

Human Communication

Lecture 12

The child's language learning algorithm

- Here is the most basic problem in how children learn language:

The input to language acquisition consists of sounds and situations; the output is grammar specifying for that language, the order and arrangement of abstract entities like nouns, verbs, subjects and phrase structures

- Since a child must somehow **lift himself up by his bootstraps** to get started in formulating a grammar for the language this is called the **bootstrapping problem**

Solutions to the bootstrapping problem

- Extracting simple correlations
- Using prosody
- Using context and semantics

Simple Correlations

- One possibility is that the child sets up a massive correlation matrix, and tallies which words appear in which positions, which words appear next to which other words, which words get which prefixes and suffixes in which circumstances
- Syntactic categories would arise implicitly as the child discovered that certain sets of properties are mutually intercorrelated in large sets of words

Problems with simple correlations

- One problem is that the features that the prelinguistic child is supposed to be cross-referencing are not audibly marked in parental speech
 - Rather, they are perceptible only to a child who has already analysed the grammar of the language
 - How is a prelinguistic child supposed to find the **subject** of the sentence in order to correlate it with the endings of the words he or she is focusing on?

Using Prosody

- A second way in which the child could begin syntax learning would be to attend to the prosody of sentences, and to posit phrase boundaries at points in the acoustic stream marked by lengthening, pausing, and drops in fundamental frequency
- This seems attractive, because prosodic properties are perceptible in advance of knowing any syntax, so at first glance prosody seems like a straightforward way for a child to break into the language system

Problem using prosody

- But on closer examination, the proposal does not seem to work
- Syntactic structure affects aspects of prosody, but aspects of prosody are affected by many things besides syntax.
- The effects of emotional state of the speaker, intent of the speaker, word frequency, contrastive stress, and syllabic structure of individual words, are all mixed together, and there is no way for a child to disentangle them from the sound wave alone

Example of problem using prosody

Example: *The baby ate the slug.*

- The main pause coincides with the major syntactic boundary between the subject and the predicate. But a child cannot work backwards and assume that the main pause in an input sentence marks the boundary between the subject and the predicate. In the similar sentence *He ate the slug*, the main pause is at the more embedded boundary between the verb and its object.

→ Is this true?

Using Context and Semantics

- A third possibility exploits the fact that there is a one-way contingency between syntax and semantics in the basic sentences of most of the world's languages. Though not all nouns are physical objects, all physical objects are named by nouns
- Even phrase structure configurations have semantic correlates: arguments of verbs reliably appear as *siblings* to them inside the verb phrase in phrase structure trees
- If children assume that semantic and syntactic categories are related in restricted ways in the early input, they could use semantic properties of words and phrases as evidence that they belong to certain syntactic categories

Problem with context and semantics(?)

- Of course, a child cannot literally create a grammar that contains rules like "Agent words come before action words."
- This would leave the child no way of knowing how to order the words in sentences such as Apples appeal to Mary or John received a package.
- But once an initial set of rules is learned, items that are more abstract or that don't follow the usual patterns relating syntax and semantics could be learned through their distribution in already-learned structures.
- That is, the child could now infer that Apples is the subject of appeal, and that John is the subject of receive, because they are in subject position. Similarly, the child could infer that appeal is a verb to begin with because it is in the verb position.

Bootstrapping simplified:

- First rules:
 - First imagine a hypothetical child trying to extract patterns from the following sentences, without any innate guidance as to how human grammar works

Myron eats lamb.

Myron eats fish.

Myron likes fish.

3 bootstrapping rules

- At first glance, one might think that the child could analyse the input as follows:
- Sentences consist of three words:
 - the first must be Myron,
 - the second either eats or likes,
 - the third lamb or fish.
- With these micro-rules, the child can already generalise beyond the input, to the brand new sentence *Myron likes chicken*

More words learned

- But let's say the next two sentences are
Myron eats noisily.
Myron might fish.
- The word **might** gets added to the list of words that can appear in second position, and the word **noisily** is added to the list that can appear in third position.

Muddled up

- But look at the generalisations this would allow:

Myron might noisily.

Myron likes noisily.

Myron might lamb.

- This is not working!

How *can* bootstrapping work?

- A child must formulate rules in grammatical categories like noun, verb, and auxiliary, not in actual words.
- That way, *fish* as a noun and *fish* as a verb can be kept separate, and the child would not distort the noun rule with instances of verbs and vice-versa.
- If children are willing to guess that words for objects are nouns, words for actions are verbs, and so on, they would have a leg up on the rule-learning problem.
- So probably grammar is learned through semantics ...

General problems in communication: language development problems

- When a child's language development is delayed or does not happen at all, it faces a communication problem with its environment ...
- What problems can occur?
- Which channels of communication can be affected?

Language delay or disorder

- **Speech** is the *sound* that comes out of our mouths. When it is not understood by others there is a problem
- **Language** has to do with *meanings*, rather than sounds.
- **Language** is related to deeper cognitive processes and language delays are more serious than speech problems

Communication disorder

- What is a communication disorder?
- Children with communication disorders have deficits in their ability to exchange information with others
- A communication disorder may occur in the realm of language, speech and/or hearing

Conditions from which communication disorders may result

- Language-based learning disabilities are the result of a difference in brain structure, usually present at birth. This particular difficulty may be genetically based.
- Other communication disorders stem from oral-motor difficulties (e.g. apraxia, dysarthria of speech), aphasias, traumatic brain injuries, and stuttering, which is now believed to be a neurological deficit.
- The most common conditions that affect children's communication include language-based learning disabilities, attention deficit disorder, attention deficit hyperactivity disorder, cerebral palsy, mental disabilities, cleft lip or palate, and autism spectrum disorders.

Characteristics of communication disorders in a child

A child with a communication problem may present many different symptoms.

- These may include difficulty
 - following directions
 - attending to a conversation
 - pronouncing words
 - perceiving what was said
 - expressing oneself, or being understood because of a stutter or a hoarse voice

Example for communication disorder

We will have a closer look at:

Autism

Communication deficits in autism

- Communication deficits include autistic people's difficulty using spoken language and gestures, inability to initiate and sustain appropriate conversation and use of inappropriate, repetitive language
- Crucial point – autism is a **spectrum** disorder: people can appear with symptoms at many different points along a spectrum from very *high-functioning* (almost normal, e.g. many Asperger cases) to almost unable to communicate at all

Sound perception deficits

It is common for autistic children to confuse speech sounds

- They may not be able to distinguish between the sound **ba** and **ka**, for instance
- As a result, words like **bat** and **cat** may sound identical to some autistic children
- Many hear only the first part of a word or the last part of a word, making words like **rectangle** and **triangle** indistinguishable
- Many autistic children are **not able to parse spoken language**

Language development difficulties

Autistic children have trouble understanding that words relate to objects and activities

- Abstract words are extremely challenging because they are not linked to something tangible that can be inspected and pointed to. For example, the word **from** may have no meaning to autistic people
- Without concrete visual connections to objects or activities, words may be nearly impossible for them to understand

Autism and “theory of mind”

- Autism is often associated with an inability to understand other people's mental states
 - having no “theory of mind” for other people
- Hence it's a deficit in *socialisation*
- And, as we've seen, social response is crucial to language learning
 - because it's crucial to knowing *what people mean*
 - it's crucial to pre-linguistic communication
- Language acquisition is based on an already existing ability to *empathise* and communicate

Non-verbal language development difficulties

Autistic children have great difficulty understanding non-verbal forms of communication

- They don't recognise the meaning inherent in other people's facial expressions and they don't learn to use facial expressions to convey meaning
- Autistic children often have blank expressions or they show inappropriate expressions
- They do not instinctively know that a **frown** represents **displeasure** or that a **smile** communicates **pleasure**

Girl with autism

<http://www.youtube.com/watch?v=BB-0sXMk75s&feature=related>