Lecture notes by Edward Loper

Course: 9.59 (Psycholinguistics)
Professor: Ted Gibson
Institution: Massachusetts Institute of Technology

Monday, September 13, 1999

1 Communications

- mapping between signal $\longleftrightarrow$ meaning.
- usually this mapping is (fairly) arbitrary
- Occasionally non-arbitrary (=iconicity). eg., gestures, some sign gestures, onomatopeia.
- Ambiguity exists for non-1to1 mappings btw signal & meaning

2 Human Language (vs. basic communication)

- human language has multiple levels of related representations
- human language has rules which organize representations within and between levels
- human language can refer to things other than here-and-now
- human language is productive ("Bob is not an x", for any x)
- human language can recurse (x within x)
- human language has lots of ambiguity

3 Levels of representation

- discourse: John was going outside. Bill stayed inside.
- sentence: John was going outside.
- word: going
- morpheme: go ing
- phonemene: /g/

Related hierarchy – each level is composed of units from the next level down.

- phones vs. phonemes vs. allophones
- phones: /p/, /d/, etc.
- phonemes: [p^h], [p], [t^h]
- allophones: [p^h], [p]
- English has ˜40 phonemes. Min is ˜10 phonemes (not many consonants), max is ˜140 phonemes.
- yay for ipa! :)

Why are phonemes distributed as they are? Ease of production and comprehension. e.g., all languages have stops & non-stops, since they are easy to produce and the distinction is easy to hear.

Phonemes aren't always at their target position. E.g., /h/ is supposedly a velar sound, but in /hi/ (he), it seems to be front. Is /h/ unspecified for position, or is it assimilating? If we say /h/ by itself, it seems velar.. if it were unspecified, we would expect mid-central?

Vowel features, height (high,mid,low), position (front, central, back), nasalization, rounding, tone

coarticulation: makes comprehension harder in some senses, but adds a degree of redundancy.

assimilation with plurals:

```
/C[+cons +voice]/_ -> /Cz/
/C[+cons -voice]/_ -> /Cs/
```

dissimilation with plurals:

```
/C[+fric +alveolar or palatal]/_ -> /C schwa z/  (C can be sh, z, s)
```

note that dissimilation rule applies first.

4 Variation across languages

Why does variance between languages exist, and what can it tell us? Some sounds, e.g., /m/ and /k/ and /y/, are more common in languages than others. Could be because they are easy to tell apart and easy to produce.

- Compare /t/ and /s/. differ only in +/-stop (continuant)
- Compare /t/ and /t_{dental}/. differ in place of articulation

The first pair is much easier to distinguish acoustically than the second – some features are primary (e.g., continuant) and some are secondary. Claim that three are 3 primary features: continuant, sonorant, and coronal (i.e., blade is raised).

5 Nonsegmentals

Suprasegments: pitch contour, loudness, duration (speech rate) Registers: falsetto, whisper, breathy voice, creaky voice

6 Source-Filter Theory

Vocal chords produce a source sound. Filter it through mouth etc., and you get an output. Coarticulation leads to lack of invariance: must be context sensitive.

7 The Segmentation Problem

How do we find word boundaries? Hard to tell from a spectrogram.

Monday, September 20, 1999

8 Categorial Perception of Speech

Despite the fact that there are continuous differences between sounds, we group them categorically.

Other animals also have categorical perception of sounds – suggests that the existence of categorical perceptions isn't caused by our ability to speak.

Babies and habituation – sucking responses to show they distinguish sounds.

Are categorical distinctions acquired or innate (and then similarities are acquired)? Somewhere between: some are innate, some acquired.

dichotic listening: different materials presented to each ear. There is a right-ear advantage for linguistic material, since language is on left hemisphere. (left ear advantage for music)

Mann & Libermann – present steady state formants in one ear, transitions in the other ear. 2 percepts result: (i) hear it as a speach sound (sounds centered); (ii) attend to one side (transition sounds like chirp). Get category shift for (i), not for (ii).

McGurk effect – visual cues affeect speech perception

9 (Auditory) Word Perception

bottom-up information: features, phonemes

1. priming evidence in lexical decisions: $\exists$ semantic priming
2. evidenced from gating (give beginning of a word, and ask them to complete it)

top-down information from words

9.1 Bottom-up flow of information (From the phonemens & features)

Cohort theory: a word is recognized through left-to-right activation of phonemes. Cohort narrows as incoming sounds rule out alternatives. Basically, theorizes that we go "*" -> "k*" -> "k{æ}*" -> "k{æ} t*" -> etc. as we hear a sound. Implies some sort of sorted phonemic table of words.

1. Gating paradigm – present subject with sucessively longer pieces of words, and ask for what the word is (and how confident they are).
2. Lexical decision – present subject with sequence of phonemes, and ask them if it's a word. Both semantic priming, and "beaker" also primes "beetle" and "bug:" cohort theory.
3. Phoneme restoration – present subject with a word, replacing one phoneme with noise, and ask subject to identify word. Later version had 2 versions: add noise to phoneme, or replace phoneme with noise; for non-words, they could tell, but for words, they couldn't. This suggests that subjects aren't just guessing.

9.2 Top-down flow of information (Lexical effects)

Evidence against cohort theory:

1. Right-context effects – Ask subjects to repeat the stimulus they hear. Use sounds at various points between "dash" and "tash." People will percieve the sound (/d/ or /t/) depending on whether the rest of the sound forms a valid word.
2. Rhyme effects in eye movements – beaker primes bug (via beetle), but not stereo (via speaker) in lexical decision. But in a more natural task, such as looking at whatever matches what you hear, you do get rhyme priming effects.

TRACE Theory (activation-based)

10 Taxonomy of writing systems

deep vs. shallow orthography

11 Syntactic Structure

For Japanese (head-final) word order: flip everything but specifiers? so (IP (NP subject) (I' (VP (modifier) (V' (argument (V verb)))) I)).

12 Parsing in real time.. Mmm..

Disamiguity and garden path and plausibility, oh my.

Difficulty in understanding sentences comes not from too many incompleted dependencies, but from distance between dependencies...

Ok, so how do we do this DLT thingy?

Well, first mark new referents.

```
(ed (was ((given (an (aligator)) (for (his birthday))))))
(1 (was ((1 1) (for 1))))
(1 ...)
(1 was ((1 ...)))
(1 was ((1 1) ...))
(1 was ((1 1) (for 1)))
```

```
((that ((the comment
          (that (the star athlete
                  (was (receiving bribes)))))
        (upset the coach))
 ((was (supported (by the university official))))))
```

```
((that ((N (that (N (V N)))) (V N))) (V (by N)))
((that [(N (that (N (V N)))) (V N)]) [V (by N)])
((that ((N (that [(N) (V N)])) [V N])) [V (by N)]) *
((that ((N (that (N [V N]))) [V N])) [V (by N)])   *
((that ((N (that (N (V [N])))) [V N])) [V (by N)]) *
((that ((N (that (N (V N)))) [V N])) [V (by N)])
((that ((N (that (N (V N)))) (V [N]))) [V (by N)])
((that ((N (that (N (V N)))) (V N))) [V (by N)])
((that ((N (that (N (V N)))) (V N))) (V {by N}))
((that ((N (that (N (V N)))) (V N))) (V (by [N])))
((that ((N (that (N (V N)))) (V N))) (V (by N)))
```

```
((that ((N (that (N (V N)))) (V N))) (V (by N)))
   0     1   0    1
```

The professor who the student who I met at the party liked ate the cheese-ball.

```
((N (who$_j$ ((N ((who$_i$ (I ((V t$_i$) {at N})))))) (V t$_j$)))) (V N))
  1   0      1    0     0    1+1       1         1+4       1 1
```

```
The reporter who$_i$ the senator attacked t$_i$ disliked bob
 0      1      0    0    1             1+2     3      1
```

```
the reporer who$_i$ the photographer sent t$_i$
 0     1     0     0     1           2+1
```

```
to the editor hoped for a good story
0   0   1       4    0  0   0    1
```

So integration cost = # of things intervening between the head and the adjoined item.. E.g., disliked is 3 because the head of the NP that it's being adjoined to is "reporter", and there are 2 items betwen them.. Add one for "disliked" itself..

Cost function: cost to adjoin to something. Well, look at the distance between it and the head that it's being adjoined to, in terms of # of discource elements added. Note that this will be langauge-specific, because of ordering effects...

```
CI([XP: Spec/XP X']) = CI(X')
CI([X'$_1$: X'$_2$ YP]) = CI(X'$_2$) + cost(YP)
CI([X': X YP]) = CI(X) + cost(YP)
cost([YP: Spec/YP Y']) = cost(spec/YP)+cost(Y')
cost([Y'$_1$: Y'$_2$ ZP]) = cost(Y'$_2$) + cost(ZP)
cost([Y': Y ZP]) = cost(Y) + cost(ZP)
```