24.904
Language Acquisition

Class 7: Words and Their Meanings, continued

Last time

- **The cross-situational learning model:** learners achieve cross-situational learning by keeping track of multiple hypotheses about a word's meaning across successive learning instances, and gradually converge on the correct meaning via an intersective statistical process.

A key premise

- Learners who appreciate the indeterminacy of a single observation should not jump to a conclusion about word meaning on first observation, but rather, **hold the choices in abeyance** until evidence from further exposures has accumulated

[[ball]] = {ball OR dog OR shoe}

Trueswell et al. 2013

- Can learners hold onto the relevant situational information until evidence is strong enough to form a hypothesis about word meaning?

Trueswell et al. 2013

- Experiment 1
  - Presented adults with novel words used as names for familiar objects
  - Participants click on a hypothesized referent object
  - Each subsequent set replaces 4 of the 5 possible referents, in a way s.t. co-occurrence frequency between target and word (100%) is higher than any alternatives (max 40%)
  - 5 “learning instances” per word

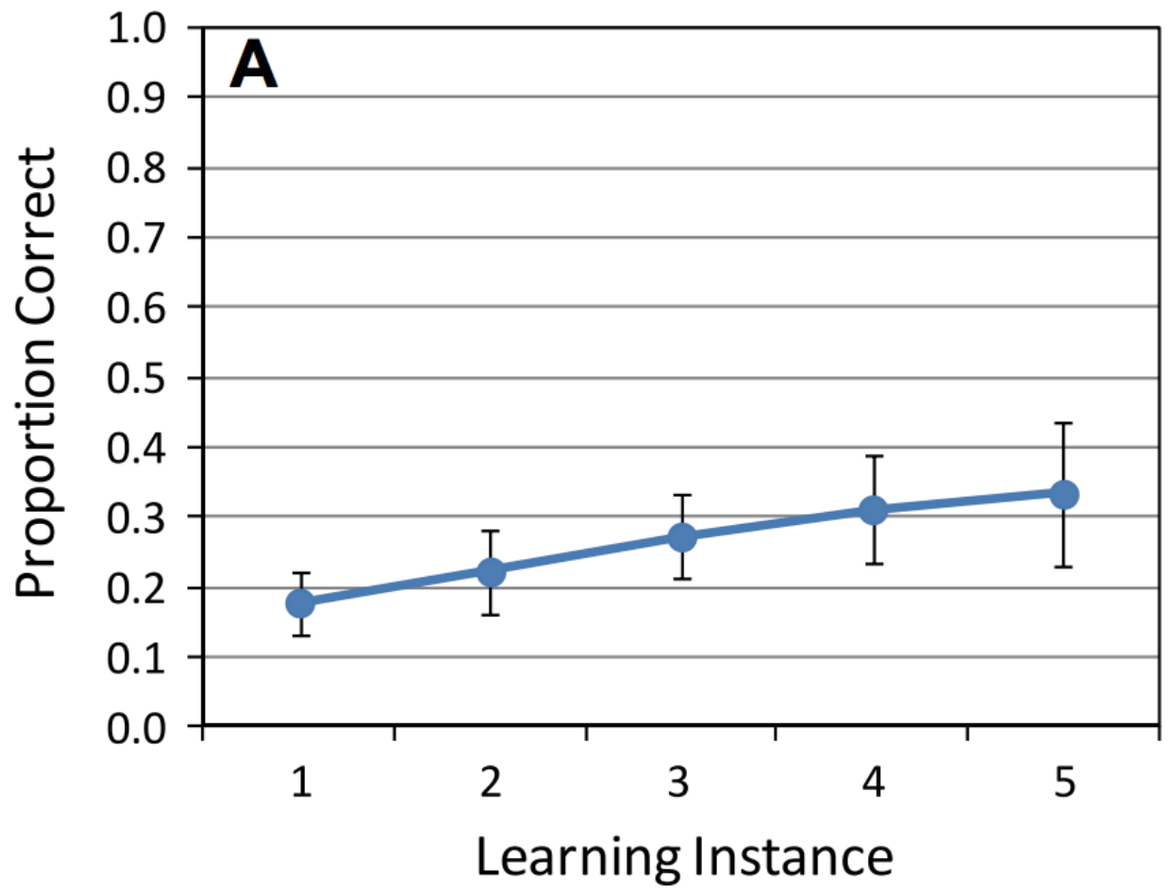
Fig. 1. Example sequence of two learning trials for the word “zud”, which meant ‘bear’. In both instances, five alternatives are displayed. Note that different examples of bears appear, that only one entity is labeled on each trial (i.e., only one nonsense word is heard), and that other learning trials for other words intervene.

Trueswell et al. 2013

- Measures
  - explicit: choice of referent
  - implicit: eye movements
- Question: does the rate of target-selection improve stepwise over time/across the 5 learning instances?

Trueswell et al. 2013

- Results
  - slow, but steady learning over time

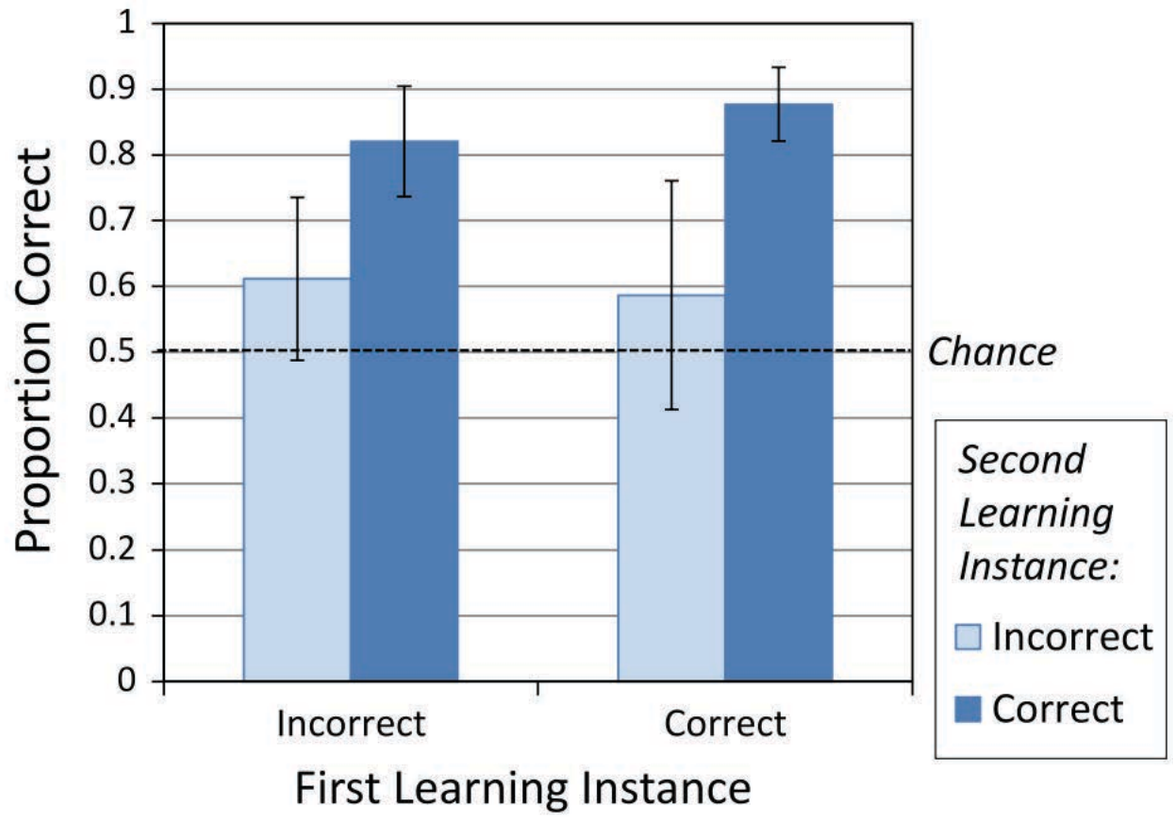


Trueswell et al. 2013

- Results
  - accuracy-contingent learning
    - success on any given trial modulated by success on preceding one
  - confirmed by eye-movement patterns

Trueswell et al. 2013

- Results
  - Highly local
  - Success on trial n is determined only by success on trial n-1; success on n-2 doesn't matter



Trueswell et al. 2013

- Learners do not reliably succeed at holding in mind possible candidate referents for a given word across learning instances. *How then can they carry out cross-situational learning?*

- If not cross-situational learning, then what?

Propose but verify

- The learner makes a single conjecture upon hearing the word and carry that conjecture forward to be evaluated for consistency with the next observed context.

- If the guess is “confirmed” in the next instance, the learner will further solidify the word meaning in memory.

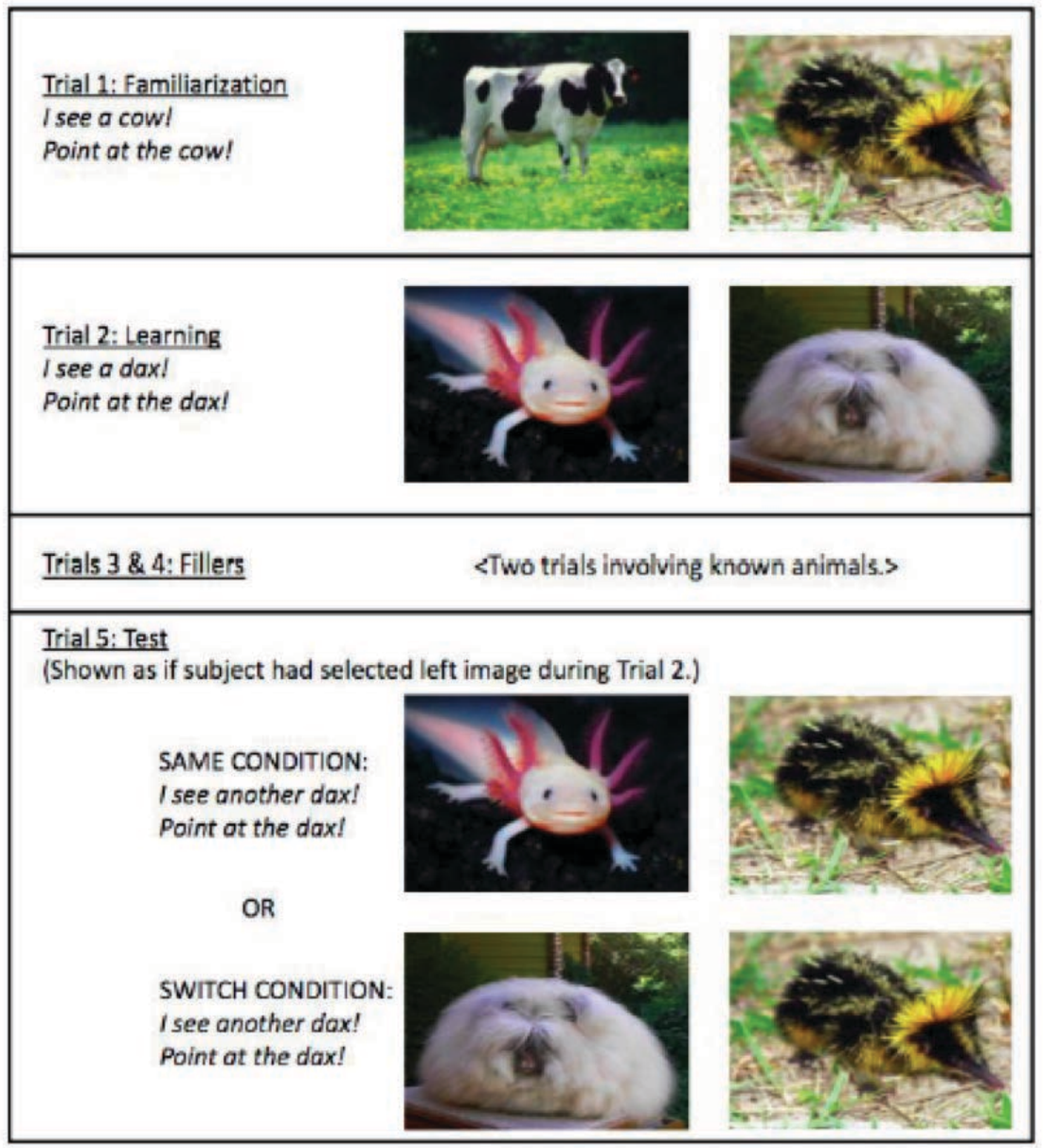
- If the guess is inconsistent with the succeeding observation, the learning machinery will abandon this interpretation and postulate a new one – which can be carried forward, in its turn, for subsequent confirmation or rejection.

Adults vs. Children

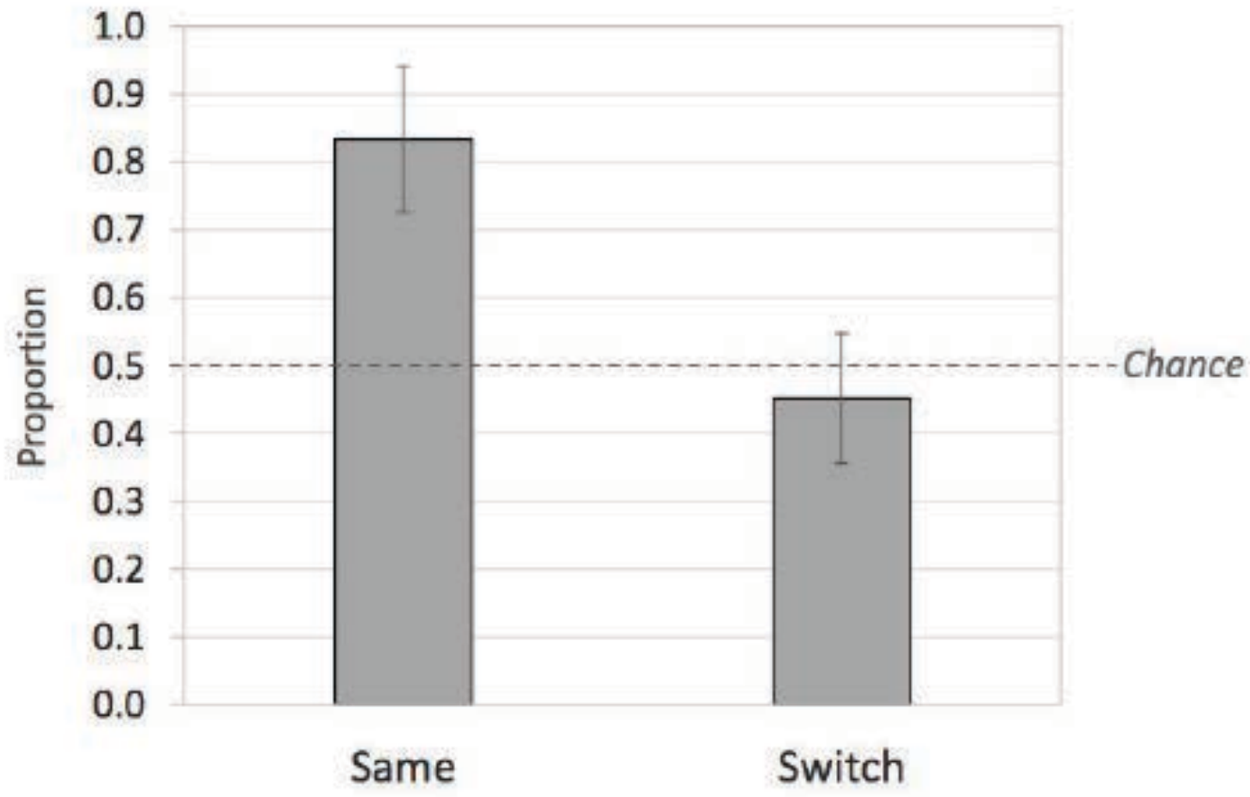
- What about child learners?

Woodard et al. 2016

- Verifying predictions of PbV in 2-3-year-olds (N=32)
- In learning trials, presented with two objects and a label (HI-condition of Trueswell)
- Manipulated the test trials following a choice to contain either:
  - the referent that was guessed (**same** condition), OR
  - the referent not guessed (**switch** condition)



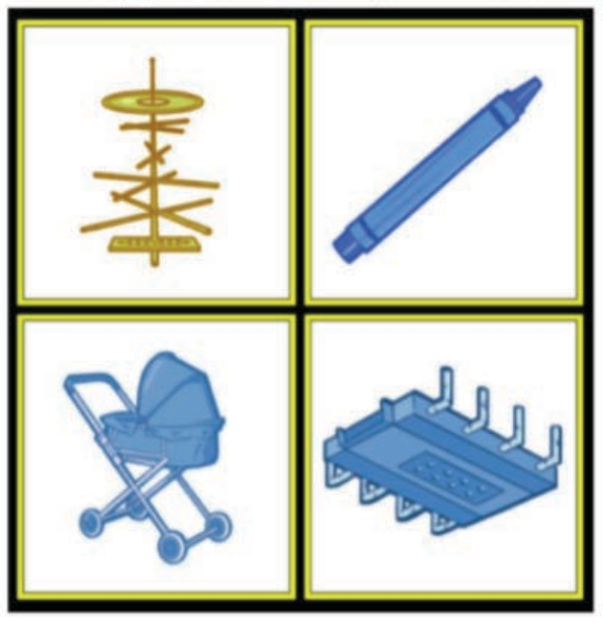
Woodard et al. 2016



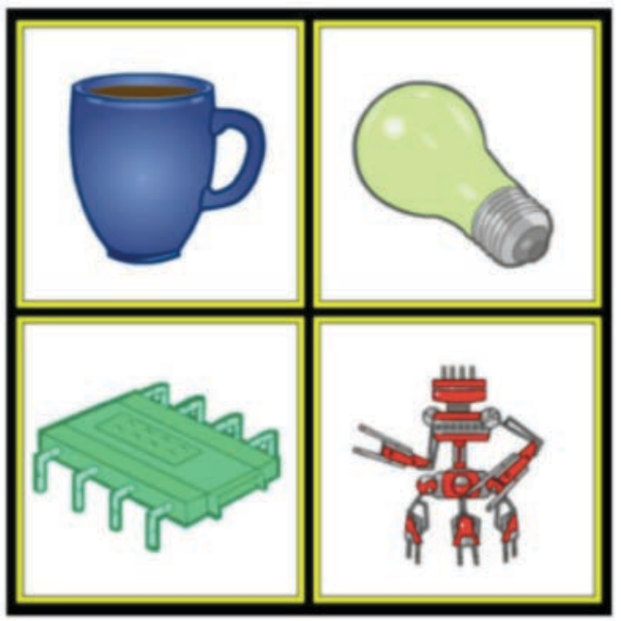
- Same: well above chance (mean = .83, SD = .22, p<.001)
- Switch: not significantly different from chance (mean = .45, SD = .19, p = .33)

Aravind et al. 2017

- 3-5-year-olds (N=674)
- Sufficient cues to make a good first guess
  - the idea: there is a "correct" answer
- Trial 2 immediately follows Trial 1

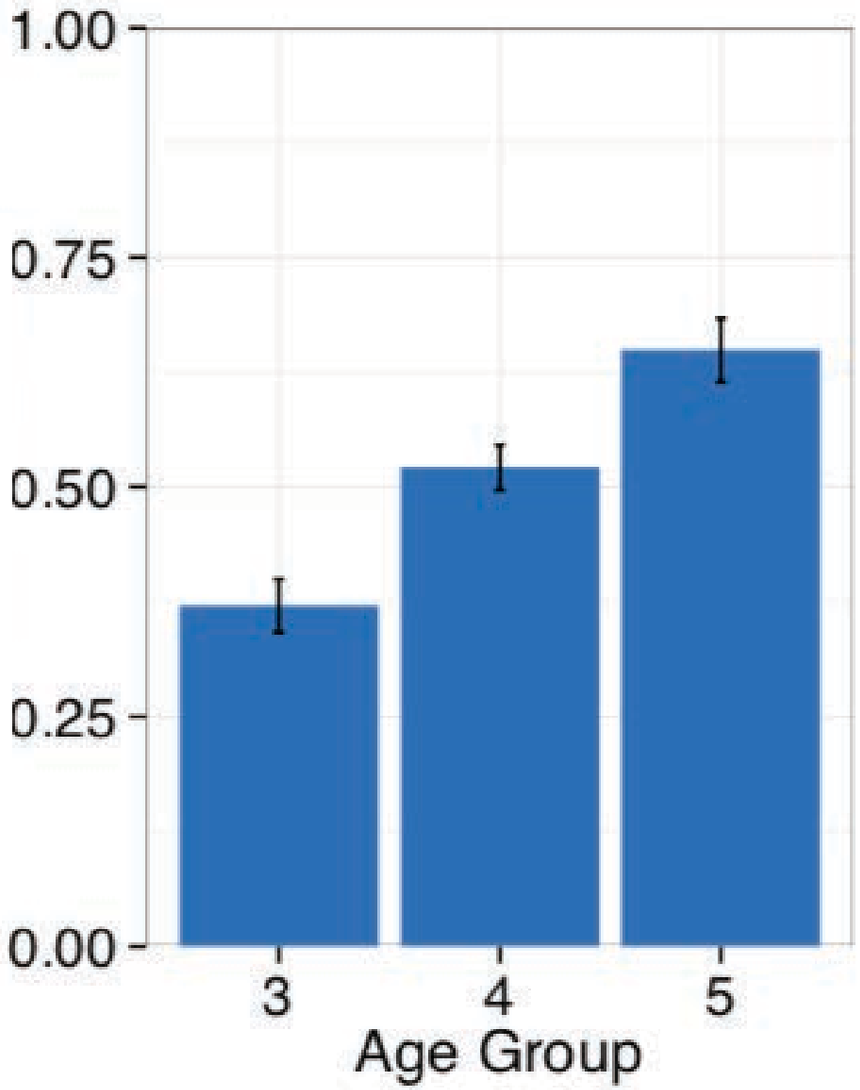


Trial 1:
"The fep is blue. Find the fep!"

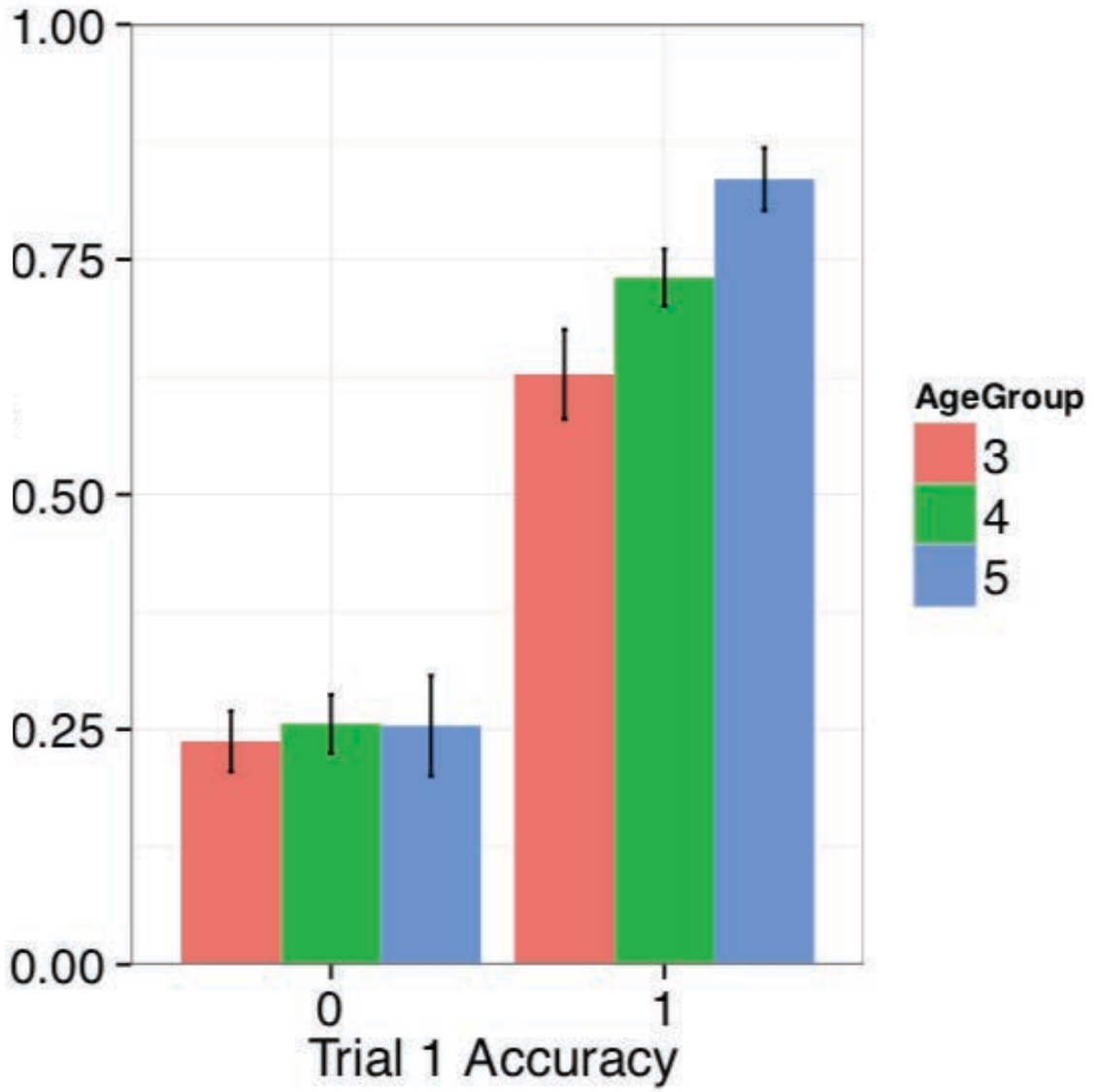


Trial 2:
"Find another fep!"

Aravind et al. 2017



Performance on Trial 1 by Age



Performance on Trial 2 by Trial 1 Success + Age

Problems? Desiderata?

- Much rides on making the right first guess; otherwise learning would be quite laborious

- What kind of evidence is needed to ensure that the initial guess isn’t radically off? What kind of evidence is utilized?

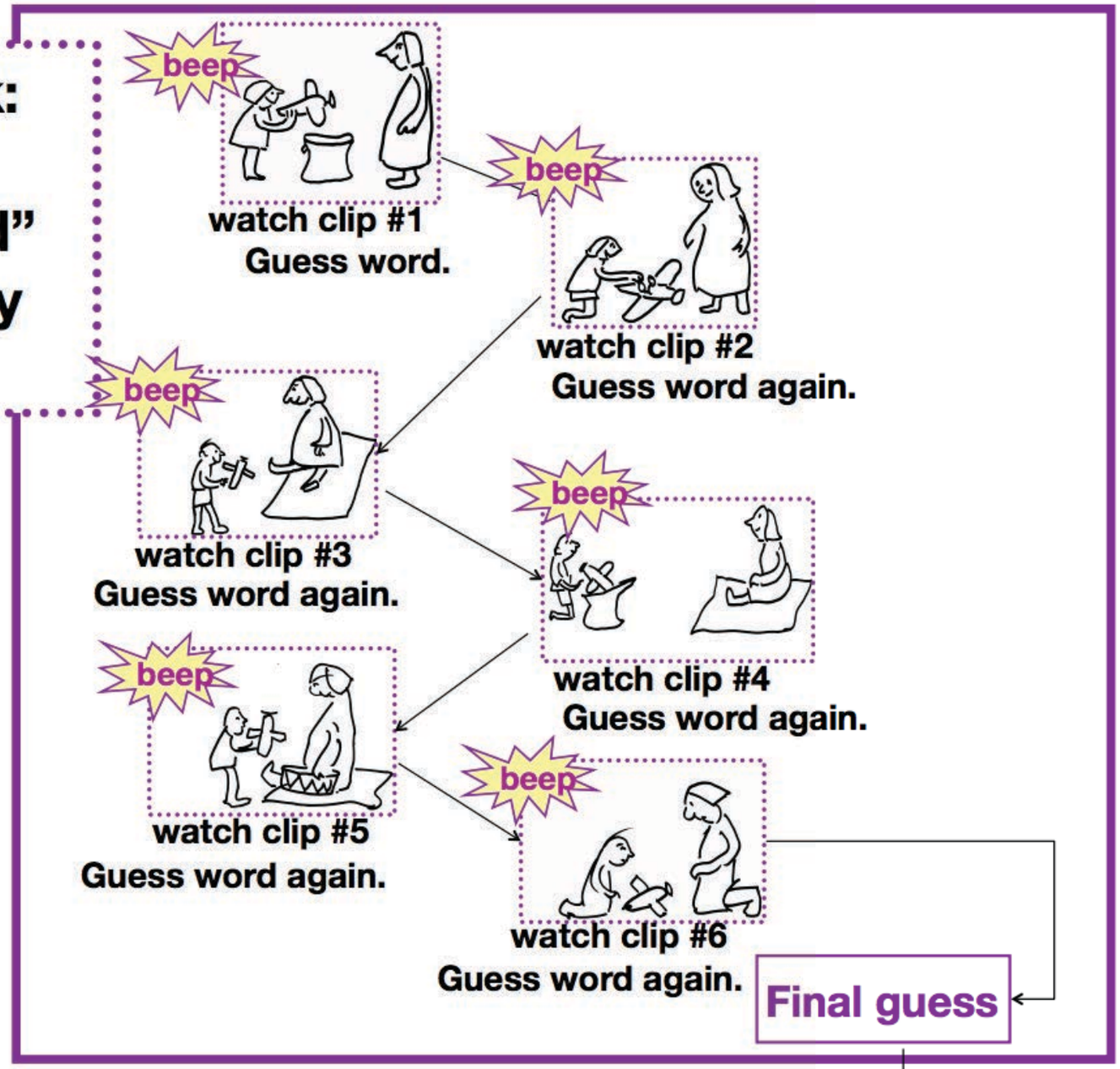
Snedeker, Gleitman, & Brent (1999)

- Human Simulation Paradigm
  - asked adult speakers (who are presumably “cognitively mature”) to view scenes of what mothers are saying to their children and see which words they could learn
  - all audio removed; “beep” at the critical word

Snedeker, Gleitman & Brent (1999)

- Stimuli preparation
  - Videotape English speaking mothers playing with their 18- to 24-month-old children
  - Transcribe video tape for mothers' 24 most frequent nouns and 24 most frequent verbs.
  - For each of the most frequent words, randomly select 6 uses of the word.
  - Edit each instance for 40 second clips. Audio was removed and a beep is sounded at instant word uttered.

Subject's Task: Identify the "mystery word" represented by the beep.

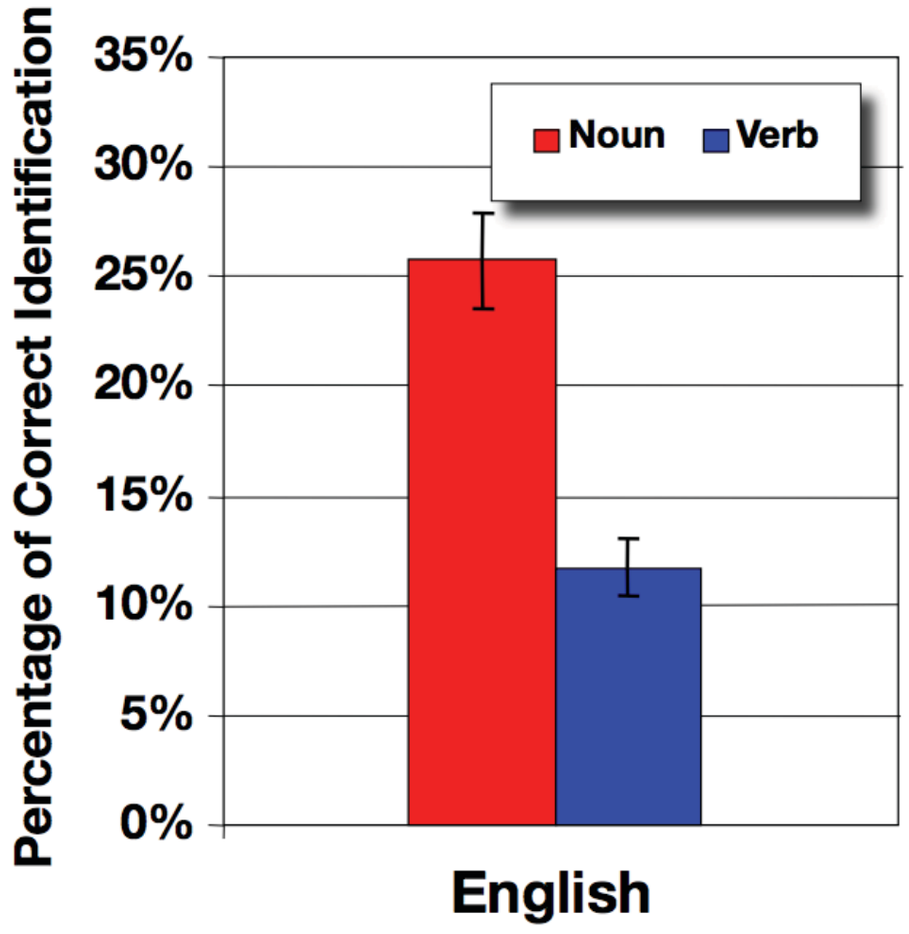


On to next mystery word

Snedeker, Gleitman & Brent (1999)

- Generally quite difficult (~15% accuracy rate overall)

- Nouns easier to identify than verbs



preponderance of nouns in early vocabularies

- 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.

- Braginsky, Yurovsky, Marchman, & Frank 2015: large-scale analysis over tens of thousands of children in English, Spanish, Norwegian, & Danish confirming an “over-representation of nouns” in early vocabularies

One idea

- Not so much noun-ness that matters, but concreteness (Gentner, 1982; Gleitman & Gleitman, 1997)

  - transparent (?) word-to-world mappings

Referential gems

- Trueswell et al. 2016
  - Corpus study of 360 parent-child interaction videos (40s) that were used as test items in the HSP
  - Predict accuracy of word-identification on HSP by features of the scene

Referential gems

- Only 7% of the videos yield target word-identification rates above 50%

- All of them were nouns

Referential gems

- What characterizes these:

    i. increased likelihood that the target referent appears immediately before word onset

    ii. increased Parent Attention to target, sharply rising 1–3 seconds before word onset

    iii. increased Parent Gesture/Presentation of the target one second before word onset

    iv. increased Child Attention to the target beginning 3 seconds before word onset if not earlier

    v. decreased Parent and Child Attention to non-target referent objects starting at word onset and persisting about 8 seconds after word onset

Beyond nouns

- How does the child move beyond an initially concrete, largely nominal vocabulary?

- Surely other sorts of expressions, e.g. verbs, are also acquired. But if observational cues don’t help here, then what does?

Next time

- The role of syntax/“syntactic bootstrapping”
  - reading: Gleitman 1990