Introduction to Language Development

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Readings for all 3 lectures

- Tomasello, M. (2000). The item-based nature of children's early syntactic development. *Trends in cognitive sciences*, *4*(4), 156-163.

- Fisher, C. (2002). The role of abstract syntactic knowledge in language acquisition: a reply to. *Cognition*, *82*(3), 259-278.

- Senghas, A., Kita, S., & Özyürek, A. (2004). Children creating core properties of language: Evidence from an emerging sign language in Nicaragua. *Science*, *305*(5691), 1779-1782.

A nice accessible discussion of Chomskian-linguistics from a historical perspective

http://inference-review.com/article/the-recovery-of-case

General audience writing of anti-Chomskian view

https://www.scientificamerican.com/article/evidence-rebuts-chomsky-s-theory-of-language-learning/

Outline

- Introducing language and the problem of language learning
- Infant speech/perception
- Quick overviews of early word learning, grammatical and pragmatic development
- Humans create language whenever they can

Why Language?

- Why does language get “special attention”?
- Critical for thinking & problem solving, socializing, cultural transmission.
- Some have thought language is the critical difference between humans and other animals.
  - The structural difference between human and animal communication is proposed to either be or reveal the capacities that have enabled civilization, culture, etc.

Aspects of Language

Phonology	Semantics	Syntax	Pragmatic
What sounds (and what combinations) are admissible in a language	Word & Sentence meanings	Grammar: how to put words together	Social conventions about use of language

Side note: Prescriptivism vs. Descriptivism

- Most people's experience with "grammar" is being told they are not using it properly
  - "don't end a sentence with a preposition" or "don't use the passive"
- (Psycho)Linguistics is not concerned with "proper usage" in this sense
- Our concern is how people actually *do* represent, process, and use language, not how they *should*
  - Not that there is anything a priori wrong with improving one's writing to meet professional standard's or greater aesthetic value, it's just not what this field of research is about.

The problem of language learning

- Infants must learn what sounds their language uses
  - R/L are two distinct sounds in English, not in Japanese
- Parse the continuous speech stream into words
  - We think there are gaps between words: there are not
- Learn the meanings of 20,000+ words
- Learn the rules of putting words together
  - In English, verbs tend to be in the middle of sentences, in Korean, at the end
- Learn the social conventions of language
  - Literal vs. figurative, polite vs. rude

The problem of language learning

- Learning a hierarchical system
- Language is componential and compositional
- At each level of description there is a finite set of units that get combined productively with a finite set of rules
- Speech sounds into syllables into words into sentences into discourses
- Not any two sounds can combine to make a syllable
  - St = ok, df = not ok
- Some combinations of words do not go together
  - Words combinations some of go not do
- Not any two sentences can go together to make a coherent discourse
  - Bill says: “Hi, I’m Bill, nice to meet you.” Fred says: “Chomsky’s media criticism, as shown in the documentary “Manufacturing Consent,” and his linguistic theory are united by assuming a deep structure beneath the perceivable surface, that explains what we can perceive .”
- Because of these constraints, language is infinitely productive
  - (will explain how over the next few lectures)

Outline

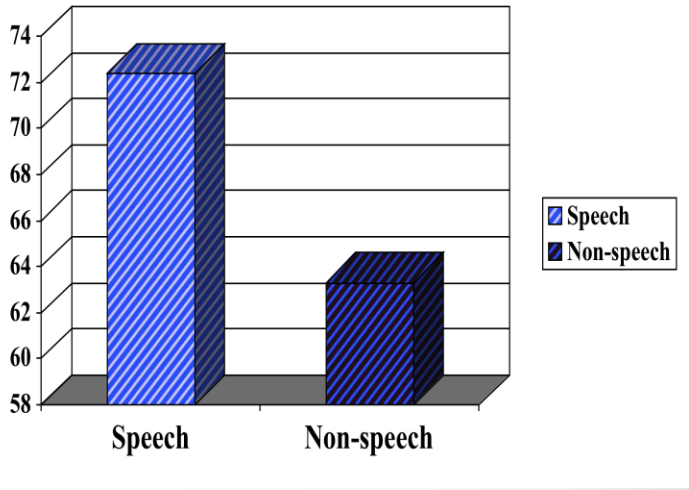
- Infant speech/perception
- Quick overviews of early word learning, grammatical and pragmatic development

Infant Vocalizations

- **2 month-olds coo:**
- Produce simple speech sounds (gooo, aaahh) and vocal gymnastics (smacks, clicks, bubbles)
- Improved motor control of vocalizations
- Imitate sounds of their partners, high pitched for Mom and lower for Dad
- Increase in vocal complexity
- **6 month-olds babble:**
- Repeated consonant vowels patterns that become more varied
- By 10 months: native language specific babbling.
- **12 month-olds: first words**

Newborn Speech Perception

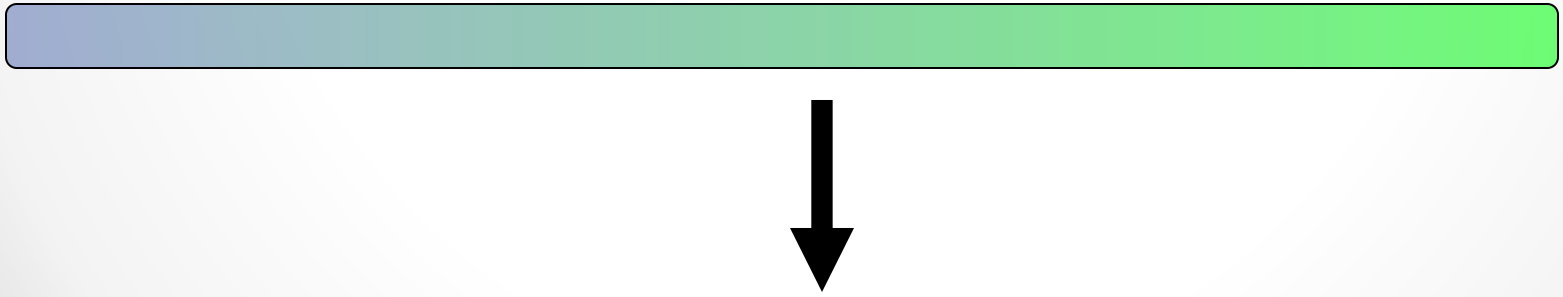
- Recognize the prosody of their native language!
  - Prosody = pitch contours
- Prefer speech to non-speech
  - Vouloumanos & Werker, *Dev Sci*, 2004; 2007
  - High Amplitude Sucking Procedure
  - Alternating minutes, speech & nonspeech
  - More HA sucks to speech



Infant Speech Perception

- Acoustic properties of speech sounds vary
  - Some variance is important, some not
- Not all languages use the same contrastive sounds
- Child's task: Figure out what sounds their native language uses contrastively.
- Categorical perception of phonemes: some variance generalize across, others draw boundaries.

Actual stimuli



Categorical Perception of stimuli

Discrimination Task

"Are these two sounds the same or different?"

Across

Within-Category

Hard

Discrimination Task

"Are these two sounds the same or different?"

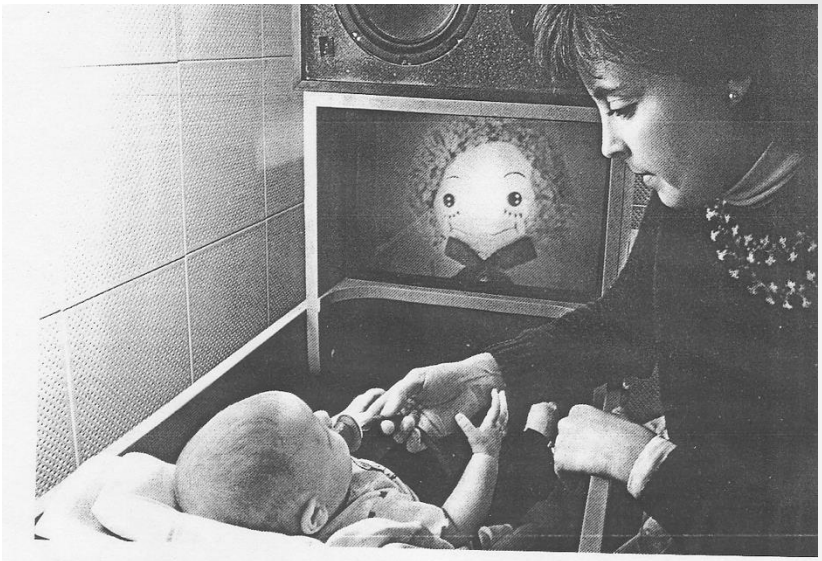
D	0ms		 20ms	D
D	20ms		 40ms	T
T	40ms		 60ms	T

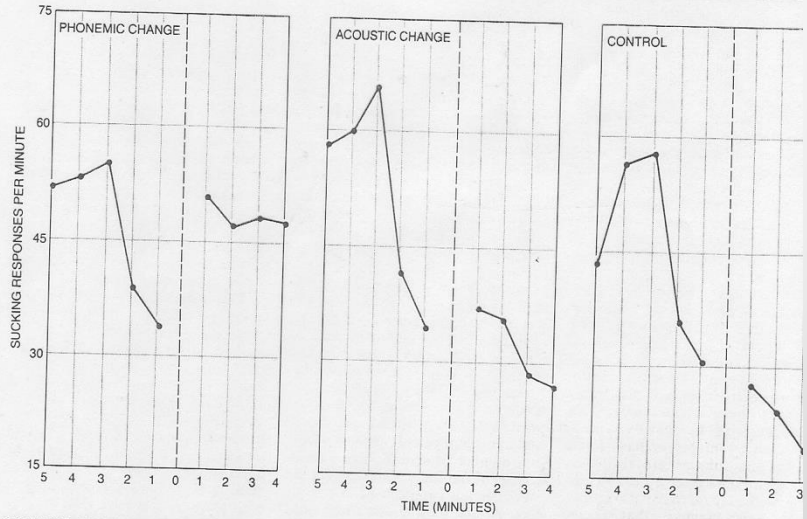
Across-Category Discrimination is Easy

Within-Category Discrimination is Hard

Categorical Perception

- Habituation method tests category-discrimination in infants (Eimas, Siqueland, Jusczyk, & Vigorito, 1971)
- Organization from the first days of life





INFANTS' SUCKING RATE indicates their response to a series of speech sounds. In the author's experimental setup (*top*) syllables of synthetic speech were played through the loudspeaker above the screen display of Raggedy Ann while a four-month-old infant sucked on a pacifier connected to recording instruments. Graphs of mean sucking rate (*bottom*), recorded under various

and then decreased as the stimulus became familiar. In some c the sound changed at a time indicated by the broken line. In group (*bottom left*) the new sound represented a different consona sucking rate increased sharply, showing that the infants perceive contrast. In a second group (*bottom middle*) the stimulus diffe

Infant Speech Perception: What Changes?

- Infants show categorical perception across the world's language sounds in first half of 1st year
- By 10 months of age, infants are no longer discriminating phonemic contrasts irrelevant to their language
  - e.g.,Japanese infants no longer discriminate between R and L

- Why is this adaptive?
- Every time you hear a sound, it has slightly different qualities (e.g., across speakers).
- Learners need to learn which contrasts are functionally important, i.e., signify different words

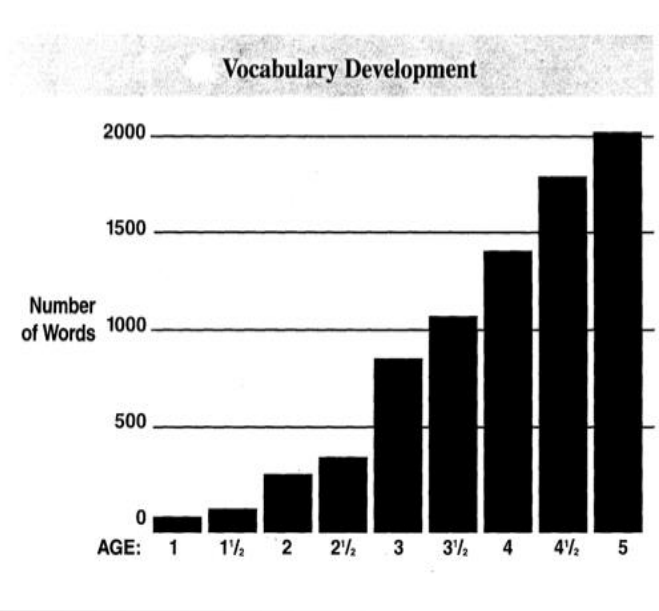
Infant Speech Segmentation

- Will discuss further in oncoming lectures but:
- Host of properties
- e.g., stress patterns
- Any utterance with only one stressed syllable (**Man**; **Du**sty; Spa**ghe**tti) is a single word, no matter how long it is.
- Gambell & Yang (2003; 2005)

Word Learning

- 1st words at 12 months

Vocabulary explosion (approx 2 - 6 years)



Children's vocabulary grows from
100-2000 words at age 2,
to 5000-20,000 words at age 7

Cognitive Mechanisms of Word Learning

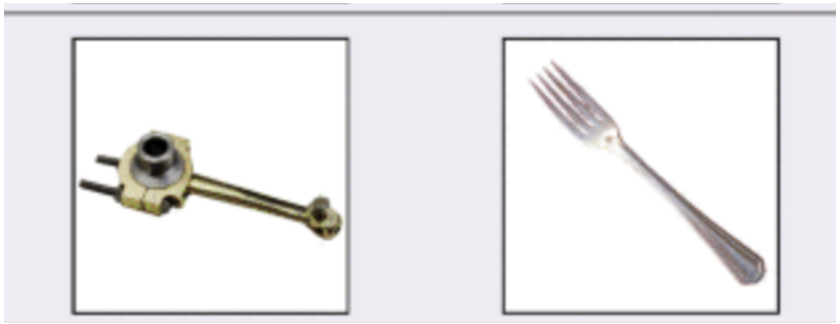
- We already saw the importance of statistical/associative learning in the development of the shape bias
- Other cognitive processes too.

Cognitive Mechanisms of Word Learning: Social Inference

- Children can track the intentions of adults, including "Referential intent" e.g., by following gaze

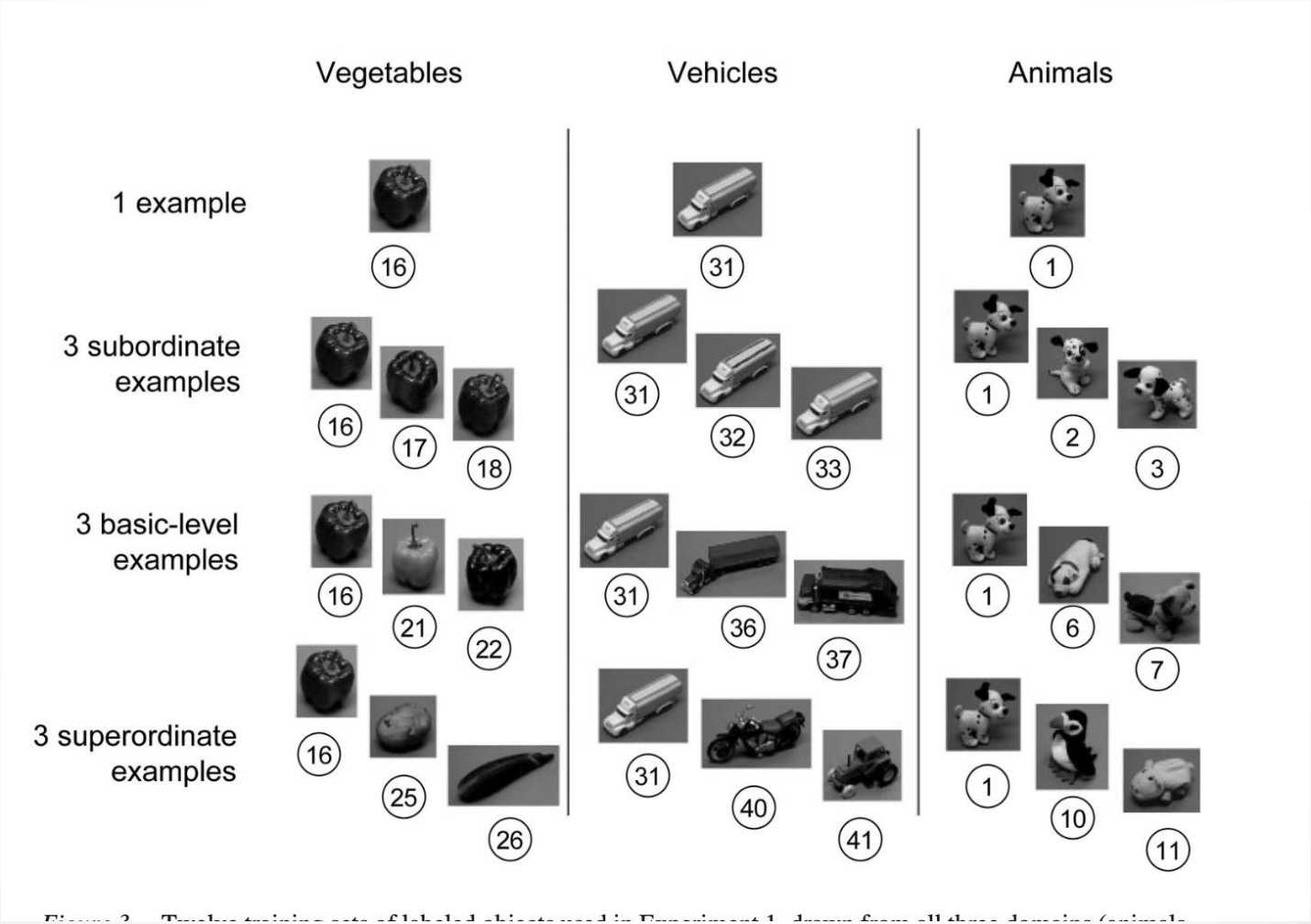
Cognitive Mechanisms of Word Learning: Social Inference

- Mutual exclusivity - see Ellen Markman; Eve Clark
- "Hand me the dax?"



- 95% of 3 year-olds pick the unfamiliar object
  - Wilson & Katsos (2021)

Cognitive Mechanisms of Word Learning: Social Inference + Hypothesis Testing



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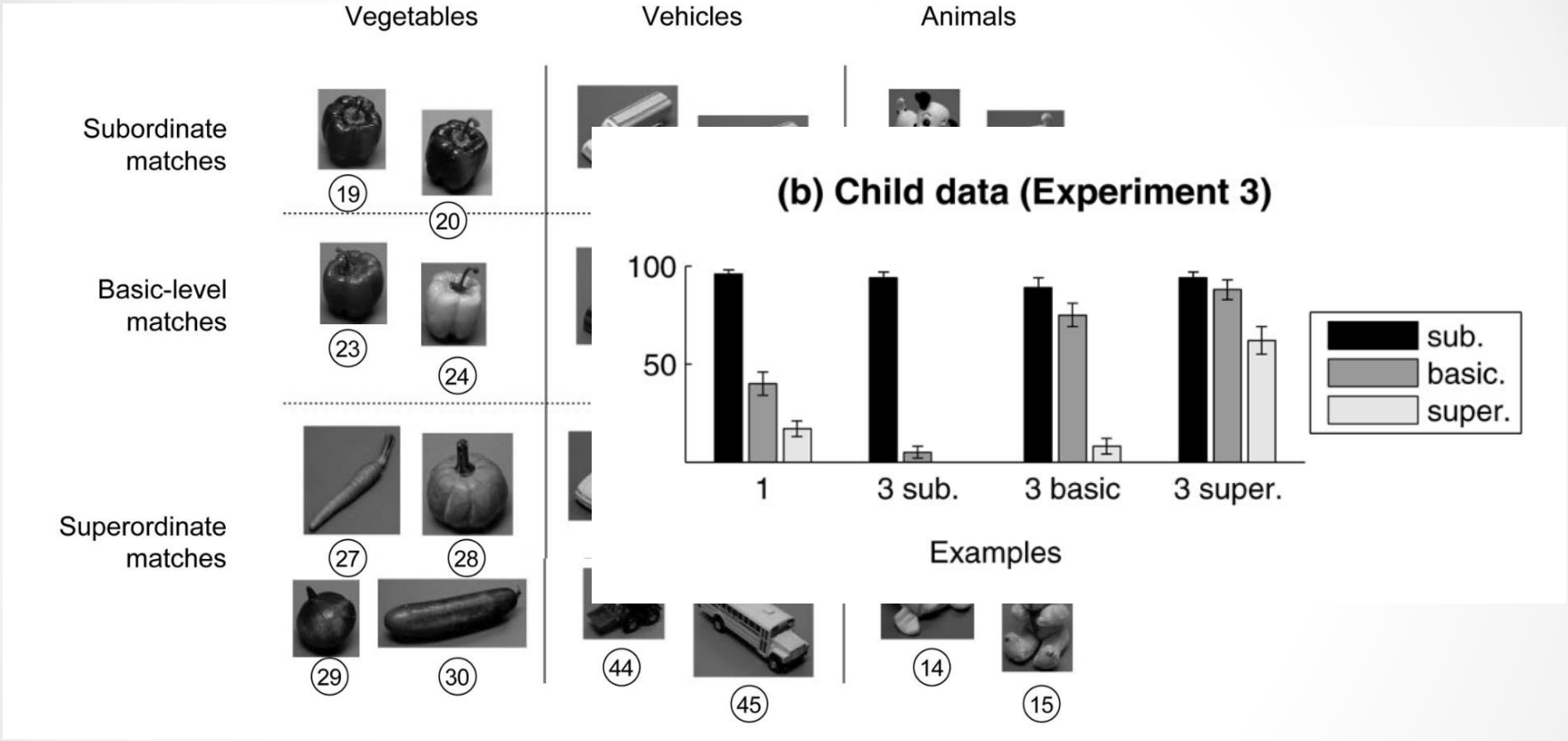
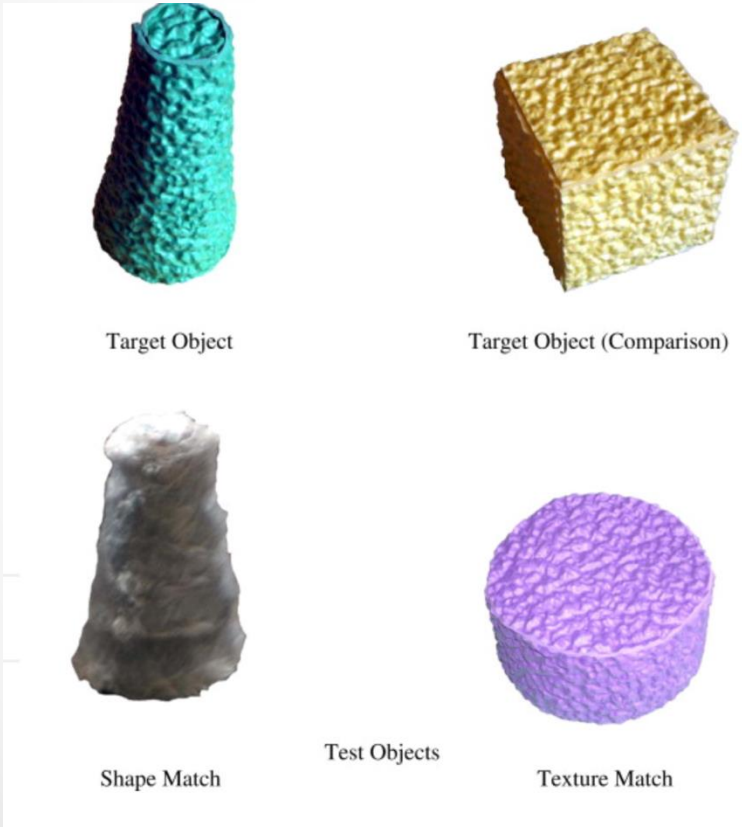


3 and 4 year-old children

Cognitive Mechanisms of Word Learning: Comparison



3-5 year-olds
When a single object- 7% texture
Shows a default strong shape bias

Two objects compared, 75% texture

Graham, Namy, Gentner & Meagher, 2020

Beginnings of Syntax

- 18 months: 2 word combinations
- The two words chosen are not random (e.g., "Daddy went to work" becomes "Daddy work")

- Child maintains most important content words and word order

- Grammar ability correlates with size of vocabulary

Morpho-Syntax

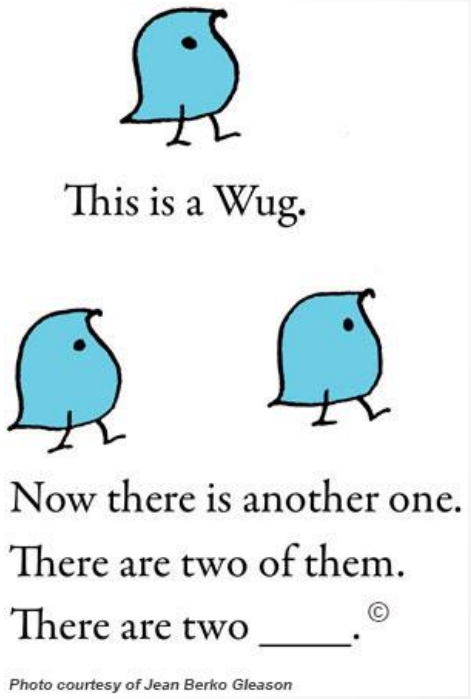
- Morphemes: meaningful units of language
- Some words have just 1: sport, man, bag
- Others are compounds of single morpheme words: tugboat
- Syntactic morphemes have syntactic function and add meaning
- Inflectional morpheme: changes in number and tense, e.g., plural “s”, past tense “ed”
- Derivational morpheme: change grammatical category, e.g., -tion turning verb into a noun “destruction”

Morpho-Syntax

- 2-3 children show productive mastery of basic inflectional morphology as shown by applying them to novel words

- Further, overgeneralization:
- tooths, mouses

- Often kids imitate irregulars
- Then learn the rules and overextend
- Then re-learn irregulars



- We're going to focus on syntax more later, but from 2 – 5 the complexity of syntactic production rapidly increases

Pragmatics

- Sophisticated pragmatics develops through middle childhood along with general social cognitive (e.g., advanced ToM abilities)
- Adjusting kinds of language for different contexts fluidly
- Metaphor, use of idioms irony, sarcasm develop 6-8
  - All non-literal language use require understanding communicative intention
- ASD children with otherwise good language skills are still behind on pragmatics
- Vocabularies and pragmatic skills just keep on growing and developing

Outline

- Humans create language whenever they can

What if you don’t have access to language?

- Many deaf children are born to speaking parents: what happens?
- If they do not have interaction with any sign language they invent simple gestural systems to communicate some basic stuff: “home-sign”
- If not exposed to sign language by puberty, they most likely will never get beyond home-sign

What if you don't have access to language?

- If parents learn to sign, then children learn it from them better then the parents know it themselves!
- Singleton & Newport (2004), case study
- Hearing parents would use correct inflectional and derivational morphemes ~70%, the rest a mix of errors
- 7 year-old child of deaf parents used correct morpheme >80%, same as sample of native signers
  - If deaf children have native signing parents, there are no language delays compared to speaking parents.
- Children found the signal in the noise and exploited it

What if you don't have access to language?

- Hudson Kam & Newport (2005) show this pattern with large sample of hearing children learning stochastic artificial grammar
  - Adults reproduce variability of input grammar, 5-7 year-old children more likely to regularize
- 7 sessions of 20 minutes to learn a fake language with 17 words: 4 verbs, 12 nouns, and 1 determiner
  - Simple syntax of "the bear falls" or "the bear eats the fruit"
- Two conditions 100% determiner use, or 60%
- Then task is "In the silly language, say "the bear falls"
- Participants were classified as "systematic determiner users" e.g., always used in one way, such as for subject ("the bear" above) or object nouns ("the fruit" above)

What if you don't have access to language?

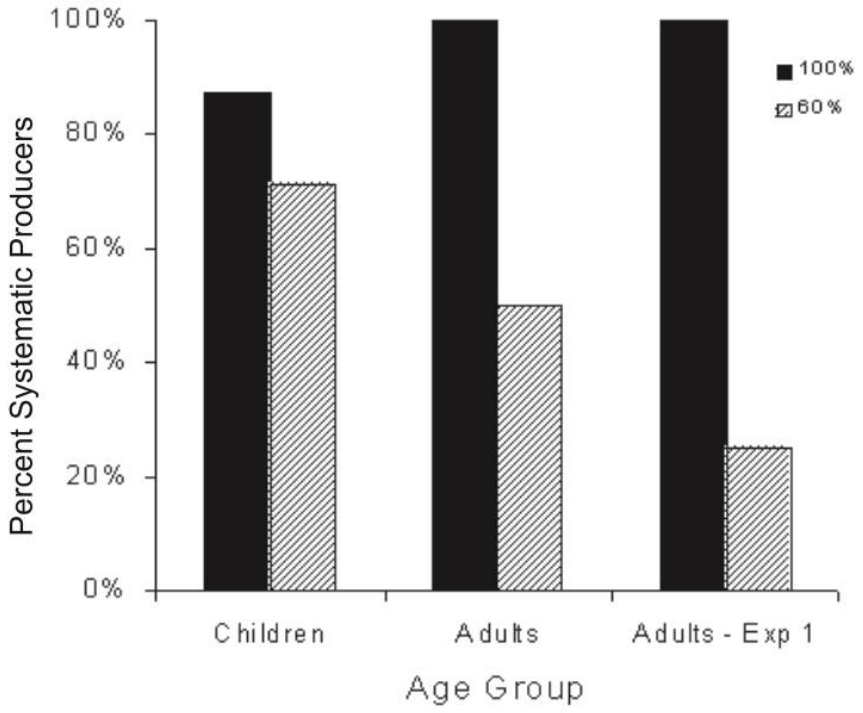


FIGURE 8 Percentage of child and adult participants exposed to 100% and 60% determiner usage who are systematic, Experiments 1 and 2.

What if you don’t have access to language?

- (at least from 2 -6 minutes)

Introduction to Language: Summary

- Language is hierarchically structured/composed from the physical structure of the signal to rules for combining words and sentences into discourses
- 1st year of life: children learn to focus only on sound categories of native language, segment words from speech, and produce sounds just from native language
- 2nd year: word learning begins, & accelerates rapidly along with onset of multi-word utterances towards end
- Toddlers learn morpho-syntactic rules and (over)generalize them to new words.
- Pragmatics grow with general social/cognitive skills in middle childhood.
- With no input, deaf children gesture to communicate
- With a community of others, or faulty input from parents, deaf children create systematic language use