Language Learning, Language Processing, and Text comprehension
Lesson VII: Language module 35

Nature vs. nurture in language acquisition
- Humans have predisposition to learn a language
- Specific lexicon, syntactic rules, etc., needs to be acquired by exposure
- Linguistic search for basic elements / basic structure of all human languages
- Chomsky’s hypothesis of a Universal Grammar and a language acquisition device
- Importance of “nurture”
  - Caspar Hauser story
  - Children can acquire any language if exposed to it early enough

Fundamentals of language acquisition
- Universal stages of language production by children
  - Cooing
  - Babbling
  - one/two word utterances (telegraphic speech)
  - simple sentences
  - more complex sentences
- Non-oral languages
  - Speech development similar for artificial, non-oral languages (e.g., ASL)
- Acquisition of grammar and lexicon
  - How and when are words first acquired?
  - How do grammatical rules develop over time?
Some interesting facts

- How well can new-borns differentiate between mother tongue and foreign language?
  - Distinction between mother tongue and foreign language from birth on
  - Discrimination between different foreign languages declines around 2 months of age

- What are babies sensitive to?
  - Prosodic information (low-pass filtered)
  - Vowels as salient features
  - Languages differ in vowel structure and prosody

- Phonological bootstrapping
  - Learning the statistical associations between elements
  - Using prosodic information (e.g., stress) to identify important words / word boundaries

How to learn words

- Exploitation of regularities at the beginnings and ends of words (e.g., function morphemes)
- Babies can pick familiar words out of word-streams at about 8 months of age

Different lexicons

- Mental lexicon of a two and a half-year old:
  - approx. 2,000
- Reading vocabulary of an American high-school graduate: approx. 40,000 (60,000)
- Educated reader: approx. 150,000 (depends on what constitutes a word and understanding thereof)
- Are basic words (learned early on) represented differently than other words (learned late)?

Language learning mechanisms

- The problem
  - Language is generative and creative - therefore not all possible sentences can be experienced
  - Learning thus requires the acquisition of rules, not simple rote memorization

- Imitation, modeling, conditioning
  - Imitation: replay of experienced behavior
  - Modeling: customized exposure of child to language by caregivers to optimize learning, Motherese
  - Conditioning:
    - Classical conditioning: Statistical correlation of events and verbal utterances
    - Operant conditioning: Shaping of child's language through reward system
Bilingualism

Terms
- Monolingual, bilingual, multi-lingual
- Simultaneous vs. sequential bilingualism
- Additive vs. subtractive bilingualism

Single vs. dual-system hypotheses: Evidence
- When recovering from brain trauma, the different languages sometimes are selectively impaired, sometimes jointly impaired, recovery sometimes similar, sometimes offset
- Similarly mixed results for electrical stimulation
- Speech errors occur within and across languages
- Age of acquisition (especially pronunciation and phonetic perception) vs. levels of proficiency

Brain activation for second language
- Large cortical network in left hemisphere for native language - spanning temporal and frontal lobe
- Less specific, symmetrical activation in left and right temporal lobes for second language
- No notable difference between second language and other, unfamiliar foreign language

Results from proficient (sequential) bilinguals
- With increasing proficiency, language areas in the brain overlap more and more for bilinguals
- Differences in phonetic perception, grammaticality judgments, speech production
- Using the same “language” network to simulate non-native language

Perceptual aspects
- Eye-movements, saccades and fixations
- Only small amount of information is taken in at any one time - multiple fixations needed per sentence
- Fixation duration indicator for cognitive processing (e.g., sentence wrap up time)

Lexical access
- Features define letters
- Letters define words
- Words constrain letter combinations
- Syntax and semantics constrain word combinations
- Word superiority effect for letter identification
Remember? Rumelhart & McClelland’s (1981) Interactive activation model

Interactive Activation Model
McClelland & Rumelhart (1981)

- Written Word
  - Feature Level
  - Letter Level
  - Word Level

- At the letter / phoneme level
  - Words selectively activate letters / phonemes that are associated with them
  - Even pronounceable pseudo-words show this type of "priming" because they exploit statistical regularities of letter occurrence (e.g., ou, th, qu)

- At the discourse level
  - Mental models of the situations described in a text passage selectively activate particular concepts and words
  - Expectations drive text comprehension
Discourse comprehension

Vocabulary
- Knowledge of word meaning essential for encoding
- Word meanings often derived from context

Propositional representation
- Readers remember propositional structure better and longer than surface structure
- Gist (thematically relevant) information is retained better than irrelevant information

Text representation in mental models
- Readers form coherent working models of a scene
- Models include many inferences by reader
- Ambiguous descriptions that are compatible with multiple models increase memory for exact wording but decrease memory for gist

Spatial and temporal distance in situation models
- When reading a story, the reader builds up a situation model of the scene
  - After entering through the main door, John followed the long hallway. At the far end he entered a small bathroom with two windows. After a brief moment / two hours, he climbed out of the left window...
  - The distance of objects to the protagonist (e.g., increasing distance to main door) influences how accessible objects are (spatial priming)
  - The temporal distance in the story (brief moment / hours) also influences accessibility of objects
  - The discourse distance (reading time) has little influence