24

Learnability

Bruce Tesar

24.1 Learnability in phonology

A fundamental tenet of cognitive science is that human mental processes, including those involved in language, are computational processes. On this view, for a child to learn their native language, there must exist a learning *algorithm* capable of determining the grammar of that language from a reasonable amount of data, and with a reasonable amount of computational effort. Language learnability is the study of the computational dimensions of language learning. Learnability works in tandem with the study of child language data, commonly known as language acquisition, to constitute the overall study of how children learn their native language.

While it is difficult to quantify how much data a child *needs* in order to reliably learn a grammar, it is not too difficult to impose a generous upper bound on the amount of data a child could possibly have by estimating the number of utterances a child could hear during the waking hours of the first few years of their life. Even such generous overestimates prove to have real consequences for learnability; it is remarkably easy to define learning algorithms which demonstrably require decades' worth of data to work for even rather simple classes of grammars.[1]

Quantifying a 'reasonable' amount of computational effort is a far more murky matter, due in no small part to science's current vast ignorance of the computational properties of the human brain. But some fairly rudimentary assumptions turn out to have non-trivial implications for language learning. The very nature of computation requires that the learning algorithm use only a *finite* amount of computational effort. That requirement turns out to be sufficient to rule out certain simple learning proposals. In practice, researchers use gross measures of evaluation, based upon basic plausibility. If a proposed learning algorithm, implemented on the world's fastest supercomputer, would require several centuries to