

Investigating development of linguistic and non-linguistic prosody

Kiwako Ito

Ohio State University

Ito.19@osu.edu

Linguistic prosody

- Lexical stress perception/production
- Lexical tone/pitch accent perception/production
- Feet structure/language-specific rhythm
- Prosodic boundaries and sentence comprehension
 - e.g., PP- / RC- attachment and sentential semantic ambiguities
- Focus prosody
- Illocutionary forces: e.g., question vs. statement
- Etc.

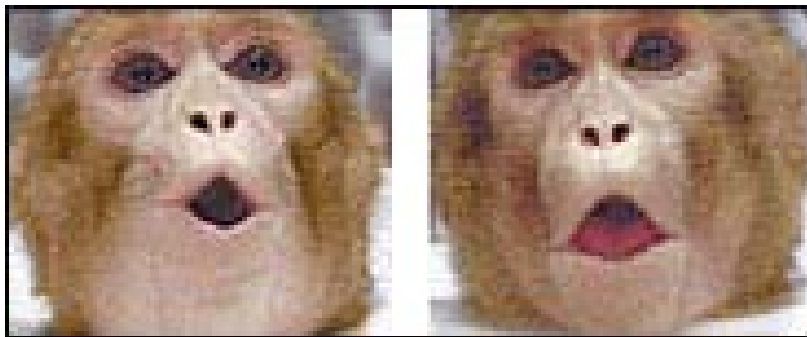
Non-linguistic/affect prosody

- Happy vs. Sad
- Positive vs. Negative
- Angry vs. Calm
- Incredulous vs. Neutral ?

Primate affect processing



- Neuronal sensitivity to species-specific vocalizations (Wang & Kadia, 2001; Romanski & Goldman-Rakic 2002; Poremba et al., 2004)
- Lateralization (LH-oriented processing) (Heffner & Heffner, 1984; Patterson et al., 1984)
- Rhesus monkeys “cooing” VS. “threat call” (Ghazanfar, A.A. & Logothetis, N.K., 2003)



Theoretical separation:

Does affect recognition precede linguistic processing?

*“enhanced sensory responses to emotional facial and vocal stimuli
might be a fundamental neural mechanism”*

(Grossmann et al., 2005)

*“the human infant is born well prepared to rapidly develop these
competencies during the first year.”*

(Walker-Andrews, 1997)

Question

Is affect prosody more fundamental and thus is acquired earlier than linguistic prosody?

Methodological issues

Affect prosody studies

Question: **How early** can humans identify/recognize affect in voice?

Target: infants & toddlers

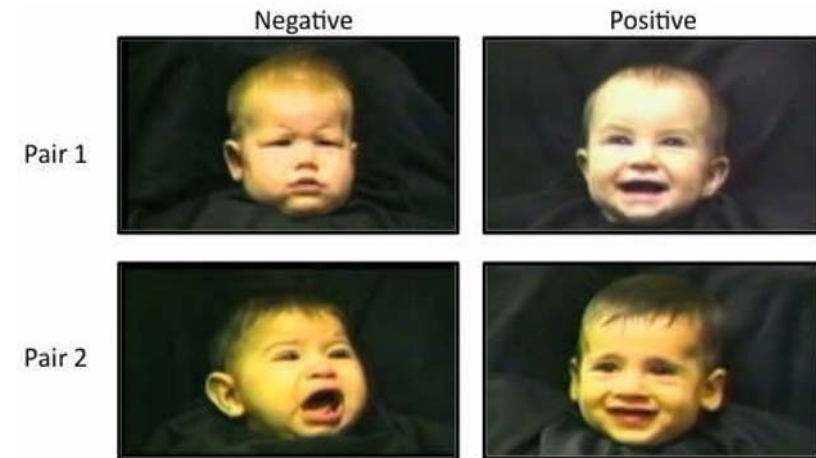
e.g., 5-mo: YES vs. 3.5-mo NO

Task: preferential looking paradigm
+ EEG

**No direct measure of metalinguistic judgment

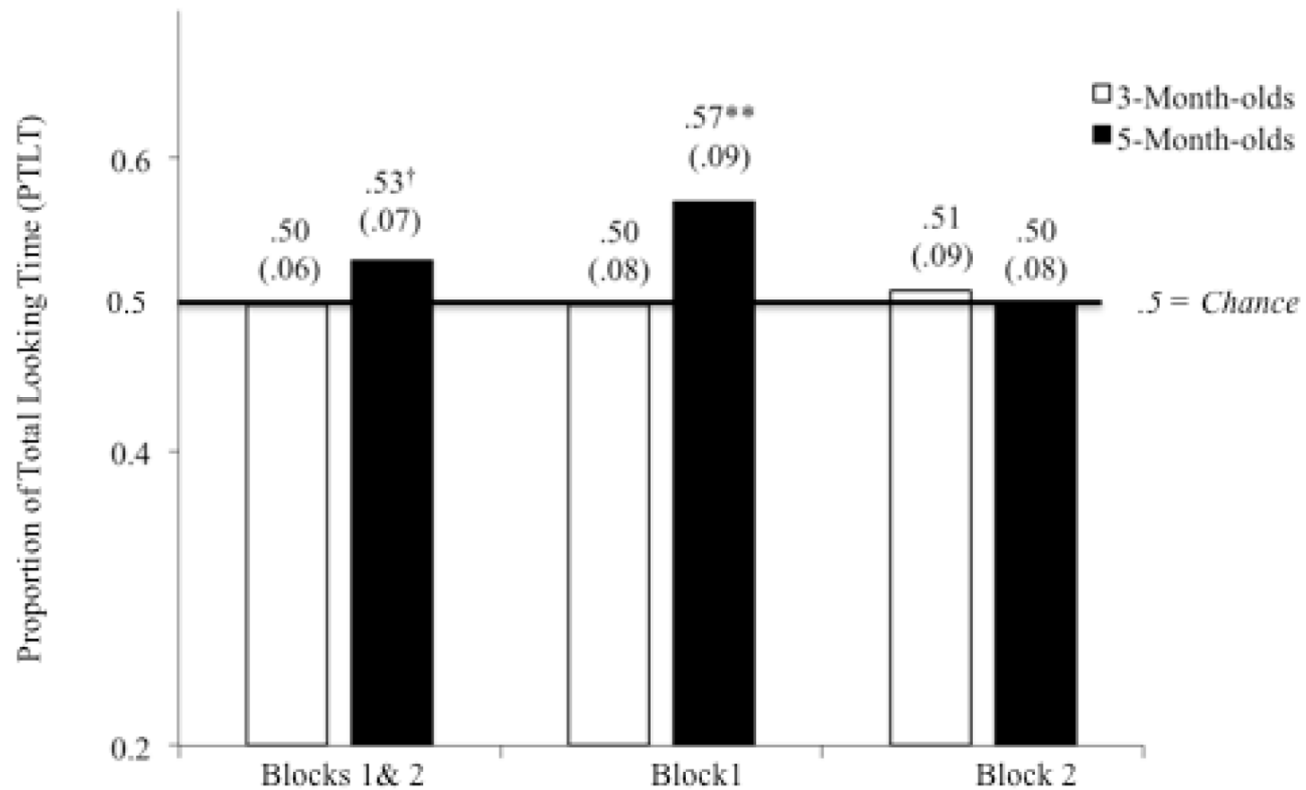


They can discriminate X from Y.



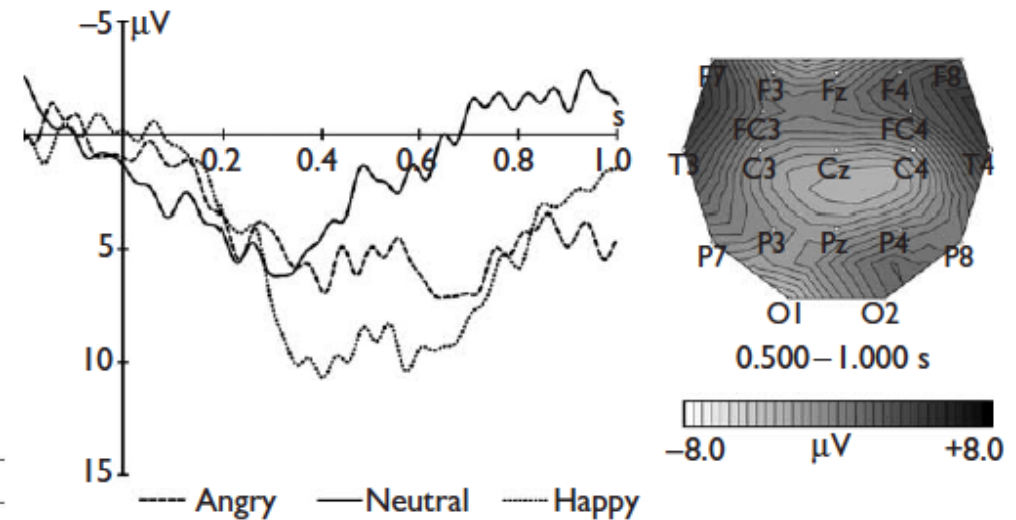
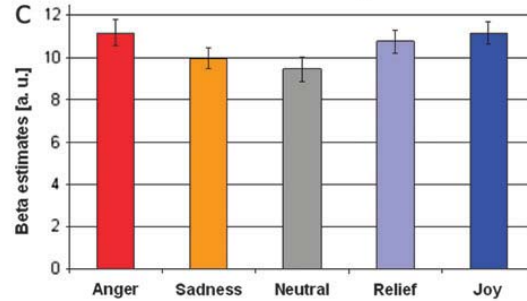
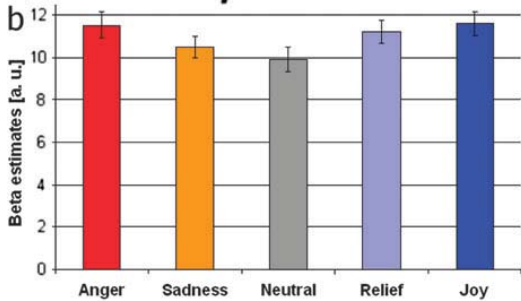
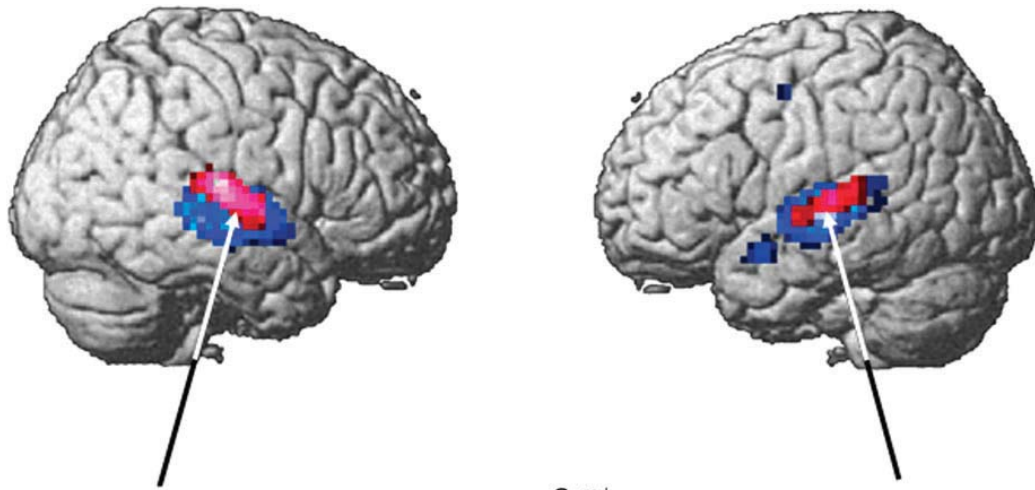
Villant-Moina et al. (2013):
Infant voice-face matching task

Looking time difference



Brain activation during affect prosody processing

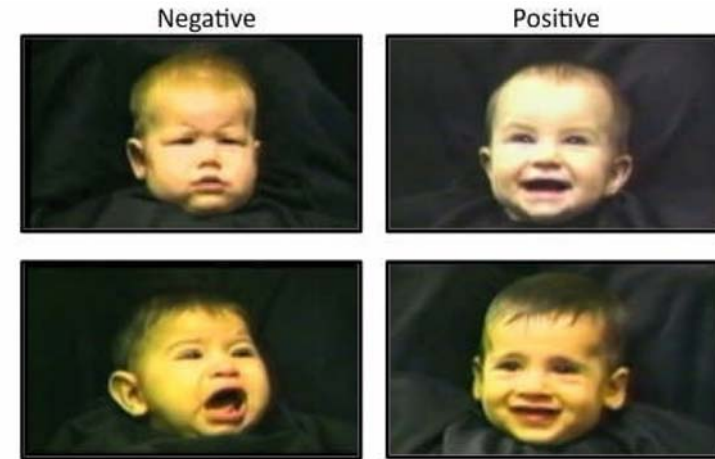
a



Grossmann et al. (2005):
ERP responses to emotional prosody in 7-month old infants

Ethofer et al. (2012): Emotional Voice Area

Emotion recognition isn't easy.



- 5-yr olds:

happy vs. sad faces: YES

fear, disgust, anger: No (Durand et al., 2007)

- Adults

happy / anger voices better than sad, disgust, fear

STG function reduced with age (Demenescu et al., 2015)

Complexity of emotion acoustics

Different categories, different cues:

- Panic (enhanced F0), hot anger (enhanced energy), happiness (low-freq energy), sadness (duration)

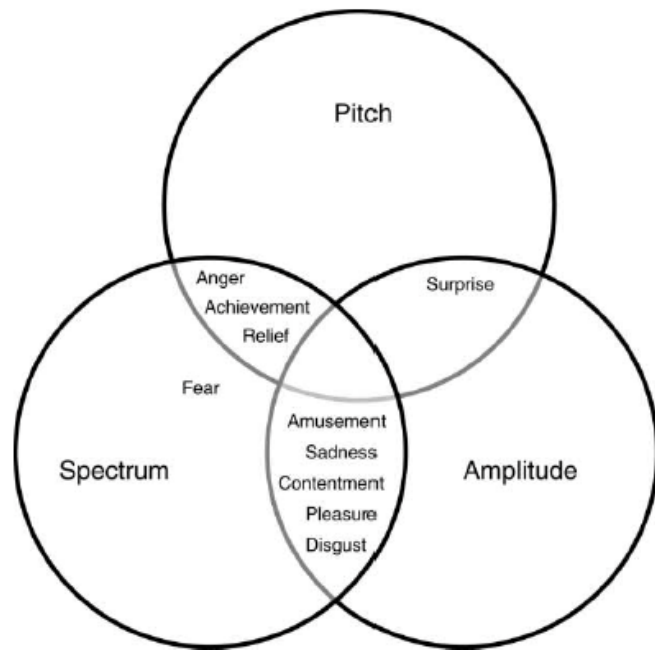
(Banse & Schele, 1996)

Arousal influences the same cues differently:

- Higher arousal boosts F0 floor/min for both happiness and fear
- Higher arousal expand F0 change and max only for fear

(Juslin & Laukka, 2001)

Complexity of emotion acoustics



10 categories

Above 80 %: Disgust(93.5%), Relief (86%)

Below: 65%: Fear (63%), Surprise (54%)

Fear often misrecognized as **Amusement** (13.5%) or **Sadness** (12%)
Surprise often misrecognized as **Disgust** (14%) and **Relief** (13%)

Figure 2. Venn diagram showing which classes of acoustic information are used to predict participants' ratings for each of the emotional scales.

Sauter et al. (2010): emotion categorization & rating

Interim message:

Processing affect prosody is not easy.

Developmental trajectory for linguistic prosody

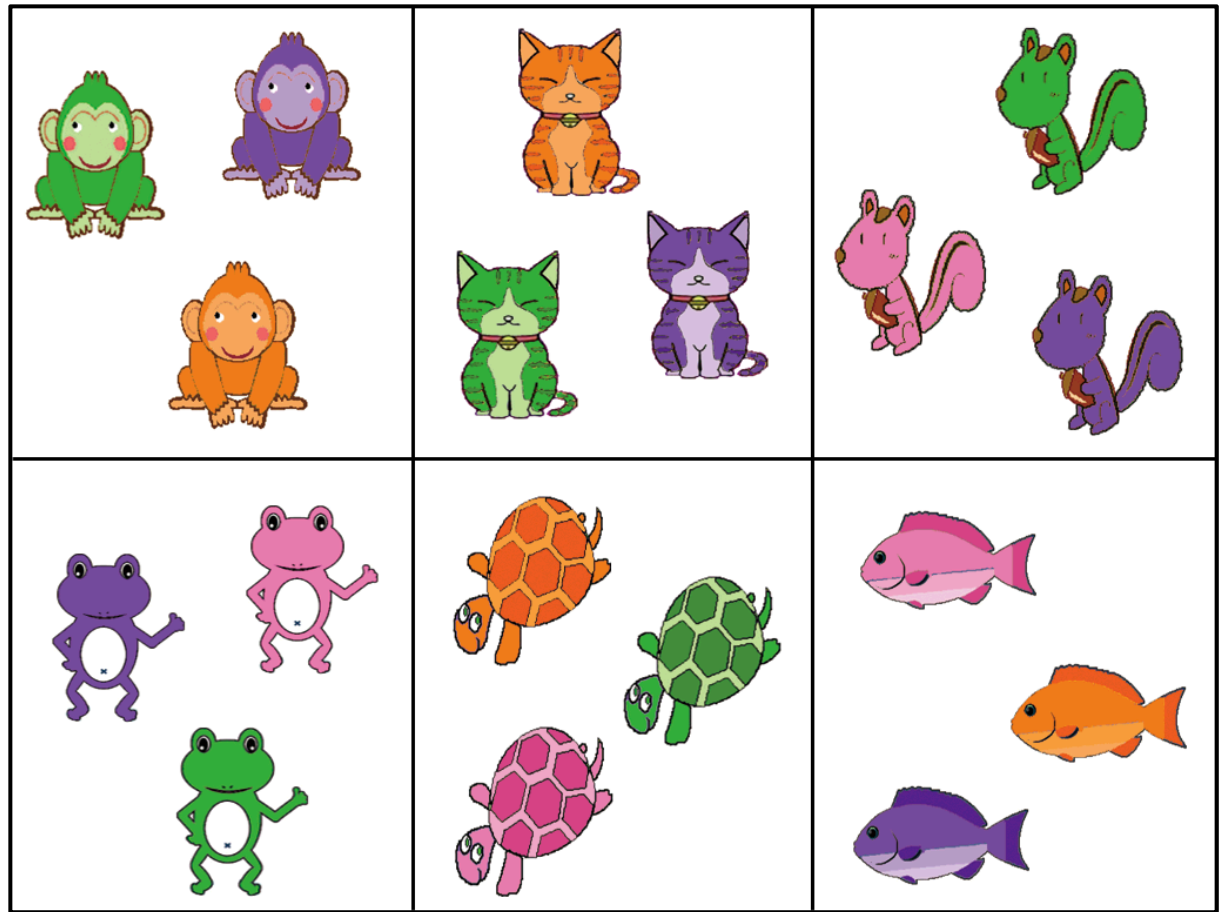
Focus prosody experimental tasks

- Act with a toy:
“Camel hit the lion and HE/he hit the elephant.”; 5-7yrs (Solan, 1980)
- Word monitoring; 4-7yrs (Cutler & Swinney, 1987)
- Scene-sentence matching: 10yrs (Cruttenden (1986)
- Scene description task; 5-13yrs (Peppé & McCann, 2003; Wells et al., 2004)
- Visual search task: 4 years and up (Arnold et al., 2008; Kurumada et al., 2016; Ito et al., 2012; 2014; 2017; Sekerina & Trueswell, 2012)

Ito et al. (2014)

“Where is the orange cat?”

“Now, where is the
GREEN/green cat?”



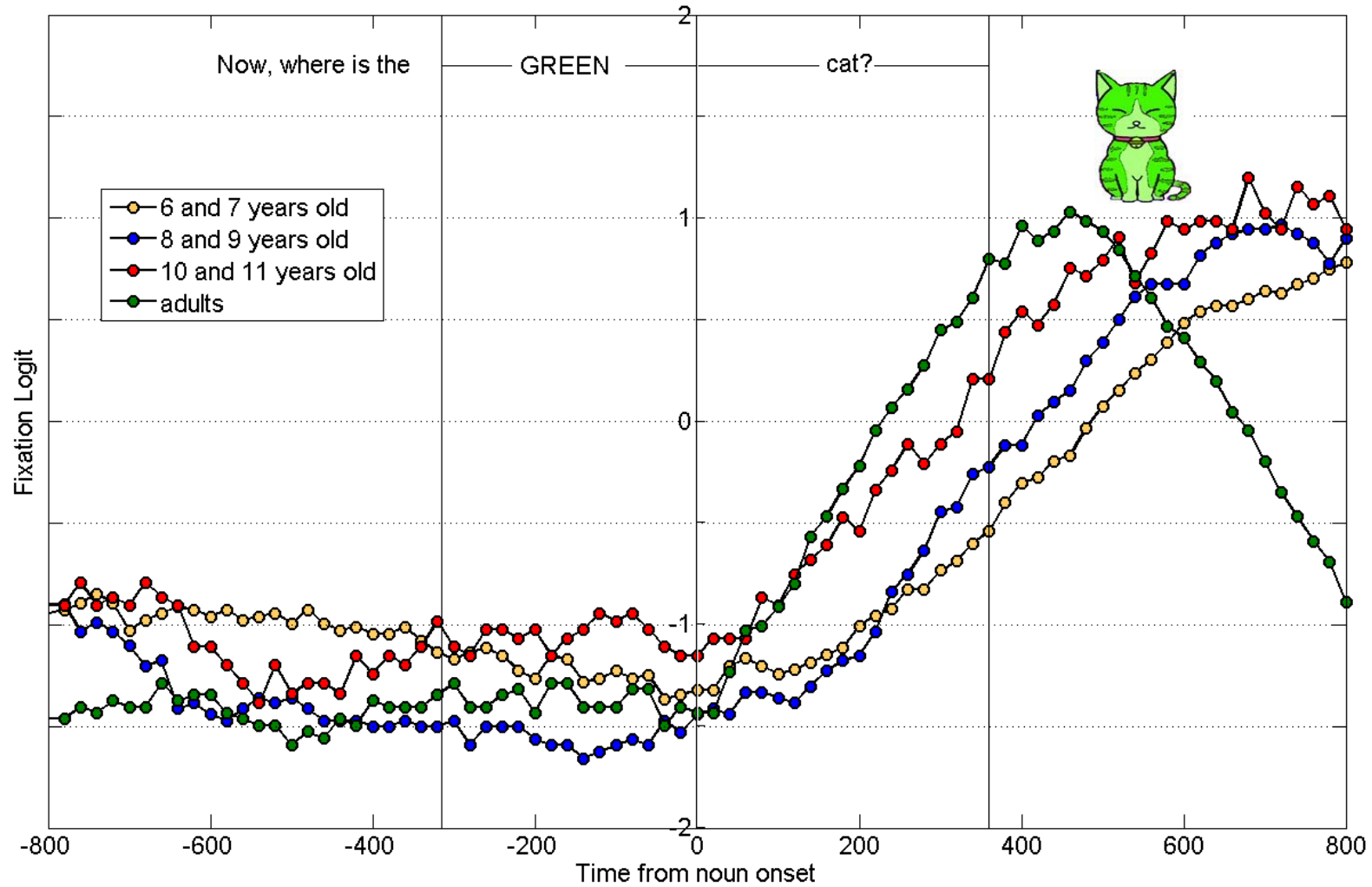
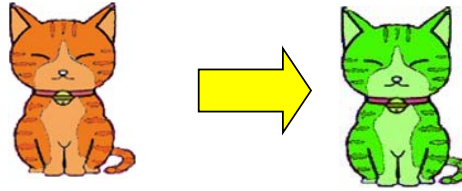
“Now, where is the
GREEN/green monkey?”

Ito et al. Task: Listen and point/click

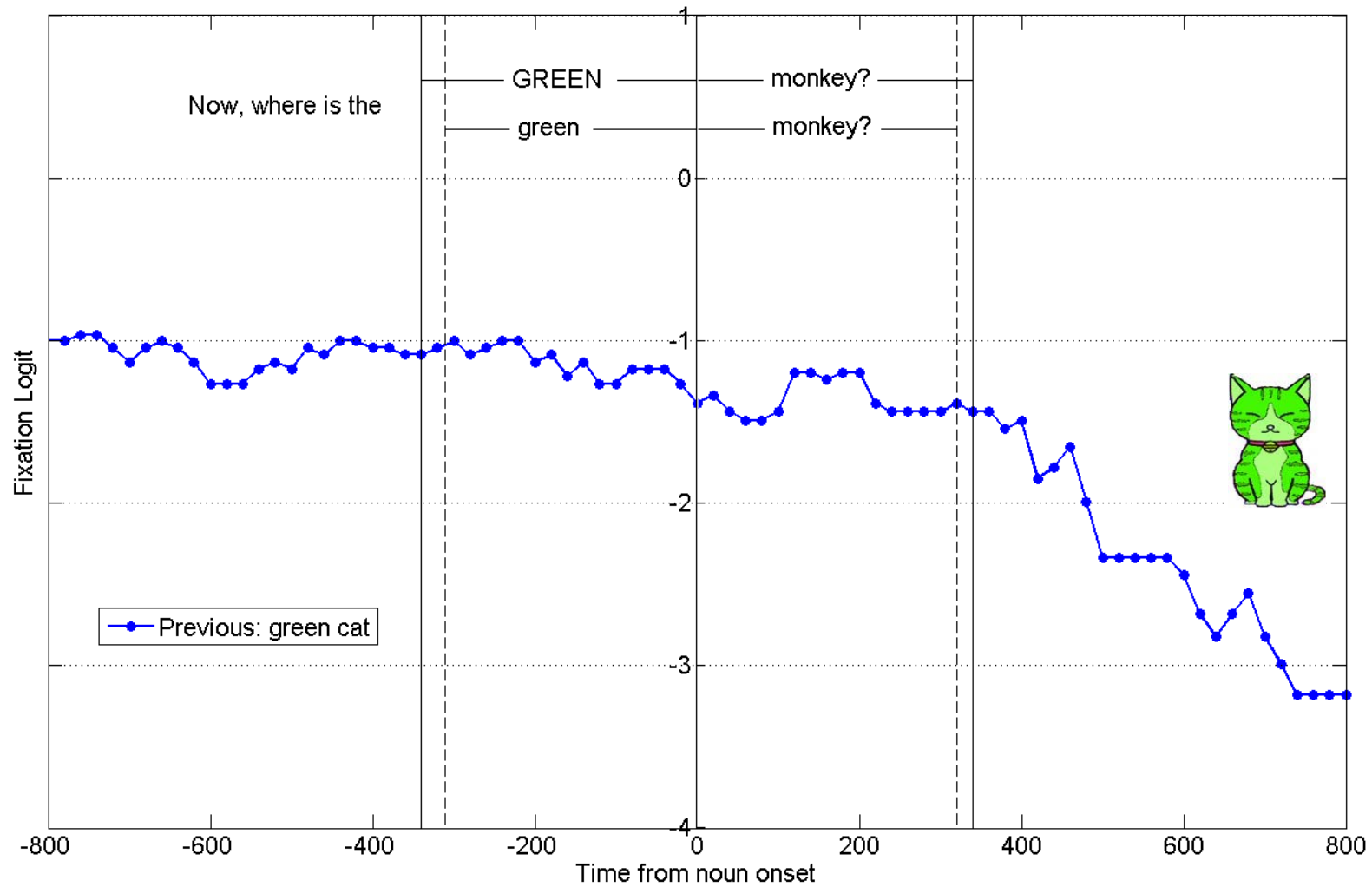
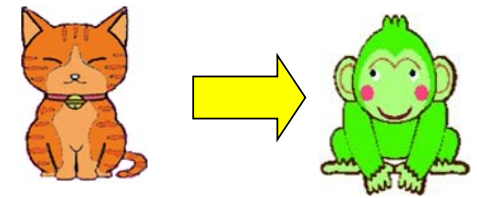
- Accuracy
- RT in gaze

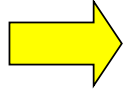


Felicitous

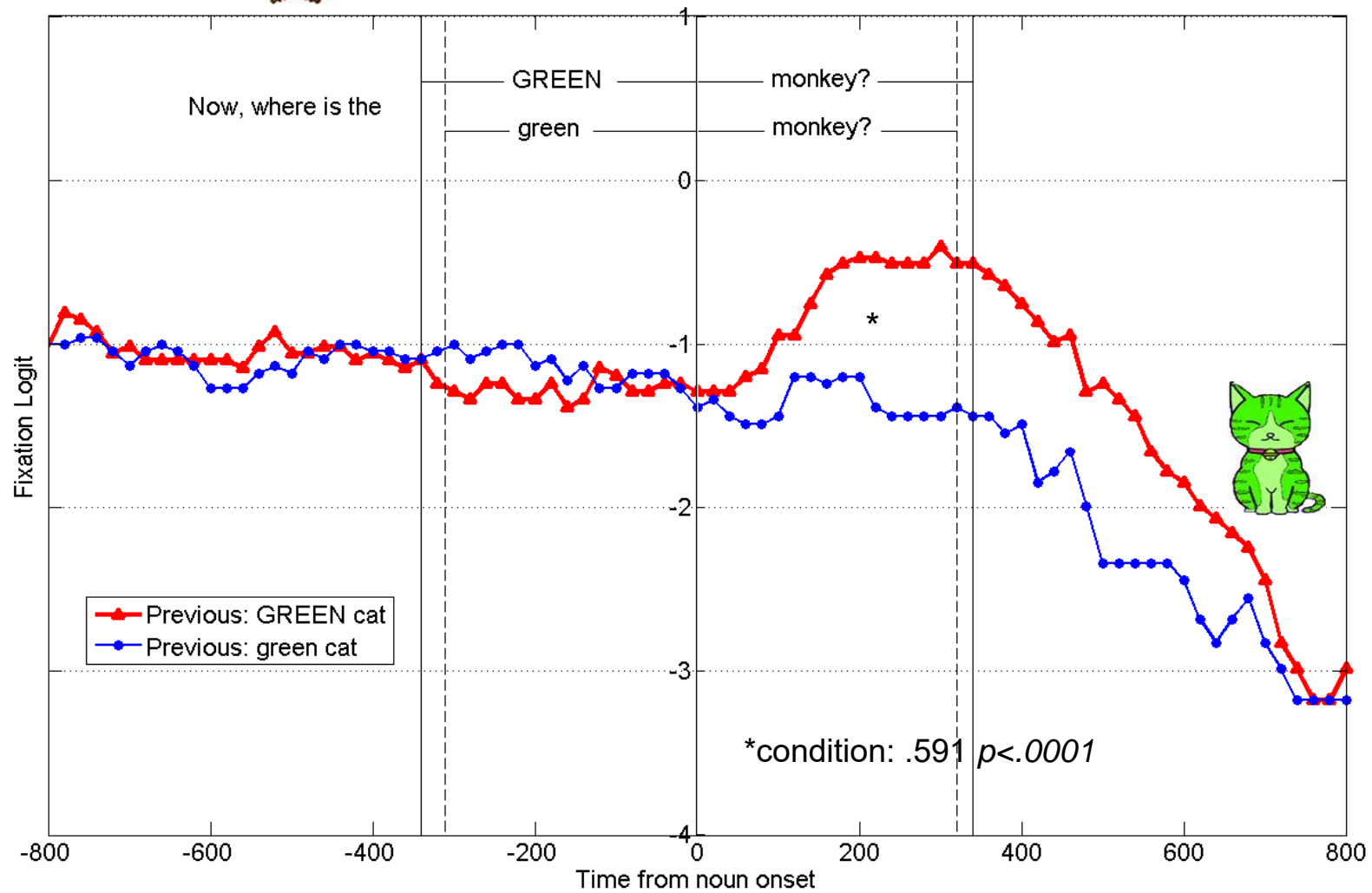


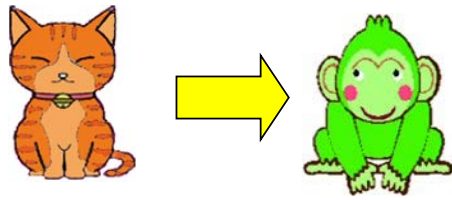
10-11 yrs data



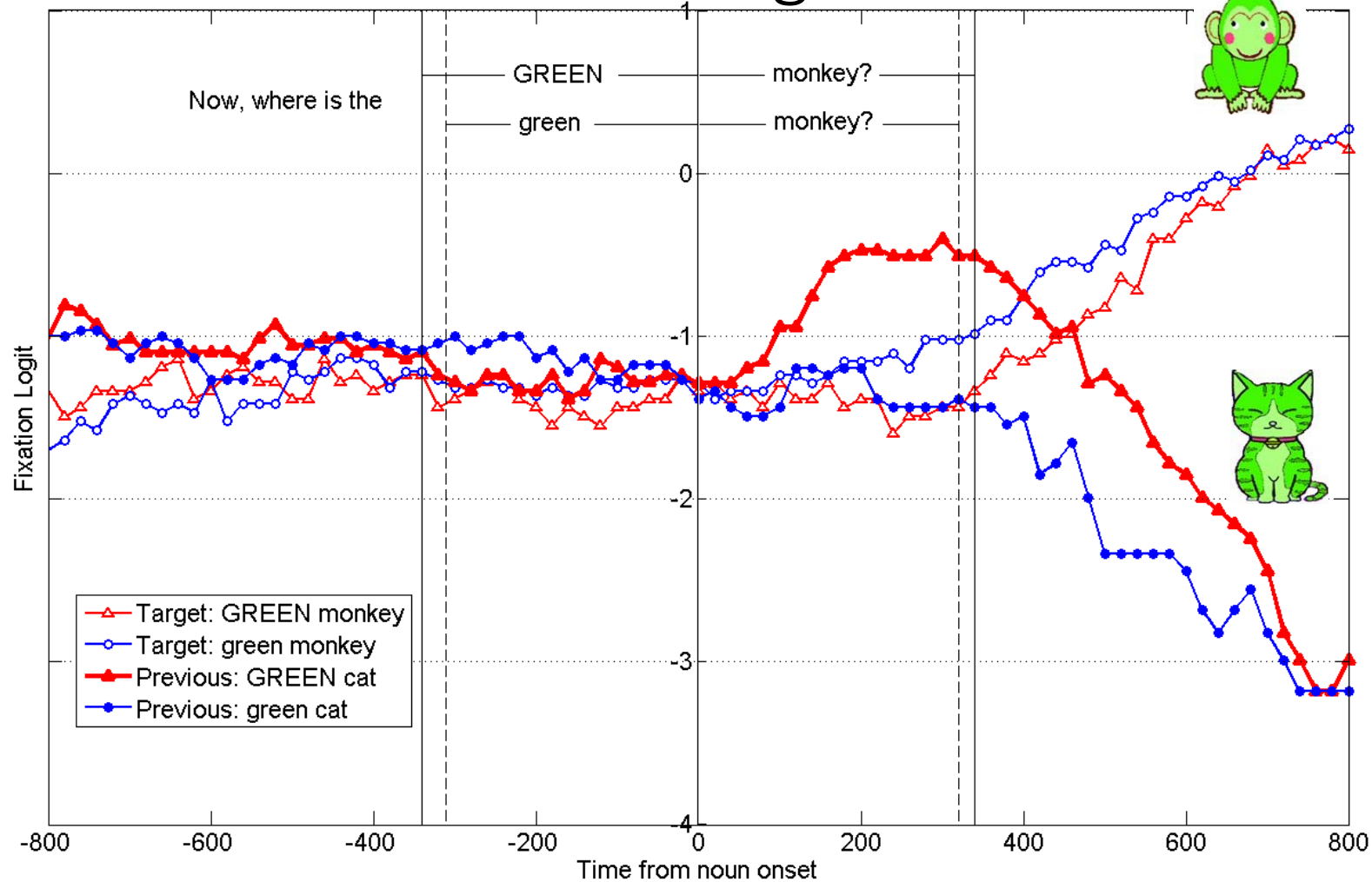


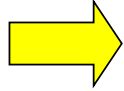
10-11yrs garden-path effect



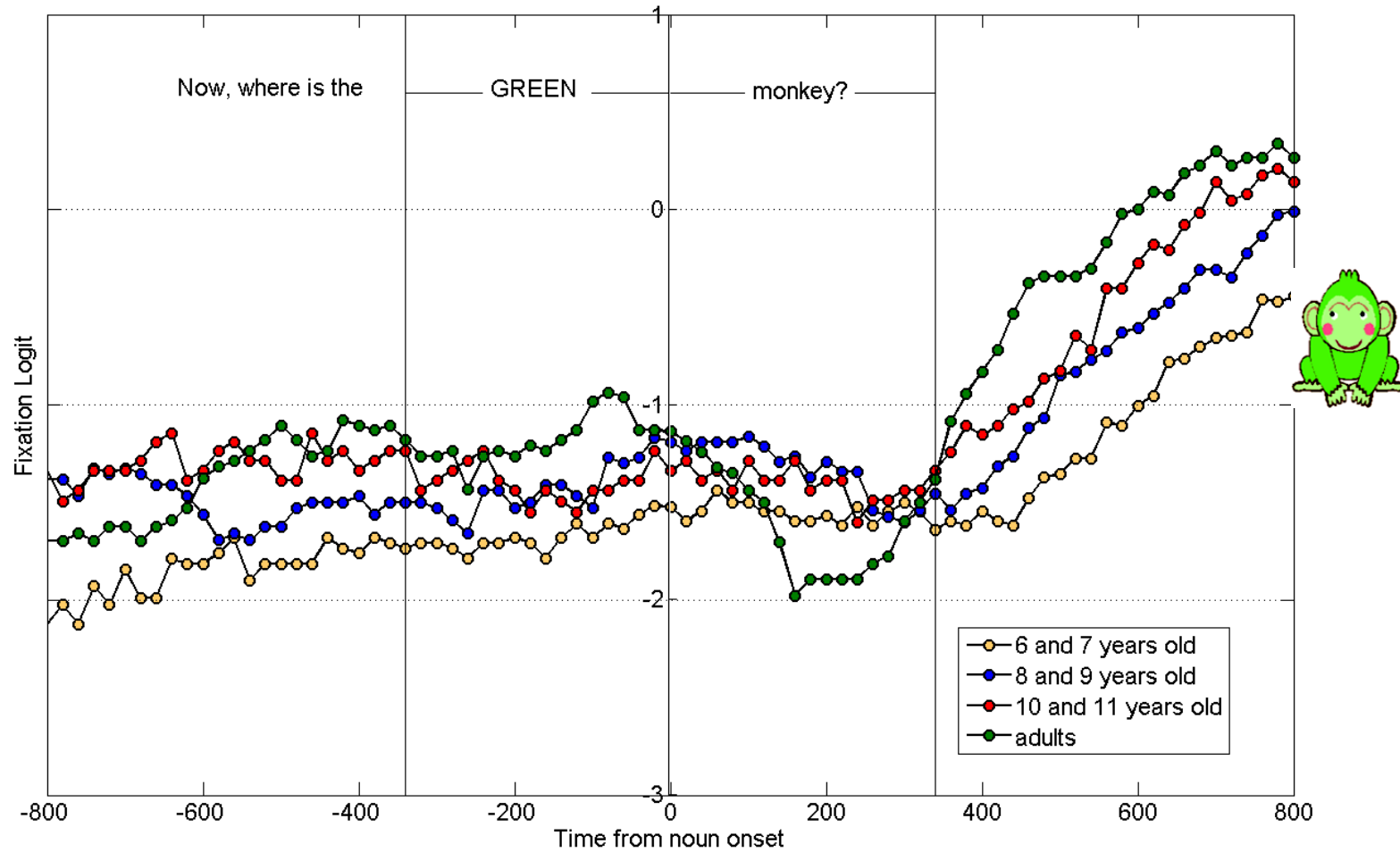


10-11yrs: delay in the detection of real target





Infelicitous: recovery



Interim message:

Processing focus prosody is not easy, either.

Multilayered prosodic processing

“I felt like she was scolding me.”



How does affect recognition affects linguistic processing

Pihan et al. (2008): Illocutionary force judgment task

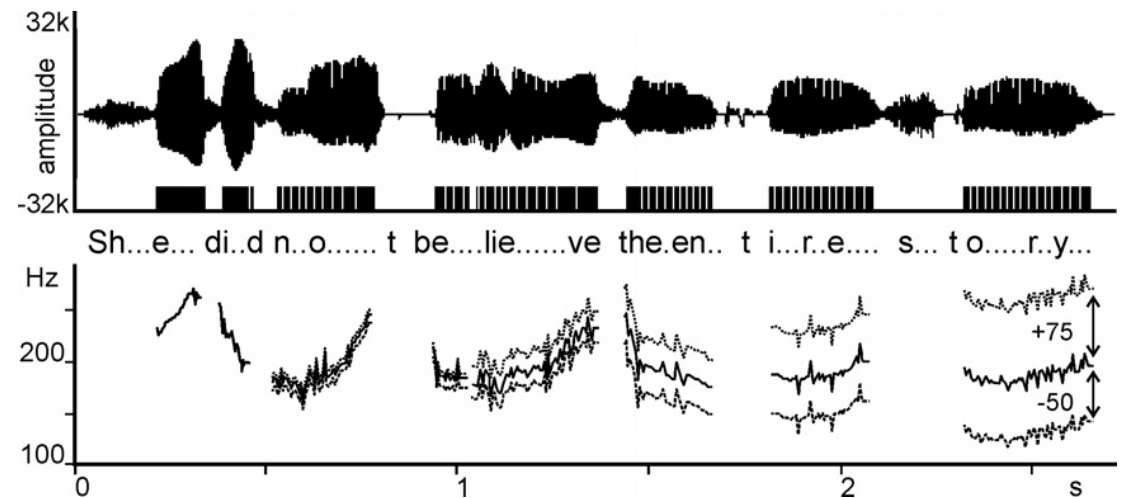
“She did not believe the entire story.”

in **Neutral, Fearful, Happy** prosody

Contour: level, rise, fall

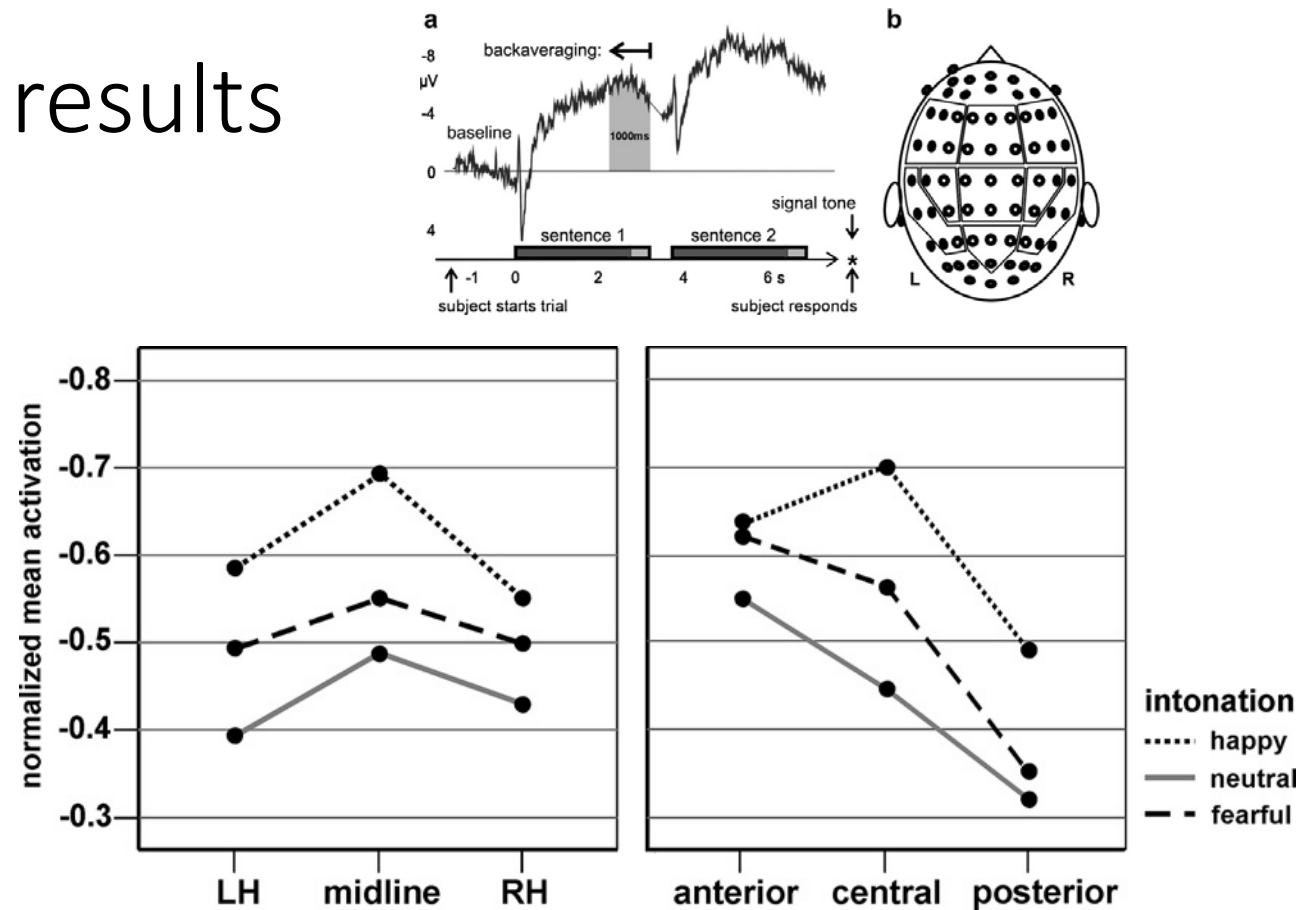
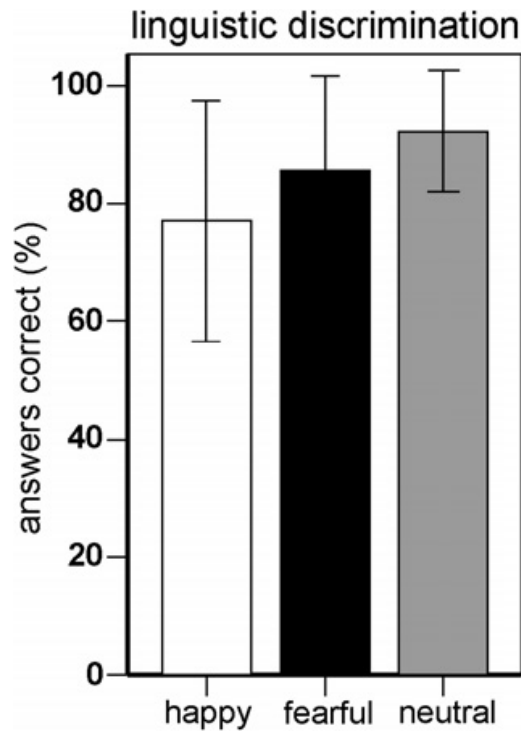
Paired stimuli: S1 – S2

e.g., happy rise vs. happy fall



“Which one is most representative of a question?”

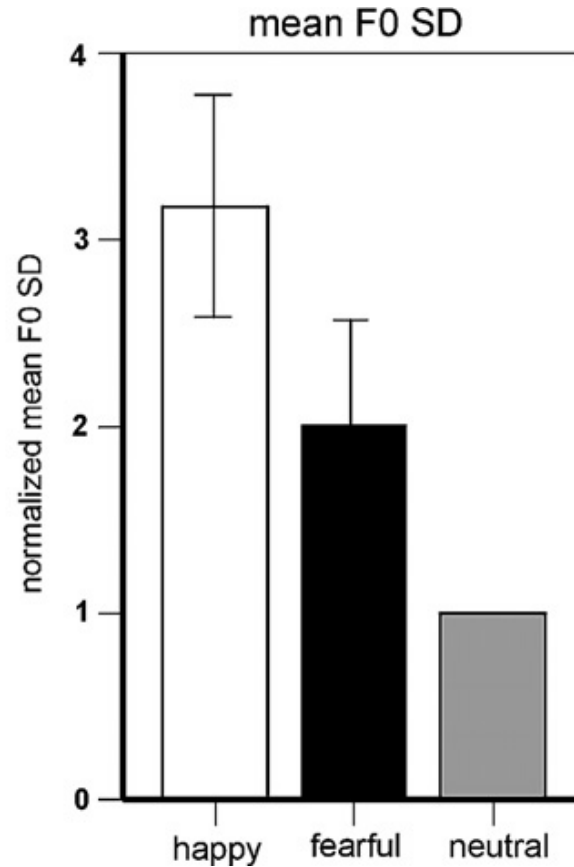
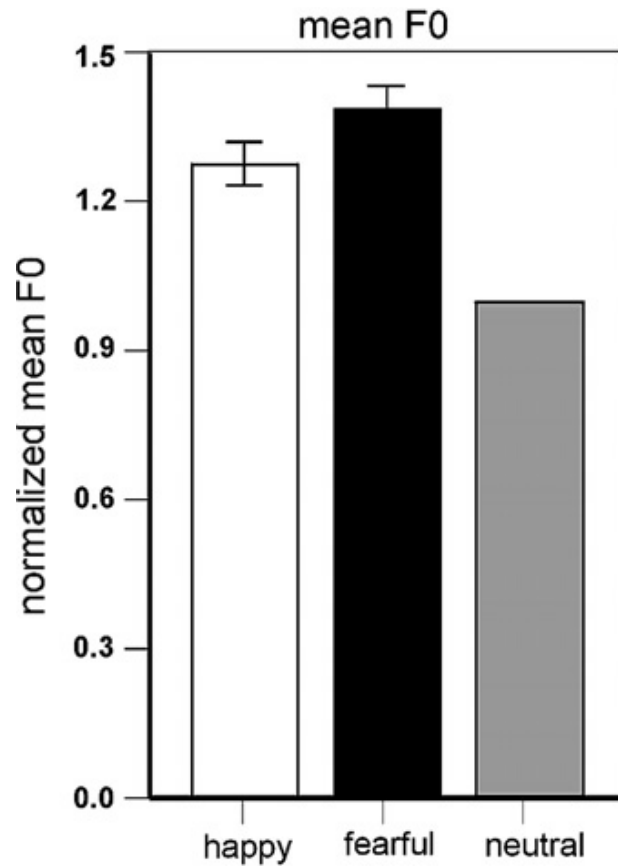
Pihan et al. (2008) results



Affect prosody influences the perception of speaker intention.

Pihan et al.:

Stimuli acoustics



Larger change in F0 made it difficult to judge the illocutionary force.

Other example studies

Petrone et al. (ongoing)

Online Request/Offer judgment task



1. Is the speaker in a good/bad mood?

Definitely ----- | ----- Not at all



2. Does the speaker want to fix the bike for the listener?

Definitely ----- | ----- Not at all



3. Who does the speaker think has more authority in this situation?

Speaker ----- | ----- Listener

Visual world paradigm: Ito et al. (ongoing)



Ito et al (ongoing): measurements

- Responses to social cues
 - Gaze to the actor face]
 - Oral/gesture response to actor's speech
 - Shared attention
- Do the above measures predict the efficacy of object detection and recall?

Why do we want to know how affect processing influence linguistic processing?

- Speech therapy intervention
- L1 vocabulary growth & grammatical development
- L2 pedagogical efficacy

Available soon...

Ito, K. (forthcoming). Gradual development of focus *and* affect prosody comprehension: a proposal for a holistic approach. In PRIETO, P. & ESTEVE-GIBERT, N. (Eds.) (2016, under contract). *Prosodic Development in First Language Acquisition*. John Benjamins (Trends in Language Acquisition Research Series): Amsterdam.

Questions?