

## Signposts to the Essence of Language

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In one of the most dramatic incidents of the French Revolution, the Abbé Sicard, director of the school for the deaf in Paris, failed to take an oath of civil allegiance. As described by Lane (1), he was imprisoned and sentenced to die. However, Sicard, who was devoted to establishing communication through sign language, was rescued through the pleas of his deaf students. They petitioned the National Assembly for his release, testifying that without him they would be like animals.

Deaf people have fiercely resisted century-old attempts to prevent them from using their own sign language for communication (2). They argue that sign language is equivalent to spoken language and that users of a sign language should be accorded the same rights as users of a spoken language. The origin and core properties of sign language, however, remain to be elucidated. On page 1779 of this issue, Senghas *et al.* (3) address this lack of information in their landmark study of three cohorts of deaf Nicaraguan signers. Their research is based on the passion for sign language of several generations of deaf children attending a special education program set up in 1977 in the Nicaraguan capital, Managua. In the 30 years since the program opened, the children have created a completely new language—Nicaraguan Sign Language (NSL)—that has continued to expand and mature and has been passed on from one group of children to the next (see the photographs). There are about 800 deaf NSL signers, ranging in age from 4 to 45 years. NSL is one of hundreds of distinctive sign languages in existence around the world (see the figure). The creation of NSL has allowed unique insights into the essence of language—both sign and spoken.

Segmentation and sequencing are considered vital core properties of all languages. In their investigation, Senghas *et al.* explicitly analyzed the segmentation and sequencing in NSL of elements such as motion. The authors did this by showing animated cartoon videos to three cohorts of

NSL signers of different ages and to a sample of hearing Spanish-speaking Nicaraguans. In one of these videos, a cat swallows a bowling ball and wobbles (manner of movement) as it descends (path of movement) down a steep road. The first cohort of Nicaraguan signers, who were the initial builders of NSL, represented manner and path information simultaneously in a single movement of the hand, much as the Spanish speakers did in the gestures that accompanied their speech. In contrast, the second and third cohorts of NSL signers overwhelmingly produced sequential hand movements involving strings of segmented manner-only and path-only elements. Such segmentation and sequence elements can be embedded within other signs (phrases) to build a hierarchical organiza-

tion of information that forms an elaborate communication system. Intriguingly, NSL has evolved from a system of nonlinguistic gestures into a full sign language with its own grammar that continues to expand and mature. Consequently, because they have learned the language most recently, the youngest children in the NSL community are the most fluent signers.

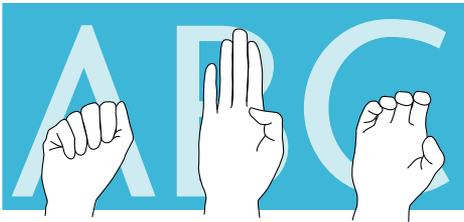
Senghas *et al.* observe that segmenting and sequencing depend on combining elements of language within a hierarchical structure that permits the generation of an infinite number of messages. The mechanisms through which segmentation and sequencing are achieved in NSL challenge the position that language evolves through



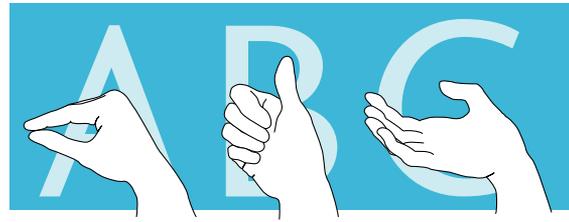
**Fluency among the youngest.** Nicaraguan children communicate through a sign language (NSL) that they developed over a 30-year period. The opening of an education program in 1977 in Managua (the capital of Nicaragua) brought together a community of deaf children for the first time in that country. The children developed their own sign language, which evolved from nonlinguistic gestures to a full grammatical language that continues to mature. The youngest children in the NSL community are the most fluent signers, having learned the language most recently.

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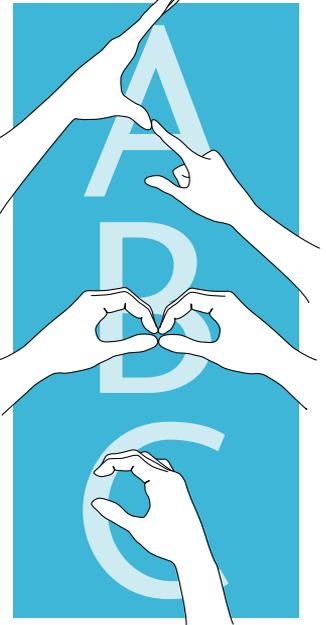
American



Swedish



British



cultural transmission. These mechanisms may have evolved through learning abilities that either shape language or have been shaped by language. Clearly, deaf Nicaraguan children have created their own language independently of exposure to a preexisting language structure.

Regarding the part played by learning in the shaping of language, the results of the Nicaraguan study are consistent with research that underscores the spontaneous development of language in both hearing and deaf children. Hearing infants at 2 months of age prefer speech to nonspeech sounds (4). Profoundly deaf infants of deaf parents display manual babbling using a reduced set of the phonetic units in American Sign Language (ASL) in a manner analogous to the vocal babbling of hearing infants exposed to a spoken language (5). In the first few years of development, virtual-



ly all children—whether hearing children exposed to a spoken language or deaf children exposed to the sign language of their deaf parents—acquire the grammar of their native language. The structure of spontaneous gestural communication (“home signing”) of American deaf children resembles more closely that of deaf children in Taiwan than that of their own hearing mothers (6). Language involves “language-making” skills—segmenting words into morphemes and sentences into words, setting up a system of contrasts in morphology, and constructing syntactic structures—that do not require a language model to be

**Signing across the world.** Examples of sign language alphabets: American, Swedish, and British. British sign language is not readily intelligible to users of ASL and, unlike ASL or Swedish sign language, uses a two-handed alphabet (13). The geographical distribution of sign as well as spoken languages reflects the input of nonnative languages introduced across cultures. In developing countries, deaf people may use the sign language of educators and missionaries from elsewhere in the world. For example, some deaf individuals in Madagascar use Norwegian sign language, whereas children in Nicaragua have created their own sign language.

activated. Language is so resilient that it can be triggered by exposure to a linguistic input that is highly limited and fragmented—an indication of the fundamental inateness of grammar (7, 8).

Early language exposure shapes linguistic ability, in that those who become deaf after having acquired spoken English appear to be more proficient in learning ASL than those born profoundly deaf with little linguistic experience before exposure to ASL at school. In contrast, deaf people who are exposed early to ASL are able to learn spoken English better than those who have been exposed late (9). But do such language-shaped learning mechanisms stop there? Can they be extended to allow or facilitate the acquisition of, for example, mathematics or propositions about the beliefs held by the minds of others?

One question to be resolved is whether language entails a learning mechanism that instantiates mathematical reasoning, given that language and mathematics share similarities in syntactic structure (10). Another question is whether the syntactic structure of language allows us to entertain propositions—for example, “John thought that Mary knew the cookies were in the cupboard”—that permit insight into the false beliefs of others, or whether it is early access to conversations that alert children to the notion that beliefs can differ from reality (11). Also, it is not clear whether the

innate structure of language allows processing of causal and counterfactual reasoning.

In this light, language can be regarded as mandatory to human development with widespread, although as yet undetermined, implications for the nature of cognition. Without access to language, our communication would rely on iconic representations that are within the grasp of nonhuman primates and even pigeons (12). The Nicaraguan research highlights segmenting and sequencing as core linguistic properties that develop innately and not as a result of cultural transmission. Such innateness confers humanity on both deaf and hearing people through language creation and immersion.

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