9.85 Cognition in Infancy and Early Childhood

Lecture 20: Statistical reasoning in infancy

Statistical learning simulation

- Make a 2-syllable word (each shape is a syllable).
- Right next to it (no more space between words than syllables) make a 3-syllable word.
- Make 2 more (either 2 or 3-syllables, your choice).
- Write several sentences with your four words (no spaces between words)

What's the problem?

- Could be frequency information rather than conditional probabilities …

tokibugikobagopilatipolu**tokibu**

gopilatipolu**tokibu**gikobagopila

gikoba**tokibu**gopilatipolugikoba

tipolugikobatipolugopilatipolu

tokibugopilatipolu**tokibu**gopila

tipolu**tokibu**gopilagikobatipolu

tokibugopilagikobatipolugikoba

tipolugikobatipolu**tokibu**gikoba

gopilatipolugikoba**tokibu**gopila

tokibugikobagopilatipolutokibu
gopilatipolutokibugikobagopila
gikobatokibugopilatipolugikoba
tipolugikobatipolugopilatipolu
tokibugopilatipolutokibugopila
tipolutokibugopilagikobatipolu
tokibugopilagikobatipolugikoba
tipolugikobatipolutokibugikoba
gopilatipolugikobatokibugopila

Controlling for frequency

- Pabiku and tibudo occurred twice as often as golatu and daropi
- Thus frequency of common part words:kutibu could be matched to frequency of uncommon words (golatu)
- Only difference is in conditional probability (1.0 for words v. .5 for common part-words)
- 8-month-olds still distinguished part-words and words

So what's a pabiku anyhow?

- Infants might extract statistical information about coherent sound sequences …

- But these units might have no particular status with regard to language.

So what's a pabiku anyhow?

- 8-month-olds habituated to one of the following:
- Condition A: pabiku, tibudo, golatu, daropi
- Condition B: tudaro, pigola, bikuti,budopa
- 2 minute exposure
- TEST: pabiku, tibudo,tudaro, pigola

English frame

	Condition A	Condition B
I like my pabiku	Word	Part-word
You play with tudaro	Part-word	Word

Nonsense frame

	Condition A	Condition B
Zy fike ny pabiku	Word	Part-word
Foo dray miff tudaro	Part-word	Word

What's a pabiku anyhow?

- English frame and Nonsense frame were significantly different.
- In the English frame, infants now preferred 'words' to 'part words'.
- The Nonsense frame and the no frame conditions were not significantly different.

What's a pabiku anyhow?

- Results replicated when English frame was compared with a 'tone' frame.
- Suggests that infants use statistical segmentation for word learning.

- Can infants use it for higher-level linguistic analyses? E.g., grammar?

Grammar

- Some parts of speech predict other parts of speech.
- Nouns often occur without articles (“Great **dinner** Mom”)
- But articles almost always require nouns (* “**The** was delicious”)
- Noun phrases often occur alone (“**Delicious turkey**”)
- Transitive verbs usually require objects (* “***The family devoured***”)

Statistical learning

- So we can use it for words …
- For grammars …
- Is it domain-specific?

Visual stimuli

- http://www.psych.nyu.edu/johnson/infantperceptionlab/visualStatLearning.html
- Also tones …
- Also non-human primates (although frequency controls have not been run)

Action stream

- Describe what you see
  - Kids playing
  - Listening to the toy
  - Waggling the gears
  - Goofing around
  - Licking the gears

Meaningful units of action

- ‘If I am going for a walk to Hyde Park, there are any number of things that are happening in the course of my walk … So for example, I am also moving in the general direction of Patagonia, shaking the hair on my head up and down, wearing out my shoes and moving a lot of air molecules. However, none of these other descriptions seems to get at what is essential about this action, as the action it is.’ (Searle, Minds, Brains and Science)

Action parsing

- Level of representation -- meaningful intentional actions
- How do you get there?
- How do we “parse” action?

Action parsing

- Pause at the end of an action
- Pause in the middle of an action

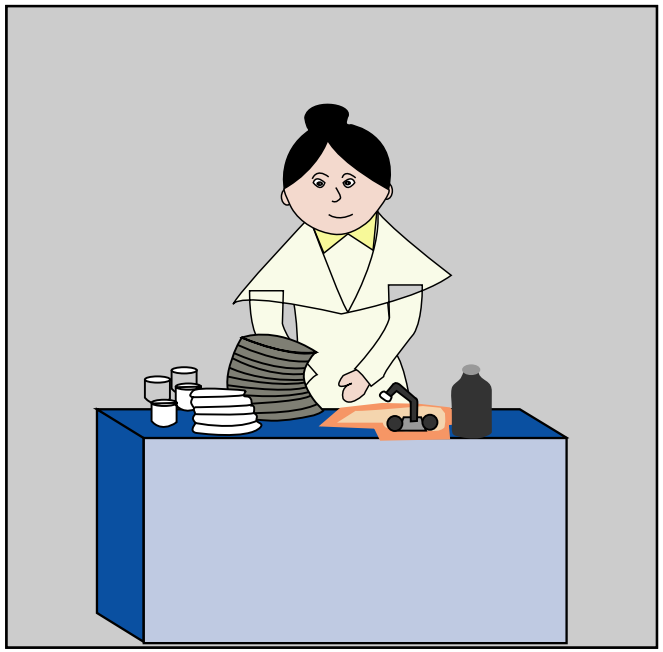

Illustration courtesy of MIT OCW.

Action parsing

- 10-month-olds dishabituated when the action was paused in the middle of a sequence but not when the action stopped at the end.

- Why?

Action parsing

- Top-down
- Use inferences about intentions to find meaningful units in action.
- Bottom-up
- Use low-level cues (changes in motion trajectories, eye gaze, **transitional probabilities**?) to parse action.

Statistical learning in action parsing

- **Habituate to: Stretch, shake, smell, knock, waggle, cap, head, stare**
- **Test to:**
- **shake, smell, cap, head**
- **Stretch, shake, smell, knock**

Statistical learning