Theories of Speech Perception

Motor theory (Cooper\&al’52, Lieberman\&al’52):

- Phonemes are defined *primarily* in terms of production actions / goals
  - /i/: raise tongue toward roof of mouth
  - /n/: close mouth w. tongue at alveolar ridge, open uvula, voice
  - /k/: hold breath w. tongue at velum, release, voice immediately
- Much-varying acoustic features $\nrightarrow$ phoneme classification
  - Little-varying gestures $\rightarrow$ much-varying features $\rightarrow$ phoneme classification
  - (Hard to directly associate stimuli: $\sim$ ‘my train runs’ or ‘Johnny Whoop’)
- Focus on intended gestures explains acceptability of reduced phonemes

Evidence in support:
- McGurk effect: visual info about gestures helps a lot
- Mirror neurons in macaque grasping (except, not really evidence)

Evidence against:
- Broca’s aphasics can recognize spoken words w/o producing
- Quail, chinchilla can distinguish immed./delayed voicing w/o producing
- People can distinguish violin bowing/pizzicato w/o producing
- With bite block, gestures seem to recalibrate to acoustic target
- Ditto with electronic alteration of speech (and ventriloquism?)
Theories of Speech Perception

Fuzzy logical model (Massaro&Chen’08):

- speech perc. not special (general auditory approach; Diehl&Kluender’89)
- phonemes, like other things, defined in terms of various stimuli, context
  - acoustic features
  - visual features
  - lexical knowledge (of words)
  - context of previous words, likely referents in environment
  - effect of speech on others
  - varying context, features + regular effects → phoneme classification

- evidence in favor:
  - quail, chinchilla can distinguish immed./delayed voicing w/o producing
  - phonemic restoration effects (Miller&Isard’63; Warren’70)...

- evidence against: ???
Phonemic Restoration Effects

Warren’70:
- measure: accuracy of localizing edit w.r.t. word (e.g. ‘at the /s/’)
- results: ‘legi[silence]lature’ → could localize accurately
  ‘legi[cough]lature’ → could not localize accurately

Warren&Sherman’74: if not localized over /s/, how is /s/ filled in?
- stimuli: ‘it was found that the [noise over /s/]eel was on the axle/shoe’
- measure: location of noise, whether completely obscured, report words
- results: many subjects report location prior to word,
  many subjects report word not completely obscured,
  ‘the [noise]eel is on the axle’ → ‘wheel’
  ‘the [noise]eel is on the shoe’ → ‘heel’
  ‘the [noise]eel is on the orange’ → ‘peel’
Phonemic Restoration Effects

Sivonen & al’06: are subjects just being accommodating?

- stimuli: ‘The wagon lost its [noise over /s/] eel’
- measure: evoked response potentials (brain waves, electrodes on scalp) used N400, previously shown to correlate with surprise at current word
- results: more frequent unmanipulated word → decreased N400
  less frequent unmanipulated word → increased N400
  more frequent manipulated word → delayed, decreased N400
  less frequent manipulated word → delayed, increased N400
- In spite of missing onset phoneme, semantic processing took place!

These studies show top-down/context influences phone recognition

Similar to ‘Cmabrigde Uinervtisy’ meme of 2003:
‘Aoccdcrnig to a rscheearch at Cmabrigde Uinervtisy, it deosn’t mttaeir in waht oredr the ltteers in a wrod are, the olny iprmoetnt tihng is taht the frist and lsat ltteer be at the rghit pclae.’
(According to a researcher at Cambridge University ...)
Book introduces semantic networks: circles & lines w. ‘spreading activation’
What do these have to do with neural networks? They are localist networks.

Concepts:
- by analogy to RGB color space, add locus for cyan, gray, puce, ...
- in RGB, cyan had coordinates R:low, G:high, B:high (it’s greenish blue)
- now, cyan has coord. for each locus — cyan:high, gray:low, puce:low, ...
- this ‘sparse’ representation is less efficient, but easier to read
- each concept has underlying ‘dense’ representation (in RGB / brain)

Relations:
- each relations holds over each pair of concepts to some degree in matrix
- same is true when translated into ‘dense’ representation: ‘dense’ matrix
- matrix defines state transitions as model processes sentence over time

Hopefully this helps you think about semantic representations in the reading!
For next time... 

Read:

- Traxler ch 3, pp. 79–97