Moving beyond the lexicon

An isolated lexicon?

Chapter 9: LDER

Main Point

- Does word learning depend on:
  - A dedicated system
    - that is different than any systems for other types of learning
  - General learning mechanisms
    - that can learn more than just words
  - If the latter, what type of general mechanism?

Markson and Bloom

- Is word learning similar to fact learning?
- Fast mapping: Novel words map onto objects which do not already have a name
- Is “fast mapping” special to words?
- Tested 3 year olds, 4 year olds, undergraduates

Words

- 20 minute training phase
  - Play a game with 10 different kinds of objects
  - Familiar objects
    - Pennies, a pencil, a ruler, string
  - Novel objects
    - Things that subjects are unable to name (6 different things)
  - Subjects were exposed to a new word “koba” for an unfamiliar object
    - “Let’s measure the koba. We can count these to see how long the koba is. We can put the koba away now.”
    - “Let’s use the kobas to measure which is longer. Line up the kobas so we can count them. We can put the kobas away now.”

and Facts

- Subjects were presented with a novel fact:
  - “We can use the things my uncle gave to me to measure which is longer. My uncle gave these to me. We can put the thing(s) my uncle gave to me away now.
  - OR
  - “Watch where this goes. This goes here [subjects watch as sticker is put on unfamiliar object]. That’s where this goes.”

Learned words and facts?

- Presented with array of 10 items
  - Which one is the koba?
  - Which one was given to me by my uncle? OR
  - Put the sticker where it should go.
- Tested for learning at three intervals:
  - Immediately
  - After a 1-week delay
  - After a 1-month delay
  - Why?

Multiple Memory Systems

- Sensory memory
  - Different systems for different senses
- Short term “working” memory
  - Necessary for processing/manipulating information
  - Limited capacity
  - Limited duration
- Long term memory
  - “knowledge”

Results

- Word learning
  - Children and adults remembered which object was the koba at all three testing delays
    - Adults were better than children immediately, but not after 1 week or 1 month
    - No decline in performance over time by any group
- Fact learning
  - All subjects equally good at remembering which object "was given to me by my uncle"
    - Children were better at fact learning than word learning when tested immediately
  - For sticker location
    - All subjects better immediately than after a delay
    - Children worse at this than at words or uncle-facts
    - After one month, children are guessing (adults did slightly better)

Is fast-mapping special to words?

- Doesn't seem to be – both words and facts can be fast-mapped under similar conditions

- BUT – maybe familiarity of 'uncle' as a word made fact learning easier than it should have been
  - Retested with word 'koba' and fact 'object came from a place called 'Koba'
  - Equally good learning in both conditions
  - Learning that an object came from a 'place called Koba' or was 'given by my uncle' equally good

Conclusions

- Fast mapping applies to
  - Learning novel words
  - Learning arbitrary facts about an object
    - Even when the fact contains a novel word
- Maybe not to any memorization task
  - Poor performance at location of sticker after one month
- Fast mapping limited to –
  - Information conveyed through language?
  - Salient/interesting information?
  - Circumstances where object identity or category is more important than a property like location

Conclusions

- No critical period for fast mapping
  - No advantage for children compared to adults
- Children do seem better than adults at learning phonology, morphology, syntax
- Word learning may be different than learning other aspects of language

Declarative Memory

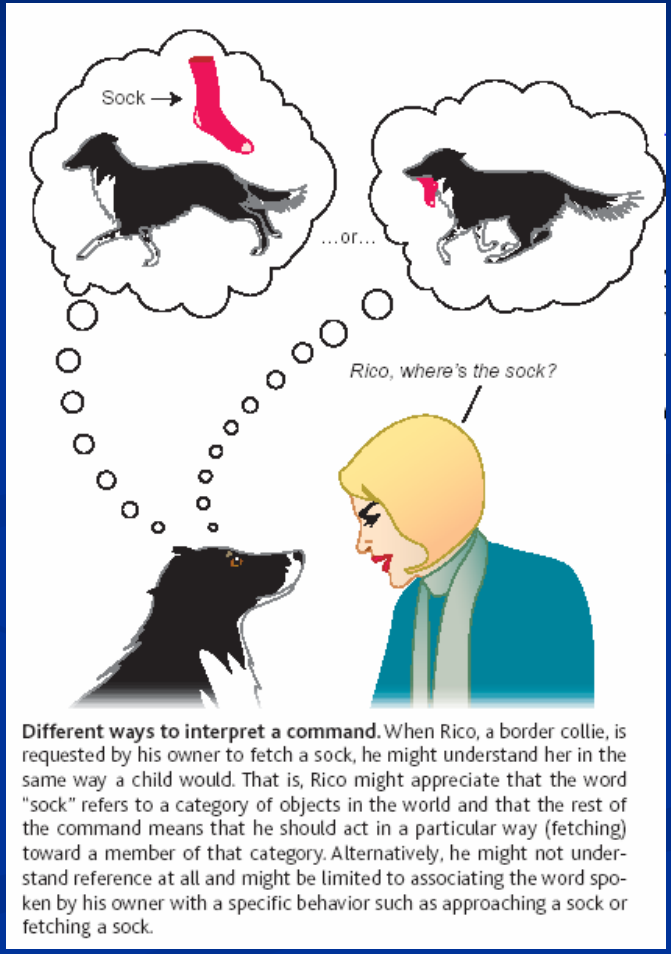
- Episodic memory (“remembering”)
  - Personally experienced ‘events’
  - Contextually encoded to specify place, time
- Semantic memory (“knowing”)
  - Memory for ‘facts’
  - Not bound to particular place, time
- Memory for words (mental lexicon)

Animals can do it too

- Border Collie “Rico”
  - 9 years old
  - 200 word lexicon
  - Vocabulary size comparable to that of trained apes, dolphins, sea lions, parrots
  - Can “fast-map” – infer meaning of new word based on presence of novel item

What does Rico know?

- Performance involves
  - Knowing objects have labels
  - Learning mechanism
  - Stored knowledge (memory)
- What does “sock” mean?
  - Abstract concept “sock”
    - temporal lobe in people
  - Sock-fetching
    - Motor concepts in people
- Performance far worse than that of 9-year old child



Different ways to interpret a command. When Rico, a border collie, is requested by his owner to fetch a sock, he might understand her in the same way a child would. That is, Rico might appreciate that the word "sock" refers to a category of objects in the world and that the rest of the command means that he should act in a particular way (fetching) toward a member of that category. Alternatively, he might not understand reference at all and might be limited to associating the word spoken by his owner with a specific behavior such as approaching a sock or fetching a sock.

Words and Grammar

Chapter 10: LDER

What is the relationship between lexicon and grammar?

- Classic “modular” view
  - Lexicon and grammar are fully distinct
  - Some words may do “grammatical work”
    - Closed class words
  - Words are combined into structures created by the grammar (larger role for grammar)
- Lexicalist view
  - Anything and everything can be in the lexicon
    - Words; structures (with no words attached)
  - Grammar ensures that words and structures are combined appropriately (smaller role for grammar)

- Babble
- Meaningful speech
  - Single words (from 10-12 months)
  - Vocabulary burst (from 16-20 months)
- Word combinations from about 18-20 months
- 24-30 months: “flowering of morphosyntax”

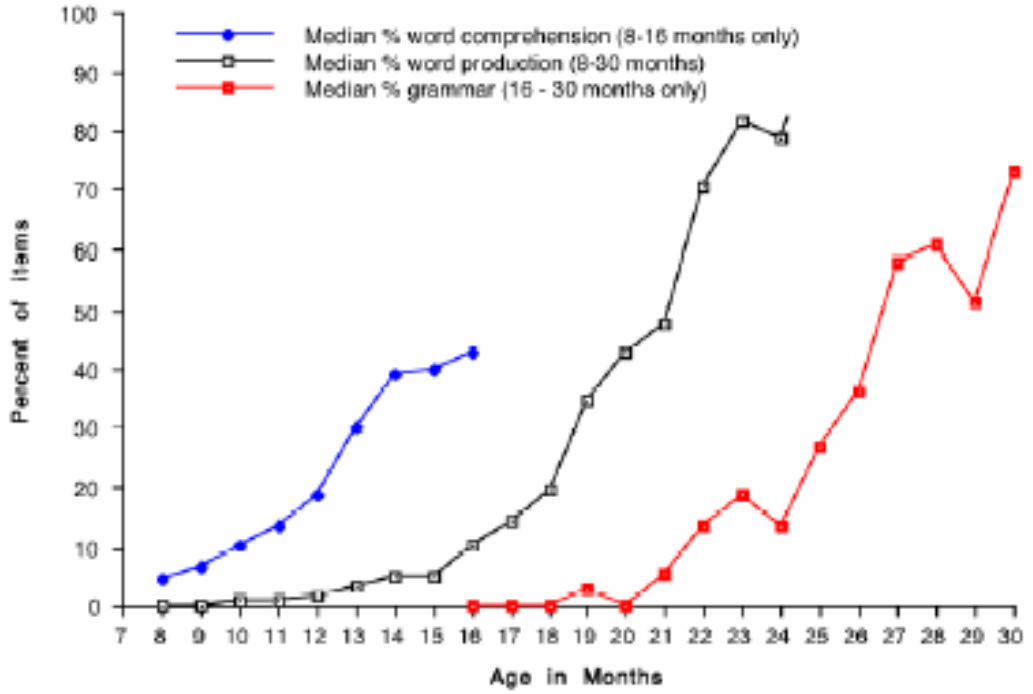


Figure 1. Median growth scores for word comprehension, production and grammar expressed as a percentage of available items (from Goodman, 1995).

comprehension → production → grammar

From single words to grammar

- Grammar cannot begin in the absence of words
  - The grammar needs at least some words to manipulate
    - How many?
    - Once some minimum number is reached, does grammatical development proceed independently? (modular view)
    - Or do they remain tightly correlated? (lexicalist view)

- Measuring grammatical complexity
- MLU
  - Mean length of utterance
  - Measured in morphemes
  - Longer = more complex
- Part II of CDI
  - Parental judgments
  - Highly correlated with MLU

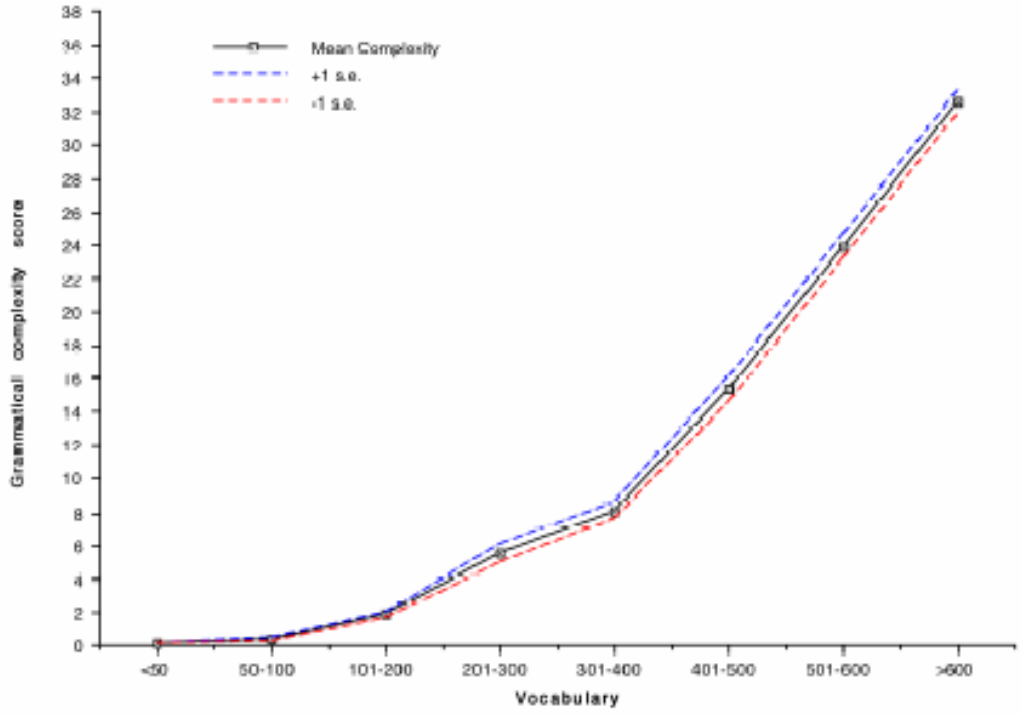
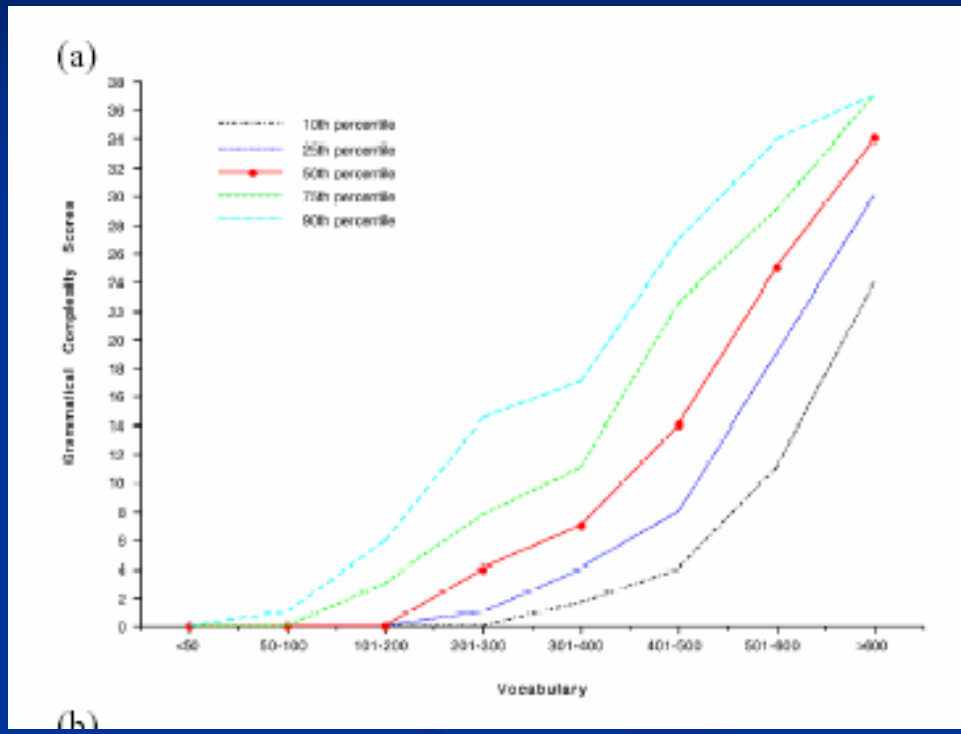


Figure 2. Mean and standard errors for grammatical complexity in children at different vocabulary levels.

- Looks like a very tight link

- Relationship between grammar and vocabulary size –
- Lines indicate 90th, 75th, 50th, 25th, 10th percentile for grammar in each vocabulary group
- Variability is relatively small, and is consistent beyond about 100 words



Maybe it's just development of closed class words?

- Remove all closed class words
- Look at open-class vocabulary only
- Still looks like a very tight relationship!
  - verbs….

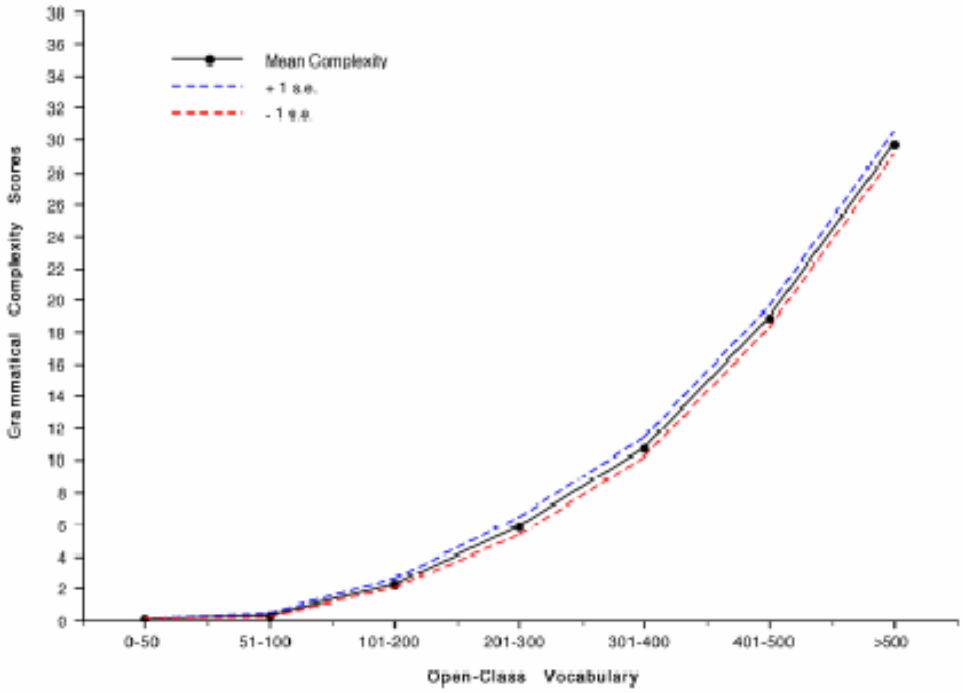


Figure 4. Grammatical complexity as a function of open-class vocabulary only.

Averaging artifact?

- Cross sectional vs longitudinal samples
- Cross sectional
  - Different children
- Longitudinal
  - Same children

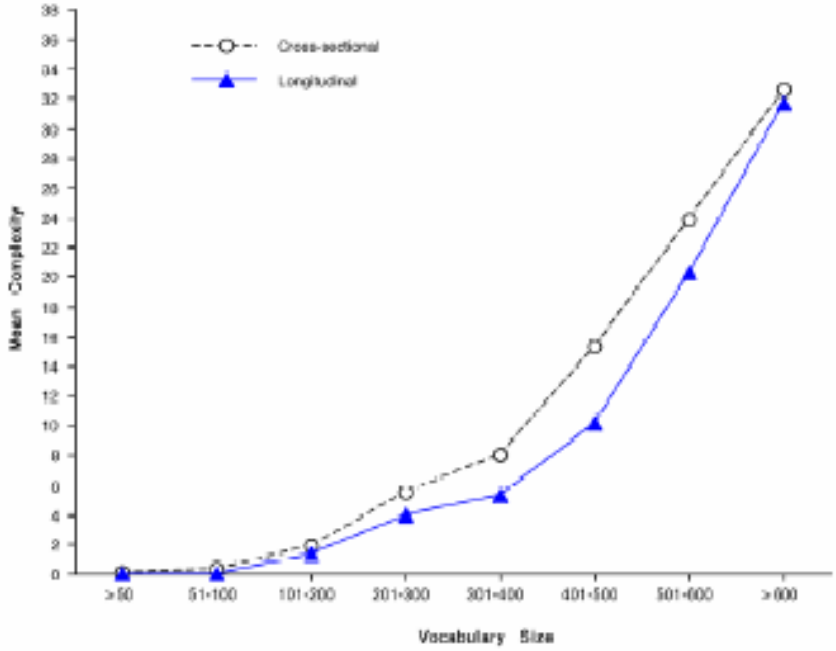


Figure 6. Grammatical complexity as a function of vocabulary level for the cross-sectional versus longitudinal samples.

Different Languages?

- Despite different grammars
- English and Italian show virtually identical relationship

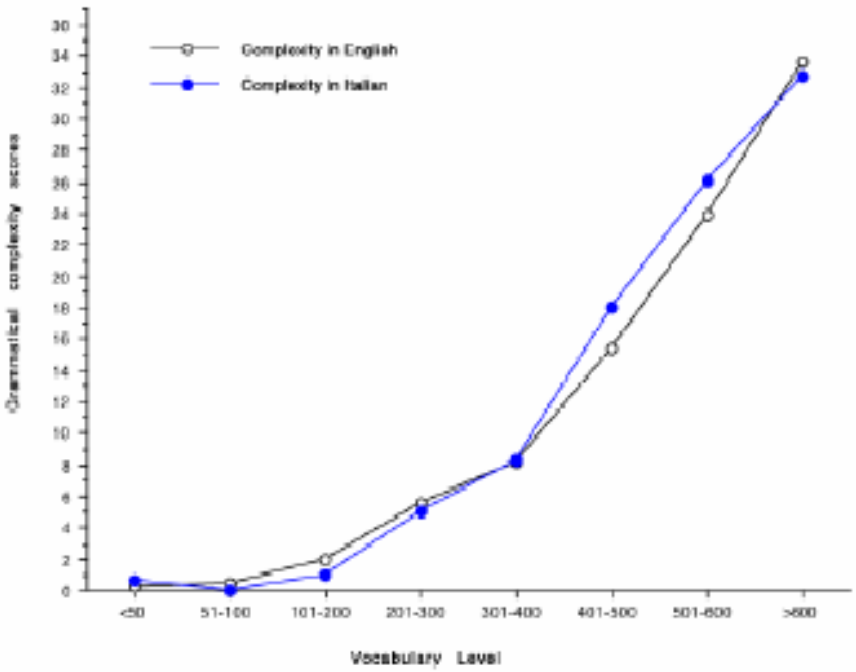


Figure 5. Sentence complexity as a function of vocabulary size for Italian and English toddlers (from Caselli, Casadio, & Bates, 1997).

Why?

- There appears to be a very strong relationship between lexicon and grammar in development (from 16-30 months particularly)

1. Perceptual bootstrapping
2. Logical bootstrapping
3. Syntactic bootstrapping
4. Non-linear dynamics of learning
5. Lexically based grammar

Perceptual Bootstrapping

- Grammatical functions words and inflections are difficult to perceive
  - “the car” “walked”
- Once you have a critical mass of content words, function words can be perceptually separated and learned more easily

Logical Bootstrapping

- Predicates (verbs, adjectives) acquired later than nouns
- Function words acquired even later

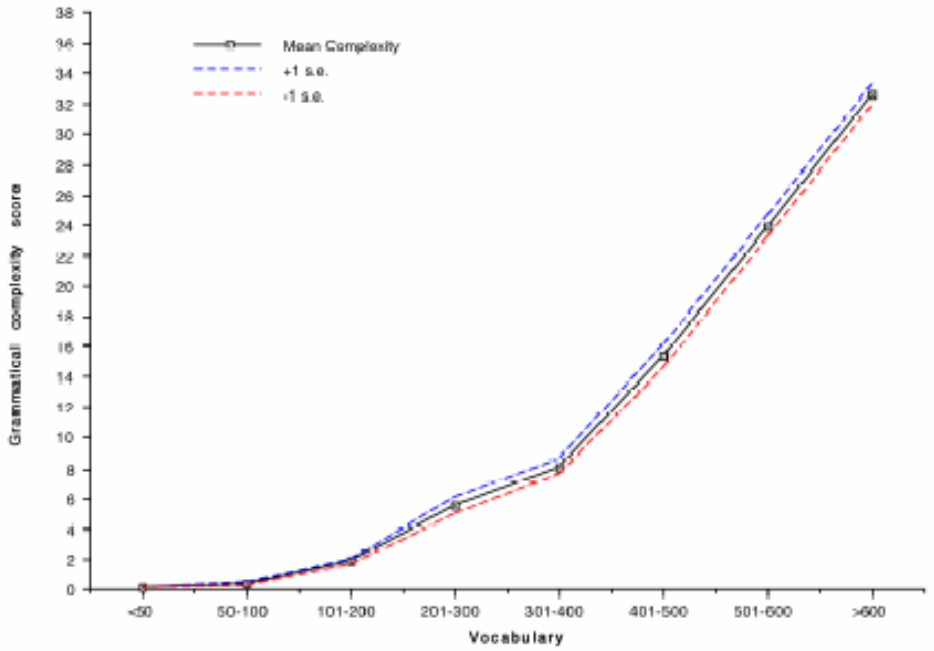
- Progression from names to predication to grammar is logically necessary:
  - Children can't understand relational terms until the understand the things being related

Syntactic Bootstrapping

- Children exploit sentential information to learn about meaning of a novel word
- Many different aspects of a sentence can be used – sentence-level semantics; morphological cues; word order; prosody
  - e.g., “that’s Zav” vs “that’s a Zav”
- Link between grammatical and lexical development is a two-way street:
  - Lexical growth feeds grammatical development
    - Perceptual and logical bootstrapping
  - Grammatical growth feeds lexical development
    - Syntactic bootstrapping

Non-linear dynamics in learning

- Lexical and grammatical development displays non-linear curve
- Any account of language learning needs to be able to account for non-linear growth



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Lexically based grammar

- Tight link between lexical and grammatical development not expected if lexicon and grammar are really distinct systems
  - It does not appear to be the case that your ability to combine words becomes independent of how many words you know
- Rather, tight link in *development* suggests tight link in *representations* of lexical and grammatical knowledge
  - Just in an early age range?
  - Recall that by 30 months, children have mastered most grammatical structures in their native language

Midterm Review

- Main Ideas
  - Acquisition vs development
  - Can language be learned by imitation?
  - Can language be learned by analogy?
- Speech Perception
  - Development of the auditory system
  - What does a fetus hear in the womb?
  - How do you measure what a fetus/newborn knows?
    - Measure heart rate/movement of fetus with habituation technique
    - High amplitude sucking for newborn
  - What does a fetus know?
  - Rhythmic Class Hypothesis
  - Stress vs syllable vs mora timed languages

- More on speech perception
  - Acquisition of native phonemes
    - Loss or gain of an ability to discriminate minimally different sounds?
    - Conditioned head turning technique
  - Categorical perception
  - Perceptual assimilation model
  - Human babies vs monkeys in language discrimination task
- Word Segmentation
  - Detecting word boundaries
    - Finding frequent sounds
    - Frequently co-occurring sounds
    - Phonotactics
    - Prosodic patterns
- Precedence vs dominance in grammar
- Infants get better/faster at identifying/recognizing words they know

- Stages of infant speech production
  - Cooing
  - Marginal babbling
  - Canonical babbling
  - Words – what is a word?
  - What's in the lexicon?
- Meta-linguistic awareness of words
- What do words mean – intent
  - Proto-imperative vs proto-declarative
- What do words mean – reference
  - Gavagai problem
  - Under vs over-extensions
  - Constraints on word learning
    - Lexical constraints hypothesis
      - Mutual exclusivity; fast mapping; whole objects; taxonomic
    - Social constraints
    - Linguistic constraints
    - Principle of contrast

- Biological vs environmental influences on vocabulary development
- Universal stages of growth
- MacArthur Communicative Development Inventory
- English vs Italian lexical development
- Today's stuff…