

LEARNING FIRST WORDS (CHS. 6 & 7)

COMD570: Language Development



Foods/Drinks

- Water
- Milk
- Beer
- Wine
- Juice
- Eggs
- Sandwich
- Hamburger
- Spaghetti
- Soup
- Fruit
- Salad

First words stage

- Begins ~12 months
 - The first words stage ends upon emergence of two-word production
- No words by 18 months: “late talker”, or Late Language Emergence (LLE)
 - At risk for development of other language or other types of disabilities
 - Some children will catch up to their peers; “late bloomers”
- Comprehension precedes production
 - Children exhibit greater comprehension abilities than production abilities at early stages of development
 - Extends from first words stage up to complex syntactic structures

First words stage: phonology/phonetics

- First words typically contain 1-2 syllables
- Mostly front consonants, i.e. bilabials and alveolars (/p,b,t,d,m,n,w/), with some back or velar consonants (/g,k,h/)

First words stage: phonology/phonetics

- Often reduplication of first syllable (akin to babbling):
 - Wawa = water
 - Baba = bottle
- Production reflects phonetic approximations of adult phonology
 - Assume underlying phonological representation is the same as the adults, but phonetic pressures are more extreme in infants

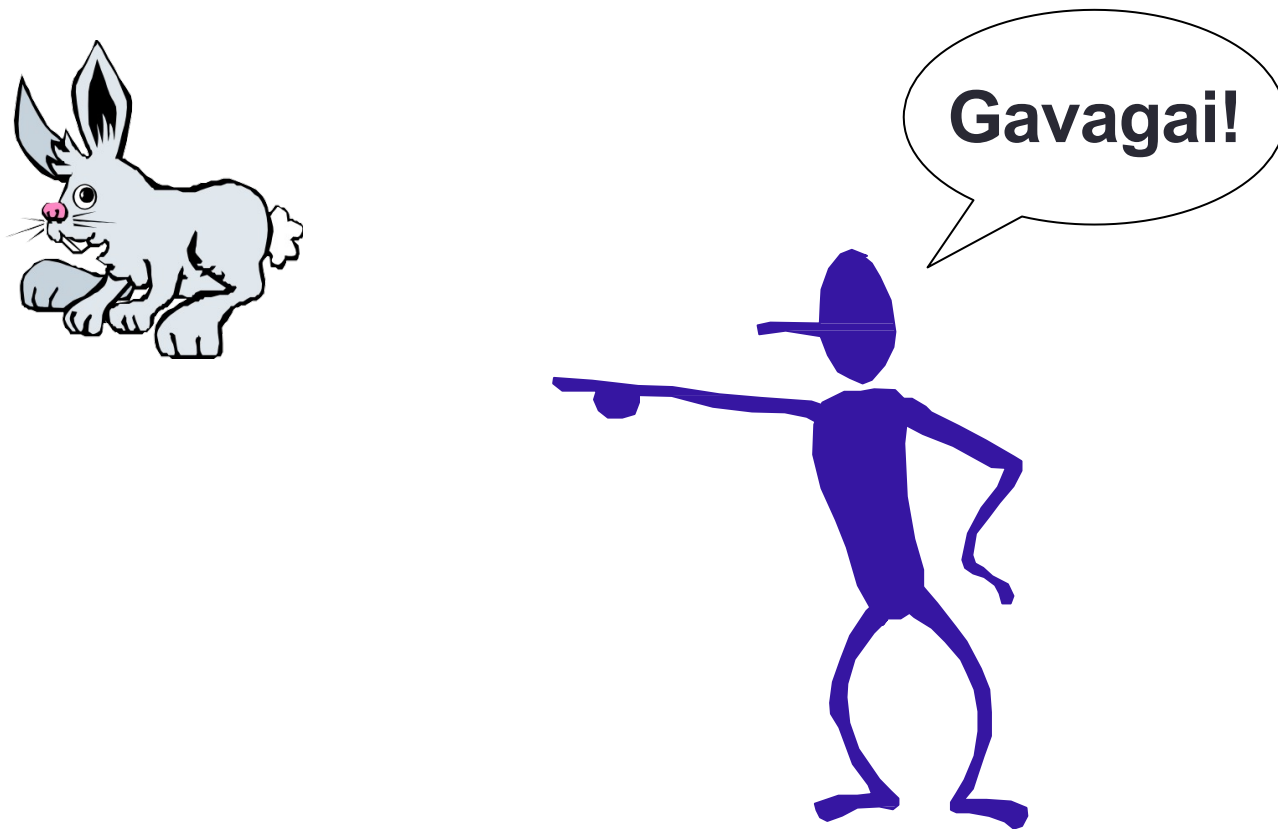
First Words Are Usually...

- Nouns
- Names of things in their environment
- General, not specific
- Concrete, not abstract
- Modelled frequently by caregivers

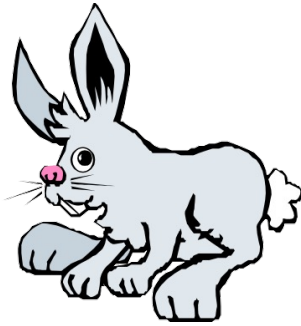
Learning first word meanings

- Goal: associate a phonological form with a particular meaning
- How do kids figure out what the intended meanings *are*?

The mapping problem



What does “gavagai” mean?



What does “gavagai” mean?

RABBIT?

MAMMAL?

GRAY RABBIT?

ANIMAL?

CARROT EATER?

VEGETARIAN?

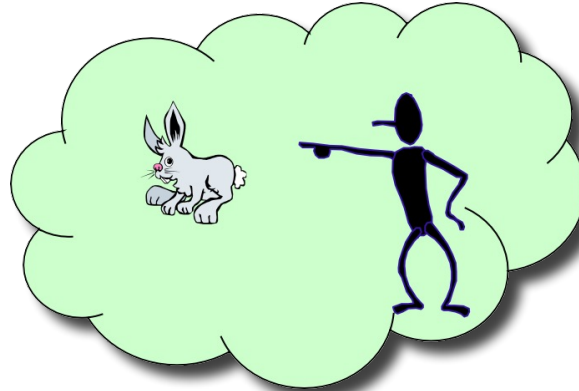
EARS?

LONG EARS?

IS IT GRAY?

FLUFFY?

WHAT A CUTIE!



THUMPING
HOPPING

SCURRYING

STAY!

LOOK!

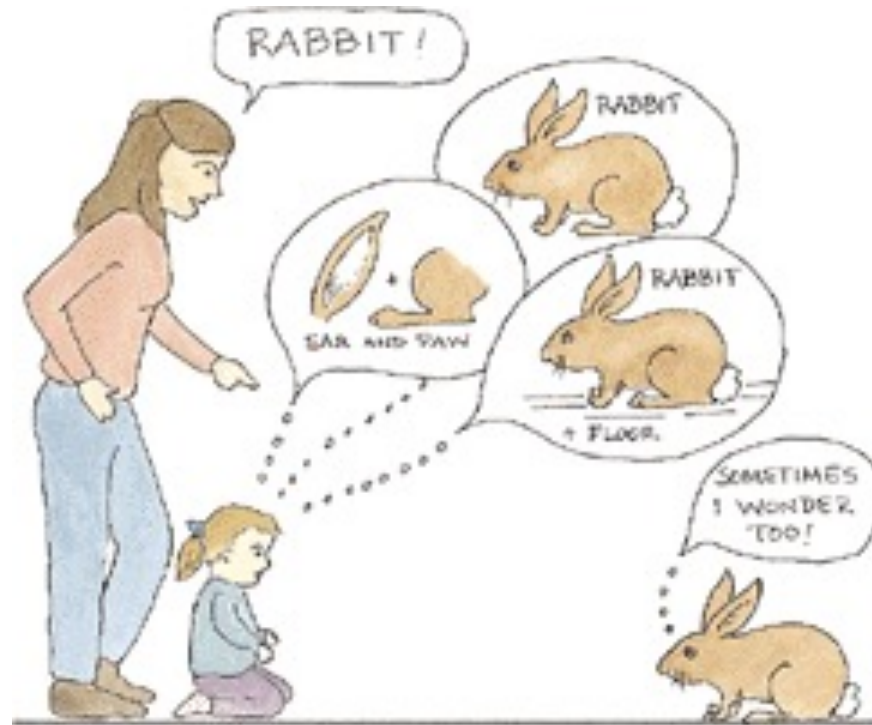
MEAL!

RABBIT ONLY UNTIL
EATEN!

CHEEKS AND LEFT EAR!

THAT'S NOT A DOG!

What does “rabbit” mean?

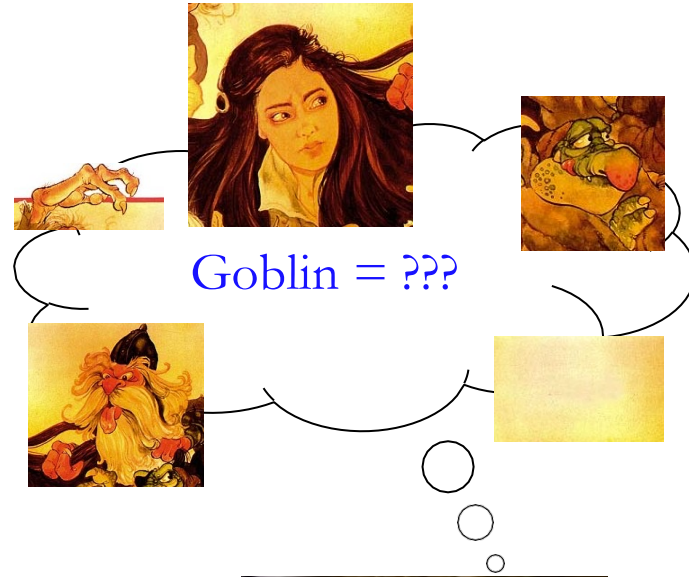


More context...

“Look! There’s a **goblin**!”



Quine (1960)



First words are referential

- “Dog!” - Kids initially expect words to be like this
- 4-month-olds expect speech sounds uttered by a human who’s looking at them to refer to something in the world (i.e., be referential)
- This helps them to solve the mapping problem



First words are context-bound

- First words tend to be **context-bound** (super referential):
 - E.g.: “cat” said for a *particular* cat
- Children have often identified one *particular* instance for which it’s appropriate to use that word
 - Haven’t realized its more abstract coverage
 - I.e., that words are often categories, not just one specific thing



First words are context-bound

- Even if children realize a word has more extended use, they *still* may not realize it has the meaning that adults have for it
 - E.g.: “more”
 - Children might extend this to mean a request for more, but not understand that the word is used for comparison (e.g., there are *more* cakes than pies on the table)
- Often, first words are parts of routines or language games
 - Children must then realize that these words can be extended beyond the scope of the game

Fast mapping

- **Fast mapping:** rapidly guessing a word's meaning, then modifying the inferred meaning with more data
- Fast mapping can occur with one exposure!
 - Three year old children can remember a word's meaning a week after a single exposure
 - More experience with the word is necessary to consolidate its memory over time

Carey and Bartlett, 1978

Markson and Bloom, 1997

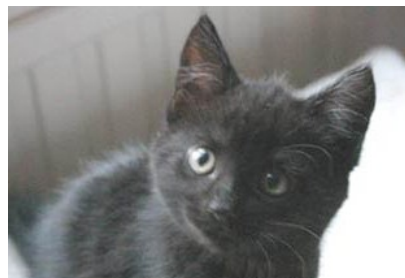
Fast mapping

“Can I have
the *zib*?”

Ball



Kitty



Bear



[Unknown]



Fast mapping

Ball



Kitty



Bear



“Can I have
the *zib*?”



Zib



Underextension & overextension

- **Underextension**: using words in a narrower range
 - E.g.: Only Siamese and Persian cats are cats
- **Overextension**: using words in a wider range (more common)
 - E.g.: All fuzzy creatures are cats

kitty



Not kitty



Underextension & overextension

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kitty



Not kitty



Underextension & overextension

- Both **underextension** and **overextension** can occur simultaneously



kitty



Not kitty



Overextension errors often have semantic features in common



More overextension examples

Ball = ball, balloon, marble, apple, egg, wool pom-pom, spherical water tank

common feature = “round-ish shape”



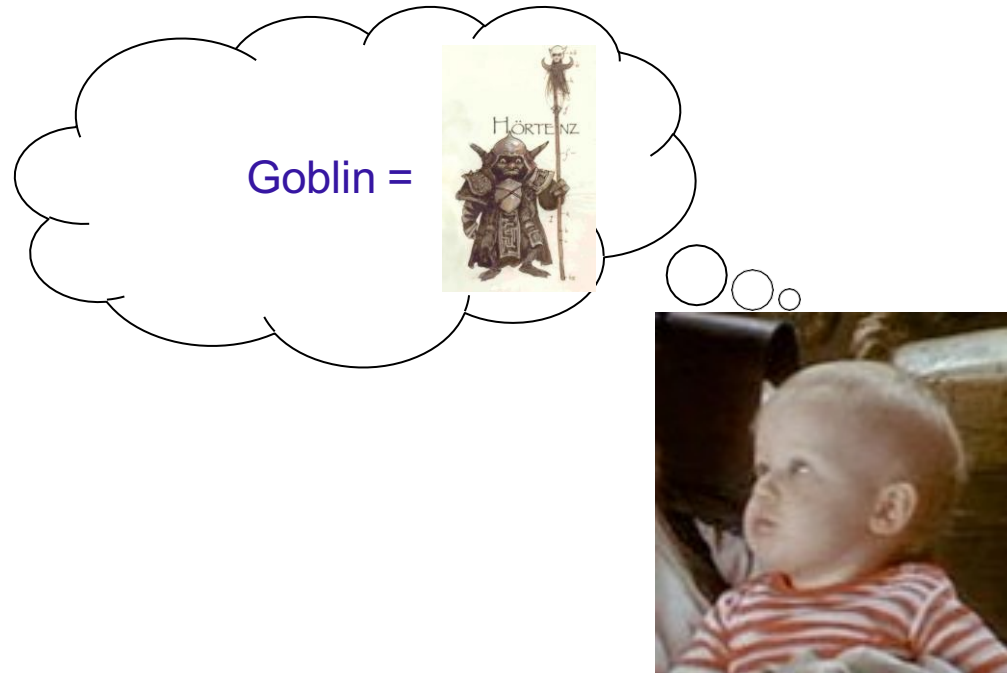
Cat = cat, cat's usual location on top of TV when absent

common feature = “associated with kitty”



Whole object assumption

- New word refers to entire object, rather than some subset of it



Mutual exclusivity assumption

- Assume new word does not overlap in meaning with known word
 - Assists fast mapping
 - Can be used to overcome whole-object assumption

Handle = some part
of the cup?

Known: *cup*

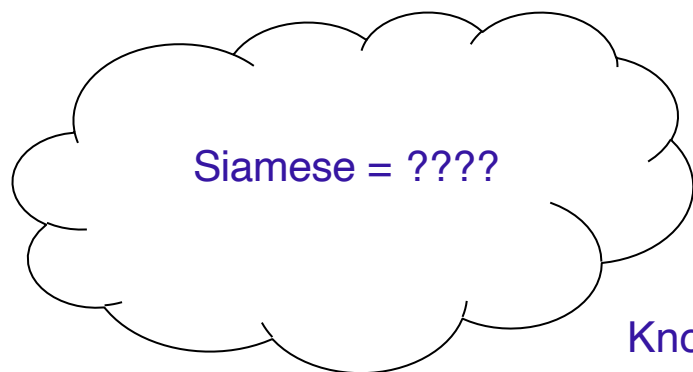


Adult utterance:
“Look! You can see the *handle!*”



Mutual exclusivity assumption

- Problem: multiple words for the same referent



Known: *kitty*

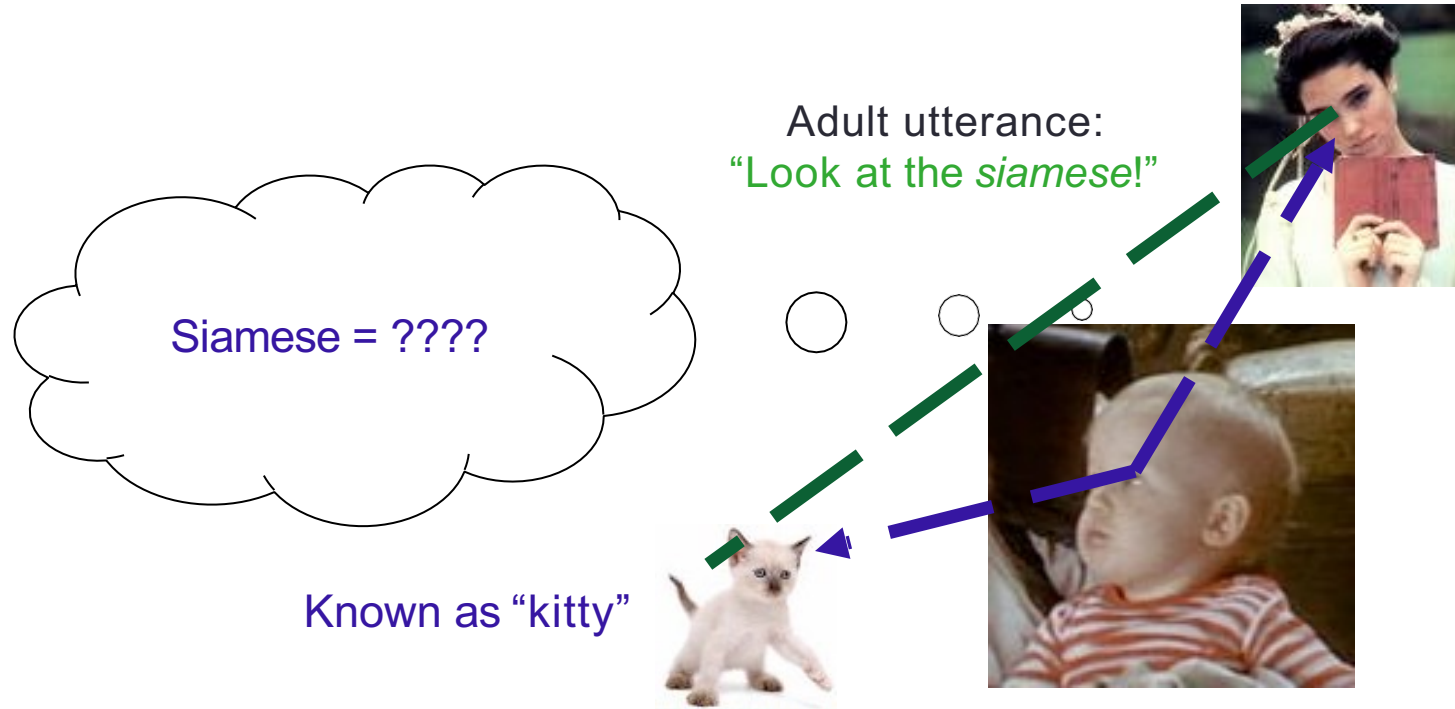


Adult utterance:
“Look at the kitty! He’s a *siamese*!”



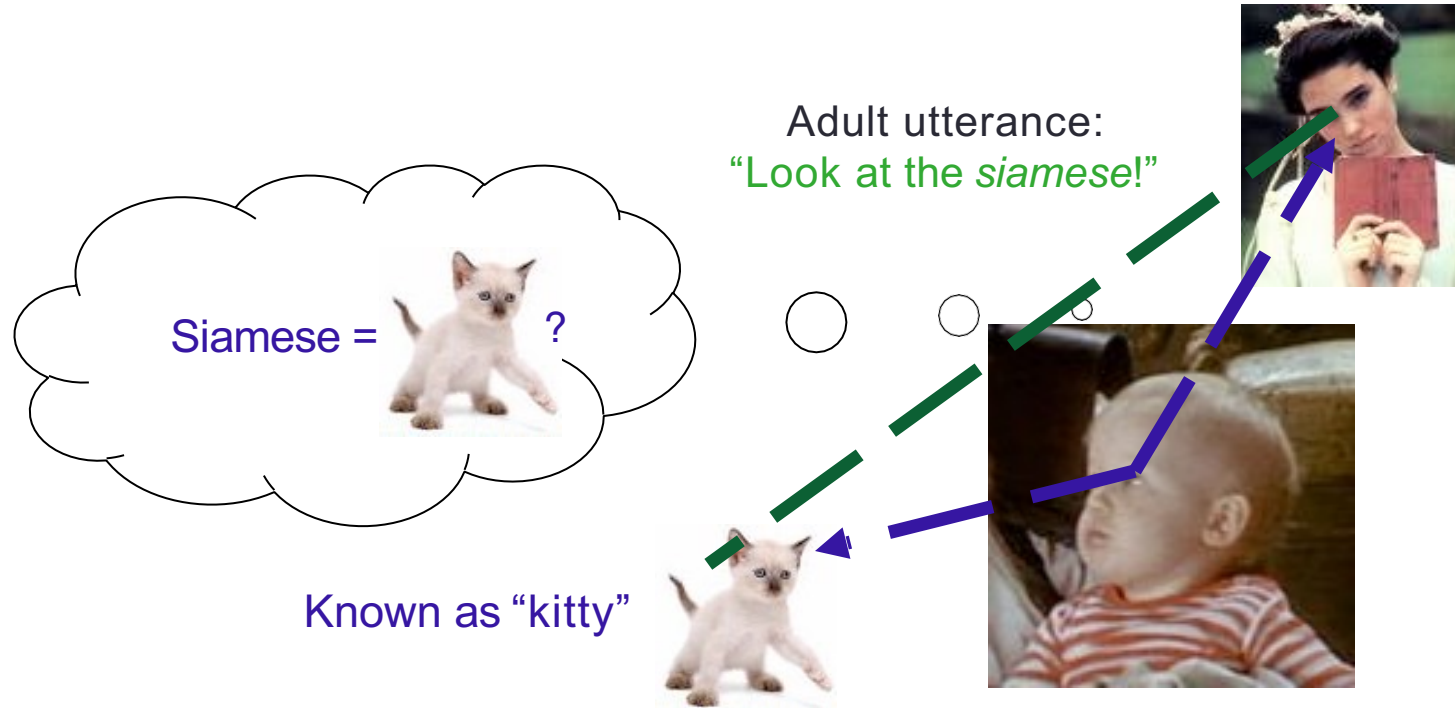
Joint attention to the rescue

- Speaker gaze can help! Joint attention important



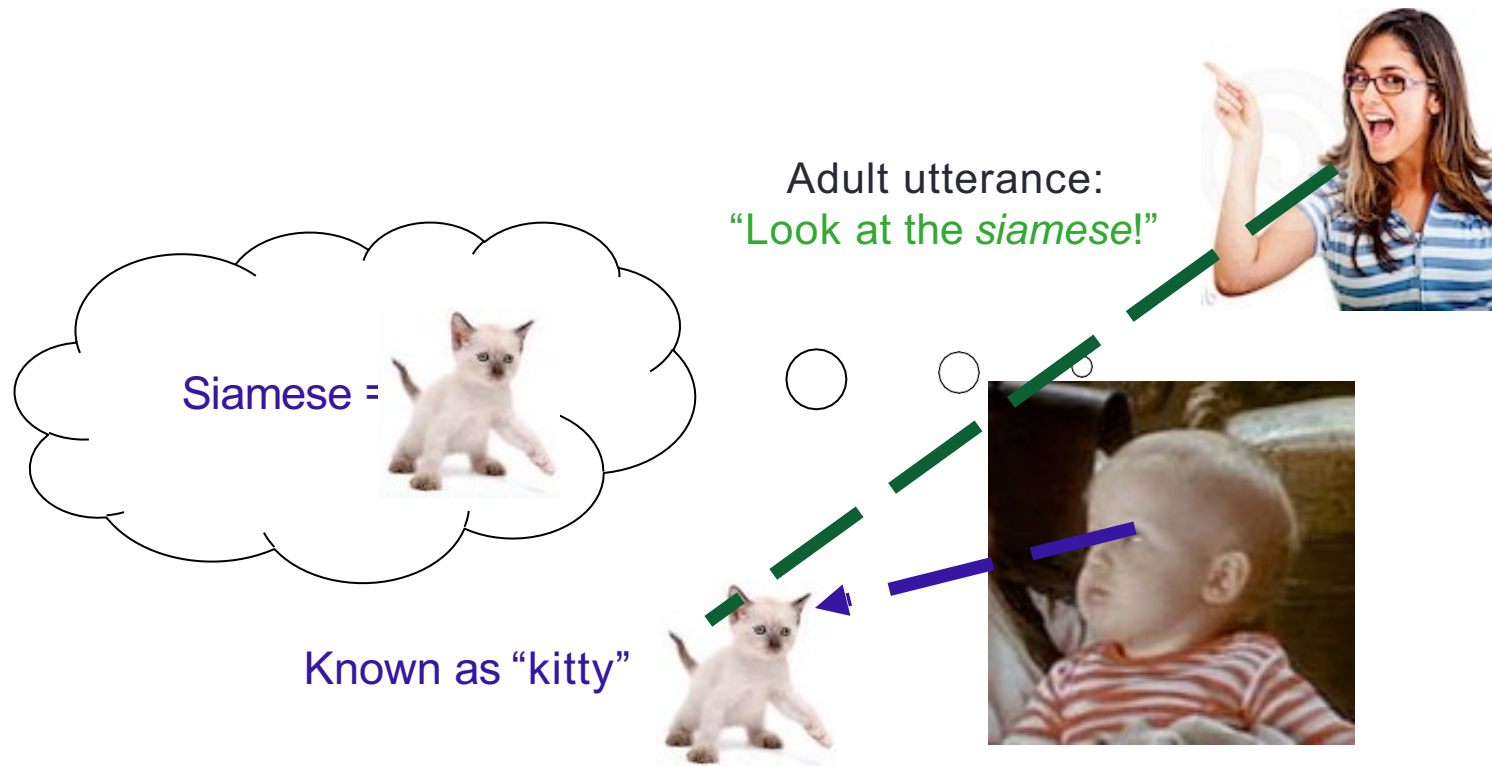
Joint attention to the rescue

- Speaker gaze can help! Joint attention important



Joint attention to the rescue

- Pointing is even more effective!



Joint attention to the rescue

- Pointing is even more effective!
 - However, only ~15% of parental utterances are accompanied by gestures like pointing



Known as "kitty"



Adult utterance:
"Look at the *siamese*!"



Joint attention to the rescue

- Children tend pay attention to things that are in their mother's hands
 - This simple attentional bias can often lead them to choose items that have recently been manipulated, offered or touched



Discourse continuity

- Young children prefer **discourse continuity**
 - A label for an object is embedded between utterances about the same object (Horowitz & Frank 2013)
 - Children learn novel object labels better this way (Schwab & Lew-Williams 2017)

References object

Adult utterance #1: “How cute he is!

Adult utterance #2: Do you see the **Siamese**? *Object label*

Adult utterance #3: Look at his soft fur.”

References object

Knowing what to guess

- Speakers generally talk to children about the *here and now*
 - Quine's problem is not nearly so serious in child-directed speech

Common child-directed speech: “Look at the *siamese!*”

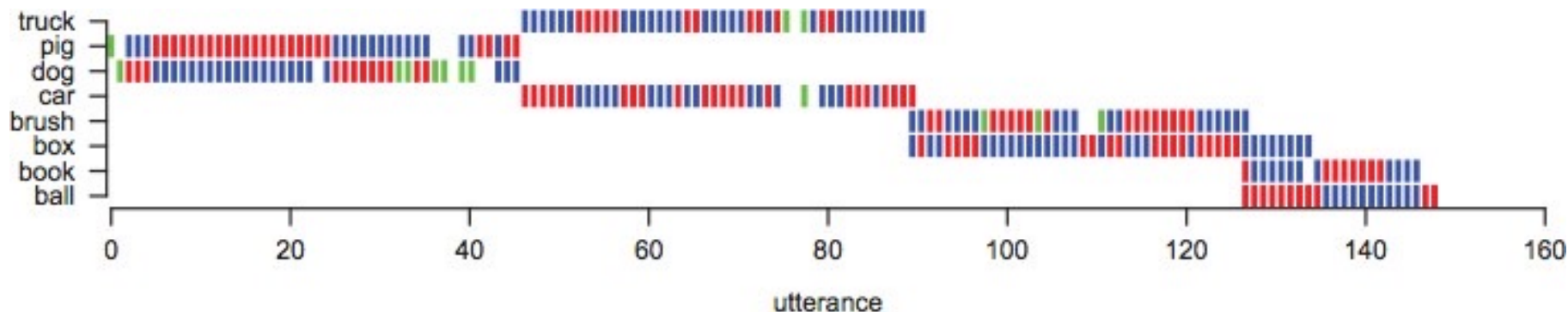
Uncommon: “I just her to the vet yesterday”



Knowing what to guess

- Speakers generally talk to children about the *here and now*
 - Quine's problem is not nearly so serious in child-directed speech

Sample interaction between caretaker and child:

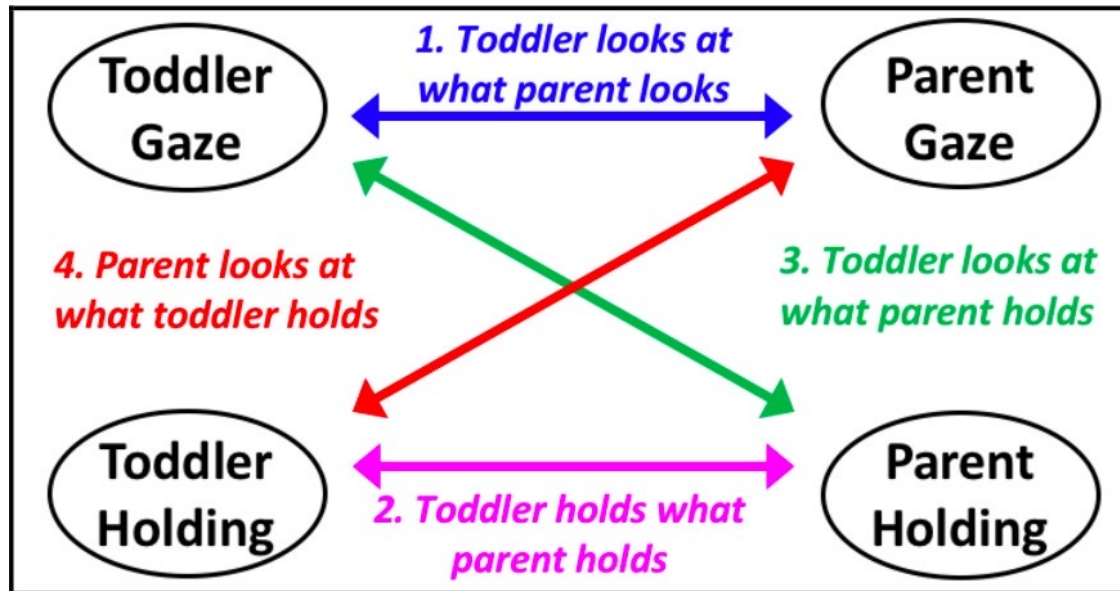


Blue = object present but not mentioned Green = object mentioned but not present

Red = object present and mentioned

Knowing what to guess

- Extended discourses: toddlers and parents exhibit greater sustained attention on objects, greater coordination between their behaviors



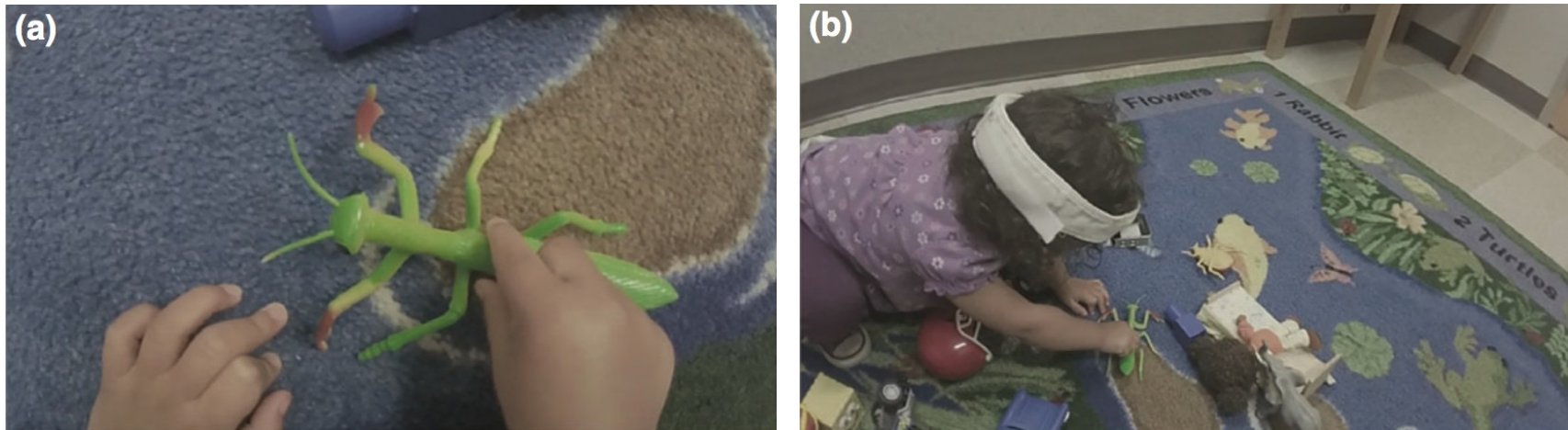
Knowing what to guess

- There's a strong correlation between the first words children learn and how often the objects these words refer to appear in children's environments (visual availability)
 - “[this]...suggests visual experience is doing the heavy lifting in very early word learning”



Knowing what to guess

- Often there may only be a few objects in clear view of the child, as opposed to all the different potential referents an adult sees

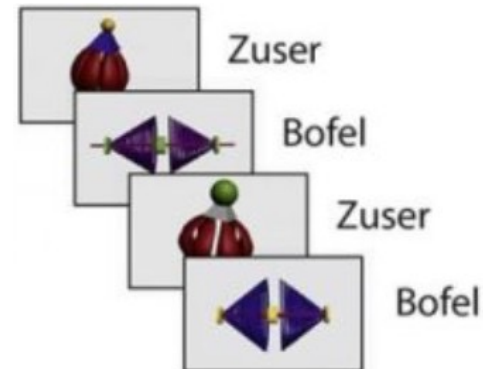


Pereira Smith & Yu 2014, Zhang & Yu
2016, Samuelson & McMurray 2017

FIGURE 2 | Differences in the number of namable objects in view from the child's (a) and parent's (b) perspective.

Sleep consolidation is important

- 6- and 8-month-olds can associate a novel word form (e.g. *bofel*) with a referent, but only after a 50 minute nap



Recap: children's lexical development

- Mapping problem: figuring out the meaning of a word is hard
- First words often refer to things in the environment (about the here and now)
- Young children use fast mapping to guess an initial meaning of a noun
- Often, children make mistakes by either assigning a narrower or wider meaning to a word than adults do
 - Eventually, through experience with the language, they home in on the correct meaning
- Children have a variety of biases that help them guess word meanings from context

Acquisition of nouns and verbs

Noun bias

- Vocabularies of children with 50 or less words are heavily concentrated on experiences child has
 - Names for people, food, body parts, clothing, animals, household items
 - Large-scale analysis over tens of thousands of children in English, Spanish, Norwegian, & Danish: nouns are much more common in early vocabularies than adult vocabularies

Noun bias

- The meaning of nouns is easier to identify than the meaning of other words, like verbs

kitty = ?



give = ?



Crosslinguistic differences

- Korean-, Japanese-, and Mandarin-speaking children show less of a noun bias
- Verb information is more salient to learners:
 - Verbs appear sentence-final (final positions more salient)
 - Nouns optionally omitted in these languages



How are verbs learned?

- Learn from **Scenes**
 - Situational context



How are verbs learned?

- Learn from **Scenes**
 - Situational context
- Learn from **Nouns**
 - Can use knowledge of nouns to bootstrap verb knowledge

I, it, you

How are verbs learned?

- Learn from **Scenes**
 - Situational context
- Learn from **Nouns**
 - Can use knowledge of nouns to bootstrap verb knowledge
- Learn from **Syntactic Frames**
 - Other words and syntactic structure form a frame around which it can be assumed that a novel word must fit into the verb slot

Can po SIRN while lo nirp nu?

Learning words helps word learning

- 19-month-olds can use known words to figure out unknown words
 - E.g., knowing that certain verbs require an animate subject

				
Informative				
<i>'Look here!'</i>		<i>'...The dax is crying...'</i>		<i>'Where is the dax?'</i>
Neutral				
<i>'Look here!'</i>		<i>'...The dax is right here...'</i>		<i>'Where is the dax?'</i>

Learning words helps word learning

- At both 19 and 24 months, the number of verbs infants know predicts their ability to use known verbs to learn novel nouns



Correction

- Speakers also sometimes provide explicit correction for meaning, and provide additional information about the word's meaning



“Can I see the bugs again?”

“Those are **goblins**, honey, **not bugs**. Goblins live in the Labyrinth and occasionally take naughty children away.”

Morphology & Syntax

- Grammatical categories (e.g. noun, verb) tend to have different meanings
 - Once children have learned some syntactic categories (after ~14 months), can use syntactic structure and inflectional/derivational morphology



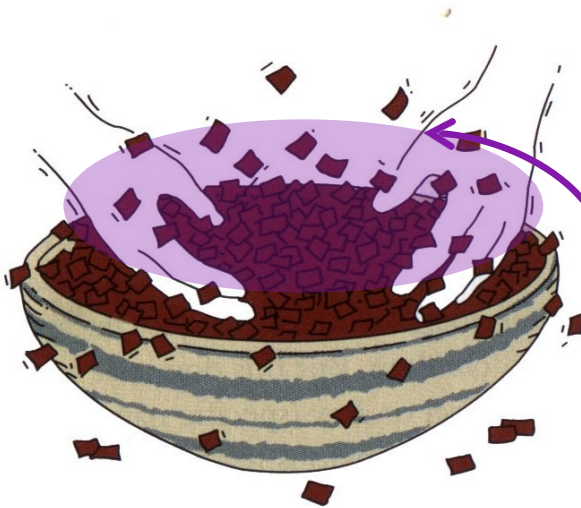
“Those are goblins.”

- goblins = noun
- nouns = objects
- goblins =



Morphology & Syntax

He's sebbing!

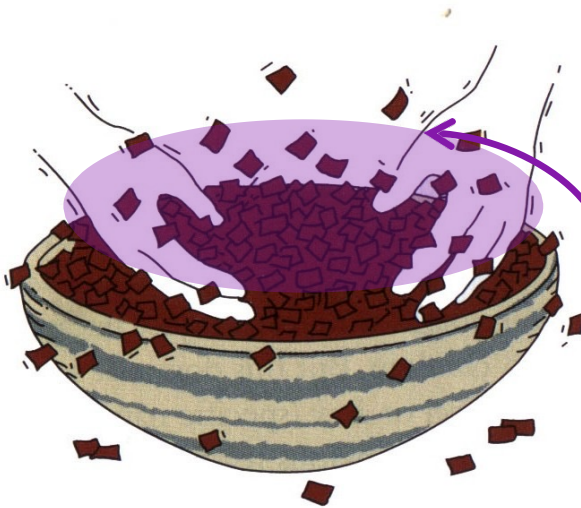


seb = verb

verb = action

Morphology & Syntax

Look – **a** seb!







seb = noun

noun = object

Grammar vs. eye gaze

- 2-year-olds already rely on some grammatical cues more than eye gaze in cases of ambiguity.

Training 1		"THESE ARE nice blicketS. Can you find the blicketS?"	
2		"Where IS the blicket_? Can you see A blicket_?"	



- During training, the speaker looks at a different referent than what the grammatical cues indicate
- During post-test, children look at the correct referent (not the one that was looked at by the speaker)



Syntactic bootstrapping

- **Syntactic Bootstrapping:** using structure (syntax) to get meaning (semantics)
 - Naigles (1990): 2-year-olds can use syntactic structure to guess aspects of word meaning, including the difference between transitive and intransitive verbs
- Transitive: The rabbit is gorging the duck.
 - Expectation: rabbit is doing something to the duck
- Intransitive: The rabbit and the duck are gorging.
 - Expectation: rabbit and duck doing actions separately



Semantic Bootstrapping

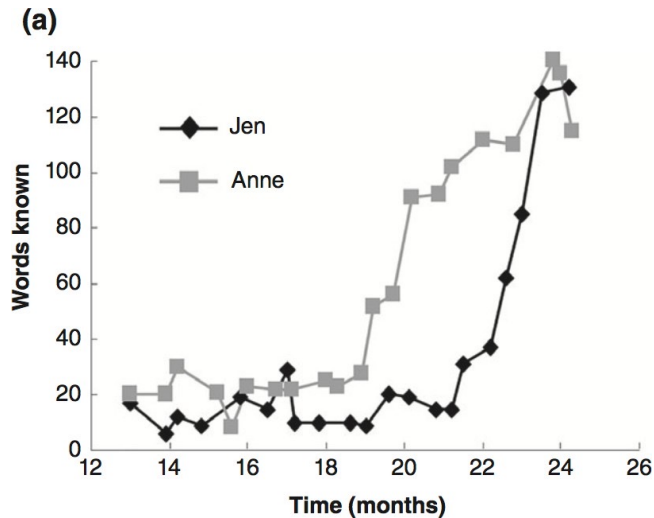
- **Semantic Bootstrapping:** using meaning (semantics) to get structure (syntax)
 - Objects -> nouns
 - Actions -> verbs
 - Attributes -> adjectives
 - Spatial relations -> prepositions

Recap of acquisition of nouns and verbs

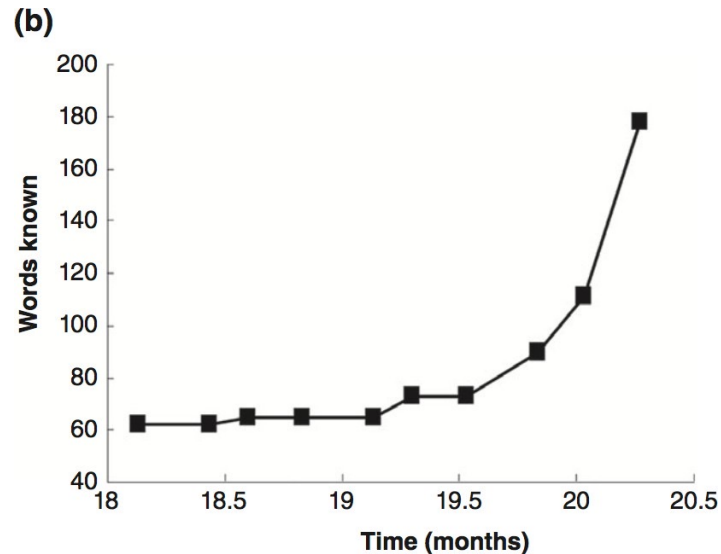
- Noun bias in first words
- Knowledge of nouns, scene information, and syntactic context/syntactic bootstrapping facilitates the acquisition of verbs
 - *Maybe* also semantic bootstrapping

The word spurt

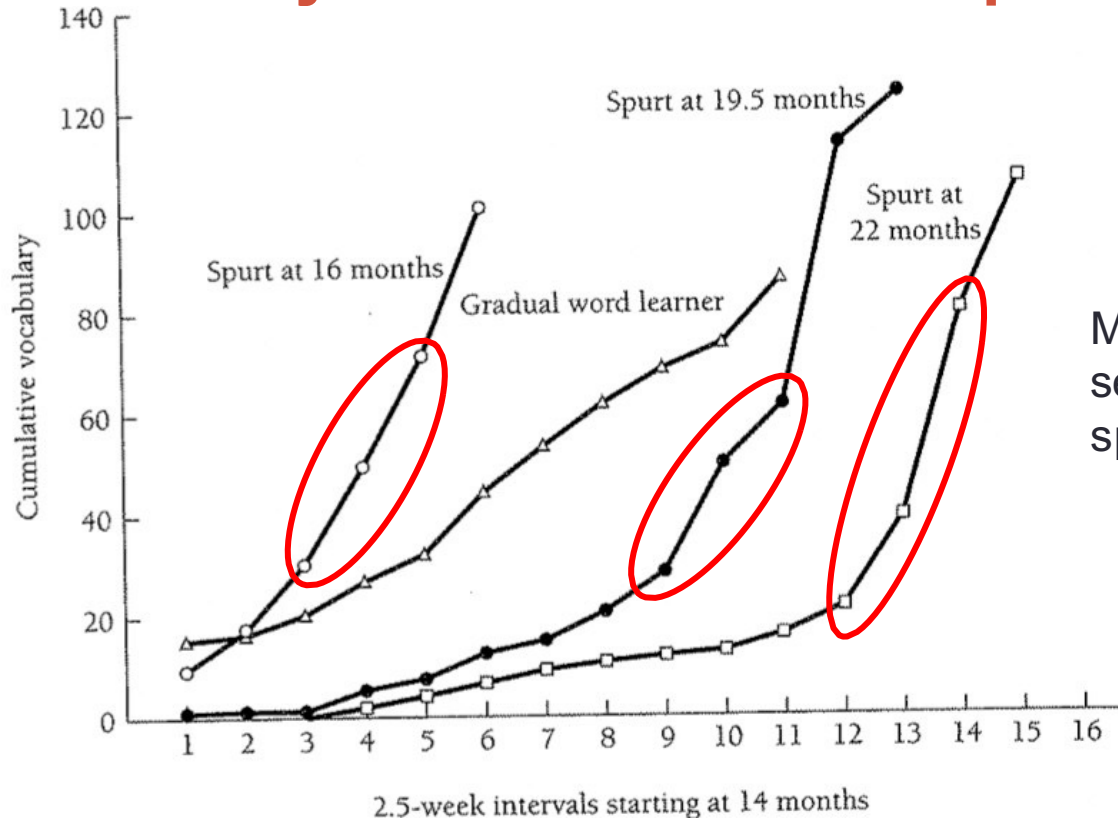
- Rapid increase of pace of word learning (Samuelson & McMurray 2017)
- Occurs around 16-22 months



from Plunkett 1993



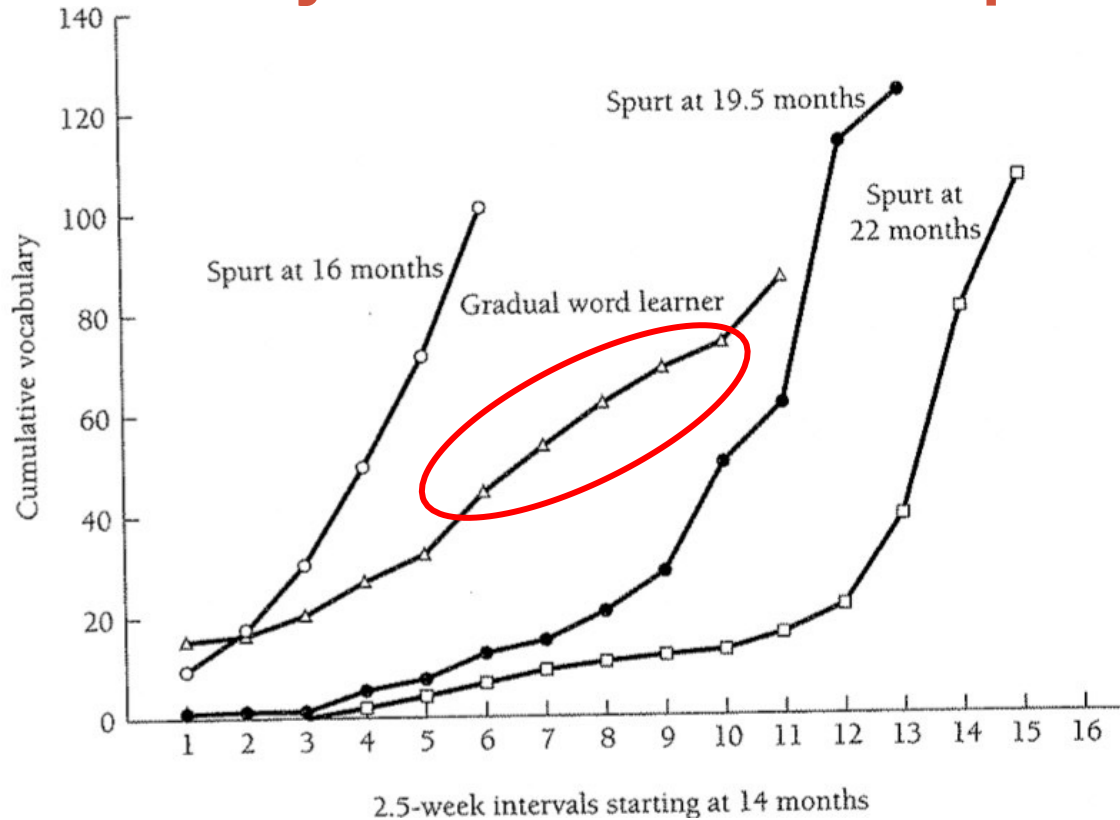
Variability in the word spurt



Many children seem to have a spurt (13 of 18)

Goldfield & Reznick 1990

Variability in the word spurt



Goldfield & Reznick (1990)

Causes of the word spurt

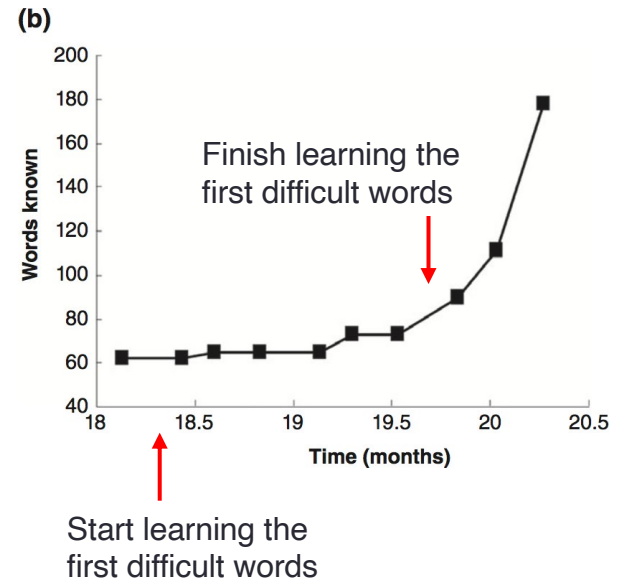
- Leveraging known words
- Some words are harder than others
- Cognitive processing improves over time

Causes of the word spurt

- **Leveraging known words**
- Knowing related words helps children recognize new words
 - E.g. learning the name of one color may aid the learning of other color words
- This cumulative effect may contribute to the word spurt

Causes of the word spurt

- **Some words are harder than others**
- Words vary in phonological, syntactic, and semantic complexity
- More complex words take longer to learn
 - The learning of these words will be complete at a later time than easier words
- Easy words are learned all the time
- Finally learned difficult words + newly learned easy words = seemingly many words all at one time



Causes of the word spurt

- **Cognitive processing improves over time**
- Cognitive processing abilities (e.g. working memory, attention) develop dramatically over the first two years and beyond
 - Leads to better ability to learn vocabulary
 - Better ability to use words that children have already learned

Theories of Word Learning

Semantic Feature Hypothesis

Functional Core Hypothesis

Prototype Complex Hypothesis

Semantic feature Hypothesis

- Every referent (thing talked about) has a set of characteristics (features) that define it
- Referents have primary, secondary, and tertiary definitions (like a dictionary entry)
- Example: “dog”

Features

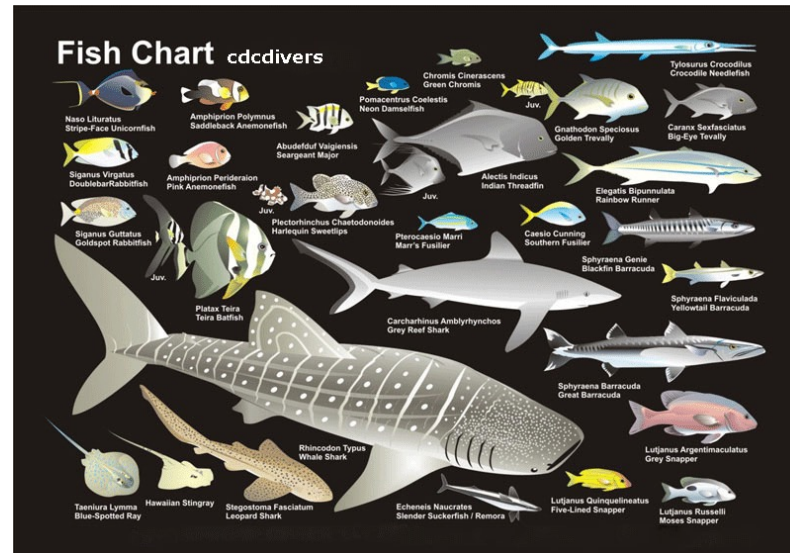
- animal
- four-legged
- hairy
- tail
- long tongue
- barks

Selectional Restrictions

- can't fly
- can't talk
- can't throw

Semantic feature Hypothesis

- Word meanings are a set of properties that are **necessary** and **sufficient** for membership in the category
- Meanings are analyzable into bundles of semantic primitives (features)
- Fish:
 - [aquatic]
 - [water-breathing]
 - [cold-blooded]
 - [animal]
 - [chambered heart]



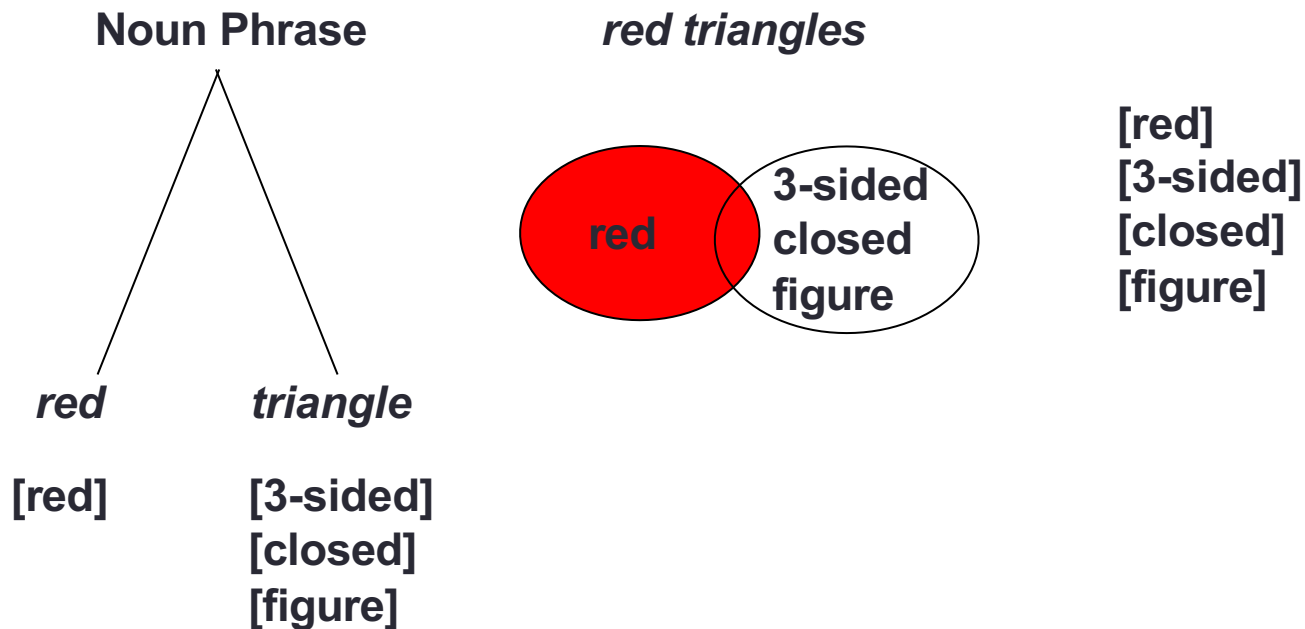
Semantic feature hypothesis

- E.g., Bachelor:
 - # My husband is a bachelor.
 - Bachelor → UNMARRIED
 - # I met a two-year-old bachelor.
 - Bachelor → ADULT
 - # My sister is a bachelor.
 - Bachelor → MALE
 - # My dog Rex is a bachelor.
 - Bachelor → HUMAN

[UNMARRIED]
[ADULT]
[MALE]
[HUMAN]

Semantic feature hypothesis

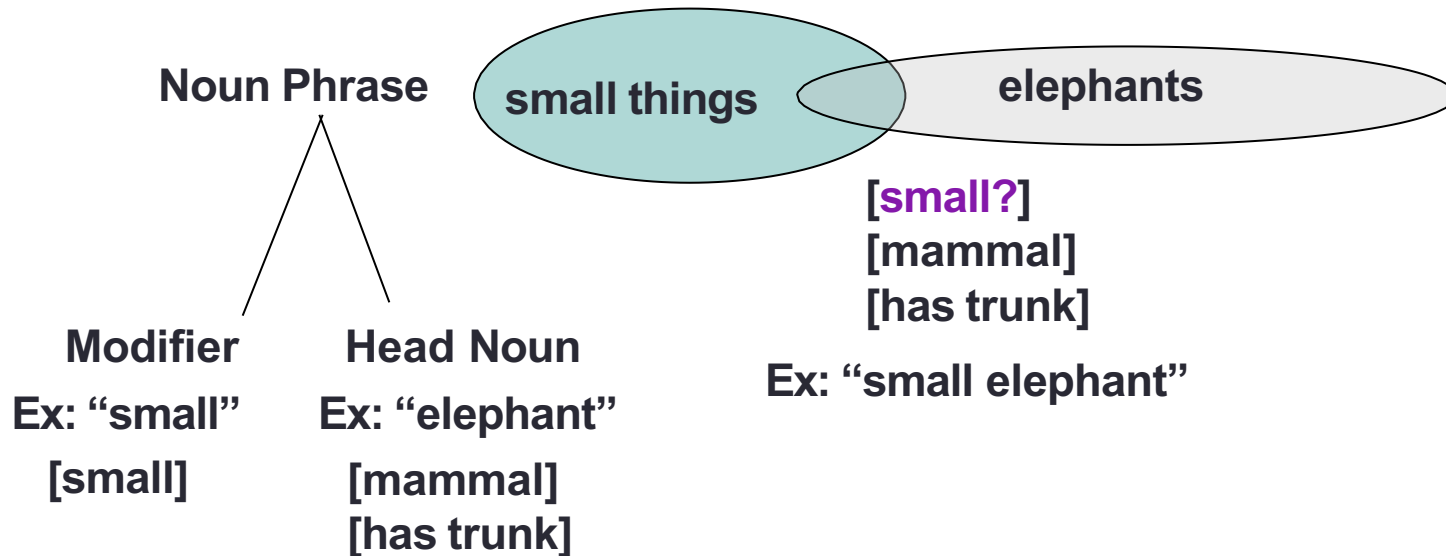
- How do we create new meanings? **Compositional semantics**



Semantic feature hypothesis

- Doesn't always work:

Are small elephants really in the set of small things to begin with?



Semantic feature hypothesis

- Necessary and sufficient features aren't always so easy to come up with

What is a game?
(Wittgenstein
1953)



Is it always amusing?

Is skill required?

Is it always competition?

Must luck play a role?

Semantic feature hypothesis

- Necessary and sufficient features aren't always so easy to come up with
 - Amos is an unmarried adult male, but he has been living with his girlfriend for the last 23 years
 - Their relationship is happy. Is Amos a bachelor?

Bachelor (revisited)

[UNMARRIED]

[ADULT]

[MALE]

[HUMAN]

Semantic feature hypothesis

- Bernard is an unmarried adult male, and he does not have a partner.
 - Bernard is a monk living in a monastery
 - Is Bernard a bachelor?

Bachelor (revisited)

[UNMARRIED]

[ADULT]

[MALE]

[HUMAN]

Prototype theory

- Categories have *graded membership*: some members of a category are reliably rated as “better” members than others

Please rate the following in the category BIRD

Ostrich vs. Robin vs. Bat

1	2	3	4	5	6	7
Good						Bad
member						member

Prototype theory

- Categories have *graded membership*: some members of a category are reliably rated as “better” members than others



- Robin: 1.1
- Eagle: 1.2
- Wren: 1.4
- Ostrich: 3.3
- Chicken: 3.8
- Bat: 5.8



Prototype theory

- Features have associated probability
- These probabilities may be thought of as weights on the features for membership/identification purposes
- Category membership is based on a weighted sum of the features

Problems with prototype theory

- People often make categorical judgments about the meanings
 - E.g., we judge things like bats to be totally not birds, even though they share features
 - Emu = bird - - - **TRUE**
 - Bat = bird - - - **FALSE**
- Circular definition of category membership
 - E.g., how was the set of Smiths determined in the first place?

Functional core Hypothesis

- Referents defined by what they do or used for
- Rather than a set of static characteristics/features, referents are known by their actions or functions
- Example: “dog”
 - Pet (lives at home)
 - Plays
 - Barks
 - Growls
 - Licks
 - Sniffs

Functional core hypothesis



Recap

- Word learning: associating a phonological form with a meaning
 - And syntactic properties!
- **Mapping problem:** infinite possible meanings for a word
- Solving the mapping problem:
 - Fast mapping
 - Whole object bias
 - Mutual-exclusivity assumption
 - Semantic bootstrapping
 - Syntactic bootstrapping
 - Joint attention

Recap

- There is an initial noun bias in early vocabulary
- Learning verbs facilitated by:
 - Leveraging known nouns
 - Scene information
 - Syntactic context
- Word spurt occurs around 16-22 months

Recap

- What are word meanings?
 - Definitions/semantic features
 - Prototypes
 - Functional cores
- Probably word meanings incorporate all of these things!

On to multiword utterances!

- Enabling factors:
 - Syntactic knowledge
 - Executive function resources (esp. working memory)
 - Communicative pressures
 - Pragmatic conversation structure