24.949

Language Acquisition

Class 1
Foundations

Requirements

Everybody:

- Attendance, reading and participation

- Responses to readings by Sunday 6PM each week

Registered students:

- Class project + in-class presentation

Readings

- Mostly empirical papers

- For background and reference (not obligatory): Guasti, M. (2016). *The Growth of Grammar*, 2nd edition.

Class project

- A main goal of the course is to acquire the skill of translating a research question into experimentally testable hypotheses for a special population (children)

- You will do that exploring a developmental topic in your class project

- It can be on anything that supports a substantive exchange between linguistic theory and language acquisition

- **Topic selection deadline: Week 6**

Presentation

- At the end of the course, you will give a class presentation that:

  ‣ lays out the problem and its significance

  ‣ identify connections to prior work

  ‣ describes the research methods and design

  ‣ explains how the proposed approach will advance our understanding of the phenomenon in question

Initial State → Adult State

Learning Procedures

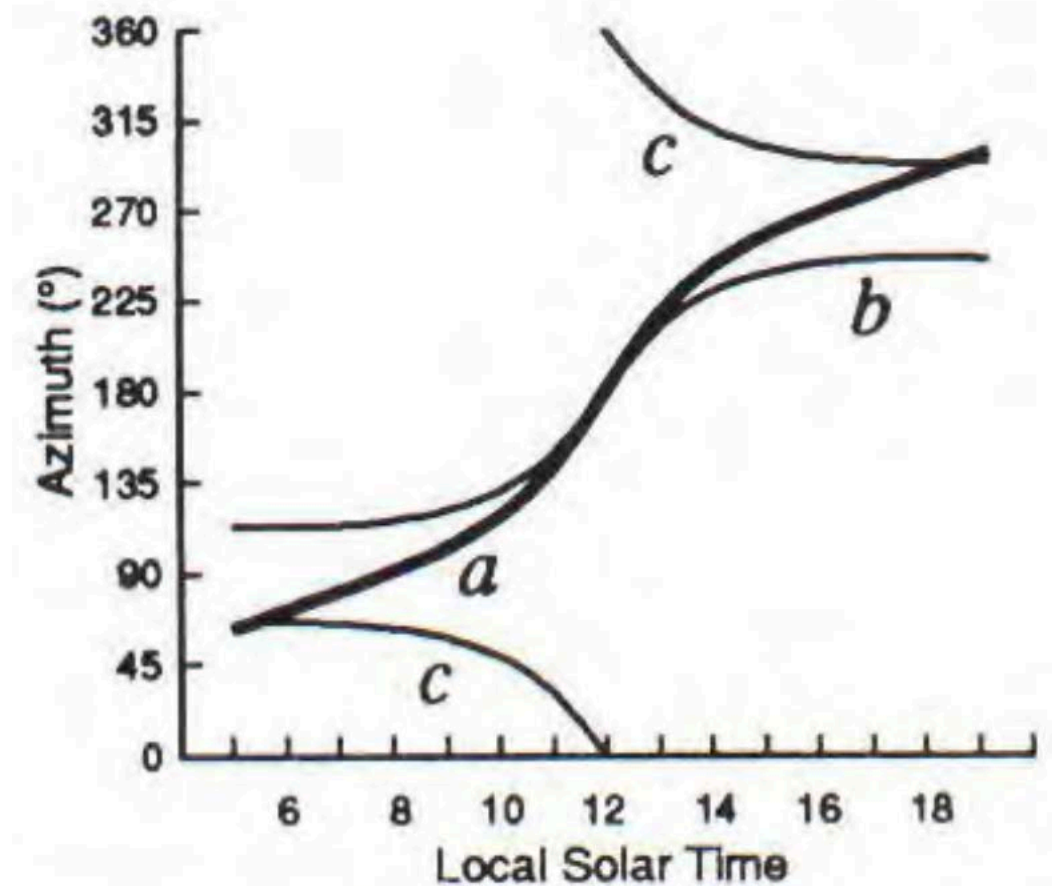Experience
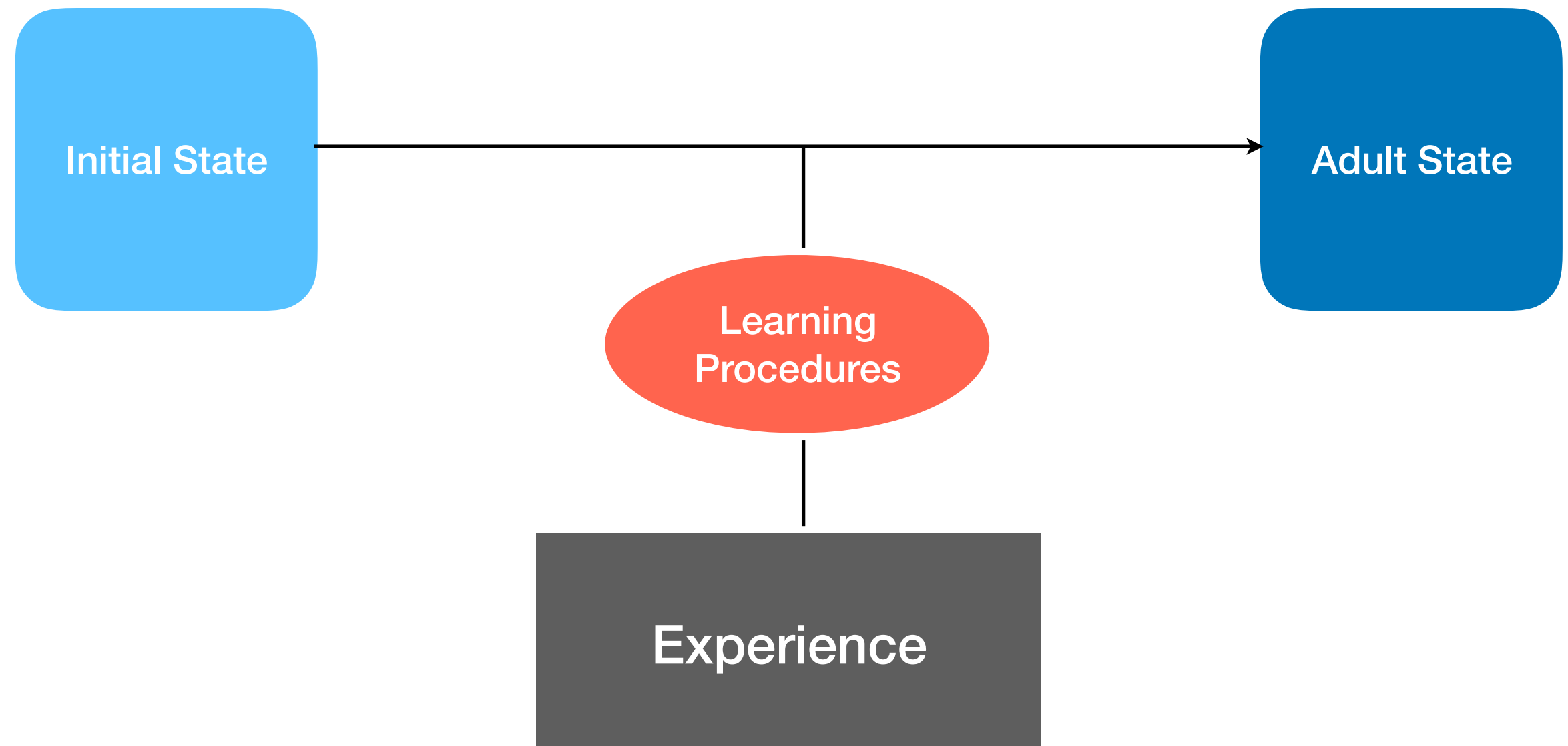
Navigational knowledge in bees

- Forager bees take an irregular path from hive until a new food source is found

- She then will fly a straight path back to the hive and make a peculiar "dance" inside the hive

- Shortly thereafter, many bees will fly a straight path to the newly discovered food source

Navigational knowledge in bees

Pre-requisites for using the sun as a true compass

- The sun's movement across the sky varies by location on the earth and season

- The sun's movement across the sky varies by time of day

- **Local ephemeris function:** The function that describes the sun's position with time at a given latitude

- Given that bees use the sun for navigation and communication, they must have a working sense of the ephemeris function.

Local ephemeris function for East Lansing, MI (D&D96)

Dyer & Dickinson 1996

- How do bees form an internal representation of the solar ephemeris from experiencing seeing the sun moving relative to the terrain?

- Not a memorized list of time-linked positions

  ▸ can estimate sun's position for times of day when they have never seen it (Lindauer et al. 1959)
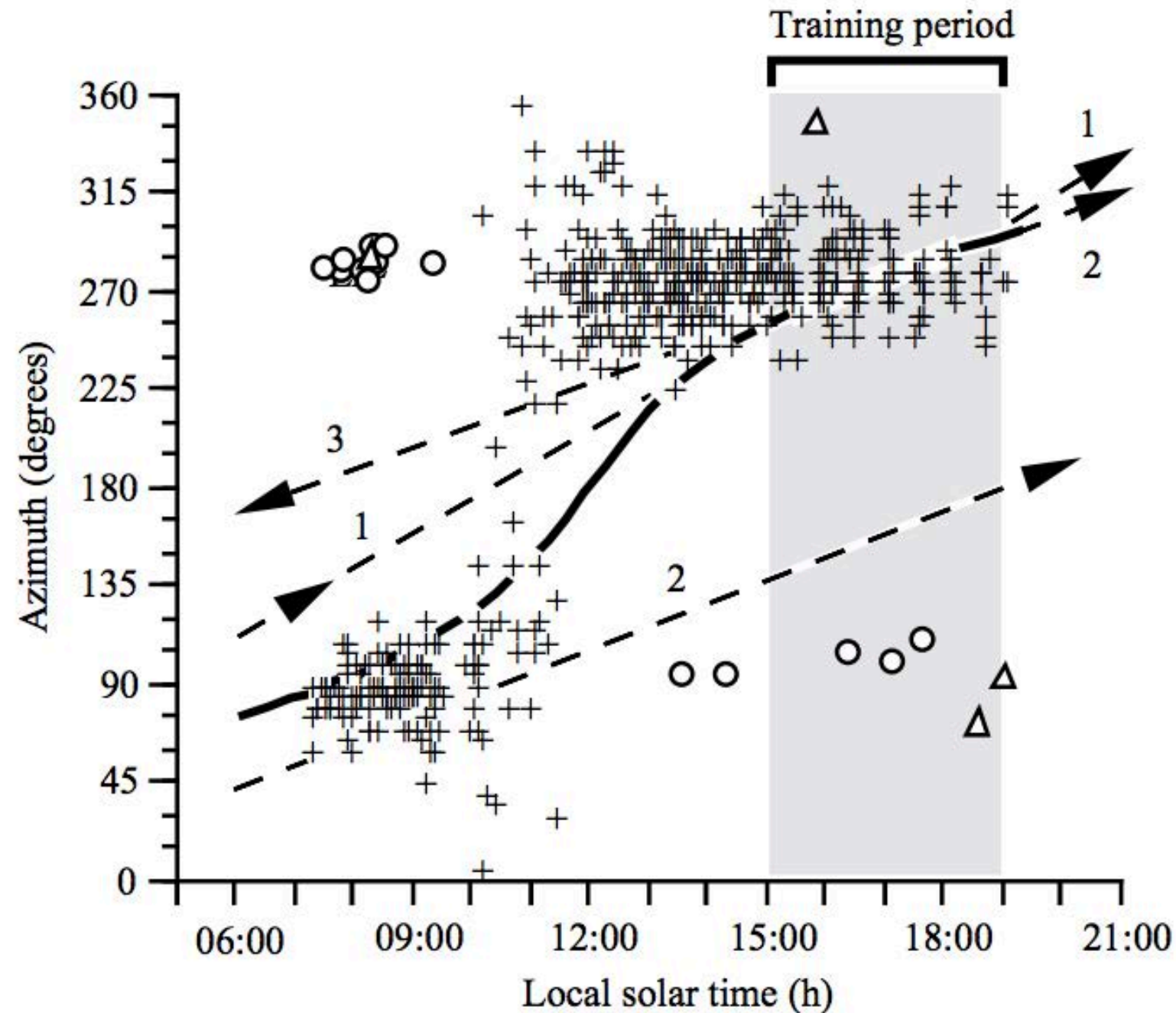
Dyer & Dickinson 1996

- Incubator-reared bees who were allowed to see only a small (~20%) portion of the sun's daily course (within the 4hr period before sunset)

- examined how these afternoon-experienced bees estimated the course of the sun in the morning and middle of the day (by observing their dances).

  - only on overcast days to preclude the possibility that they learn online
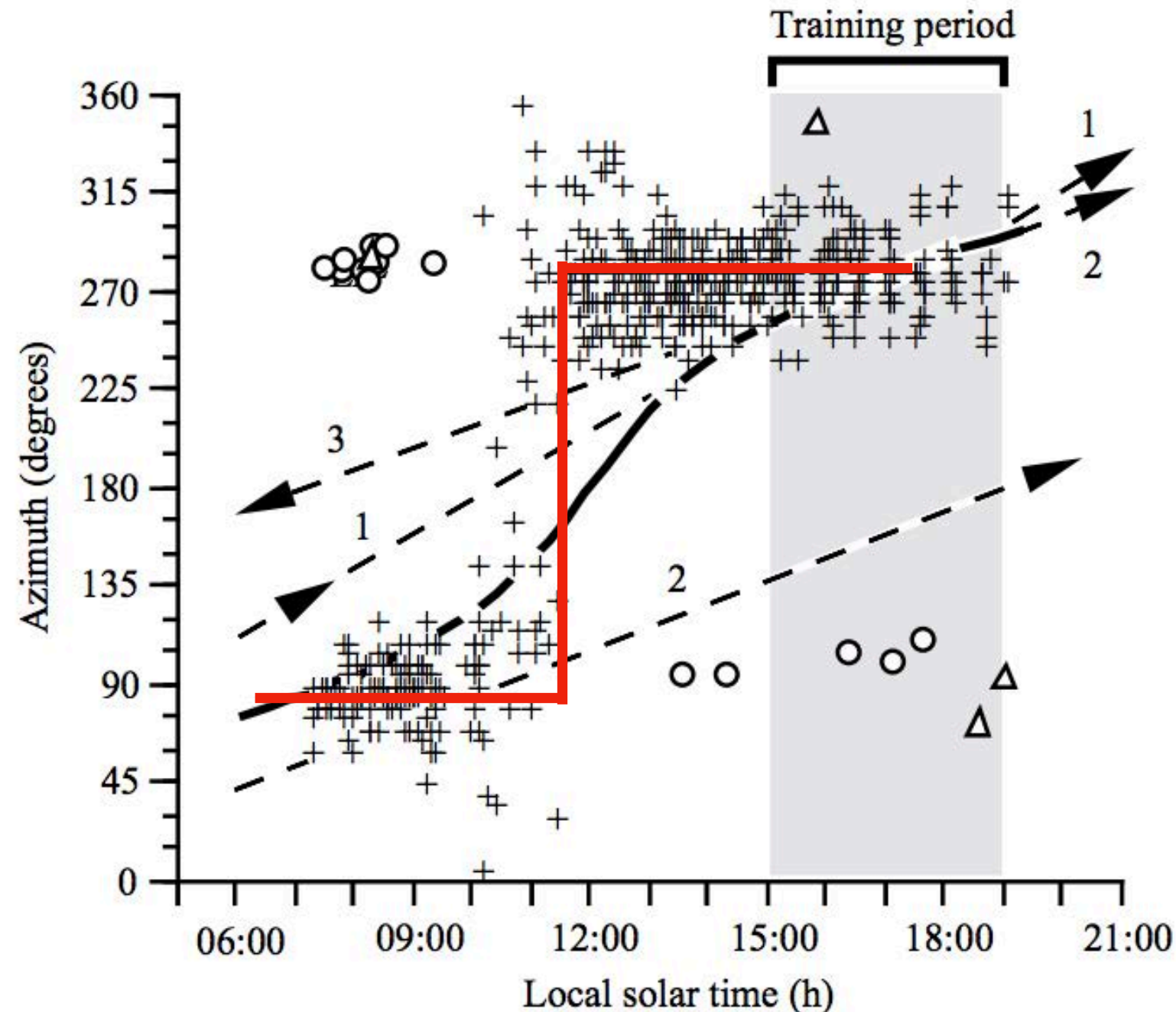
Dyer & Dickinson 1996

- Three hypotheses:

  1. bees might 'interpolate' at a linear rate to find the sun's position between two known positions

  2. extrapolate forward into the morning hours at a linear rate based on the most recently observed rate of movement

  3. extrapolate backwards at a linear rate into the morning hours of the sun's rate as measured at the beginning of the training period on previous days
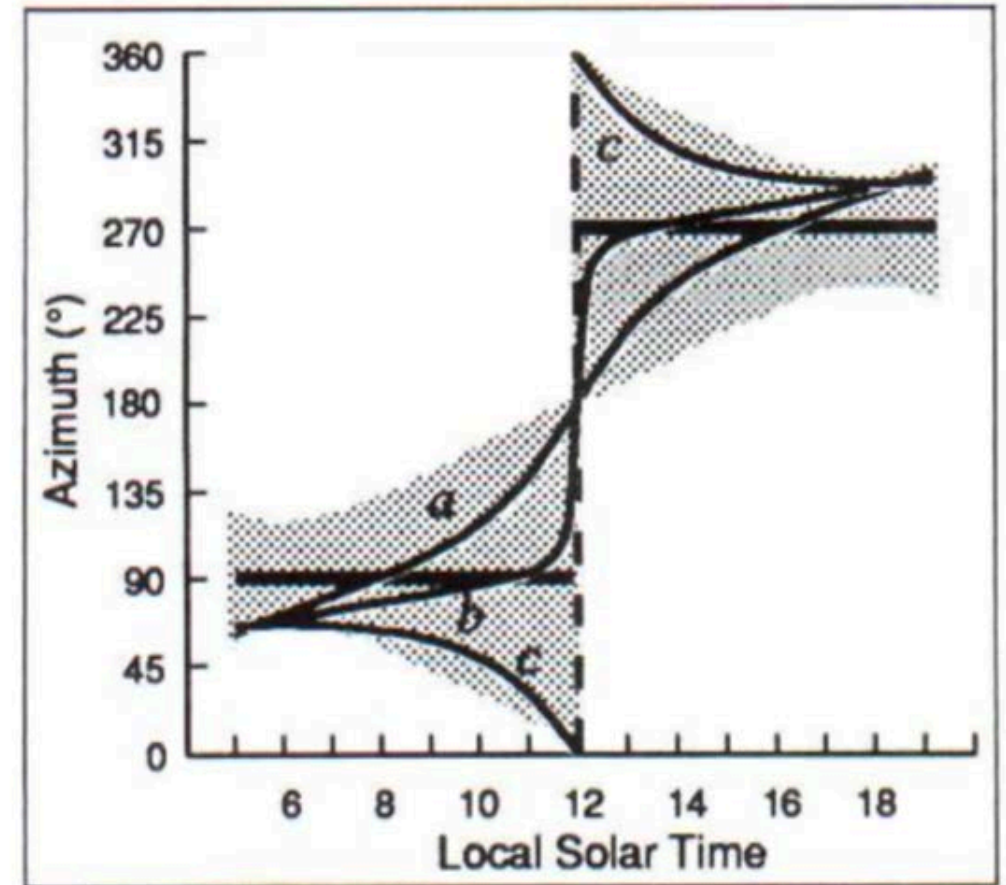
Dyer and Dickinson 1996

Dyer and Dickinson 1996

Dyer & Dickinson 1996

- In the morning, they used an azimuth ~180° from what they had learned from training. In the afternoon, they shifted by ~180°

- Rather than some constant rate of movement, bees behaved as if they used an (imperfect/incomplete) representation of the sun's actual non-linear pattern of movement

**Actual patterns of solar movement on Earth, with shaded area representing all possible solar ephemeris functions**

Acquisition of navigational knowledge in bees

- An innate template

  ▸ representation of an approximate ephemeris in the shape of a 180° step function

- Learning as filling in that template

  • to refine, with experience, the shape of the particular relevant local ephemeris

First language acquisition
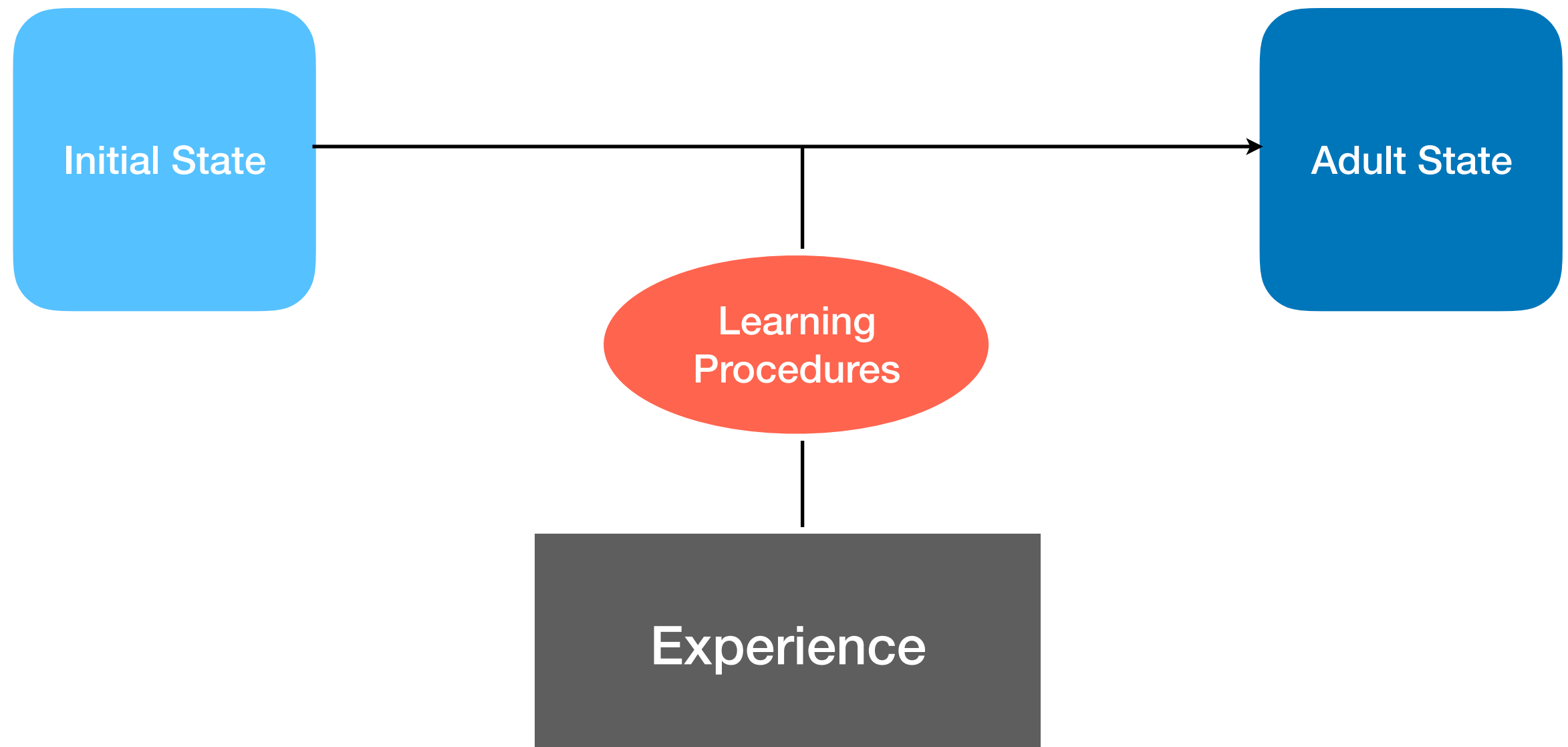
Adult state entails sophisticated knowledge

- A native speaker of English apparently knows:

(1)   a. John read the book vs.
       b. *John the book read

Adult state entails sophisticated knowledge

- A native speaker of English apparently knows:

(2)   a. Who do you think {∅/that} your cat likes?
      b. Who do you think {∅/*that} likes your cat?

and…

(3) a. The man {∅/that} your cat likes is nice.
     b. The man {*∅/that} likes your cat is nice.

Adult state entails sophisticated knowledge

- A native speaker of English apparently knows:

(5)   a. Who do you <u>want to/wanna</u> play with?
         b. Who do you <u>want to/*wanna</u> play with you?

(6) a. Who did the host family <u>want to/wanna</u> believe will stay at their home?
       b. Who did the host family say that they <u>want to/*wanna</u> stay at their home?

Adult states vary across speakers/speaker communities

On the surface variation:

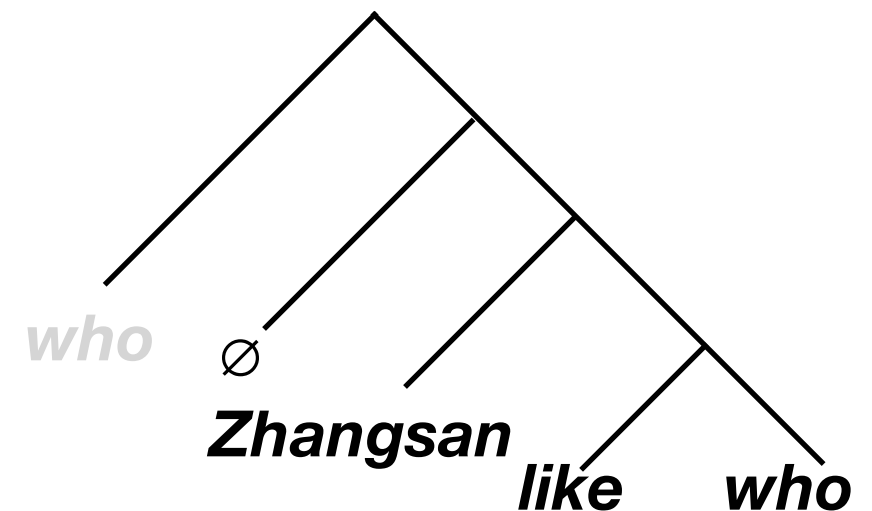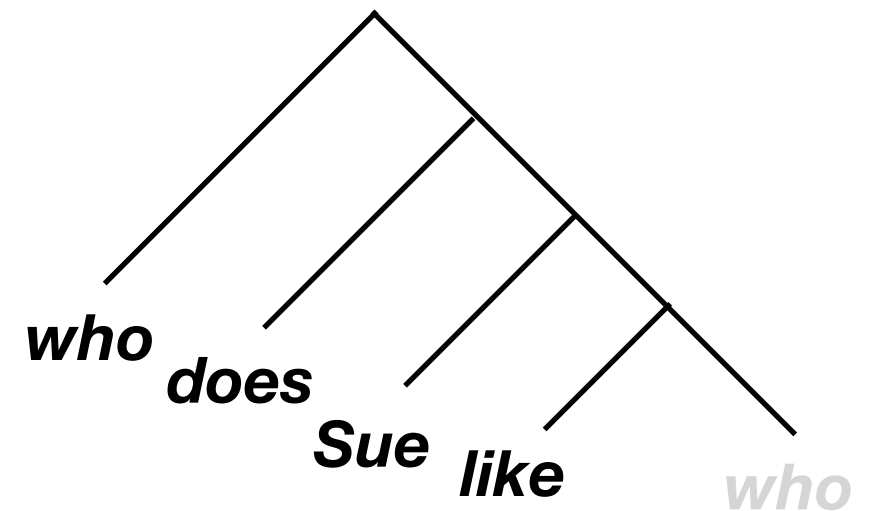- English speakers know an SVO language, Japanese speakers know an SOV language

  (8) a. John ate a pizza *vs.*
       b. John-ga piza-o tabeta

Adult states vary across speakers/speaker communities

On the surface variation:

- English *wh*-questions involve overt wh-movement, Mandarin does not

(9) a. Who does Sue like?   *vs.*
     b. Zhangsan xihuan shei?
        Z.   like   who

Adult states vary across speakers/speaker communities

On-the-surface, but less straightforward, variation:

• Verb placement in English vs. French

(10)   a. Marie does **not speak** French   *vs.*   English
       b. Marie ne **parle pas** français   French

   but also…

(11) a. …to **not speak** French   *vs.*   English
      b. …ne **pas parler** français   French

Adult states vary across speakers/speaker communities

On-the-surface, but less straightforward, variation:

- Verb placement in English vs. German

(12) a. …[that the woman **saw the man** (yesterday)] *vs.*   English
      b. …[dass die Frau gestern **den Mann sah**]   German

  but also…

(13) a. The woman **saw the man** (yesterday) *vs.*   English
      b. Die Frau **sah** gestern **den Mann**   German
      c. Gestern **sah** die Frau den Mann
      d. den Mann **sah** die Frau gestern

Adult states vary across speakers/speaker communities

Below-the-surface variation:

(16) a.   Billy$_i$ ate an apple while he$_i$ was playing videogames.
      b.   He$_i$ ate an apple while Billy$_i$ was playing videogames.

(17) a. While Billy$_i$ was playing videogames, he$_i$ ate an apple.
      b. While he$_i$ was playing videogames, Billy$_i$ ate an apple.

Adult states vary across speakers/speaker communities

Below-the-surface variation:

(16) a. ✓English, ✓Russian, ✓Malayalam
      Billy$_i$ ate an apple while he$_i$ was playing videogames.

  b. ✖English, ✖Russian, ✖Malayalam
      He$_i$ ate an apple while Billy$_i$ was playing videogames.

(17) a. ✓English, ✓Russian, ✓Malayalam
      While Billy$_i$ was playing videogames, he$_i$ ate an apple.

  b. ✓English, ✖Russian, ✖Malayalam
      While he$_i$ was playing videogames, Billy$_i$ ate an apple.

Characterizing the learning problem

- The output of learning is complex

- The output of learning not always easy to observe

- The input for learning not always easy to observe

The process of language acquisition is…

Uniform

- Linguistic milestones achieved in parallel fashion

  ‣ babbling around 6-8 months

  ‣ first word production around 10-12 months

  ‣ spurt of vocabulary growth and productive word combinations in the second year of life

The process of language acquisition is…

Uniform

- Congenitally blind children[1]

  ‣ acquire language at similar rates and manner, despite sensory limitations

  ‣ even vision-relevant words!

- Language-isolated deaf children[2]

  ‣ manual babbling around 6-8 months

  ‣ single manual gestures around 10-12 months

  ‣ gesture combinations in the second year of life

1 Landau and Gleitman 1985, Koster-Hale et al. 2014
2 Feldman, Goldin-Meadow and Gleitman 1978, Goldin-Meadow and Mylander 1984

The process of language acquisition is…

Speedy

- Infants as young as 6mos show understanding of several words[1]

- Children's earliest multiword utterances (~1;6yo) reveal knowledge of language-specific syntactic properties

  - Knowledge of head-directionality (OV vs. VO)[2]

  - Knowledge of verb-placement relative to negation[3]

- ✱ **By ~age 6, child language virtually indistinguishable from adult language**

1 Bergelson 2012, Bergelson & Swingley 2013
2 Bloom 1970, Brown 1973, Clahsen 1985, Wexler 1994, 1998, Sugisaki 2005, 2008
3 Stromswold 1990, Pierce 1992, Deprez & Pierce 1993, Harris & Wexler 1996

Characterizing the learning problem

- The output of learning is complex

- The output of learning not always easy to observe

- The input for learning not always easy to observe

- Yet learning is **robust** and **fast**

The enterprise

- Characterize a learner who can formulate a grammar that generates all and only the sentences of the community language, within a narrow timeframe, across a wide range of exposure conditions

A hypothesis

- **Non-emptiness of initial state:** the learner is traversing a restricted hypothesis space

- **Language Acquisition Device:** machinery inside child's mind proprietary to learning language

A hypothesis

- The LAD provides the learner with a bit of knowledge about how human languages work to get them started.

  ➡ **Universal Grammar:** this bit of knowledge

- This allows the child to use her input effectively: to search selectively, to identify relevant information, to entertain only certain hypotheses, etc.

- For example: While the learner's mind may well be capable of both set-formation and concatenation, in the domain of language acquisition, she may only ever hypothesize the former (i.e. Merge)

The enterprise, v2

Working hypothesis: the mind has some pre-existing structure it imposes to the data it encounters

- Characterize a learner who can formulate a grammar that generates all and only the sentences of the community language, within a narrow timeframe, across a wide range of exposure conditions

  ▸ Characterize the pre-existing structure that guides the learner

  ▸ Characterize how it interacts with input data to produce knowledge of the native language

Goals of the course

- The only way to make progress on these things is to gather data from the actual learner, in the case of language acquisition, that happens to be the human child.

- In this course, we will therefore cover some case studies that illustrate basic properties about how the human child learns language.

Topics we will (try to) cover

- Learning the lexicon

- Syntactic structure

  ‣ puzzles in specification tense/agreement

  ‣ A-movement

- Semantics/pragmatics

  ‣ binding

  ‣ quantification

  ‣ presupposition

  ‣ implicature

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Methods in developmental research

Special population

- Child minds are minds in development

  ‣ can't always extrapolate backwards from adult state

- Children cannot always tell us what they know

  ‣ externalized language contingent on extraneous factors, e.g. motor development, social-cognitive skills

Naturalistic studies

- Diary or Parental Report

  - Parents or other caregivers record or report their child's receptive or productive vocabulary, grammatical milestones, or rates of language usage (esp. for bilingual children), a.o.

- Corpus-Based (CHILDES: https://childes.talkbank.org/)

  - Children are recorded in naturalistic settings to collects bodies of data "from the wild".

  - Transcribed in a uniform fashion, making it easy to measure/ mine data for particular properties to gather information and test hypotheses

Naturalistic studies

- **The good:**

  - The child producing a particular structure is a compelling argument for them knowing that structure

  - Allows us to systematically study child language as it naturally occurs, with frequency, usage and contextual factors all as richly present as in the actual learning context

- **The less good:**

  - lots of information that we cannot extract from naturalistic production
    - what they think is ungrammatical
    - the meaning they assigned (extremely difficult to extract from a corpus)
    - infrequent sentences

Experimental studies

- Behavioral or neuroimaging

  - tasks designed to collect specific types of data to test specific hypotheses

  - either exploiting behaviors extant in the subject or measuring e.g. activation in neuroimaging

- Different tasks for different age groups

Passive looking and listening

visual fixation procedure

head-turn preference

preferential looking

- Ideal for infants and young toddlers

- All capitalize on interest: e.g. infants may listen longer to ungrammatical sentences, infants may prefer to look at the image that matches a sentence they heard
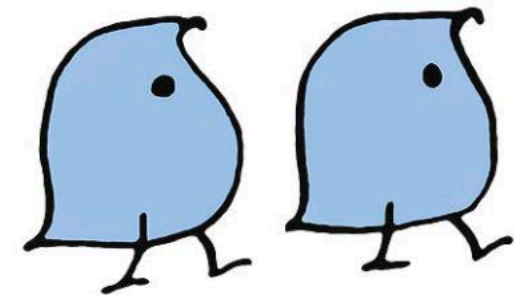
Nonce word tasks

- use fake words – which the child could not have memorized from the input – to test…

  - how word learning happens
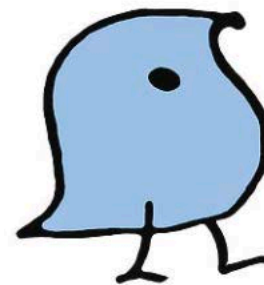
  - whether children have generalized productive linguistics rules,

  such as how to form plurals in their language

THIS IS A WUG

NOW THERE IS ANOTHER ONE
THERE ARE TWO OF THEM
THERE ARE TWO _____

(Berko Gleason 1958)

Artificial language learning

- Learners are taught miniature constructed languages in a controlled laboratory setting

- Test how they generalize to new items

gentif

gentifka

Act-out Task

- Experimenter presents a sentence and child is instructed to act out the sentence (often with the toys and props in the work space)

  (1) After you touch your nose, touch your ears
  (2) Before you touch your nose, touch your ears

Elicited production

- Children are presented (aurally or visually) with a scenario and prompted in a manner that lets them essentially give a free response

- More control over the constructions that the child could use can be exerted by more constraining questions/prompts

Kiss

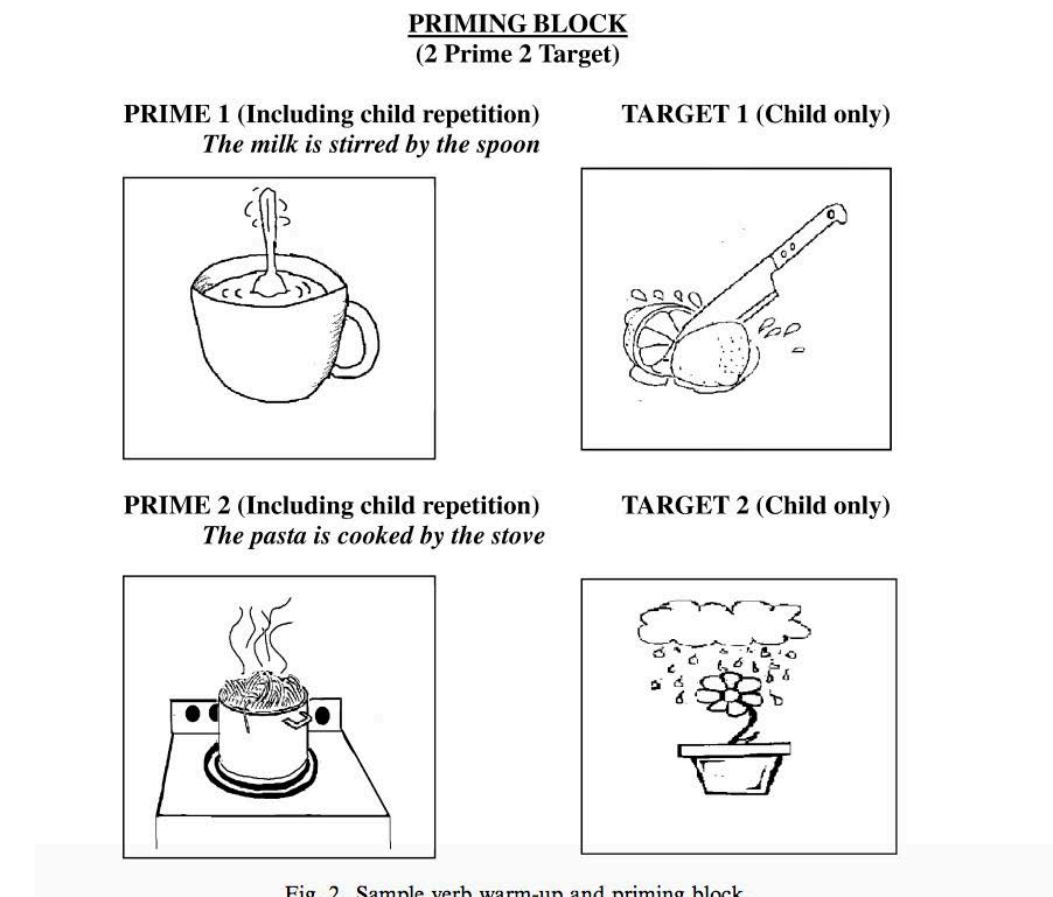**This is a picture about kissing. What's happening to the boy?**

Demuth, Moloi, & Machobane 2010

Elicited imitation

- Ask children to repeat back sentences presented to them. Do they change their input in some way?

- Premise: children cannot repeat what they cannot mentally represent or comprehend

  - Repeat what the experimenter says:
    The boy with the the dog with the hat got an ice cream.

  - Repeat after the experimenter but correct any errors:
    The boy is eat an ice cream cone >> "…eating…"

  - Repeat after the experimenter and reproduce errors:
    The boy is eat an ice cream cone >> "…eat…"

Structural priming

- Priming effect: an increase in the likelihood of producing a sentence of a particular form, or ease-of-processing of sentences of a particular form, as a result of recent prior experience with that form

- **Rationale for using the method with children:** if a given structure successfully "primes", then the child must have underlying competence with that structure

PRIMING BLOCK
(2 Prime 2 Target)

PRIME 1 (Including child repetition)
The milk is stirred by the spoon

TARGET 1 (Child only)

PRIME 2 (Including child repetition)
The pasta is cooked by the stove

TARGET 2 (Child only)

Fig. 2. Sample verb warm-up and priming block.

Bencini & Valian 2018

Truth-Value Judgment Task

- Investigates which meanings children can and cannot assign to sentences.

- E.g. Are sentences that are ambiguous for adults also ambiguous for children?

(1) Every horse didn't jump over the fence.

   a. It's not the case that every horse jumped over the fence
(true if some horses jumped some horses didn't jump)

   b. Every horse failed to jump over the fence
(false if some horses jumped)

Lidz and Musolino 2002

Felicity Judgment Task

- Present children with pairs of sentences that differ in wellformedness

- Children are asked to give a comparative judgment ("Who said it better?" "Which one sounds sillier?")

A. The girl can hide really well.

B. The girl can disappear really well.

Which one sounds silly?

Koring and Thornton 2018

For next class

- All read:

  ‣ Bloom 2000, Ch. 1

- Pick at least one to read carefully (and be prepared to summarize it in class):

  ‣ Aravind et al. 2018; Gillette et al. 1999; Gleitman 1990

- If you do not have much prior experience with experimental research:

  ‣ Michael Frank's class slides on experiment design

➡ ***Comments on reading to me via email by 6PM Sunday***