

Title:

Infant artificial language learning

Synonyms:

Nonsense language, miniature language, patterned syllable stream

Definition:

Artificial languages are miniature languages purposely constructed by linguists and psychologists to test a specific hypothesis regarding the origins of language knowledge or language learnability. The phrase 'infant artificial language learning' refers to a particular type of experimental paradigm in which infants are briefly exposed to an artificial language and then tested on their recognition of patterns or rules contained within that language. Unlike Esperanto or Klingon, the artificial languages used in infant studies are generally not designed for communicative purposes. Rather, they typically consist of a stream of carefully patterned but meaningless syllables. Due to their highly simplified nature, these artificial languages reflect only a select property (or set of properties) observed in natural languages. For example, a researcher interested in how infants start learning the sound structure of language might construct a language containing a lexicon full of words conforming to some predictable sound form template, but the words in the lexicon will have no meaning and the language will have no grammatical rules for stringing together words into longer multi-word utterances. In contrast, a researcher interested in the acquisition of the syntactic rules of language would need to include rules for stringing together words into longer utterances, but may pay little attention to the sound form of the words in the language's artificial lexicon.

Theoretical Background:

The debate over the role of nature versus nurture in the acquisition of language has always been a major point of contention for both linguists and psychologists. Historically, those who believed that nature must play a greater role than nurture have pointed to the complexities of language, arguing that children could not possibly use simple statistical (or associative) learning mechanisms to acquire the complex structure of human language. Those who believed that nurture must play the primary role in language acquisition, on the other hand, have argued that children's computational abilities are strong enough to deduce the structure of many aspects of language based on experience alone. According to this latter view, extensive innate linguistic knowledge is not needed to explain the speed with which children acquire their native tongue because the language they hear contains distributional cues needed to work out many aspects of its underlying structure. It was not until the mid 1990's that experimental studies were able to shed some light on the debate over whether or not infants possessed learning mechanisms powerful enough to extract complex patterns from language input. In this now classic study, Saffran, Aslin, and Newport (1996) demonstrated that 8-month-old infants could extract the statistical structure of an artificial language after a mere two minutes of exposure. Dozens of infant artificial language studies appeared in the literature soon thereafter, all revealing the power of infants' learning abilities (see Gómez & Gerken, 2000, for review). In these studies, researchers created artificial languages containing simplified versions of patterns that exist in natural languages. If infants succeeded in extracting the targeted patterns from the simplified artificial language, researchers would argue that infants possessed the necessary skills to extract the similar (albeit admittedly more complex) patterns from natural language. The logic underlying

these studies was that the more infants could learn based on experience alone, the less innate language knowledge they had to be endowed with in order to succeed in acquiring language. Note, however, that although evidence from artificial language learning experiments suggests that many aspects of language can be learned from experience, these findings have not typically been used to argue that all aspects of language can be learned. That is, the findings are not used to support a purely empiricist view on language acquisition. Rather, the goal of most artificial language learning experiments has been to determine what aspects of language could be learned from experience and how that learning might be constrained by built-in perceptual, cognitive, or linguistic biases.

Important Scientific Research and Open Questions:

One of the greatest strengths of artificial language learning experiments is the tight control they allow the experimenter to have over the learning conditions experienced by an infant. This experimental control has enabled researchers to ask questions that would otherwise be impossible to address. For example, in the artificial language study by Saffran et al. (1996), twenty-four 8-month-olds were tested on their recognition of syllable sequences that were defined by very precise statistical properties. The researcher knew exactly how many times the infant had been exposed to each particular syllable sequence that occurred in the miniature language. Short of recording and transcribing every utterance ever heard by each of a few dozen 8-month-olds (or better yet: have these children hear only an artificial language for the first 8 months of their life), it would be impossible to design anything even remotely resembling a natural language analogue to the Saffran et al. artificial language learning study. Thus, the beauty of an artificial language is that it puts the researcher in complete control of the input received by the child. Artificial language studies capitalizing on this capability have taught us a great deal about infant learning. For example, we have learned how infants' tracking of statistical dependencies between syllables changes over the course of development (e.g. Thiessen & Saffran, 2003). We have also learned how infants might track statistical relationships in speech versus non-speech stimuli (e.g. Marcus, Fernandes, & Johnson, 2007). And we have been able to explore how the phonological naturalness of an artificial language might interact with pattern learning (Seidl & Buckley, 2005). However, despite everything that we have learned from artificial languages, there are still some open questions regarding the legitimacy of this methodology's use to study infant language acquisition. While the greatest strength of the artificial language paradigm is the absolute control it gives the researcher over the learning environment of the infant, this strength is unfortunately also this paradigm's greatest weakness, since there is always a trade off between experimental control and ecological validity in laboratory studies. That is, natural languages are far more complex than artificial languages. For example, unlike the artificial language used by Saffran et al., no natural language consists of just four trisyllabic words that all have identical syllable structure. Similarly, no natural language contains sound structure in the absence of meaning or syntax in the absence of sound structure. Given this lack of simplicity in natural languages, one may wonder whether it is a fair assumption that the rules and patterns infants learn from artificial language input will necessarily be the same type of rules and patterns infants extract from natural language input. In other words, will the learning mechanisms used in the laboratory necessarily scale up to the challenge of natural language? Could the learning strategies infants apply in an artificial language learning task differ qualitatively from those used in natural language acquisition? In recent years, researchers have started to address these questions. One approach has been to expose infants to slightly more complex languages

and see whether infants succeed at pulling out the same rules and patterns that they pull out with less complex languages. Initial studies have suggested that learning may indeed break down in some cases when artificial languages are made slightly more complex (Johnson & Tyler, 2010). An important line of research in the future will thus involve further exploring whether infant artificial language learning studies are too simplified (or artificial) to tap into the same learning processes involved in natural language acquisition.

In sum, it is clear that the large number of high impact infant artificial language learning experiments published in the past 15 years have permanently altered theoretical views on early language acquisition. Even if the learning mechanisms infants apply to artificial languages are not exactly the same as those they apply to natural language, the fact remains that infants learn artificial languages with incredible ease and speed. This finding by itself is enough to posit that infants may be capable of learning more aspects of language based on experience alone than most language researchers would have imagined possible before the advent of infant artificial language learning research.

Cross-References:

Acoustic and phonological learning
Associative learning
Bayesian learning
Can children learn by bootstrapping
Chunking mechanisms and learning
Connectionism
Infant language learning
Infant learning and development
Language acquisition and development
Learnability
Learning by chunking
Perceptual learning in speech
Speech perception and learning
Statistical learning

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