psych10008 – lecture 9

early speech

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reading

Core reading: **what you should definitely read**

Schacter, D.I,. Gilbert, D.T., Wegner, D.M & Hood, B. (2011). Psychology Houndmills: Palgrave MacMillan. **Chapter 7; pages 257-264**

Supplementary core reading: what you should also read for lecture

Brookes, P.J. & Kempe, V. (2012) Language Development

Chapter 2: What do infants learn before they speak their first word? Pp.25-37

(copies at **ASSL: P118 BRO – also find Chapter 2 on Blackboard)**

Supplementary & extension (from papers): if you are keen to read more..

Werker, J. & Tees, R. (2002). Cross-language speech perception: Evidence for perceptual re-organisation during the first year of life. *Infant Behaviour and Development, 7*, 49-63.

today's lecture

1. early perceptual capacities: auditory system
2. transnatal learning and vocal preference
3. methods for studying perception – sucking paradigms
4. discrimination and categorical perception
5. methods for studying perception – head turn paradigms
6. tuning into the detail of native speech
7. language learning vs language exposure

taxonomy of language

- **Phonology:** speech sounds carry meaning: phonemes "box"=/b/ /o/ /k/ /s/
- **Morphology:** words and word formation: morphemes: smallest units of meaning (un-happy-ness).
- **Syntax:** rules governing word order, and meaning of resulting sentences. e.g.: Mary pushes John *vs.* John pushes Mary.
- **Semantics:** meaning of words and sentences. e.g., "bank" *vs.* "bank". e.g., "The green speed falls up".
- **Pragmatics:** the use of language in conversation i.e. factors influencing the words and sentences one chooses as a function of the context: "hiya", "hi", "hello", "good morning”

theories of acquisition

- **Nativist view:** Language structure is acquired through a primitive form that must be innate. Predict language facilities in place at birth; biological adaptation for language

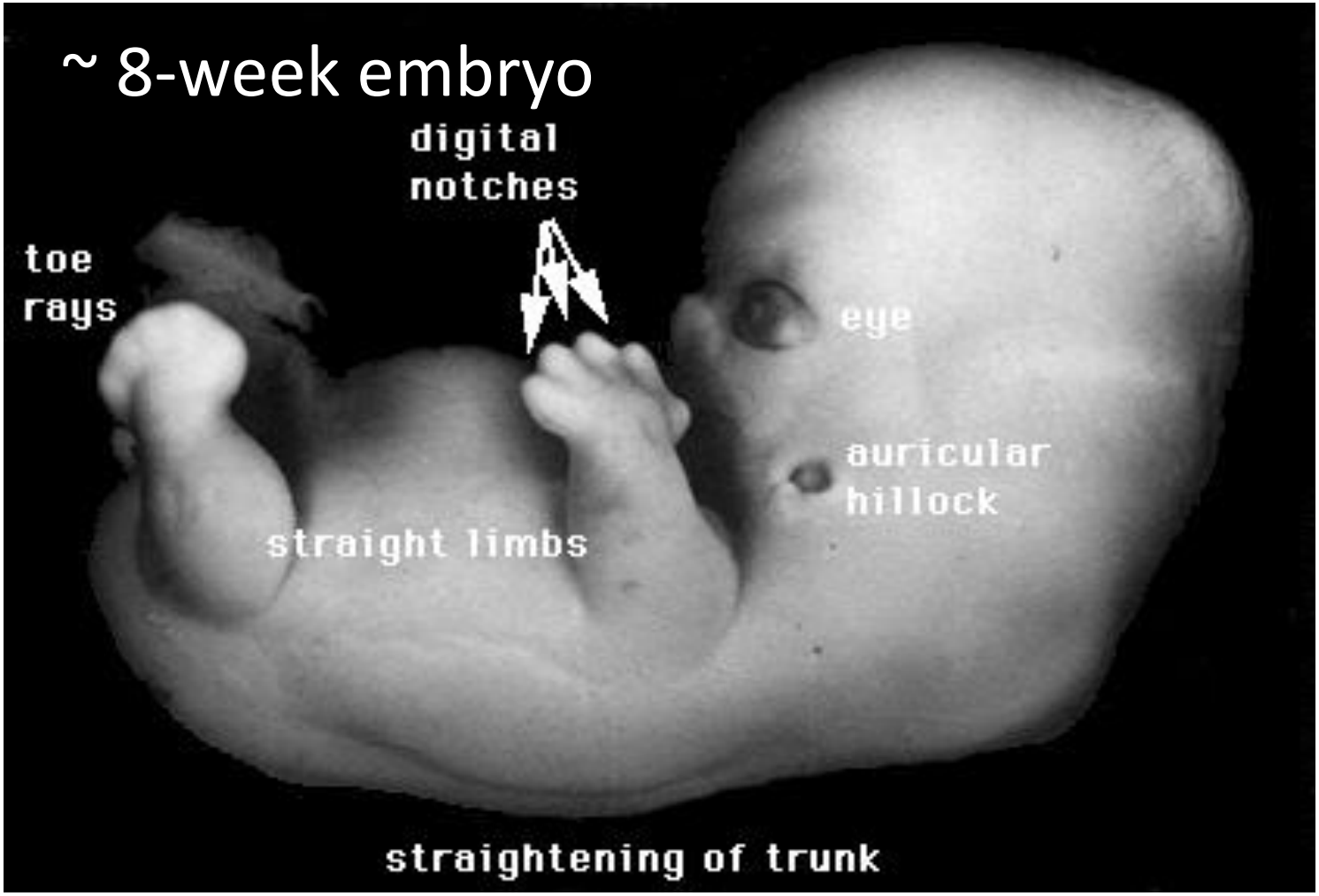
  (Idea draws on Chomsky, 1965: Language Acquisition Device)
- **A behaviourist view**: language is learned from a rich language input and through basic principles of learning

  (*Idea draws from behaviourist tradition; Skinner '57 reinforcement, shaping, extinction*)

  > is 'feedback' from parents important?

  > what is the 'scale' of the learning task?
- **Interactionist view**; focus on the mechanics of learning (how)

‘capacity to hear’ develops early



~ 24-week foetus (beginning of 3rd trimester)

The auditory system is in place.

Can respond to auditory stimulations, but sensitive to low rather than high frequencies (Querleu ’88)

Prenatal measure of sound sensitivity: Fetal Heartbeat Rate changes or changes in position.

External sounds are muffled (low pass filtering – resort to lower fundamental frequencies) so ‘phonemes’ indistinguishable

perceiving sounds in utero

Transnatal auditory learning in utero:

- **Habituation** to sounds at 22-24wks
pitch, prosody & rhythm *(Moon & Fifer, '00)*
- Maternal voice most **salient** *(Querlu, '88)*

Detecting familiarity (after in utero exposure) in neonates
- Shift in Fetal Heart Rate (FHR) after in utero exposure to **familiar rhyme** read by mother (vs novel rhyme) (De Caspar, '94)
- Increase in FHR for maternal voice (decrease for unfamiliar female); **voice discrimination** *(Kisilevsky '09)*
- Sensitive to speech with prosodic cues (singing), *Sambeth '08*

So - infer that language-related skills at birth are **not pre-wired**?

methodological problems

Problem: How can we study language in preverbal and un-cooperating individuals ?

Need for indirect methods. Methods based on observable and measurable motor activities.

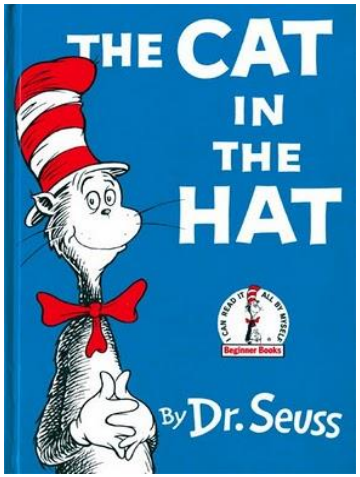
Methods adapted to modes of expression at different ages (heart beat rate, breathing rhythm, eye, head, limb control, motricity, verbal communication).

preference – choosing between sounds

Neonates adjust sucking rate (contingency learning) towards:

- speech over non-speech (e.g., female voice over white noise)
  Colombo & Bundy (1981)
- low pass mother's speech over unfiltered speech
  Spence & Freeman *(1996)*
- mother's (native) language (not voice) over foreign languages
  Moon, Cooper, & Fifer (1993)
- Mother's voice vs. other women's voices

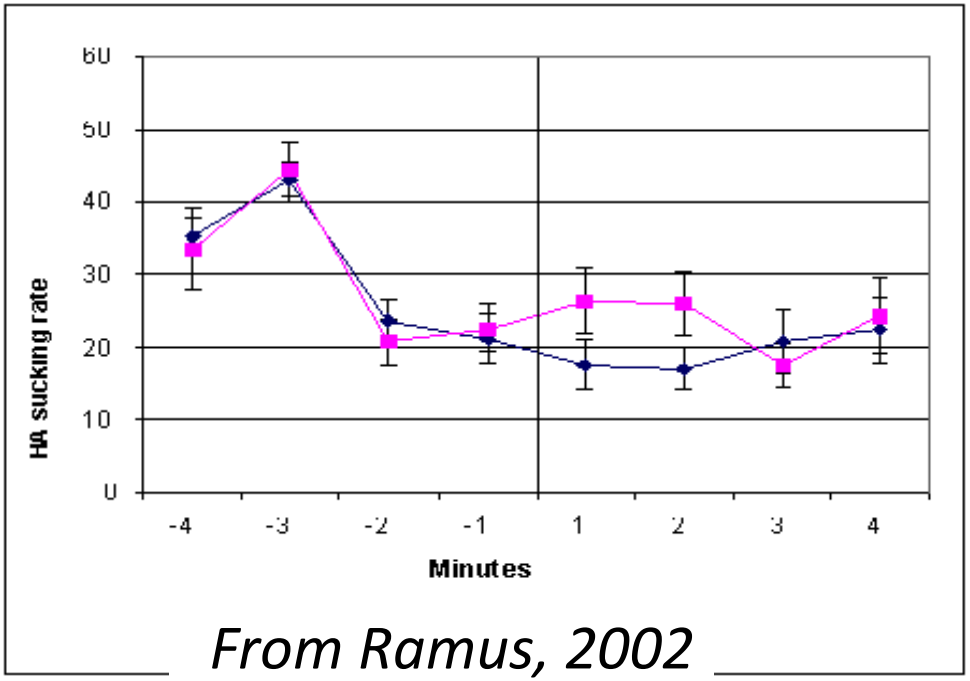
classic 'Dr Seuss' study; *DeCasper & Fifer (1980)*
or after in utero exposure; DeCasper & Spence ('88)



Familiarity and stored knowledge of (maternal) vocal patterns in neonates, from in utero exposure

high-amplitude sucking - habituation

Can measure sucking (or heart-beat) in response to speech
- for example a sentence in Dutch, or a syllable “ba”.
Once they habituate to the stimuli, their **sucking rate slows**.
Then, a new stimulus is introduced (Japanese /syllable “da”)
If babies can **detect differences** in the two stimuli, the sucking rate alters (dishabituation).



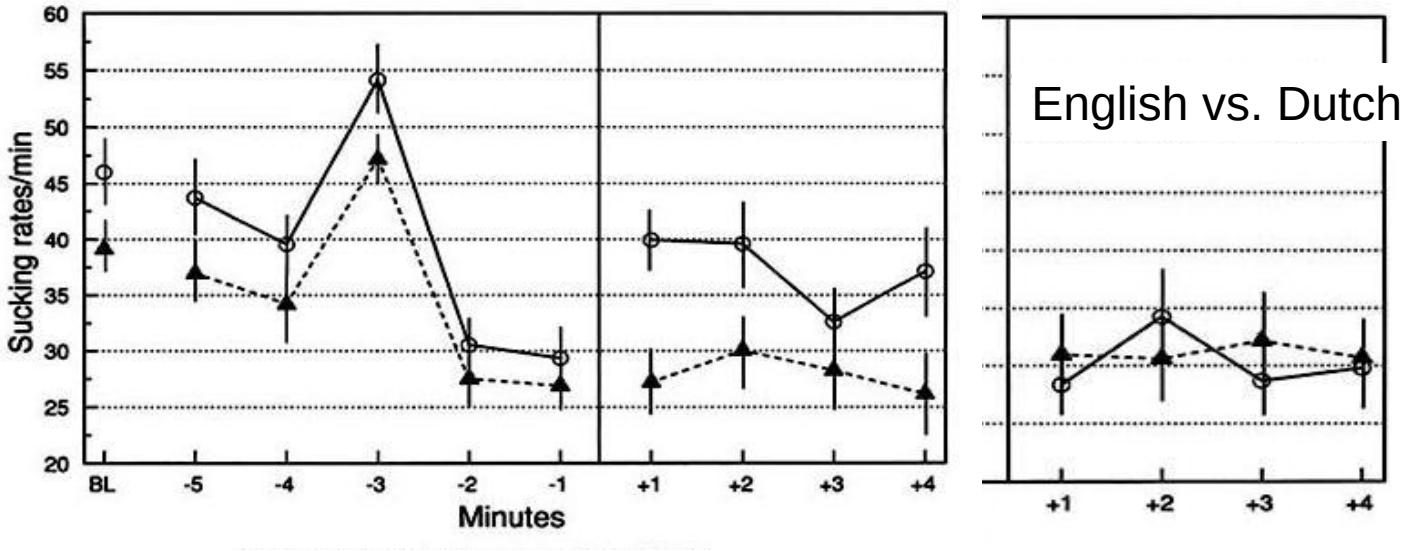
From Ramus, 2002

discrimination – telling sounds apart

Aptitude of **neonates** via habituation is remarkable

- Within a language – detect familiarity of father' voice vs. other men's voices (no preference) *DeCasper & Prescott '84*
- Across unfamiliar languages; French neonates *Nazzi et al. '98*

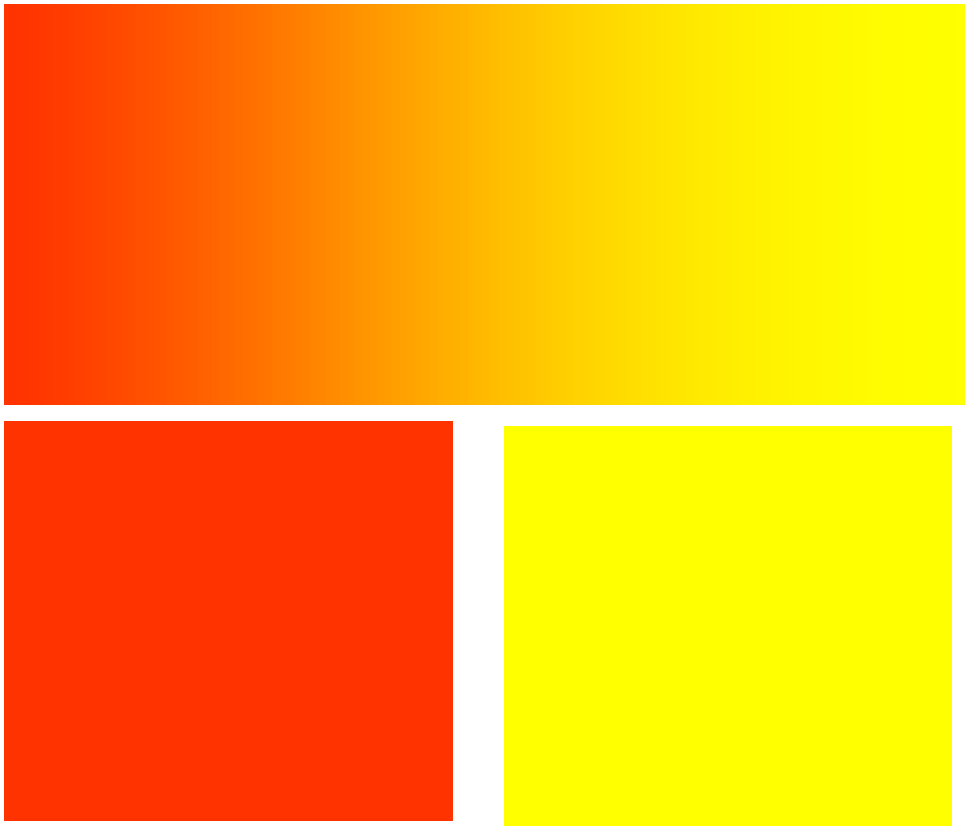
By 2mo; 'tune-in' to rythmn & intonation (lose discrimination)



LPF English vs. Japanese; Christophe & Morton, '98

categorical perception

Perceptual phenomenon whereby events (e.g., sounds, colours) that lie along a continuum are perceived as belonging to one category or another.



perceiving ‘boundaries’

- perceptual phenomenon; events (e.g., sounds, colours) that lie along a continuum are perceived as belonging to one category or another.

/pa/ /pa/ /pa/ /ba/ /ba/ /ba/

a physical continuum but categorical perception

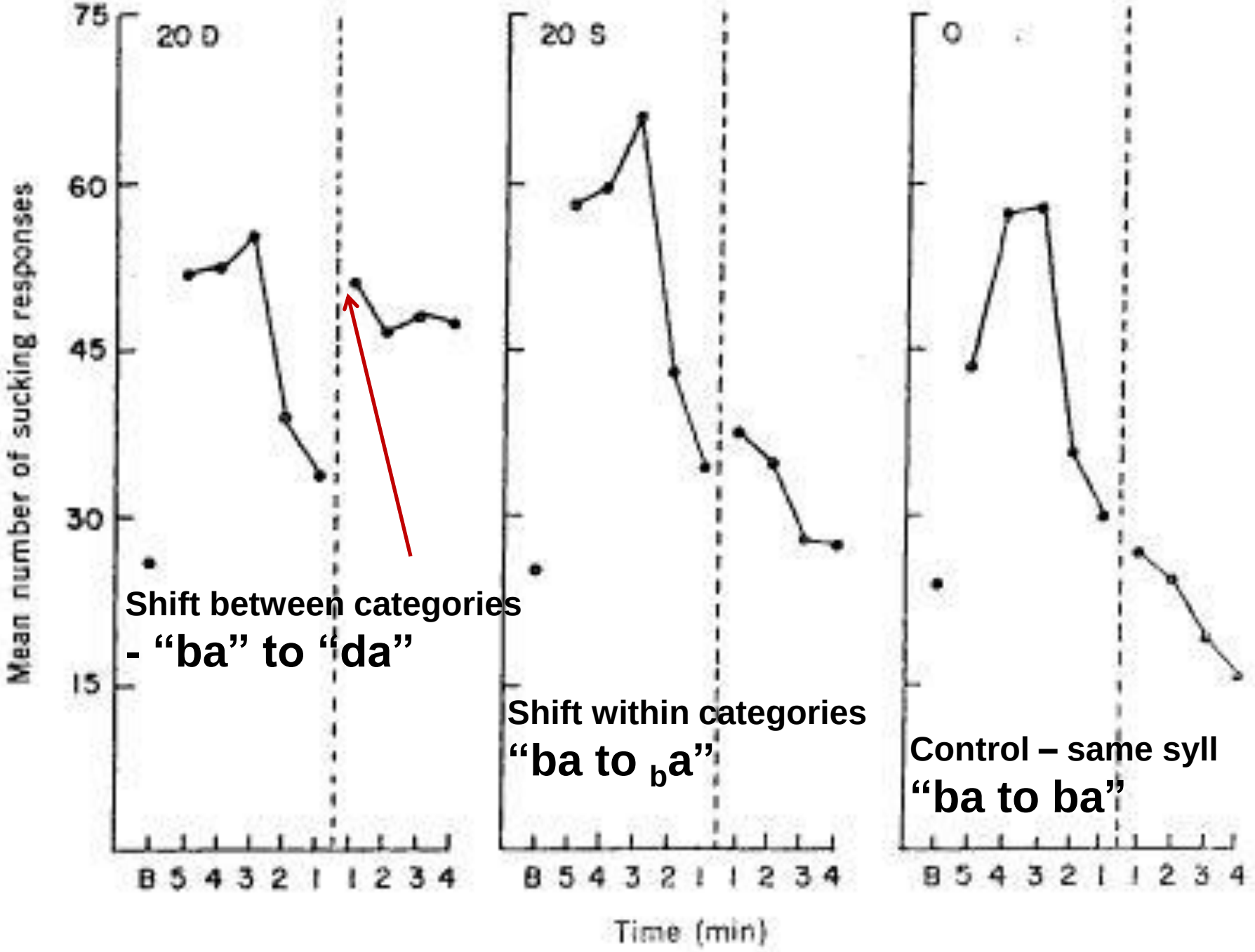
Liberman, Harris, Hoffman, & Griffith (1957)

- categorical perception in 1- to 4mo old infants (*Eimas et al., 1971*)

Habituation to a spoken syllable (e.g., /ba/).

Switch to a syllable that belongs to either a different category (e.g., /da/) or the same category (e.g., /ba/), but is the same physical distance away from it in both cases.

Infants perceive **between-category shift** but not within- category shift.


Mean number of sucking responses
75
60
45
30
15
20 D
20 S
0
B 5 4 3 2 1 1 2 3 4
Time (min)
Shift between categories
- "ba" to "da"
Shift within categories
"ba to $_b$a"
Control – same syll
"ba to ba"

early categorical perception?

- categorical perception as an **epi-phenomenon** due to transnatal learning? No.
- categorical perception as a **predisposition?** No.

...is found in non-human species, e.g., chinchillas,

Kuhl & Miller (1978), Kluender, Diehl, & Killeen (1987)

... is found in non-speech sounds, e.g. music intervals

Burns & Campbell (1994)

therefore reflects *general properties* of the auditory system or discontinuities in sounds.

speech production lags behind

Prior to babbling (birth - 6 months):

Vocalisations (cries, coughs, physiological vocal noises)

Cooing and laughing: first communicative verbal acts.

http://www.youtube.com/watch?v=2bU3k5-p8yU

6 – 9 months (Oller, 1980)

Canonical and **reduplicated** babbling: a single CV syllable repeated a few times; sounds like a word.

http://www.youtube.com/watch?v=vk0tObxNxbQ

Starts to drift to ambient language; then mirror stress patterns

babbling as a communicative act

9 –12 months

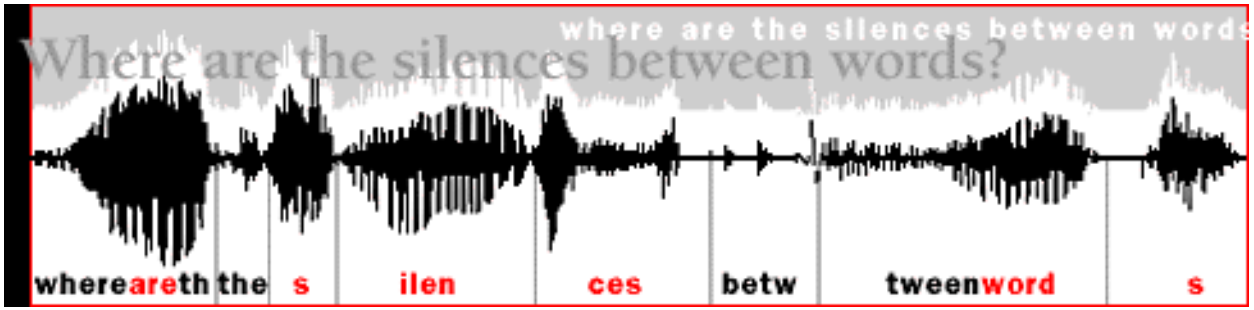
Variegated and modulated babbling: different CVs (baduga);

pitch modulation possibly following the prosody of the native language.

http://www.youtube.com/watch?v=cA7Gjb-o9lY

Babbling seems to be biologically determined; deaf infants babble using hand gestures (Petitto & Marentette, '91).

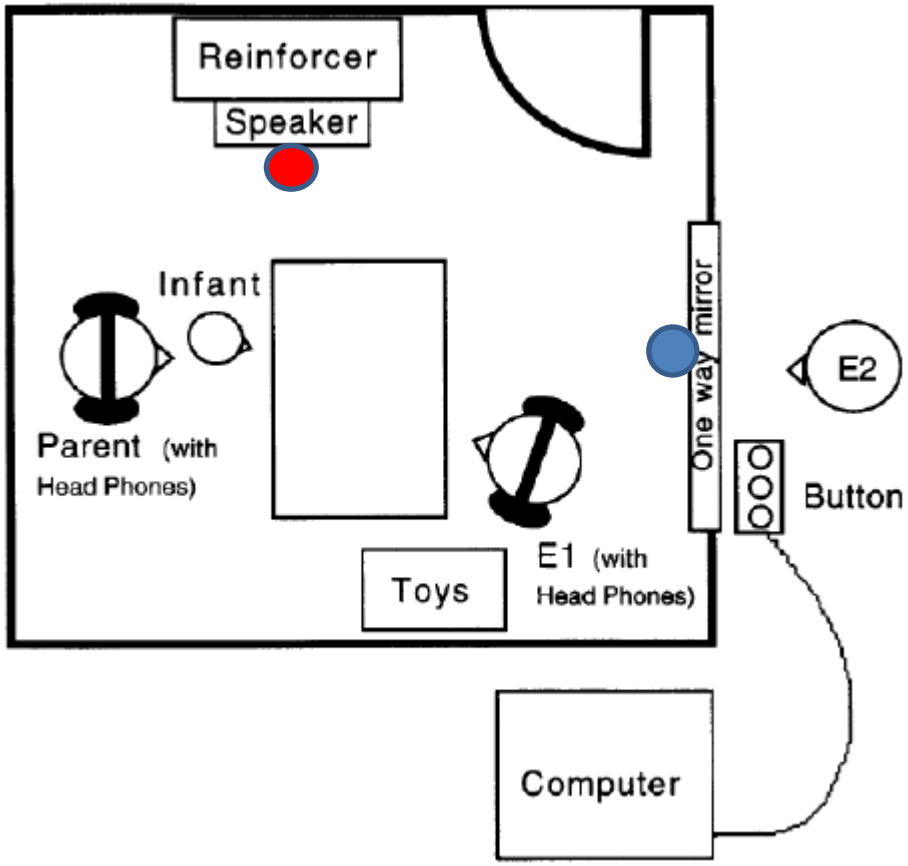
perceiving speech - ‘tuning in’



head-turn preference procedure

Trains child to turn **towards** reinforcer when they hear auditory stimulus:

preference = look longer



preference for native speech sounds - after exposure

- head-turn preference procedure (*Werker & Tees, 1984*)
- probe 2 contrasts /ba/-/da/ & /ki/-/qi/ (& Hindi too)
- babies aged 6-8 mths perceived both contrasts

→ but fewer older infants (8-10mths, 10-12 mths)

→ non-native discrimination declines in the 1st year

learn ‘distributional regularities’

Sensitivity to co-ocurring sounds in an artificial language
e.g. Saffran, Aslin & Newport ‘96

8 mths - listen to artificial language stream
Expt1.Test listening time to ‘words’ vs ‘nonwords
Expt2.Test listening times to ‘words’ vs ‘part-words’

Experiment	Mean listening times (s)		Matched-pairs *t* test
	Familiar items	Novel items	
1	7.97 (SE = 0.41)	8.85 (SE = 0.45)	$t(23) = 2.3, P < 0.04$
2	6.77 (SE = 0.44)	7.60 (SE = 0.42)	$t(23) = 2.4, P < 0.03$

A capacity for stochastic learning – not the language itself!

is listening & learning from speech
a **passive** process?

how do 9mth olds learn best?

A Foreign-Language Exposure

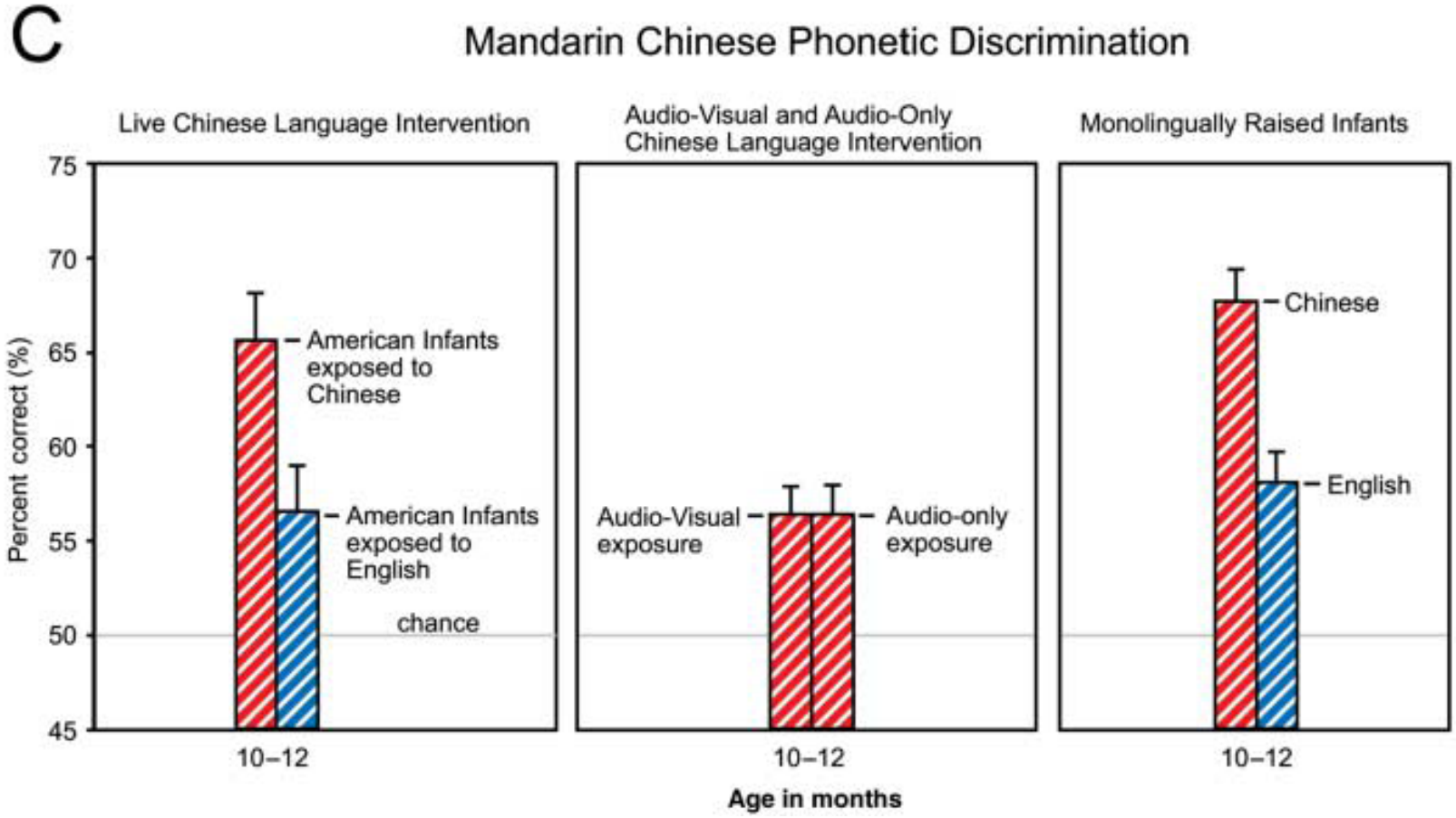
Live Exposure

TV Exposure

B Phonetic Perception Test

Khul, Tsao & Liu, 2003

no - ‘social’ exposure is critical



data from Kuhl et al. 2003

what we learned..

- auditory system is in place early – first responses to sound
- transnatal learning largely captures prosody/rhythm
- neonates; preference for mothers voice & language
- also early discrimination and categorical perception as crude pathways to auditory processing of language
- native language exposure brings greater specialization in babbling and native language preferences for speech
- language and speech perception occurs in a social context

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