is the input alone sufficient to explain the child's construction of the grammar, or do other factors contribute to the process of acquisition; if so, how do these interact with the input? The aim of this chapter is to review the theoretical positions on these questions and to examine the available evidence. We focus on the role of input in the acquisition of language structure, the subject of the most long-standing and vigorous debates.

Q1: What is the nature of the input, and what information about the grammar can the child extract from it?

Theories of the role of input

The nativist view: Input plays a minor role. One of the staunchest positions on the input is that taken by many nativists. In response to the three questions above they have argued (1) that the input to the child is an inadequate database from which to induce language structure, (2) that children need relatively little exposure to the input to induce the structure of the language, and input has little to do with sequence or speed of acquisition, and (3) that children must be attributed with innate linguistic knowledge for them to be able to construct language.

The nativist position is grounded in Chomsky's (e.g., 1965, 1968, 1975) description of language as a system of marvelous complexity, his assertion that a description of that system is a description of linguistic knowledge represented in the human mind, and the corollary assertion that studying the acquisition of language is thus to study how the language-specific system "flowers" from that knowledge. With this, Chomsky also claimed that children acquire language "on relatively slight exposure and without specific training" (Chomsky, 1975, p. 4). Furthermore, he argued, the input could not be very important because it is an inadequate database from which to induce language structure. This "poverty of the stimulus" assertion has two component claims: (1) that the speech children hear is full of errors, and (2) that any set of sentences in a language is, in principle, inadequate as a database because the underlying structure of language is not fully revealed in surface structures of sentences. Chomsky also asserted that general-purpose learning mechanisms operating on input alone would be insufficient to construct the grammar of any language. These claims that the knowledge acquired is complex, that the available data are insufficient, and that the learning mechanisms are inadequate together have been termed "the logical problem of language acquisition" (Baker & McCarthy, 1981). The nativist solution to this problem has been to attribute innate linguistic knowledge of the universal properties of language to the child. That universal knowledge is then said to guide the child in constructing the language-particular instantiation of those universals from the input (see also Lidz, this volume).

Since the original formulation of this problem, proposals concerning exactly what is innate and how children manage to learn the particulars of the language they hear have been refined (see, e.g., Crain & Thornton, 1998; Pinker, 1994; discussions in MacWhinney, 2004, and Sabbagh & Gelman, 2000, and commentaries). Among the proposals is the parameter setting model of acquisition (e.g., Hyams, 1986; Roeper & Williams, 1987), which attributes complex sets of parameters to the innate endowment of the child. Each parameter may give the child a choice of two or three "settings," and the child's job as an acquirer of the language is to determine from the input which setting fits the language s/he is hearing. (For example, the "*pro*-drop" parameter specifies that a language can have either obligatory overt subjects, like English (*he was walking*), or optional overt subjects, like Spanish (*_caminaba*).) Determining the correct parameter setting might be complicated because it may involve several correlated features of the grammar. (For example, whether or not a language allows *pro*-drop is correlated with whether that language allows expletive subjects (as in *it is raining*), or has "real" auxiliaries (*may*, *can*), without person, tense, and number marking; see Hyams, 1987.) Critically, the theory explicitly holds that the innate parameters are designed in such a way that the child can set each parameter on the basis of very minimal information in the input, according to a "subset principle" (Berwick, 1985; Wexler & Manzini, 1987; but see Atkinson, 2001; Lust, 1999). The role of the input is simply to act as a "trigger" for setting parameters. This view has engendered many debates and proposed alternatives (see Goodluck, this volume; Drozd, 2004; Sabbagh & Gelman, 2000; and commentaries for recent discussions).

It may even be possible, under the nativist position, to acquire language in the absence of input. Nativists point to the development of fully complex creoles from grammatically simpler pidgins as children acquire pidgins as their native language (see, e.g., Bickerton's (1981, 1984) bioprogram hypothesis). A recent case in point is the development of the Idioma de Señas Nicaragüense/Nicaraguan Sign Language (ISN). Kegl and colleagues have documented the rise of ISN from the 1970s, when a Nicaraguan school for the deaf was opened (Kegl, 2002, 2004; Kegl, Senghas, & Coppola, 1999; Senghas, Kita, & Özyürek, 2004). This new full language grew out of disparate – and very basic – "home sign" and gesturing systems used in individual families before the families' coming together in the school. Proponents of the nativist position argue that the complexification of the gesturing systems into ISN occurred within a single generation and was possible because the children learning the sign system as their native language contributed aspects of their innate linguistic knowledge to develop a more abstract, more complex system. Some have counter-argued, however, that the creolization process does not reflect the contribution of Universal Grammar to pidgins but inter-borrowing of linguistic patterns from the native languages of the adults into the creoles children create (e.g., Goodman, 1985; Maratsos, 1984; Lightfoot, 1984). Furthermore, the complexification process in the case of both oral creoles and ISN may be a result of shortcuts typical of grammaticization (Slobin, 1997), which is also not necessarily dependent on innate knowledge. It is of note as well that the development of ISN occurred over more than one generation (Senghas & Coppola, 2001), which one might argue is counter to the expectation if the complexification arose out of the individual children's access to Universal Grammar.

Alternative views: Input plays a major role. The nativist position has been challenged on a number of general grounds. Alternative linguistic theories have challenged the Chomskyan position on the nature of adult grammar. Cognitive and functionalist theories ground language structure in general properties of human cognition and in the communicative functions of language (Culicover & Jackendoff, 2005; Foley & Van Valin, 1984; Tomasello, 1995, 2003). Theories of acquisition based on these descriptions of the grammar argue that children achieve grammar via its basis in communicative function (Bates & MacWhinney, 1989; Budwig, 1995). Construction grammars (Croft, 2001; Goldberg, 1995) posit that grammars consist of networks of constructions, based to a degree on meaning and existing at multiple levels of concreteness and abstraction. Language, in these alternative views, is not less complex, but it is less abstract than in the Chomskyan descriptions. In addition, universals of language are posited to lie not in innate linguistic structures, but in universal cognitive structures and universals of the human condition (Croft, 2001; Tomasello, 1995, 2003). Under these theories, language acquisition is more plausibly achievable without innate language-specific knowledge. The less abstract constructs posited make language more accessible through the input, and the child's task can be taken as one of induction from the input (MacWhinney, 2004).

Other challenges to Chomskyan nativism have focused more directly on the role of input and have argued against the claims that input is deficient and that children rely only minimally on input to construct a grammar. This work is of two sorts: (1) illustrations that the input is more well-formed and revealing of linguistic structure than nativists had argued, and (2) evidence that patterns in the input are associated with patterns in children's developing language, suggesting that language acquisition makes direct use of distributional patterns in the input. We will examine these in turn.

Descriptions of the input

Motherese. In response to the claim that input is deficient, early research first took a closer look at the nature of the input. The initial work asked whether, in fact, input to children is errorful and therefore a deficient database from which to derive the regularities of language. The clear finding was that, when talking to children, adults produce speech that is slow and highly grammatical and that has a higher pitch and broader pitch range than speech among adults (Fernald et al., 1989; see Gerken, 1994). Furthermore, adults adjust the complexity of their speech, at least grossly, to the child's level of comprehension (Snow & Ferguson, 1977). Beyond simplifying their speech, adults also tend to follow the child's attentional focus, produce multiple utterances on the same topic, ask questions, and provide contingent replies; these may have their own consequences for language learning beyond those posited as contingent on the simplification processes. This special register for talking to children was dubbed "motherese" (Newport, Gleitman, & Gleitman, 1977). Subsequent work revealed that the high pitch and exaggerated intonation contour of motherese made it especially interesting to infants (Cooper & Aslin, 1994; Fernald, 1985). One hypothesis was that the correspondence between intonation contour and grammatical structure might make this special register helpful to children's learning of language structure; this was supported by the finding that infants preferred to listen to exaggerated contours that corresponded to phrase boundaries over equally varied patterns that did not (Hirsh-Pasek et al., 1987).

Another suggestion was that motherese supported language development by providing a simpler model of language than does adult-directed speech and, by extension, that within the variability in child-directed speech that exists, simpler is better. That latter hypothesis finds little support in the evidence. There is one finding in the literature that shorter maternal mean lengths of utterance are positively related to children's syntactic development (Furrow, Nelson, & Benedict, 1979), but that finding has never been replicated despite multiple attempts to do so (Pine, 1994). To the contrary, several studies have found that children who hear longer utterances in input are more advanced in syntactic development (Harkness, 1977; Hoff-Ginsberg, 1998; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002). Additionally, some input features that are positively associated with children's syntactic development, such as adult question-asking, involve grammatically complex forms. (Despite such findings, it may still be the case that the average degree of simplification in child-directed speech benefits language acquisition. All of the observed benefits of complexity in mothers' speech have been obtained within a range of complexity that was more limited than in speech directed to adults.)

One recent hypothesis has suggested that the *child*, not the caregiver, may be the source of simplification of input. Newport (1990) and her colleagues have suggested that the limited perceptual and memory capacities of young children give the child an advantage. If the child can process and store only "pieces" of the input, this facilitates analysis, because it minimizes the logically possible combinatorial hypotheses the child will have to consider. Thus, "less is more." The child will access more complex forms when ready to take in larger chunks of input.

Another argument against a critical role for motherese draws on the considerable variation that exists across cultures in the extent to which parents modify their speech to children, or even speak directly to children (Lieven, 1994). Despite a wide range in patterns (e.g., Ochs, 1985; Schieffelin, 1985), children still learn language. It is argued, therefore, that because motherese is not universal, language development cannot be contingent on the child hearing motherese (see Hoff, 2006).

Input as a source of corrective feedback? A second potential characteristic of input that research addressed early on is the provision of corrective feedback for error. If input provided corrective feedback, this would contradict Chomsky's claim that children receive no training in language. An early study found that mothers did not correct their children's ungrammatical utterances (Brown & Hanlon, 1970). Furthermore, children seem remarkably resistant even when parents do make occasional corrections. On the basis of these findings, the consensus in the field has long been that children do not generally receive corrective feedback.

More recent work has explored whether adults may provide more subtle feedback. Some have found that when children produce well-formed utterances, adults are more likely to repeat them verbatim, whereas when children produce ungrammatical forms, adults are more likely to modify them, to provide correct forms, or to ask for clarification (Bohannon & Stanowicz, 1988; Chouinard & Clark, 2003; Demetras, Post, & Snow, 1986; Saxton, 1997; Saxton, Backley, & Gallaway, 2005). Just how useful this feedback is to the child is a matter of debate. Chouinard and Clark (2003) argue that children do frequently recognize reformulations as corrections; Saxton et al. (2005) report that contrastive use of correct forms by adults predicts changes in children's error rates. Countering this view, Atkinson (2001) notes that demonstrations of occasional feedback do not necessarily mean that the adult *reliably* signals the grammaticality of children's utterances, nor that such feedback is a *necessary* element of acquisition. Given the probabilistic nature of feedback, Marcus (1993) estimated that a child would have to say the same ungrammatical sentence 85 times in order to have enough data to determine that the sentence was ungrammatical. Any feedback the child is receiving, therefore, can be seen, at best, only as an aid to language development; language development cannot be seen as contingent on such feedback. Moreover, Shatz and Ebeling (1991) argued that children actually revise their own utterances syntactically more than their parents do.

Input as data for distributional learning. The theoretical importance of feedback declines if structural properties of the language can be induced directly from distributional patterns in the input, as argued first by Maratsos and Chalkley (1980). Several sources of evidence support this possibility, ranging from computer simulations of language development, to analyses of distributions of forms in parental input, to evidence of children's attention to frequency distributions in the input.

Computational models have demonstrated clearly that computers can induce grammatical features of language and syntax–semantics mappings. Redington and Chater (1997), for example, have shown that given a large sample of speech (including adult-to-adult and adult-to-child speech) as input, computer models can extract word classes (nouns, verbs, etc.), often posited as innate, from distributional patterns in that input. Smith and colleagues (Colunga & Smith, 2005; Gasser & Smith, 1998) have shown similarly that nouns can be distinguished from adjectives based on characteristics of the input, and that the association of nouns with solids and non-solids can emerge through associative learning. Landauer and Dumais (1997) have demonstrated that a computer can "learn" semantic associations among words using simple associationist mechanisms. Such demonstrations confirm that, in principle, structure-relevant patterns are available in the input language.

In direct examinations of speech addressed to children, Mintz (2003) found that frequently occurring word frames reliably surround words of the same grammatical category, and Naigles and Hoff-Ginsberg (1995) found that verbs in different semantic categories (e.g., internal state verbs, motion verbs) appeared in different syntactic environments. These findings make plausible the argument that children could induce form classes from the input. Pine and his colleagues (Gobet, Freudenthal, & Pine, 2004) have gone one step further: in computer simulations of children's language development using real parental speech to children as input, they have successfully simulated a number of phenomena observed in children's language, including the emergence of optional infinitive phenomena, verb-island phenomena, subject omissions, and case marking errors.

These studies examining patterns in the input and simulations of learning based on input data are complemented by behavioral studies showing that children can and do extract patterns of language from the input. Recent research has provided an explosion of evidence that human infants are powerful learners, able to extract information about the perceptual properties of language from the distributional properties of the speech they hear. Jusczyk and colleagues (e.g., Jusczyk, 1997) have demonstrated that infants have keen abilities to attend to stress, prosody, syllable, and lexical patterns in speech, and these aid in the infants' extraction of patterns in the input. Saffran and colleagues have found reliable effects showing that infants carry out rapid learning of statistical probabilities in language – whether those have to do with phonological patterns, lexical items, or phrase structure patterns (see, e.g., Saffran, 2003). These abilities to track statistical probabilities are not limited to language but extend also to tones and visual patterns as well as to rhythmic patterns (Hannon & Trehub, 2005; Kirkham, Slemmer, & Johnson, 2002; Saffran & Thiessen, this volume). However, infants do favor certain patterns over others, in particular, patterns consistent with those found in the world's languages (Saffran, 2003). But, importantly, since these abilities at tracking statistical probabilities are present in other species as well, Saffran (2003) argues that "the similarities across languages . . . are not the result of innate linguistic knowledge. Instead, human languages have been shaped by human learning mechanisms" (p. 110). (See also Gerken; Saffran & Thiessen, this volume.)

A rich body of research with toddlers has suggested how this early sensitivity to form in the input provides the basis for language-specific morphosyntactic and semantic inductions. For example, English-speaking children learn early that a word following *a* probably refers to an object, while the same new word following *some* (*some blicket*) probably refers to a substance (Bloom, 1994; Carey, 1994; Gathercole, Cramer, Somerville, & Jansen op de Haar, 1995; Gordon, 1988; Soja, 1992; Soja, Carey, & Spelke, 1991). English-speaking children also use the correspondences between the semantics of verbs and the structures in which they appear as clues to verb meaning (Naigles & Hoff-Ginsberg, 1998; Naigles & Swensen, this volume). Similarly, English-speaking children who hear a new word ending in *-ish* (*foppish*) learn to infer that that word refers to a property of an object, not the object itself, while Spanish-speaking children treat adjective-like forms in their language as if they refer to objects, because of the structure of Spanish (Waxman, Senghas, & Benveniste, 1997). Welsh-speaking children learn that if they hear a new word in a noun slot, that word might refer to either a single object or to a collection, while English- and Spanish-speaking children learn that a new noun in their language is likely to refer to a single whole object (Gathercole, Thomas, & Evans, 2000). In a similar vein, Spanish-speaking children learn that a new verb referring to a motion is likely to incorporate the direction of motion (as in *Juan <u>subió</u> la colina corriendo*, "Juan <u>ascended</u> the hill running"), while English-speaking children learn that a new verb referring to a motion is likely to incorporate the manner of motion (as in *John <u>ran</u> up the hill*) (Hohenstein, 2001).

In addition, the distribution of forms in children's speech often reflects the distributional frequencies in the adult language, indicating that children are highly sensitive to those distributions. Theakston, Lieven, Pine, and Rowland (2002) reported that children's early use of the verb *go* in English involves several isolated structures linking syntactic form with semantics, and that these correspond highly with the structural forms of *go* in the input. De Villiers (1985) found that the structures in which young children used particular verbs corresponded to the structures in which their mothers used those verbs. Henry (2003) reported on children's use of past forms in Ulster English, which allows both irregular and regularized forms for many verbs. She found that the children's patterns of usage closely followed those of the adults around them. Gobet et al. (2004) demonstrated that English-, Dutch-, and Spanish-speaking children's use of bare infinitives versus finite verb forms – which has figured prominently in nativist arguments (Wexler, 1994, 1998) – can be successfully mimicked in computer simulations that combine simple distributional analyses with a well-known child strategy (Slobin, 1973) of focusing on the ends of input utterances.

Together these studies support the position that the speech children hear contains structure-revealing information and that children have the capacity to find that information and use it to induce structural properties of their language. Further, the evidence argues that children are sensitive to the form–meaning correspondences of their language and use these to predict and infer linguistic properties of new forms when they encounter them (see also Choi, 2006; Gathercole, 2006; and see Lidz, this volume, on children's recovery from incorrect inferences). Whether these abilities rely solely on the child's attention to the input or involve other factors will be considered when we address question 3. We turn now to our second question.

Q2: Does input control either the sequence in which or the speed with which children construct the grammar?

We begin with evidence indicating that input – or more properly, frequency of input – does not control the *sequence* in which forms are acquired (except in the limited case in which sufficient input is not available); we follow with evidence showing that input does affect *speed* of acquisition.

Input and sequence of acquisition

If the acquisition of language were a simple process of storing and mimicking the input, one might expect that the sequence in which forms develop would correspond directly with their relative input frequency. It is clear that this is not the case. First, the forms that often are the most frequent in the input, such as function words (like *a*, *the*, and *of*), are rarely those that appear first in children's speech. Second, if children simply copied patterns available in the input, one would not expect them to make errors, at least not frequently. Again, this is not the case. Third, examinations of developmental sequences (e.g., for grammatical morphemes) make it clear that, assuming some minimal input level, other factors such as linguistic complexity and perceptual salience (see below) are more influential in determining order of acquisition than frequency in the input (Brown, 1973; de Villiers & de Villiers, 1973).

Even though input does not largely control the order in which children acquire the forms of language, input is relevant to order of acquisition in at least two ways. First, input affects order of acquisition in the extreme, in that children cannot acquire what they do not hear in the input. Several researchers have proposed, in fact, the need for a "critical mass" of input for acquisition or abstraction to occur (Conti-Ramsden & Jones, 1997; Elman, 2003; Gathercole, 2002b, 2002c; Marchman & Bates, 1994). If such a critical mass is not available to a child, the relevant structure may not be acquired, may be acquired late, or may not be acquired fully.

Two cases in point are the passive in English and the present perfect in American English. English-speaking children learn the passive (e.g., *he was beaten by his opponent*) quite late. Some nativists have posited that this is due to the late maturation of certain relevant innate linguistic principles (Borer & Wexler, 1987; see Goodluck, this volume). However, the passive is used infrequently in English. Children learning languages in which the passive is more frequent have been observed to use the passive early (Allen & Crago, 1996; Demuth, 1989; Pye & Quixtan Poz, 1988). Furthermore, if the frequency of passive forms is increased in speech to English-speaking children, children can learn some aspects of the passive earlier (de Villiers, 1980). Another telling case is the acquisition of the present perfect in American versus British English. While these two dialects share the same syntactic and semantic forms for the present perfect, American English uses the present perfect much less frequently than British English (optionally substituting, for some uses of the present perfect, the regular past: *Did you eat yet?* for *Have you eaten yet?*). This difference in frequency affects timing of acquisition, with British children using present perfect constructs by 3 years, and American children not until much later (Gathercole, 1986).

The exact quantity that constitutes the "critical mass" for the acquisition of a structure may be debatable, but appears to be linked with the relative transparency/opacity of the structure. Structures that are transparent appear to require a lower critical mass than opaque structures for abstraction of the relevant patterns. For example, grammatical gender in Spanish, which is very transparent, is acquired at an early age (Cain, Weber-Olsen, & Smith, 1987; Hernández Pina, 1984); grammatical gender in Welsh, which is very opaque, involving multiple overlapping form–function correspondences, is not learned until after age 9 (Gathercole & Thomas, 2005; Gathercole, Thomas, & Laporte, 2001; Thomas, 2001). Similarly, *that*-trace structures (e.g., ¿Quién piensas *que* tiene ojos verdes?/Who do you think (*that* omitted) has green eyes?) and the overall use of complementizer *que* in Spanish are transparent and are learned early, whereas *that*-trace structures and the overall use of complementizer *that* in English are opaque and learned late (Gathercole, 2002c; Gathercole & Montes, 1997).

A second way in which frequency of input might affect sequence of acquisition, or, rather, the nature of acquisition in that sequence, has to do with the extent to which children generalize beyond learned instances. If children construct language from patterns in the input, one theoretical question is how they arrive at appropriate levels of productivity for structures. Productivity is essential to linguistic knowledge, for it allows the use of language beyond learned instances. We know that at certain points in development children can extend their grammatical knowledge to novel forms (e.g., Berko, 1958), and they generalize and overgeneralize to novel instances – for example, using regularized forms in place of irregular items (e.g., *falled* instead of *fell*; *I disappeared it* instead of *I made it disappear*). Two critical questions regarding (over)generalizations concern (1) when these forms occur and (2) how the child manages to eventually eliminate incorrect forms from his/her speech. Tomasello (2000) has recently argued that input frequency plays a role in determining when overgeneralizations occur in child speech. He argues that specific items that are frequently heard become entrenched, and such items are less likely to be overgeneralized than items that are less frequent in input. For example, the high-frequency verb *laugh* becomes entrenched as an intransitive verb and is not likely to be overgeneralized to a transitive use, *I laughed him*. Overgeneralizations are also constrained by presence in input of alternative forms, which preempt overgeneralization. In this way, hearing the construction *made X disappear* blocks the overgeneralization of *disappear* to a transitive use, *I disappeared it* (Brooks & Tomasello, 1999). Items of an intermediate level of frequency (e.g., *giggle*) are the most susceptible to overgeneralization (*You giggled me*), according to this argument, because the appropriate forms are not heard frequently enough to become entrenched, yet are likely to be learned before the system is fully worked out. There is empirical support for some postulates of this account (Brooks, Tomasello, Dodson, & Lewis, 1999), although the issue of how children manage to be productive language users without being wildly overproductive has not been fully resolved (see Maratsos, 2000, and Elman, 2003, for related arguments).

Concerning the sequence in which constructs develop, then, frequency of input *per se* does not control order of acquisition. Something else does. However, frequency of input does affect the availability of a structure, and for each structure, the child must accumulate enough experience to be able to draw the relevant generalizations when ready to do so. If the structures in question are quite transparent, that critical mass will be smaller than if the structures in question are quite opaque. In addition, as the child is accumulating that critical mass, s/he is not likely to make errors of overgeneralization on entrenched items (learned early and heard frequently), only on items that are less entrenched, and only before the system is fully worked out.

Input and speed of acquisition

While relative frequency of input does not affect sequence of acquisition, it can influence speed of acquisition. One "natural laboratory" source of evidence is in comparisons of bilingual and monolingual groups learning the same pair of languages. Comparisons of children growing up in contexts in which the relative proportion of input in languages A and B varies yield consistent differences in the timing of acquisition of structures. Gathercole (2002a, 2002b, 2002c) found this to be the case for Spanish–English bilinguals learning mass/count structures in English, grammatical gender in Spanish, and *that*-trace structures in English and Spanish: Bilinguals who had the greatest amount of English input had an earlier command of the English constructs than their peers, while bilinguals who had the greatest amount of Spanish input had an earlier command of the Spanish constructs than their peers. (This also meant that English and Spanish monolinguals gained command of these structures before their bilingual peers.) Gathercole and Thomas (2005) found this also to be the case for Welsh–English bilinguals learning grammatical gender and verb-argument structures in Welsh: Those with a greater amount of Welsh input on a daily basis showed an earlier command of the Welsh constructs than their peers with less Welsh input. (See also Rieckborn (2006) and Kupisch (2003) for similar effects in bilinguals' development of tense/aspect and determiners, respectively.)

Monolingual children also differ in how much they hear the language or particular structures in the language they are acquiring, and this affects their rate of grammatical development. The total quantity of speech addressed to children at home and in day care relates to children's linguistic development (Bradley & Caldwell, 1976; Clarke-Stewart, 1973; McCartney, 1984; National Institute of Child Health and Human Development, 2000). The talkativeness of English-speaking mothers in interaction with young children relates to the children's syntactic and semantic development (Barnes, Gutfreund, Satterly, & Wells, 1983). Kindergarten children whose teachers use more complex sentences grow more rapidly in their use of complex sentences than those whose teachers produce fewer complex sentences (Huttenlocher et al., 2002). The more frequently children hear questions with auxiliary inversion, the more rapidly they grow in their own use of auxiliary verbs (Hoff-Ginsberg, 1985; Newport et al., 1977; Shatz, Hoff-Ginsberg, & MacIver, 1989). The variety of syntactic frames in which children hear verbs used predicts the syntactic flexibility of children's verb use (Naigles & Hoff-Ginsberg, 1998). The discourse environment of forms in input also affects language development. Expansions and recasts by adults may positively predict syntactic development (Newport et al., 1977), as may mothers' inexact self-repetitions (Cross, 1978; Hoff-Ginsberg, 1985, 1986).

Besides amount of input, other properties of children's conversational experience have also been shown to affect rates of grammatical development, including the amount of time spent in joint attention (Carpenter, Nagell, & Tomasello, 1998; Laakso, Poikkeus, Katajamaki, & Lyytinen, 1999; Mundy & Gomes, 1998), maternal responsivity to child verbalizations (Tamis-LeMonda, Bornstein, & Baumwell, 2001), and contingency of maternal speech (Snow, Perlmann, & Nathan, 1987). The benefits of these features of conversational experience might in the end reflect the amount of input provided the child. That is, when mothers and children are more engaged in conversation, children receive more language-advancing data. It may also be, however, that having a responsive conversational partner motivates language acquisition by demonstrating to children that communication is both possible and interesting (Hoff, 2003, 2006); alternatively, the partner who shares focus with the child may be more likely to provide input in line with the child's cognitive abilities (see below).

The upshot of all of this research is that (a) frequency of input *per se* does not control the sequence of acquisition across forms, but (b) input does affect rapidity of acquisition. More input means more rapid development – through a course of development whose sequence appears to be largely dictated by other factors.

Why might the quantity of input affect the rapidity of acquisition of forms in language? There are a number of possibilities:

1. With more input, there is greater frequency of the tokens of any form, which may contribute to the better storage and retention of tokens (e.g., *walked* heard 30 times is more likely to be retained than *walked* heard twice). Token frequency may be particularly important for the acquisition of isolated irregular forms (*drank*, *flew*) (Maratsos, 2000).
2. More input may also entail more distinct contexts (linguistic and non-linguistic) in which tokens are heard. This may facilitate the mapping problem of a form with its sense.
3. Greater input frequency likely entails greater frequency of lexical types participating in a given morphological or syntactic structure (e.g., hearing not only *walked*, but also *talked*, *laughed*, etc.). Frequency of types provides the "grist" for the language development mill that will help the child to construct morphosyntactic structures (here, use of *-ed* for past tense).
4. Greater input frequency is likely to provide richer information on relations across tokens and types, thus enabling a faster and stronger construction of networks of forms in the child's repertoire. That is, not only will the child be hearing each token (*talked*, *flew*) more often and in more non-linguistic contexts (e.g., *flew* in relation to a bird at the pond last week, in relation to a bug that has just flown in the window, etc.), but s/he will be hearing other types used with similar morphological forms (*walked*, *laughed*, *threw*, *drew*) in similar non-linguistic contexts (in reference to past time, in reference to time immediately preceding the utterance, etc.).

It is likely that all of these factors contribute to success in the child's ability to construct the language being learned from the available input. They constitute the elements that will make up the "critical mass" of data that will eventually allow the child to abstract out the common structures that link them.

Q3: Is the input alone sufficient to explain the child's construction of the grammar, or do other factors contribute to the process of acquisition; if so, how do these interact with the input?

Let us turn now to the third question, regarding what might be needed in addition to input for the child to construct a language. We have already seen above that input alone cannot explain the order of acquisition across structures. So what contributes to acquisition besides input to explain the order?

Influences other than input

A strong nativist position might explain the sequence of development across structures as controlled by the innate Universal Grammar. Some have posited that innate knowledge comes on line according to a maturational program, which controls the sequence of development and helps explain why children's knowledge does not necessarily match what might predominate in the input. Thus, for example, the late acquisition of functional categories (e.g., determiners and prepositions) relative to lexical categories (e.g., nouns and verbs), or the later acquisition of tense marking relative to person marking, might well be explained according to different maturational schedules for distinct elements of Universal Grammar (e.g., Grinstead, 2000; Radford, 1990, 1996). However, this is not the only possibility. Another possibility, one that does not rely on innate knowledge, is that what children can take from the input is dependent on their own "readiness" for attending to, noticing, or understanding what the input has to offer. That readiness might be, at least in part, in the form of cognitive understanding or of the child's linguistic development up to that point.

Cognitive understanding and language acquisition. Input clearly interacts with cognition in determining what the child acquires when. Some demonstrations of the role of cognitive preparedness come from the acquisition of lexical items (see, e.g., Rice's (1980) classic study of children's acquisition of color terms), but grammatical examples, the focus of this chapter, are also in evidence. Some of these come from children's early misuses of terms that involve, in adult usage, complex cognitive knowledge. For example, children's early uses of comparative forms (which in their adult-like use demand some understanding of seriation or scalarity) often involve incorrect applications in contexts where intensification ("very X"), a simpler concept, would be appropriate (Gathercole, 1983); early uses of relative clauses may be for compounding instead of relativization (Tavakolian, 1981). In a recent study, Shirai and Miyata (2006) demonstrated that Japanese-speaking children use past tense morphology productively long before they use it appropriately for deictic past reference. In children's use of object labels, the greater difficulty of understanding functions related to substances than to shape seems to make children's extension of word categories based on material function harder (Gathercole & Whitfield, 2001). These examples show that if what is frequent in the input corresponds to complex cognitive concepts, the forms may be learned early with a simpler meaning (as in the case of the comparative in English or the past in Japanese), or may wait for the child's cognitive understanding to advance to a certain level (as in the case of word categories based on substance functions).

This is not to say, however, that cognition always drives language acquisition; the reverse is also possible, that language can help "push" the child to attend to aspects of referents and to develop certain cognitive concepts earlier (e.g., Bowerman, 1996; Choi, 2006; Gopnik & Choi, 1990). (However, the cognitive options open for such manipulation by language may be within a certain available cognitive range: Gathercole, 2006; McCune, 2006.) But ultimately, input alone cannot control order of acquisition because it must interact with, among other things, the child's cognitive understanding of the world to which language is referring.

Linguistic complexity and language acquisition. The order in which children acquire forms also depends to some extent on linguistic complexity. Take, for example, the acquisition of the third person singular form of verbs. In Spanish, this is the first finite form that becomes productive; in English, it is a relatively late development. In Spanish, this form can be considered the unmarked, least complex, form of the verb, while in English, the third person singular can be considered a marked, complex, form (Gathercole, Sebastián, & Soto, 1999, 2002). Similarly, children typically acquire simple sentences before complex ones (involving more than one clause). Likewise, as noted above, constructions that involve opaque form–function mappings (e.g., Welsh grammatical gender, English *that*-trace) take longer to acquire than similar constructions involving more transparent form–function mappings (e.g., Spanish gender, Spanish *que*) (see Smoczynska, 1985). Another example, from Morgan, Barrière, and Woll (2006), comes from the acquisition of British Sign Language, in which agreement morphology is learned late; they attribute this to the difficulty of segmenting the relevant signs into morphemes and to the complexity of semantically and syntactically conditioned agreement rules which must be mastered.

It should be noted that complexity may depend not only on the structure in question but also on the relationships between the given construct and others in the linguistic system. Researchers have long noted that acquisition of a form may hinge on the prior acquisition of simpler related forms (e.g., Brown's (1973) "law of cumulative complexity"), a notion that has returned recently in the shape of "construction conspiracies" (Abbot-Smith & Behrens, 2002; Morris, Cottrell, & Elman, 2000). Abbot-Smith and Behrens, for example, demonstrate that their German subject learned stative passives before eventive passives because he had already acquired the "source constructions" for the former. Similarly, Rice (1980) found that all of the children in her color study took much longer to learn the first two-color-word contrast than to add a third color term to their system once they had acquired the first contrast. Children clearly build on previously acquired knowledge to move forward in the development of their linguistic system. The knowledge they have already acquired can ultimately serve to help them make more efficient use of new, related information in the input.

Conclusion

The questions addressed in this chapter concern the degree to which the input children receive can explain the course that language development follows. When the modern field of child language began in the 1960s, the dominant linguistic view was that language was an innate faculty of the human mind and that the complex structure of language is only faintly evident in the surface forms; thus the child's achievement of that complex structure could only be explained by positing innate linguistic knowledge. The evidence reviewed in this chapter suggests that the role of input in accounting for the fact of language acquisition is much greater than this early view allowed. Studies suggest that input does more than faintly reveal language's abstract structure, and that human infants and children have the capacity to induce language structure from surface regularities. We have seen that not only is an input-dependent account of language acquisition plausible, but that there is strong support for its validity. Variation in the amount and nature of the input children receive correlates with variation in the rate at which they acquire language. This evidence suggests that input provides the database for language induction.

The evidence reviewed in this chapter also suggests, at the same time, that the language acquisition mechanism is not solely input driven. The sequence in which the structures of language are acquired does not directly reflect the frequency with which structures occur in the input. Cognitive preparedness on the part of the child, and the linguistic complexity of the forms to be acquired, also play key roles. The fact that children's cognitive understanding can influence the acquisition of language structures makes the point that language is not a completely isolable domain, and the influence of linguistic complexity brings us full circle to input. Linguistically complex structures are, in part, those for which it is difficult to discern consistent patterns in the input. Thus, the effects of linguistic complexity serve to underline the fact that the child's extraction of regularities in the input must ultimately play a key role in the final analysis of how language acquisition takes place.

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