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Beyond Babble:

Early Linguistic Experience and Language Learning Ability

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Abstract

For over 100 years scientists and educators alike have believed that "earlier is better" for language learning. Researchers have traditionally used two circumstances to investigate the relation between early linguistic experience and the success of language acquisition, namely, linguistic isolation in early childhood and second-language learning. This paper summarizes experiments designed to investigate the question using a third situation, individuals who were born deaf. Childhood deafness often creates a situation that combines aspects of linguistic isolation with delayed first- and second-language acquisition of signed and spoken languages. The results of our studies demonstrate that *first*-language acquisition is highly sensitive the age when the learning begins but that second-language learning is not. Early experience with a signed language facilitates later learning of a spoken language and early experience with a spoken language facilitates later learning of a signed language. A lack of early experience in early life seriously compromises all later language learning ability, regardless of whether the language is signed or spoken. The results of these studies suggest that language ability arises from language experience occurring during early brain growth.

Introduction

Scientists and educators have long believed that languages must be learned in childhood if the learning is to be successful.[1] This belief underlies the rationale for early second-language educational programs worldwide. At the same time, this belief has not been applied to signed languages. Educators have long believed that signed languages are the exception to this rule, that signed languages can be learned at any time in life. Is this true? The answer has important implications both for the education of deaf children and scientific theory. To answer the question, my colleagues and I designed a series of studies that ask whether there is a critical period for language learning that includes signed languages.

Researchers have traditionally used two different circumstances to investigate the critical period for language, rare cases of linguistic isolation in early childhood and the common situation of second-language learning. The existence and nature of a critical period for language is difficult to assess with cases of social isolation in early childhood due to complicating factors such as malnutrition and psychological trauma.[2] A number of studies have taken a different tact and investigated the relation between the age when *second language* learning begins and its outcome. Several studies have found a strong relationship between the age onset of second-language learning and outcome with respect to phonological production and perception and grammatical skills.[3] However, other studies have found contradictory findings that suggest factors such as the amount of education received in the second language and second-language practice mitigate these effects.[4,5]

Signed Languages are Real Languages

What about the case of signed languages? Does the age when signed language acquisition begins predict its outcome? Before addressing this question, it is important to understand the basic findings of the past 30 years of signed language research. First, linguists have discovered that signed languages are natural languages characterized by the same linguistic architecture as spoken languages, that is, signed languages consist of multiple layers of rules that specify how signs (the lexicon) are constructed with sub-lexical patterning (phonology) and how morphology, syntax, and semantics are organized.[6,7] Researchers have discovered that signed languages, like spoken languages, have evolved across generations of language learners in Deaf communities worldwide.[8] Children whose families use signed languages with them from birth spontaneously acquire them in a fashion comparable to children acquiring spoken languages. Babies exposed to signed language begin with a sign-babbling stage, progresses to one- and two-word stages and continue toward the acquisition of complex morphological and syntactic rules. [9,10] Signers must mentally manipulate the linguistic structure of signed languages in order to produce and comprehend them, just as speakers must mentally manipulate linguistic structure when speaking and listening.[7] In other words, research on how babies acquire signed languages and how adults comprehend and produce them demonstrates that the linguistic structure of signed language is psychologically real. Finally, recent research has discovered that, despite differences in sensory-motor modalities and the use of space in signed languages, the brain centers responsible for spoken language comprehension and production, most notably Broca's and Wernicke's areas, are also responsible for signed language comprehension and production. Evidence for these

striking finding comes from studies of aphasia in brain-damaged signers and neuroimaging research.[11,12]

To summarize these important findings, three decades of signed language research has revolutionized our concept of human language. The properties that make language what it is, linguistic structure, rapid and orderly acquisition of structure, mental manipulation of linguistic structure, and specific brain centers for linguistic structure, all transcend peripheral sensory and motor modalities. The human language capacity is deeply mental in nature.

Age of Learning Effects on Signed Languages

Given that signed languages are natural languages governed by the same learning, mental and brain principles as spoken languages, the question arises as to whether their acquisition is constrained by early linguistic experience. First, several studies have found a linear relation between the age when signed language learning begins and signed language outcome.[13,14] For example, Mayberry & Eichen[15] tested the American Sign Language (ASL) skills of 49 adults who were born profoundly deaf and had first begun to learn it at ages ranging from birth to 11 years of age. When length of ASL practice was both lengthy and controlled, deaf adults' ability to repeat complex ASL sentences from immediate memory declined significantly as age of acquisition increased.

The important next question is whether the effects of age of acquisition on signed language outcome are the same for *first* and *second* language acquisition. When deaf children learn a signed language, they often have not yet acquired a *first* language. This situation is due to a number of complex factors, including variable ages of detection of hearing loss, variable onset of intervention for the child and family, and variable success

at acquiring spoken language by the deaf child if, for example, signed language is only made available after speech proves to provide insufficient language input for the child to acquire language spontaneously. Thus, the age at which deaf children are exposed to a signed language is highly variable. Moreover, due the factors just described, signed language acquisition by deaf children is often a case *first* rather than *second* language acquisition.

The complex and unique situation of deaf children's signed language learning leads directly to the question of whether the effects of early experience are the same for *first* as compared to *second* language acquisition. Note that this question cannot be answered with studies exclusively focused on the hearing population. This is because all children who hear normally are immersed in spoken language from birth onward. By contrast, less than 10% of babies born deaf are immersed in signed language from birth, specifically those who have deaf parents. 90% or more of children born deaf and who use sign as a primary language are thus exposed to it at variable ages as a *first* language, but sometimes as a *second* language. This unusual situation of language acquisition thus allows a unique test of the relation between early linguistic experience and language outcome.

Study I: Early Experience and Signed Language Learning

We first investigated the question of whether early experience with a spoken language facilitates the subsequent acquisition of a signed language. We tested two groups of adults who were deaf and first began to learn ASL between the matched ages of 9 and 15 years and had used it continuously for twenty years. One group ($n = 9$) was born with normal hearing and learned ASL as a *second* language after becoming

profoundly deaf due to viral infections such as meningitis. After becoming deaf, they were educated in the company of other deaf children who used signed language and thus learned it in an immersion setting. The second group (n = 9) was born profoundly deaf ($\geq$ 90 db HL). They had little language experience before being exposed to ASL in school. Some of these participants had attended no school until late childhood and others failed to learn to talk in oral educational programs that used no sign or gesture. (Their auditory speech-perception abilities were at chance levels even with hearing aids). The two groups of participants were given a set of 18 complex ASL sentences to recall one at time. The deaf adults who had little language experience in early life prior to learning ASL showed low levels of ASL comprehension and memory performance. By contrast, the late-deafened adults who had learned spoken English in early life and subsequently learned ASL as a *second* language showed high levels of ASL performance at near-native levels, as the first panel of Figure 1 shows.

Study II: Early Experience and Spoken Language Learning

Next we asked whether the facilitative effects of early language experience transcend sensory-motor modality and are cross-linguistic. We tested 3 groups of adults who had learned English at the same ages in school between 4 and 13 years and had used it continuously for 12 years. One group (n = 14) was born deaf and had little language experience before being exposed to ASL in school. The second group (n = 13) was also born deaf but had experienced ASL in infancy because their deaf parents had used it with them in the home. The third group (n = 13) was born hearing and had experienced various spoken languages in infancy (Urdu, French, German, Italian or Greek). We gave all the groups a grammatical judgement task where they decided with a button press

whether or not 120 stimuli were grammatically acceptable in English. Deaf and hearing adults who experienced either a signed or a spoken language in early life showed no differences in their *second* language performance. They also performed at near-native English levels. By contrast, deaf adults who had little language experience in early life showed low levels of performance, at near-chance levels, as the second panel of Figure 1 shows.[16]

Implications

These results show that early language experience is crucial for *first* language acquisition and much less so for *second* language learning. The ability to learn language is not constant across the lifespan but rather appears to arise from a synergy between early brain development and language experience during early life. When language is experienced in early life, the capacity to acquire language throughout in life emerges and fully develops. However, when language is unavailable to the child in early life, the ability to learn language is seriously compromised and never develops fully. Importantly, these effects are cross-linguistic and transcend sensory-motor modalities. Early experience with signed language facilitates later learning of a spoken language and, conversely, early experience with spoken language facilitates later learning of a signed language. Little or no language experience, of any kind, in early life impedes the ability to learn any language in later life, be it signed or spoken.

Ongoing research in our laboratory suggests that these robust effects of early language experience may be a significant factor in the reading development success or failure of deaf children. Prolonged delay in exposure to an accessible language impedes

language development, which, in turn, impedes reading development, even when the language is signed.[17, 18]

To summarize, we have found that early language exposure, regardless of whether the language is signed or spoken, scaffolds the lifelong ability to learn language. When deaf children are exposed to a language they can use in early life, they are able to learn languages throughout life. The converse is true as well. When deaf children are isolated from a language they can perceive, their ability to learn language throughout life is severely compromised. Finally, it is important to note that these findings about the relation of early experience and language development are consistent with scientific findings from a number of perceptual and learning domains in both humans and animals.

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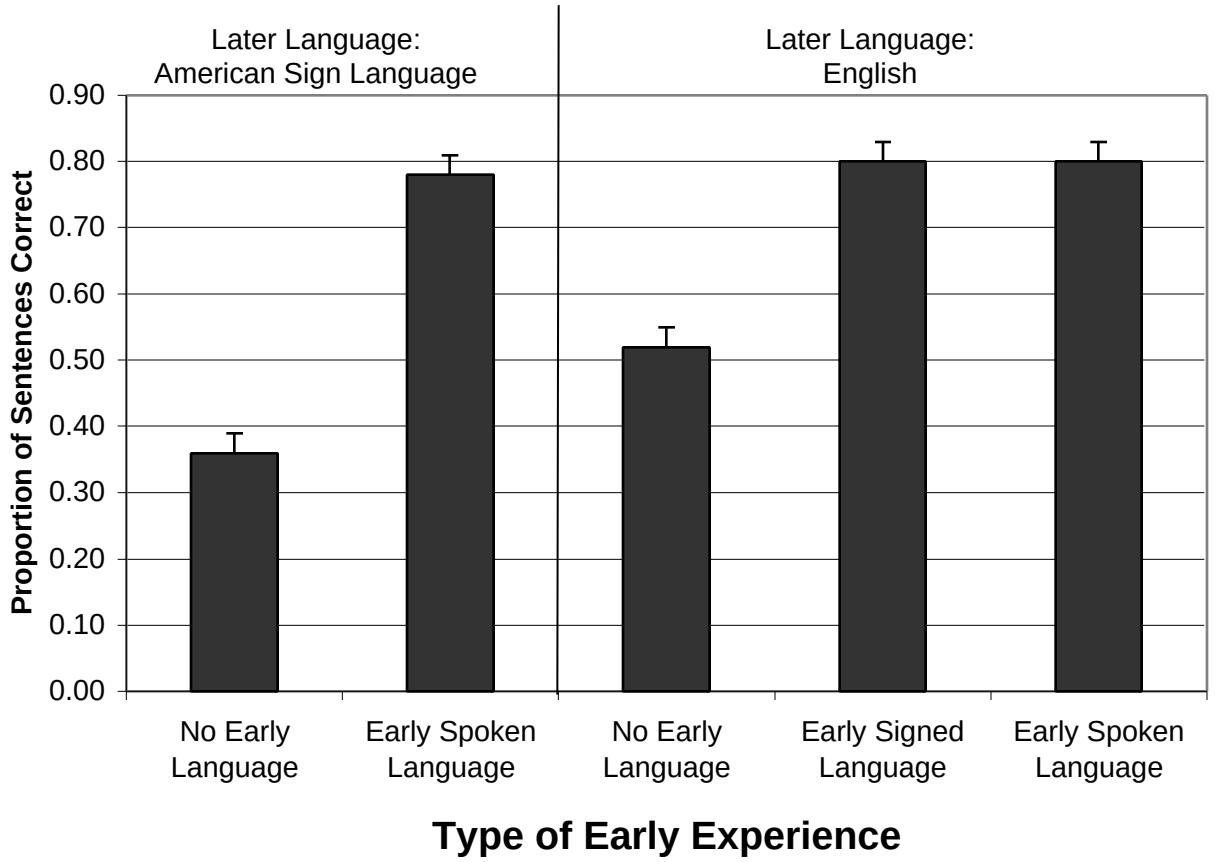
Figure 1.

Effects of early experience on later language learning. **A**. American Sign Language (ASL) performance of deaf adults who had experienced no language in early life and of deaf adults who had experienced spoken language in early life. **B.** English performance of deaf adults who had had no experience of language in early life, of deaf adults who had experienced ASL in infancy, and of hearing adults who had experienced a spoken language other than English in infancy; chance performance is 50%. [Mayberry, R. I., Lock, E. & Kazmi, H. (2002). Linguistic ability and early language exposure. *Nature, 417,* 38.]


Later Language:
American Sign Language
Later Language:
English
Proportion of Sentences Correct
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
No Early Language
Early Spoken Language
No Early Language
Early Signed Language
Early Spoken Language
Type of Early Experience