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# *How Children Learn Language: A Focus on Resilience*

**Susan Goldin-Meadow**

Children learn language in varied linguistic environments, and these environments can have an impact on how language-learning proceeds, particularly on the rate at which certain properties of language are learned (see Hoff, this volume). The goal of this chapter, however, is to explore the properties of language whose development is *not* beholden to the vagaries of environmental input but are, instead, robustly over-determined and expressed in almost all language-learning environments. Any particular manipulation of the environmental conditions under which language-learning takes place has the potential to alter the language-learning outcome. To the extent that a property of language is *unaffected* by a given manipulation, it can be said to be developmentally *resilient* – its developmental course is impervious to the change in input conditions. The more radical the manipulation is – that is, the more different the conditions are from the conditions that surround the typical language-learning situation – the more impressive it is that a given property of language continues to crop up.

To begin to identify the properties of language that are resilient across environmental variation, we examine language-learning in a variety of naturally occurring circumstances – when children learn different languages, when children learn language in a different modality, and when children get different amounts of input in their language. We also explore whether there is convergence across these manipulations in the properties identified as resilient. It is an empirical question as to whether the same property of language will survive a variety of input manipulations – that is, whether it will be resilient across a range of learning conditions. If so, we can be that much more certain that this particular property of language is fundamental to human communication. Thus, the chapter describes what we can learn about a child's preparation for language-learning from naturally occurring variations in learning conditions. I begin with a brief description of the steps children follow in a typical language-learning environment and then turn to language-learning in environments that vary from the norm.



## Out of the Mouths of Babes

### *Starting with the word*

Children produce their first words between 10 and 15 months, typically using each word as an isolated unit. They then proceed in two directions, learning (1) that the word can be composed of smaller, meaningful parts (morphology), and (2) that the word is a building block for larger, meaningful phrases and sentences (syntax).

But what is a word? Consider a child who wants a jar opened and whines while attempting to do the deed herself. This child has conveyed her desires to those around her, but has she produced a word? A word does more than communicate information – it stands for something; it's a symbol. Moreover, the mapping between a word and what it stands for is arbitrary – "dog" is the term we use in English for furry four-legged canines, but the term is "chien" in French and "perro" in Spanish. There is nothing about the form of each of these three words that makes it a good label for a furry creature – the word works to refer to the creature only because speakers of each language act as though they agree that this is what it stands for.

At the earliest stages of development, children may use a sequence of sounds consistently for a particular meaning, but the sequence bears no resemblance to the sound of any word in their language. These "proto-words" (Bates, 1976) are transitional forms that are often tied to particular contexts. For example, a child uses the sound sequence "brmm-brmm" every time he plays with or sees his toy truck. In fact, a child's proto-word need not be verbal at all – gesture works quite well. For example, a child smacks her lips every time she feeds her fish (Acredolo & Goodwyn, 1988). Indeed, some children rely heavily on gestural "words" to communicate with others at the early stages.

### *Learning that words are made of parts*

Words in all languages are composed of parts. For example, the word "dogs" refers to more than one furry creature, but it does so systematically – "dog" stands for the animal, "s" stands for many-ness. We know this, in no small part, because we know that words like "cats," "shoes," "books," all refer to more than one cat, shoe, or book. We have extracted (albeit not consciously) what the words have in common – the "-s" ending in their forms and "plural" in their meanings – to form what is called a morpheme, a consistent pairing between a form and a meaning.

At the earliest stages, children seem to learn morphologically complex words as unanalyzed wholes, "amalgams" (MacWhinney, 1978). How can we tell when a child has analyzed "dogs" into its morphemic parts? One key piece of evidence, possible only when the pattern in the language the child is learning is not completely regular, comes from children's over-regularizations – errors in which children make exceptions to the adult pattern (e.g., feet) conform to the regular pattern (e.g., foots). Children who produce the incorrect form "foots" must have extracted the plural morpheme "-s" from a variety of other regular forms in their system, and added it to the noun "foot." Similarly, children who produce "eated" must have extracted the past tense morpheme "-ed" from verbs like "walked" and "stopped" and added it to the verb "eat" (Marcus, 1995). Creative errors of this sort also indicate that children know the difference between nouns and verbs; children add the "-ed" ending to verbs like "eat" or "walk" but rarely to nouns like "foot" or "shoe."

English does not have a very rich morphological system, unlike a language like Turkish, whose words contain many morphemes. For example, *ellerimde* is a single word in Turkish meaning "in my hands"; the word is composed of four meaningful parts, that is, four morphemes – *el* 'hand', *-ler* 'plural', *-im* 'first person possessive', *-de* 'locative' (Aksu-Koc & Slobin, 1985). Children learning languages rich in morphology turn out to learn the parts of words earlier in the course of language development than do children acquiring morphologically impoverished languages (Berman, 1985). And a morphological system that is regular is particularly easy to master. The inflectional system in Turkish is not only rich, it is predictable and perceptually salient. Children learning Turkish begin to produce words containing grammatical morphemes even before they produce words in sentences (Aksu-Koc & Slobin, 1985). In contrast, children acquiring English generally do not begin to learn the morphemes of their language until after they begin to combine words into sentences.

### *Combining words into ordered sentences*

At about 18 months, children begin to produce two-word strings that have at least two characteristics in common (Bloom, 1970; Bowerman, 1973a; Brown, 1973). First, the content is the same. Children note the appearance and disappearance of objects, their properties, locations, and owners, and comment on the actions done to and by objects and people. Second, the words in these short sentences are consistently ordered (Braine, 1976). The particular orders children use mirror the orders provided by the language models they experience. Even when the languages they are learning have relatively free word order, children tend to follow a consistent pattern (based on a frequently occurring adult order; Slobin, 1966).

Moreover, before they produce two-word combinations, children have some understanding of word order. Children who only produce single words, when shown two scenes (Big Bird washing Cookie Monster versus Cookie Monster washing Big Bird), will look reliably longer at the scene that matches the sentence they are listening to – the first scene for the sentence "Big Bird is washing Cookie Monster" and the second for "Cookie Monster is washing Big Bird" (Hirsh-Pasek & Golinkoff, 1991). The order of words must be conveying information to the child about who is the doer (agent) and who is the done-to (patient) of the action.

### *Syntactic versus semantic categories*

Young children produce words in consistent orders as soon as they combine them and, in this sense, adhere to a syntax. But is it the syntax of adults? Adult regularities are formulated in terms of syntactic categories (e.g., subjects precede verbs in English declarative sentences). However, the earliest sentences that children produce can be described at a semantic level and thus do not *require* a syntactic analysis (Angiolillo & Goldin-Meadow, 1982). For example, the sentence "baby drink" can be described as "agent precedes action" rather than "subject precedes verb." Indeed, the fact that young children often interpret sentences like "babies are pushed by dogs" to mean the babies are the *pushers* (not the *pushees*) suggests that, for these children, the first word is an agent, not a subject (i.e., it's defined in terms of its role in the action rather than its role in the syntactic structure of the sentence).

A description in terms of syntactic categories is needed when the words that fill the subject position are no longer restricted to a single semantic category (Bowerman, 1973b; e.g., "bottle falls" – bottle is not affecting an object and thus is not an agent) and when other aspects of the sentence depend on this non-semantic category (e.g., subject–verb agreement). It is not until children begin to fill in their telegraphic utterances with grammatical morphemes (e.g., verb endings that must agree in number with the subject – bottle falls versus bottles fall) that we have clear evidence for syntactic categories. However, the fact that children use their grammatical morphemes appropriately as soon as they appear in their repertoires suggests that the groundwork for syntactic categories may have been laid quite early, perhaps from the start (cf. Valian, 1986).



### *Underlying predicate frames*

Children who are limited to two words per sentence in their talk nevertheless know something about the larger predicate frames that underlie their short sentences. They produce, at times, all of the appropriate arguments (semantic elements) that a given predicate allows. For example, at one time or another a given child produces "baby" or "juice" with the verb "drink" (i.e., both arguments associated with the *drink* predicate – actor, patient) and "mommy," "juice," or "baby" with the verb "give" (the three arguments associated with the *give* predicate – actor, patient, endpoint). Moreover, for children at the two-word stage, the rate at which a semantic element is put into words depends on the predicate frame underlying the sentence (Bloom, Miller, & Hood, 1975). If a predicate frame underlying a two-word sentence is relatively small (like the *drink* frame), an element in that structure will be more likely to be produced as one of the two words in the sentence than will an element that is part of a larger predicate frame (the *give* frame) – there's less competition for one of the two word slots in a sentence with a smaller versus a larger predicate frame. Thus, for example, children are more likely to produce "juice" with "drink" (a predicate with a two-argument underlying frame) than with "give" (a predicate with a three-argument underlying frame) simply because there is less competition for one of the two word slots in a sentence with two versus three underlying arguments (Goldin-Meadow, 1985; Goldin-Meadow & Mylander, 1984). The fact that the child's rate of production of a given element in a sentence varies systematically according to the size of the predicate frame hypothesized to underlie that sentence is evidence for the existence of the predicate frame itself.

In addition, when provided with sentences that differ in their argument structures, children can make the appropriate inferences about the type of action described. For example, children will look longer at a scene in which Cookie Monster is making Big Bird turn (as opposed to one in which each is turning independently) when they hear the two-argument sentence, "*Cookie Monster* is turning *Big Bird*," than when they hear the one-argument sentence "*Cookie Monster* is turning with Big Bird" (Hirsh-Pasek, Golinkoff, & Naigles, 1996).

### *Complex sentences*

Children go on to enlarge their sentences in two ways. They elaborate one element of a single proposition: e.g., "baby drinking big bottle," where "big" modifies the object of the sentence, "bottle." They combine propositions to produce complex or compound sentences. For example, English-learning children produce sentences with object complements ("I hope I don't hurt it"), embedded clauses ("that a box that they put it in"), coordinate clauses ("maybe you can carry that and I can carry this"), and subordinate clauses ("I gave him some so he won't cry"). The advent of two-proposition constructions brings with it the problem of relating the propositions. Who is doing the climbing in the sentence "the lion pushes the bear after climbing the ladder"? Children under 6 incorrectly think it's the bear that climbs rather than the lion (Hsu, Cairns, Eisenberg, & Schlisselberg, 1989; but see de Villiers, Roeper, & Vainikka, 1990, for signs of some remarkably subtle judgments about complex sentences even at age 3).

Having taken a brief tour of language-learning under unremarkable circumstances, we turn to more varied conditions. Any change in the environmental conditions under which language is learned could, at least in theory, alter the course and even the outcome of the learning process. To the extent that a property of language is unaffected by a particular change, it can be said to be developmentally resilient, or buffered, against that change.

## Language-Learning by Hand

Deaf individuals around the globe use sign languages as their primary means of communication and those sign languages are structured like all natural languages – despite the fact that they are processed by hand and eye rather than mouth and ear. The first question to ask is whether deaf children exposed to a sign language from birth acquire that language in the same way that hearing children acquire spoken language.

### *First signs*

Deaf children produce their first recognizable signs slightly earlier in development than hearing children produce their first recognizable words (Meier & Newport, 1990) – presumably because sign production requires less fine motor control than word production. However, these early signs do not appear to be used referentially (Bonvillian & Folven, 1993). It is not until approximately 12 months that deaf children clearly use their signs in referential contexts (i.e., to name or indicate objects and actions in their worlds) – precisely the age at which hearing children produce their first recognizable words in referential contexts (Petitto, 1988). Thus, although it may be easier to produce signs than words, it is not easier to use those signs symbolically. This important step in the language-learning process is taken at the same developmental moment, whether the child is learning a signed or spoken language.

Moreover, the iconicity present in parts of all sign languages appears to have little effect on language-learning. Signs like "drink" (a cupped hand tilted at the mouth) are easy to remember and are very often the first signs learned by *adults* acquiring American Sign Language (ASL) as a second language. However, children do not take advantage of the iconicity in the signs they are learning. Only one-third of the first signs that children produce are iconic (Bonvillian & Folven, 1993), and the meanings of those signs are no different from the words that one-word speakers initially produce (Newport & Meier, 1985).

Another example of how deaf children learn sign languages just like hearing children learn spoken language comes from the acquisition of pronouns. Pronouns for *me* and *you* are produced in ASL by pointing either at oneself (first person) or the addressee (second person). We might expect these first- and second-person pronouns to be acquired early simply because they resemble pointing gestures. However, they turn out to be relatively late acquisitions, learned at about the same age that children learn first- and second-person pronouns (*I* and *you*) in spoken languages (Petitto, 1987).

### *The parts of signs*

Like words in spoken languages, signs turn out to be constructed out of morphemes (T. Supalla, 1982). For example, an inverted V-hand representing a person can be simultaneously combined with a linear path representing forward movement to indicate someone moving forward. However, as this example illustrates, signs often resemble the events they represent. Sign-learning children might then guess wrong and assume that these signs are pictures with no internal structure. If so, we might expect them to acquire signs of this sort early. Alternatively, if children do not make use of the iconicity that underlies these multi-morphemic forms, they should treat the signs as complex combinations of smaller units from the start and thus acquire them relatively late. This is precisely what deaf children learning ASL do (T. Supalla, 1982). Even by age 5, deaf children do not produce all of the morphemes required in complex signs. As in a hearing child's acquisition of a morphologically complex spoken language, morpheme acquisition continues in deaf children until at least age 6.

Many verbs in sign languages (both the productive signs just described and the "frozen" signs whose stems are unanalyzable wholes) are inflected to agree with their noun arguments. For example, the ASL verb "give" agrees with the nouns filling the *x* and *z* slots in the frame "*x* gives *y* to *z*." In its uninflected form, "give" is produced in neutral space (at chest level), with a short outward movement. To indicate "I give to you," the signer moves the sign from herself toward the addressee. To indicate "you give to me," the signer reverses the movement, beginning the sign at the addressee and moving it toward herself (Padden, 1983).

Iconicity could play a role in the deaf child's acquisition of verb agreement system. After all, the sign "I-give-you" is largely identical to the motor act children actually perform when they give a small object to an addressee. The agreement system should be relatively easy to acquire if iconicity is playing a role. However, if children are treating a sign like "I-give-you" not as a holistic representation of the giving act, but as a verb with markings for two arguments (the giver and the givee), the sign will be morphologically complex in their eyes and should therefore be acquired relatively late. And indeed it is not until between 3 and 3½ that deaf children use agreement widely and consistently (Meier, 1982). Moreover, the path of acquisition children follow seems to adhere to morphological principles rather than iconic ones – signs that agree with two arguments (e.g., "give") are acquired *later* than signs that agree with only one argument. Any iconic hypothesis ought to predict that "give" would be an early acquisition.

### *Combining signs into sentences*

Children learning sign begin to produce two-sign sentences around the middle of the second year – approximately the same time that children learning spoken language produce their two-word sentences. Despite the differences in the modality of the languages they are learning, sign-learning children express approximately the same range of semantic relations in these early sentences as children learning spoken languages. Moreover, particular semantic relations emerge in about the same order as they do for English-learning children: existence relations appear early, followed by action and state relations, then locative relations, and finally datives, instruments, causes, and manners of action (Newport & Meier, 1985).

Deaf children learning sign language from their deaf parents use consistent word order as a syntactic device for marking role early in development, despite the fact that adult signers do not always do so. Thus, for example, whereas an adult signs "I-give-you" by moving the sign from herself toward the addressee, a deaf child produces three separate signs and produces them in a consistent order (point at self, give, point at addressee; Newport & Ashbrook, 1977). As in children learning spoken languages, children pick up the least marked or pragmatically most neutral orders in the sign languages they are exposed to: for example, subject–verb–object (SVO) in ASL (Hoffmeister, 1978) and subject–object–verb (SOV) in the Sign Language of the Netherlands (Coerts, 2000).

To summarize thus far, children are sufficiently flexible that, if presented with a language system processed by hand and eye, they will not only learn that system but they will do so without a hitch. Whatever predispositions children bring to the task of language-learning, they must be broad enough to work in the manual or the oral modality.



## Language-Learning Around the Globe

Languages vary around the globe. Do the differences across languages make a difference to the language-learning child? If they do, we should see differences in the way children who are exposed to different languages progress through the language-learning stages. If they don't, we should see similarities across children despite the fact that they are exposed to different languages. Similarities of this sort are good candidates for the resilient properties of language.

For the most part, children accept the different constructions that appear across languages from the earliest stages. For example, English and Korean present children with different ways of talking about joining objects. Placing a videocassette in its case or an apple in a bowl are both described as putting one object "in" another in English. However, Korean makes a distinction that highlights the fit of the objects – a videocassette placed in a tight-fitting case is described by the verb "kkita," whereas an apple placed in a loose-fitting bowl is described by the verb "nehta." Young children have no trouble learning to talk about joining objects in terms of containment in English or fit in Korean (Choi & Bowerman, 1991). However, there are times when children seem to over-ride the linguistic input they receive, and these are the cases that we focus on in this section.

### *Privileged meanings*

At times, children learning different languages express a particular meaning without apparent regard for the varied forms the meaning takes across the languages. For example, children learning English, Italian, Serbo-Croatian, and Turkish all follow the same developmental pattern when learning to talk about location – "in" and "on" precede "under" and "beside," which precede "between," "back," and "front" for objects that have an inherent front–back orientation (e.g., cars, houses), which precede "back" and "front" for objects that do not have an inherent orientation (e.g., plates, blocks; Johnston & Slobin, 1979). Importantly, the forms used to express these meanings differ across the languages – prepositions (English, Italian), prepositions and case inflections (Serbo-Croatian), and postpositions and case inflections (Turkish). The absolute ages for these developments differ across children learning each language. However, the *order* of development remains the same, suggesting that this order may be determined by the children themselves (for example, by changes in their understanding of locations and spatial relations independent of language).

There are other ways in which children can convince us that they are playing an active role in constructing their language. The range of meanings children express with a given form may be *broader* than the adult range. For example, children often use the same grammatical form for both animate and inanimate reference points in a locative relation, despite the fact that adult talk makes a distinction between the two. German-learning children incorrectly generalize "zu," the preposition used to express location (a relation involving an inanimate recipient), to express possession (a relation involving an animate recipient and conveyed by the preposition "von" in adult talk; Mills, 1985). As another example, English-learning children at times confuse "give," which adults use to refer to moving objects toward a person, and "put," which adults use to refer to moving objects to a place – "give some ice in here, mommy," and "can I go put it to her?" (Bowerman, 1982). The children are effectively ignoring animacy distinctions that are present in the adult language to which they are exposed.

In addition to broadening the meaning of an adult grammatical marking, children also *narrow* the meanings of adult grammatical forms, presumably to focus on distinctions that are conceptually salient for the child. For example, children around the globe begin by grammatically marking agent–patient (i.e., doer–done to) relations in basic causal events (Slobin, 1985). These are events in which an agent carries out a physical and perceptible change of state in a patient, by means of either direct body contact or an instrument – what Hopper and Thompson (1980) call *highly transitive* events. In Russian, a particular linguistic marker called an accusative inflection must be placed on all words that fill the syntactic slot *direct object*, regardless of the type of event conveyed. However, children acquiring Russian initially use the accusative inflection only for direct objects in sentences describing manipulative physical actions (giving, putting, throwing). In sentences describing actions that are less obviously operating on an object (e.g., seeing), young children use a noun without any inflection at all (Gvozdev, 1928/1961, as described in Slobin, 1985).

Children's initial use of tense reflects the same narrowing focus on events that bring about visible change of state. For example, children first use past-tense verb inflections on a select set of verbs – verbs that name momentary events resulting in a visible change of state or location (e.g., *find, fall, break*), and not on verbs that name events extending over time without an immediate and clear result (e.g., *play, hold, ride, write*; Bloom, Lifter, & Hafitz, 1980). Only later do children develop a more general past tense that applies to all verbs, including those describing events that do not result in visible changes of state. Moreover, the focus on results may bring with it a tendency to concentrate on marking patients at the expense of agents. For example, Italian-learning children will make the past participle of transitive verbs agree in number and gender with the direct object/patient, not the subject/agent – despite the fact that, in the input language, the participle agrees with neither object nor subject of a transitive verb, and agrees with the subject (actor) of an intransitive verb (Antinucci & Miller, 1976). The close relation between objects and results in the real world may encourage the child to create grammatical structure where there is none.

### *Privileged forms*

In addition to *meanings* that appear to be privileged in the early stages of child language, there are *forms* that children apparently find easy to incorporate into their language. For example, children use consistent word order in their early sentences even when the language they are learning has relatively free word order (Bates, 1976; MacWhinney, 1977; Slobin, 1966). As another example, children place one-argument verbs in two-argument predicate frames whether or not the alternation is permissible in their language. For example, an English-learning child said "Kendall fall that toy" to mean that she dropped



the toy (Bowerman, 1982). By placing "fall" in a "*y* __ x" frame rather than the correct "*x* __" frame, Kendall is giving the word a transitive meaning (action on an object) rather than an intransitive meaning (action with no object). Comparable examples have been reported in children learning French, Portuguese, Polish, Hebrew, Hungarian, and Turkish – even in languages where the input does not model this possibility (Slobin, 1985).

Children are sensitive to regularities of form not only within sentences but also across sentences. They detect regularities across word sets called *paradigms*. As an example of a paradigm, the various forms that verbs can take (*walk – walks – walked*) constitute a verb paradigm. We saw earlier that English-learning children detect regularities within paradigms, and often attempt to "regularize" any ill-fitting forms they find. For example, children alter the past tense form for "eat" so that it conforms to the paradigm constructed on the basis of the regular verbs in their language (*eat – eats – eated* rather than *eat – eats – ate*). Morphological paradigms in English are rather simple compared to paradigms in other languages but children are equally capable of regularizing the more complex morphological systems. For example, in Spanish, nouns that are masculine take the indefinite article *un* and the definite article *el* and generally end in *-o*; in contrast, nouns that are feminine take the articles *una* and *la* and generally end in *-a*. Spanish-learning children learn these regularities early, as is evident from the fact that they will attempt to "clean up" any nouns that happen to violate this paradigm: for example, they produce "una mana" rather than the irregular, but correct, form, "una mano" (= hand, feminine), and "un papelo" rather than the irregular correct form, "un papel" (= paper, masculine; Montes Giraldo, 1976, as described in Clark, 1985).

To summarize thus far, we find that children do exhibit commonalities in the early steps they take in the language-learning process despite differences in the languages to which they are exposed. These commonalities could well constitute "conceptual starting points for grammaticized notions" (Slobin, 1997). Starting points are just that – a place to begin. In the longer term, children are clearly able to cope with the wide diversity across languages, learning whatever system is put before them. The job of any theory of language acquisition is to account for the developmental progression that takes children from their starting point to such very different endpoints. If the endpoint language matches the child's starting point in a particular domain, that domain is likely to be relatively easy to learn. If, however, the endpoint language uses categories that are wider, or narrower, than the categories with which the child starts the language-learning process in a domain, that domain is likely to be more difficult to learn. Where the rough and easy spots are in the developmental process may thus depend on how the particular language a child is learning overlaps with the child's starting point.

## Does More or Less Input Matter?

Some children hear a lot of talk, others hear much less. Do differences of this sort make a difference? To address this question, we need to observe variations in how a particular language – English, for example – is used across families, and then explore whether those variations have an impact on child language-learning.

### *The natural variation in language input that children receive*

The sentences spoken to children are, by and large, short, usually consisting of a single clause; they are clearly spoken and therefore intelligible; they almost never contain grammatical errors; and they tend to focus on events that are taking place in the here-and-now and involve objects that are visible (Snow, 1972). All adults – and even 4-year-old children (Shatz & Gelman, 1973) – simplify their speech in these ways when addressing younger children. However, adults vary in how much they simplify their speech, and in how much they talk at all. The question is whether this variability in input is related in any way to child language-learning.

Newport, Gleitman, and Gleitman (1977) conducted the first of the studies designed to explore the impact of linguistic variation on child language-learning by taking a large number of measures of parental input at time 1, and relating these measures to changes in child language from time 1 to time 2. In general, frequency in the input a child receives seems to matter for both vocabulary- and syntax-learning. The amount of talk mothers address to their children is directly related to the number and types of words (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Naigles & Hoff-Ginsberg, 1998) and complex sentences (Barnes, Gutfreund, Satterly, & Wells, 1983; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002) that children acquire.

However, frequency is not the whole story. One of the most robust findings across a variety of studies is that the development of auxiliaries (e.g., *is, can, do, will*) is related to adult speech (Furrow, Nelson, & Benedict, 1979; Hoff-Ginsberg, 1985; Newport et al., 1977). But the relation is not a straightforward one. The rate at which adults use auxiliaries is *not* related to the child's use of auxiliaries. What does predict child use is mothers' use of *yes/no* questions – questions in which the auxiliary appears at the front of the sentence: for example, "*are* you coming over here?" (Newport et al., 1977). Thus, it is not just how often mothers produce auxiliaries that matters; it is how often auxiliaries are produced in salient positions in the sentence that predicts acquisition (where "salient" is defined in terms of the child's information-processing biases). Children thus appear to bring "learning filters" to the linguistic input they receive, and those filters determine whether input becomes "uptake" (Harris, 1992).

To make the story even more complicated, children are not merely "copying" (Valian, 1999) the input they receive. The fast auxiliary learners tend to hear auxiliaries in first position of sentences addressed to them. However, they first produce auxiliaries in the *middle* of their own sentences, even for questions (e.g., "what he *can* ride in?" "how he *can* be a doctor?"; Klima & Bellugi, 1966). Thus, what linguistic input does is provide opportunities for learning the language system – but it is up to the child to do the inductive work to figure out what that system is.

### *Enriching the input to children*

We can increase the range of variation in the input children receive by providing richer linguistic environments than those found in nature. Experimenters can provide children with concentrated input by expanding particular aspects of the child's utterance. For example, a child says "you can't get in" and the experimenter turns the utterance into a question, manipulating auxiliaries in the process, "no, I can't get in, can I?" (Nelson, 1977). Overall, enrichment works – at least when it comes to auxiliaries. Moreover, enrichment works selectively. When children are provided with enriched input in predicate constructions, their predicates (including auxiliaries) become more complex, but the average length of their utterances and their noun phrases don't change at all (Nelson, Carskaddon, & Bonvillian, 1973).



Enrichment studies can provide clear data on the positive effects of linguistic input on language acquisition, that is, on properties of language that are *sensitive* to the effects of environment. However, enrichment studies cannot provide unequivocal data on the negative effects of linguistic input on acquisition, that is, on the environment-*insensitive* properties of language. If the language children naturally hear already provides enough input for a given linguistic property to develop, enriching their input is not likely to have a further effect on the development of that property.

To avoid this problem, we need to *reduce* the input children typically receive. If there is a threshold level of linguistic input necessary for certain language properties to develop, these properties should *not* develop in a child who lacks linguistic input. If, however, linguistic input is not necessary for a set of language properties to develop, these properties ought to emerge in the communications of a child without input. Note that, in studies of speech in natural and enriched environments, non-effects of linguistic input must be inferred from negative results – a property is assumed to be environment-insensitive if input *does not* affect its development. In contrast, in a deprivation study, the presence of a particular property in a child's language is positive evidence for environment-insensitive properties of language – a property is assumed to be environment-insensitive if it *does* appear in the deprived child's repertoire. These are language properties whose development is not affected by linguistic input. They therefore might be properties that children themselves are able to introduce into linguistic systems.

### *Degrading the input to children*

It is unethical to remove a child's language input. Nevertheless, circumstances have arisen in which children have been deprived of linguistic input. For example, a young girl was discovered at age 13, after having been isolated and confined to a small room with no freedom of movement and no human companionship. This child, called "Genie," was deprived of not only linguistic input but also physical and social stimulation. Not surprisingly, she did not develop language or any other form of communication during her years of isolation and deprivation (Curtiss, 1977; Fromkin, Krashen, Curtiss, Rigler, & Rigler, 1974). Children do not develop human language under developmental conditions this extreme, suggesting that there are limits on the resilience of language.

But radical deprivation studies cannot tell us whether linguistic input is essential to language-learning. To address this question, we need to locate children experiencing normal social environments except for their impoverished linguistic input. For a variety of reasons, deaf children are often exposed to less-than-perfect linguistic input yet live in a supportive social world. Consider the case described by Singleton and Newport (2004). The child, Simon, was born to deaf parents, but his parents were late-learners of sign and thus did not have complete mastery of ASL morphology. Simon was exposed only to this imperfect model yet he developed morphological structure that was more complex than that of his parents and comparable in many respects to the morphological structure developed by deaf children exposed to complete models of ASL. Simon was not limited by his linguistic input.

The newly developing Nicaraguan Sign Language (NSL) provides further evidence of children going beyond their linguistic input. Opening the first school for the deaf in Managua in the late 1970s created an opportunity for Nicaraguan deaf children to interact with one another for the very first time. The children in this situation created a new sign language, which was initially very simple and had many irregularities. However, the language became the input for the next group of young signers, who developed new and more complex linguistic structures (Senghas & Coppola, 2001).

We also see linguistic creativity when deaf children are exposed not to a naturally evolving sign language (such as ASL or NSL) but rather to Manually Coded English (MCE), a sign system invented by educators to map English surface structure onto the visual/gestural modality. Deaf children find it difficult to process MCE and end up altering the system, introducing grammatical devices reminiscent of those found in ASL (S. Supalla, 1991). Thus, when provided with *inadequate* linguistic input, children are capable of transforming that input and constructing a rule-governed system of their own.

An even more remarkable example of the resilience of language comes from children who have had *no exposure* to a conventional language model whatsoever. These children are born with hearing losses so severe that they cannot acquire spoken language and born to hearing parents who have not exposed them to a model of a sign language (either ASL or MCE). Such children are, for all intents and purposes, deprived of a usable model for language – although, importantly, they are not deprived of other aspects of human social interaction. Despite their lack of linguistic input, deaf children in these circumstances use gesture to communicate. This, by itself, is not striking. What is noteworthy is that the gesture systems these deaf children create are structured like natural language (Goldin-Meadow, 2003a). Table 13.1 lists the properties of language that have been found thus far in the deaf children's gesture systems. There may, of course, be many others not yet discovered. The table lists properties at the word- and sentence-levels, as well as properties of language use, and details how each property is instantiated in the deaf children's gesture systems.

In terms of word-level structure, the deaf children's gesture-words have five properties found in all natural languages. The gestures are *stable* in form, although they needn't be. It would be easy for the children to make up a new gesture to fit every new situation. However, the children develop a stable store of forms which they use in a range of situations – they develop a lexicon, an essential component of all languages. Moreover, the gestures they develop are composed of parts that form *paradigms*, or systems of contrasts. When the children invent a gesture form, they do so with two goals in mind – the form must not only capture the meaning they intend (a gesture-to-world relation), but it must also contrast in a systematic way with other forms in their repertoire (a gesture-to-gesture

**Table 13.1** The resilient properties of language

| *The resilient property* | *As instantiated in the deaf children's gesture systems* |
|---|---|
| Words | |
| Stability | Gesture forms are stable and do not change capriciously with changing situations |
| Paradigms | Gestures consist of smaller parts that can be recombined to produce new gestures with different meanings |
| Categories | The parts of gestures are composed of a limited set of forms, each associated with a particular meaning |
| Arbitrariness | Pairings between gesture forms and meanings can have arbitrary aspects, albeit within an iconic framework |
| Grammatical functions | Gestures are differentiated by the noun, verb, and adjective grammatical functions they serve |
| Sentences | |
| Underlying frames | Predicate frames underlie gesture sentences |
| Deletion | Consistent production and deletion of gestures within a sentence mark particular thematic roles |
| Word order | Consistent orderings of gestures within a sentence mark particular thematic roles |
| Inflections | Consistent inflections on gestures mark particular thematic roles |
| Recursion | Complex gesture sentences are created by recursion |
| Redundancy reduction | Redundancy is systematically reduced in the surface of complex gesture sentences |
| Language use | |
| Here-and-now talk | Gesturing is used to make requests, comments, and queries about the present |
| Displaced talk | Gesturing is used to communicate about the past, future, and hypothetical |
| Generics | Gesturing is used to make generic statements, particularly about animals |
| Narrative | Gesturing is used to tell stories about self and others |
| Self-talk | Gesturing is used to communicate with oneself |
| Metalanguage | Gesturing is used to refer to one's own and others' gestures |

relation). In addition, the parts that form these paradigms are *categorical*. The manual modality can easily support a system of analog representation, with hands and motions reflecting precisely the positions and trajectories used to act on objects in the real world. But, again, the children don't choose this route. They develop categories of meanings that, although essentially iconic, have hints of *arbitrariness* about them (the children don't, for example, all share the same form–meaning pairings for handshapes). Finally, the gestures the children develop are differentiated by *grammatical function*. Some serve as nouns, some as verbs, some as adjectives. As in natural languages, when the same gesture is used for more than one grammatical function, that gesture is marked (morphologically and syntactically) according to the function it plays in the particular sentence.

In terms of sentence-level structure, the deaf children's gesture sentences have six properties found in all natural languages. Underlying each sentence is a *predicate frame* that determines how many arguments can appear along with the verb in the surface structure of that sentence. Moreover, the arguments of each sentence are marked according to the thematic role they play. There are three types of markings that are resilient: (1) *deletion* – the children consistently produce and delete gestures for arguments as a function of thematic role; (2) *word order* – the children consistently order gestures for arguments as a function of thematic role; and (3) *inflection* – the children mark with inflections gestures for arguments as a function of thematic role. In addition, *recursion*, which gives natural languages their generative capacity, is a resilient property of language. The children form complex gesture sentences out of simple ones. They combine the predicate frames underlying each simple sentence, following systematic, and language-like, principles. When there are semantic elements that appear in both propositions of a complex sentence, the children have a systematic way of *reducing redundancy*, as do all natural languages.

Finally, in terms of language use, the deaf children use their gestures for six central functions that all natural languages serve. They use gesture to make requests, comments, and queries about things and events that are happening in the situation – that is, to communicate about the *here-and-now*. Importantly, however, they also use their gestures to communicate about the non-present – *displaced* objects and events that take place in the past, the future, or in a hypothetical world. In addition to these rather obvious functions that language serves, the children use their gestures to make category-broad statements about objects, particularly about natural kinds – to make *generic* statements. They use their gestures to tell stories about themselves and others – to *narrate*. They use their gestures to communicate with themselves – to *self-talk*. And finally, they use their gestures to refer to their own or to others' gestures – for *metalinguistic* purposes.

The properties of language found in the deaf children's gesture system are resilient in the sense that their development does not require input from a conventional language model. Moreover, even though the deaf children's hearing parents produce gestures when they talk to their children (as do all hearing speakers; Goldin-Meadow, 2003b), the parents' gestures do not exhibit the linguistic properties found in the deaf children's gestures. Thus, the children themselves are inventing the linguistic structures.

Interestingly, and perhaps not surprisingly, the deaf children's gesture systems exhibit the privileged meanings and privileged forms that children around the globe develop when exposed to conventional linguistic input. For example, the deaf children's grammatical systems are constructed around highly transitive events and focus on the results of events with little attention to animacy. In addition, the deaf children construct grammatical systems that have structure within sentences (e.g., ordering patterns, underlying predicate frames), as well as structure across sentences (e.g., word sets or paradigms), as do all children learning conventional languages. It is these forms and meanings that children themselves seem prepared to develop. If a model for these properties is not present in their input, children will invent them – operationally defining the resilient properties of language.



## Is Language Innate?

The fact that all known human groups (even those incapable of hearing) have developed language is reason enough to consider the possibility that language-learning is innate. And the fact that human children can invent components of language even when not exposed to any linguistic input makes it more likely still that language-learning ought be considered innate. However, the problem in even beginning to address this issue is finding a comfortable definition of "innate."

One might naïvely think that if learning is involved in the development of a behavior, the behavior cannot be innate. However, we'd like our definition of innate to be more subtle – some learning is involved in the acquisition of all human skills, even one as basic as walking (Thelen & Ulrich, 1991). The issue is not whether learning has occurred but whether learning is guided by the organism as much as, if not more than, by the environment. A study by Marler (1990) best exemplifies the point. Two closely related species of sparrows were raised from the egg in identical environments and exposed to a collection of songs containing melodies typical for each species. Despite their identical input, the two species learned different songs. Each species learned only the songs in the collection that adult members of its own species typically sing. Similarly, Locke (1990) argues that to a certain extent human infants select the sounds they learn preferentially, often learning frequently heard phonemes relatively late and infrequently heard phonemes quite early. Birds and children both learn from the input they receive, but their learning is selective.

Another way of saying this is that the range of possible outcomes in the learning process is narrowed, and the organism itself does the narrowing. This narrowing, or "canalization," is often attributed to genetic causes (cf., Waddington, 1957). However, canalization can also be caused by the environment. For example, exposing a bird to a particular stimulus at one point early in its development can narrow the bird's learning later on – the bird becomes particularly susceptible to that stimulus, and buffered against responding to other stimuli, at later points in development (Gottlieb, 1991). Thus, for any given behavior, we need to investigate the causes of canalization rather than assume a genetic base.

In human studies, we cannot freely engineer organisms and environments, and developmental histories are quite complex. It is therefore difficult to attribute canalization to either genetic or environmental causes. Does this difficulty render the notion "innate" meaningless? Not necessarily. The definition of "innate" need not be anchored in genetic mechanisms. Indeed, of the large number of criteria that have, over many years and many disciplines, been applied to the term "innate," Wimsatt (1986) argues that the one that is *least* central to the notion's core is having a genetic base (see also Block, 1979; Spelke & Newport, 1998). In his view, a more fundamental definition is developmental resilience. A behavior that is developmentally resilient is one whose development is, if not inevitable, certainly one that each organism in the species is predisposed to develop under widely varying circumstances. Language seems to be a prime example of such a behavior.

We have seen in this chapter that language is resilient in the face of variations *external* to the organism. Interestingly, language-learning is also resilient in the face of variations *internal* to the organism. For example, grammar-learning in the earliest stages can proceed in a relatively normal manner and at a normal rate even in the face of unilateral ischemic brain injury (Feldman, 1994). As a second example, children with Down's syndrome have numerous intrinsic deficiencies that complicate the process of language acquisition; nevertheless, most acquire some basic language reflecting the fundamental grammatical organization of the language to which they are exposed (Fowler, Gelman, & Gleitman, 1994). Finally, and strikingly given the social impairments that are at the core of the syndrome, autistic children who are able to learn language are not impaired in some aspects of their grammatical development, specifically syntax or morphology, although they do often have deficits in the communicative, pragmatic, and functional aspects of their language (Tager-Flusberg, 1994).

Thus, language development can proceed in humans over a wide range of environments and a wide range of organic states, suggesting that the language-learning process is buffered. It looks as though there is a basic form that human communication naturally gravitates toward and a variety of developmental paths that can be taken to arrive at that form. In this sense, language development in humans can be said to be characterized by "equifinality" – a term coined by the embryologist Driesch (1908/1929, as reported in Gottlieb, 1996) to describe a process by which a system reaches the same outcome despite widely differing input conditions.

Of course, not all language users are alike. There are differences across individuals in what they do with language and perhaps even how much they know about language (e.g., Gleitman & Gleitman, 1970; see Hoff, this volume, for a discussion of factors that might lead to such individual differences). But there are some fundamental properties that are found in *all* human language users (properties like having a stable lexicon or using order to signal who does what to whom). It is these resilient properties that have been the focus of this chapter. Whatever developmental mechanisms we come up with to account for the aspects of language-learning that vary across individuals must also be able to account for the equifinality that characterizes the resilient properties of language.

Language is not a unitary whole, particularly when it comes to issues of resilience and innateness. Deaf children inventing their own gesture systems develop some but not all of the properties found in natural human languages (Goldin-Meadow, 2003a). The absence of a conventional language model appears to affect some properties of language more than others. Even when linguistic input is present, that input is more likely to affect rate of acquisition for certain properties of language than for others (e.g., auxiliaries more than complex sentences; Newport et al., 1977). Further, when language is acquired



"off-time" (i.e., relatively late in the ontogenetic timespan), certain properties of language are more likely to be acquired (word order, complex sentences) than others (auxiliaries; Curtiss, 1977; Newport, 1991). Interestingly, it appears that the *same* properties of language may be resilient across many different circumstances of acquisition. For example, word order and the production of complex sentences are two properties that seem to be resilient across acquisition without a conventional language model, acquisition with varying input from a language model, and acquisition late in development after puberty (Goldin-Meadow, 1978, 1982). It is these resilient properties that form the bedrock of language-learning when it follows a typical course, and that may be able to serve as the starting point for intervention when language-learning goes awry.

In closing, I suggest that innateness is best evaluated through the perspective of developmental resilience. Innateness is operationalized by specifying the range of environments in which certain aspects of language-learning develop. There clearly are limits on language development in humans – children raised without human interaction do not develop language. But, as we have seen throughout this chapter, language development can proceed even in the face of deviations from typical learning environments. By exploring this resilience, we learn that certain aspects of language are central to humans – so central that their development is virtually guaranteed, not necessarily by a particular gene but by a variety of combinations of genetic and environmental factors. It is in this sense that language is innate.

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