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## Language Emergence: Clues from a New Bedouin Sign Language

A sign language has emerged among three generations of deaf people and their families in a Bedouin community in the Negev desert. This newly reported case sheds light on the minimal environmental social factors required to generate a language.

Ann Senghas

Language is found in every human community. Some groups lack mathematics, writing systems, even the wheel, but every community has a symbolic system for encoding and transmitting information from person to person. What cognitive, social, and environmental conditions give rise to these complex systems? In most cases, we cannot isolate the factors that produce language. Nearly all communities offer members far more than is necessary in what are likely to be the relevant domains, including a large social network, a language that has been honed over generations, and immersion from an early age.

We cannot tinker with the size of social communities, or deprive children of exposure to their community's language. We can, however, seek out real-world

situations in which access to these resources is limited to varying degrees. Deaf people find themselves in such a variety of circumstances. Out of their situations arise a range of communication systems, from minimally structured gesture systems to sign languages as complete and complex as any spoken language.

The most recently reported case, documented by Wendy Sandler and her colleagues [1], concerns a sign language that has emerged within a small Bedouin community in present-day Israel (Figure 1). In its details, this case complements previous accounts in which people had to find a new way to communicate. By considering these accounts together, we can hone in on the conditions that engender language.

At one end of the spectrum is the single deaf child in a family

that communicates using spoken language. Children in this situation invent simple gestural systems [2], called 'homesigns', to communicate with other family members. Homesign systems from places as different as Taiwan and North America exhibit similar patterns of gesture order [3]. These patterns evidently originate in the children themselves; they are not found in the gesturing of their hearing family members. Work with adolescent and adult homesigners shows that homesigning can develop more complexity with time and use [4]. Though homesign systems never develop into full languages, Susan Goldin-Meadow [5] argues that they reveal language's most resilient properties.

At the other end of the spectrum are large, multi-generational communities of deaf people, in which fully developed sign languages are passed from each generation to the next [6]. Children exposed from birth to such a community present a situation similar to typical hearing children exposed to spoken language: their environment is more than rich enough in all of the relevant domains.

Historical work can inform us about the nature and size of early



Figure 1. Examples of signs from Al-Sayyid Bedouin Sign Language. (Photos: Shai Davidi, Sign Language Research Laboratory, University of Haifa.)

Table 1. Social conditions under which signed communication systems emerge.

Situation	Number of people	Number of generations	Number of years	Learners' age at first exposure	Input to current learners	Hearing status of interlocutors	Context for transmission to new generations
Al-Sayyid Bedouin Sign Language	10 in first generation 150 to date	3	70	Birth	2nd generation signing	Deaf and hearing	Multi-generational family home
Homesign	1	1	Individual lifespan	Birth	Co-speech gesture	Hearing	None
Nicaraguan Sign Language	50 in first cohort 800 to date	1 (in 3 cohorts)	25	5	2nd cohort signing	Deaf	School and urban community
American Sign Language	Hundreds of thousands	8	200	Variable	Full language	Mostly deaf	Family home, school, and larger community
Optimal situation	High	High	High	Low	Full language	Unknown	Frequent close contact, older to younger

deaf communities. It is difficult, however, to establish when the earliest sign systems attained a complexity greater than homesigns, or when particular linguistic properties emerged [7–9]. This makes it challenging to recover precisely the social conditions under which each language emerged.

In Nicaragua, a sign language has arisen recently enough that its first stages can be recovered; indeed, its originators are still living [10–12]. Since the late 1970s in Nicaragua, rapidly expanding programs in special education brought deaf children and adolescents together in greater numbers than before [13,14]. Although teachers emphasized learning to speak and lip-read Spanish (with little success), students spontaneously began using signs and gestures with each other during recess and after school. The signs have been taken up by a new entering class of deaf children every year since. Nicaraguan Sign Language is now the primary language of approximately 800 people, ranging in age from four to forty-four.

Recently attention has been drawn to a young sign language used by the Al-Sayyid Bedouin group, a community of 3500 that has resided in the Negev region of Israel for the past 200 years [1]. Approximately 80 of the community's members today are congenitally deaf — at 2%, this is about 20 times the incidence observed elsewhere [15]. All 150 deaf people born into the past

three generations are descendants of two of the founder's five sons. This high concentration of deafness, in combination with a culture of extended family households, means that deaf children are typically raised in a home with at least one older deaf person who signs. Deaf adults are fully integrated into the community, are not stigmatized, and always marry to someone who is not deaf. In this context, many hearing members of the community sign as well.

The oldest signers in this community report that their sign language dates back to the generation before them — a generation that included ten deaf members. Accordingly, Al-Sayyid Bedouin Sign Language can be dated to be approximately 70 years old, and in its third generation. Sandler *et al.* [1] report on the signing of the second generation, who range from 20 to 40 years in age. These signers produce structured sentences with a word order that differs from the other languages of the region: Arabic, Hebrew or even Israeli Sign Language (which is not used locally in any case). Al-Sayyid Bedouin Sign Language is evidently a new, independent language.

Taking this new case into consideration, we can assess the range of situations that do and do not result in a new language (Table 1). The number of people involved is certainly a determining factor. Homesigns, having essentially a community of one, never develop

into full languages, not even after 20 years of use. Nicaraguan Sign Language emerged within its first decade as its numbers rapidly grew from 50 to 200 and more. (Classrooms had had as many as 24 children together before that time [13]; it is worth noting that a language did not arise among these smaller groups.) The Al-Sayyid Bedouins started out with fewer deaf people and grew more slowly, from 10 to 150 over three generations. Systematic structure in the language is evident already in the second generation; it would be informative to determine how many deaf individuals that generation includes.

A related factor is the size of the extended community with which the deaf individuals communicate regularly. A smaller community, with a high degree of shared knowledge, might put less pressure on a communication system to develop ways to encode complex information or fine distinctions. This means a language would develop more slowly within a small community, and, if the community were very small (as in a homesigner's nuclear family), might never develop beyond the most basic structures.

Also varying across these cases is the number of times the system has been passed down to a new generation of learners. This factor turns out to be especially relevant to theories in which child learners play an important role in giving languages their structure [16,17]. For a system passed from parent to child, the number of generations

will correlate with the age of the language. Al-Sayyid Bedouin Sign Language has been around about twice as long as Nicaraguan Sign Language, and has passed through more family generations. On the other hand, Nicaraguan Sign Language is passed to a new cohort of 15–20 learners each year, a number that approximates a 20-year Al-Sayyid Bedouin Sign Language generation. By comparing the rates of development in the two languages, we can determine which aspects of language appear with iterations of child learners, and which appear merely with years of use.

The situations also differ in the social context in which the system is passed down, and the age at which it is first encountered. Early exposure typically enables better language-learning [18]. This suggests that younger children may have more language-creating abilities than older children, or at least more years to apply such abilities. Al-Sayyid Bedouins are exposed to signing from birth, within the family environment. Nicaraguan Sign Language is transmitted from peer to peer, starting at the age of four or six when a child enters school. Historically, mature sign languages, such as American Sign Language and Australian Sign Language, underwent both kinds of transmission. They have been passed down in families with deaf parents, particularly those with deaf children. But because most deaf children have hearing parents, sign languages are even more commonly transmitted from child to child within a school environment [6]. It seems the particulars of the social community can vary; what is crucial for language birth is a context that provides intergenerational contact, an opportunity for a partially developed system to be passed on to new children. This is lacking in the case of homesign, and may be a determining factor.

There are other dimensions on which these communities vary: the proportion of deaf to hearing users, and the resulting degree of bilingualism; the gestural practices

of hearing people (that is, the richness of raw materials available); the availability of written materials; the presence of all-deaf families; and many others. We cannot know the relative importance of these factors with certainty. But we can make some educated guesses about what situations best promote language creation. Early exposure is key (the younger the better); some critical mass of individuals must be brought together (the more the better); and a social mechanism must be available for passing the language down to new generations. The new case of Al-Sayyid Bedouin Sign Language will help constrain the ranges of these candidate properties, enabling researchers to hone in on the critical mass, critical age, and critical transmission frequency needed for a language to be born.

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## Virus Evolution: Fitting Lifestyles to a T

**The structure of a double-stranded RNA virus outer shell has revealed unexpected similarities with virions of positive-strand RNA viruses. These similarities intersect with emerging parallels in RNA replication to create intriguing evolutionary possibilities.**

Paul Ahlquist

Viruses are exceptionally diverse in morphology, replication strategies, genetic organization and many other characteristics.

Such differences raise significant questions about the diversity of virus origins and the possible extent of functional and evolutionary relationships among existing viruses. These issues are