Unit 4: *Intersections with Linguistics and Psychology*

Language Acquisition

Introduction

It's a remarkable fact that normal human children effortlessly – and without explicit instruction – acquire at an early age a mastery of a systematic and productive language.

Big Question: How is this possible? How do children manage to learn a language?

This question has attracted a good deal of attention from linguists, psychologists, and philosophers. Two main positions:

- *Nativists* about language claim that at least some important aspects of our knowledge of language is innate.
- *Empiricists* about language claim that our knowledge of language comes from experience; it is not innate.

Clarification: No one would claim that *all* knowledge of language is innate. Clearly, no one is born knowing specific English words such as "chair" or "philosophy". Rather, the debate is whether language learning can be explained entirely in terms of *domain-general* learning mechanisms, or whether language learning requires *domain-specific* learning mechanisms.

- According to nativists, we can only explain how a child learns a language by appealing to language-specific knowledge/learning biases.
- According to empiricists, we can explain language acquisition in terms of very general knowledge/learning strategies (e.g., pattern recognition, statistical learning) that apply to a wide variety of areas, not just language.

Components of Language Learning

To answer the Big Question, it is helpful to break down language learning into components. When a child learns a language, it seems they need to learn a number of different things:

1) The words in their language
2) Which grammatical categories these words belong to (e.g., learning that "house" is a noun, "kick" is a verb, "green" is an adjective, etc.).
3) The meanings of the specific words in their language (e.g., that "green" means green, rather than blue, or grue…)
4) Syntactic rules governing how sentences can be composed out of these grammatical categories (e.g., learning that "The woman swam in the ocean" is a well-formed sentence in English, but "The woman ocean swam swam" is not).

Covering all these tasks in detail would require an entire course. Today, we'll focus on the first task (how a child manages to learn the words in their language) and the fourth (how a child manages to learn syntactic rules governing the construction of well-formed sentences), with reference to the nativist-empricist debate.

Acquiring Words

One major task facing the infant language learner is carving the speech stream into individual words.

- It takes a bit of work for adults to appreciate the magnitude of this task. We often think there are "spaces" or "gaps" between words in a sentence. But as a matter of fact the gaps that we "hear" are largely an illusion: in everyday space, acoustic breaks do not reliably signal word boundaries. To get a sense for this, try listening to a conversation in a language with which you are totally unfamiliar and try to identify what the different words in the sentence are.

How do infants manage to do this?

These days, psychologists and linguists think that infants may be using a variety of sources of information to figure out the words in the language. Recent research has pointed to one particularly interesting and important source of information: *transitional probabilities between syllables*.

Transitional Probabilities

Consider the following syllables:

ti – pre – bay

Which of these would you most likely hear following the other?

One thing to notice here is that in English, *pre – ti* makes a word ("pretty"), whereas *ti – pre*, *pre – bay*, *bay – pre*, and *ti – bay* do not. Now, you might still hear some of these combinations within the speech stream, but it would only be at the boundaries between words. As a result, the probability of hearing *ti* followed by *bay* is pretty low – it would only happen if you heard two words in succession (e.g., "pretty bay"). By contrast, the probability of hearing *pre* followed by *ti* is much higher.

To make this a bit more precise, we can talk about the transitional probability of a syllable Y given a syllable X (written: "T(Y|X)") – that is, the probability that syllable Y will occur given that syllable X has just occurred. We can calculate this by dividing the frequency of the string XY (that is, X followed immediately by Y) by the frequency of X:

$$T(Y|X) = \text{frequency } (XY)/\text{frequency } (X)$$

Exercise: using this formula, calculate T(*ti*|*pre*) and T(*ti*|*bay*) for the following sentence:

"We went to a bakery and watched the pretty boats on the pretty bay."

- *Hypothesis:* babies pick up on these transitional probabilities, and use them to break up the speech stream into word-size chunks.

An important study by Saffran et al. (1996) seems to bear out this hypothesis:

- In the familiarization phase, eight month old infants were exposed to a two-minute speech stream made up of three syllable nonsense "words" – e.g., *bidaku, golabu, padoti, dutaba.* The only cues to word boundaries were the transitional probabilities between syllables, which were higher within words than at word boundaries.
- In the test phase, researchers looked at how much babies pay attention to the "words" they heard in the familiarization phase, and compared this to the extent to which they paid attention to three-syllable nonsense "words" that straddled the word boundaries (e.g.,

dakupa). Babies paid more attention to the latter, arguably because they were bored by the frequent repetition of the word units.

Uniquely Human? There is a further question as whether the statistical learning mechanisms that babies use to segment words are unique to humans. Some evidence that it is not:

- Hauser and colleagues replicated Saffran et al.'s experiments on tamarin monkeys. In the familiarization phase, the monkeys heard 20 minutes of a speech stream in a language of made up words. In the test phase, they heard some words from the familiarization phase, as well as some "words" that straddled word boundaries. The monkeys seemed to distinguish between them, staring at the researchers more when they heard one of the unfamiliar "words".
- Toro and Trobalón (2005) also reproduced the results on rats, using the same artificial language used on human infants and monkeys. They found the rats were also able to distinguish between the words in the original speech stream and the unfamiliar "words" straddling word boundaries.[1]

How does this bear on the Nativist/Empiricist Debate?
Some have thought that Saffran et al.'s results lend indirect support to empiricist approaches to word learning. The idea here is that tracking and calculating transitional probabilities involves domain-general statistical/probabilistic reasoning. It doesn't require anything domain-specific – that is, any knowledge or abilities that are tailored specifically to language.

Q: Do you agree with this interpretation of the results?

But even if this is right, it would be too early to declare victory for empiricist approaches. Let's turn next to the area where the nativist/empiricist debate has been most heated: explaining how children acquire their knowledge of the syntactic rules for forming sentences.

Acquiring Sentences

Universal Grammar: An influential form of linguistic nativism, due to Chomsky, is that humans are born with an innate set of basic syntactic rules. This hypothesis is known as "universal grammar" (UG).

The main argument that Chomsky gives for UG is what is known as the "Poverty of the Stimulus" (POS) argument:

> *POS argument.* There is a problem explaining how children acquire their knowledge of syntax, given the limited nature of their primary linguistic data (PLD) – that is, the set of all utterances that they've heard. According to the POS argument, children's PLD is insufficient to explain this knowledge. Therefore, some component of this knowledge must be innate.

One of parade cases of this argument comes from "auxiliary fronting".

Consider how we transform a declarative such as (1a) into a polar interrogative (yes/no question) such as (1b):

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[1] These studies only show so much: they show that non-humans are capable of tracking transitional probabilities between words. It remains an open question whether human infants are also capable of tracking more subtle sorts of statistical regularities – regularities that non-human animals cannot track.

(1a) The bottle on the table is blue.
(1b) Is the bottle on the table blue?

Two possible rules for converting (1a) into a polar interrogative:

R1: Move the first occurrence of the auxiliary to the front of the sentence.
R2: Move the first occurrence of the auxiliary in the main clause to the front of the sentence.

Both R1 and R2 agree that (1b) is the only way to get a sentence out of (1a). But they disagree about complex sentences like (1a):

(2a) The bottle that is on the table is blue.
(2b) *Is the bottle that on the table blue?
(2c) Is the bottle that is on the table blue?

Claim: Children learn at an early that (2c) is the correct form of the question, whereas (2b) is not. But *how* do they know this? Chomsky claims that their PLD would not yet contain any data that directly decides between these two rules.

Here's one way of leveraging this into a "Poverty of the Stimulus" argument for UG:

1) Either children learn their first languages via entirely domain-general processes, or they learn their first language, at least in part, via domain-specific processes.
2) If children learn their first languages by entirely domain-general processes, they can never learn any generalizations for which they lack evidence in their PLD.
3) Children learn that R2) is the correct linguistic rule, rather than R1), without having any evidence in their PLD for this. (Empirical Premise)
4) So, children do not learn their language by entirely domain-general processes. (from 2, 3)
5) So children learn their first language, at least in part, via domain-specific processes. (from 4, 1)

Question: What do you think of this argument? Is it compelling? Is there any way to resist it?