

# Environmental influences on *language development* of children with hearing loss

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# What you will learn:

› Language development from a **social-interactionist** perspective

› How **hearing loss** affects interaction with the environment

› Considering the environment in **audiopedagogical intervention**

EXERCISE  
IN CLASS

# CRACKING THE LANGUAGE CODE

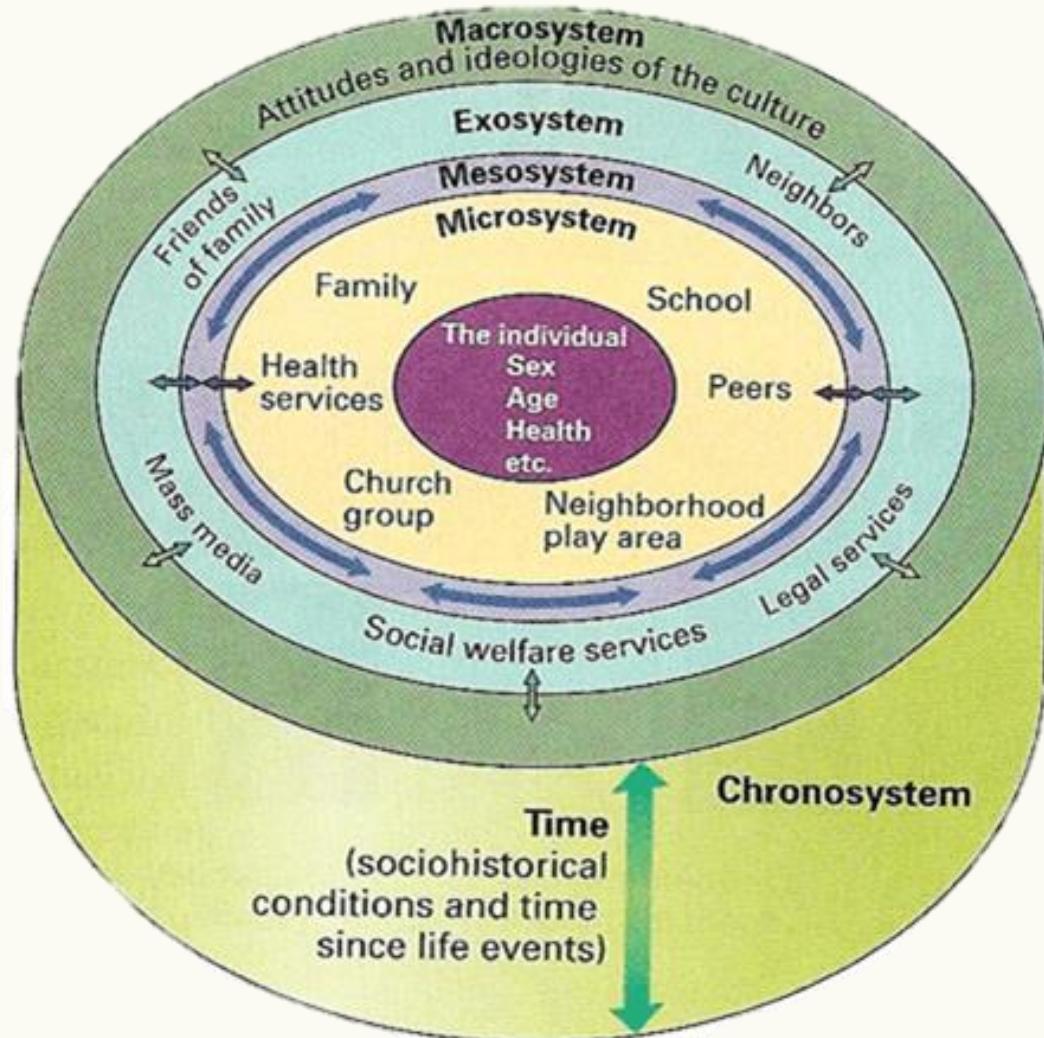
The background of the image is a dark, solid color. Scattered across it are several walnuts and pinecones. The walnuts are light brown and have a distinctively wrinkled, segmented texture. The pinecones are also light brown and appear more rounded and spiky. In the upper half of the image, there is large, bold text. The words 'CRACKING THE' are in white, while 'LANGUAGE CODE' is in yellow. The letters are thick and have a slight shadow, giving them a three-dimensional appearance.

# The social-interactionist view of language development



# Bronfenbrenner's Ecological systems

*What makes an  
“environment”?*



# Building blocks of language

PRAGMATICS

SYNTAX

LEXICON

PHONOLOGY



# Language is messy!

## Phonology

- › Many speech sounds
- › Small acoustical differences
- › Variation across speaker and context

## Lexicon

- › Referential ambiguity
- › Variable forms, homonyms & synonyms
- › No reliable acoustical boundaries

## Syntax

- › Structure not represented on the surface of the speech signal
- › Full of errors and ellipses





# Bootstrapping strategies & perceptual biases

*Allowing the child to learn from  
messy language input.*



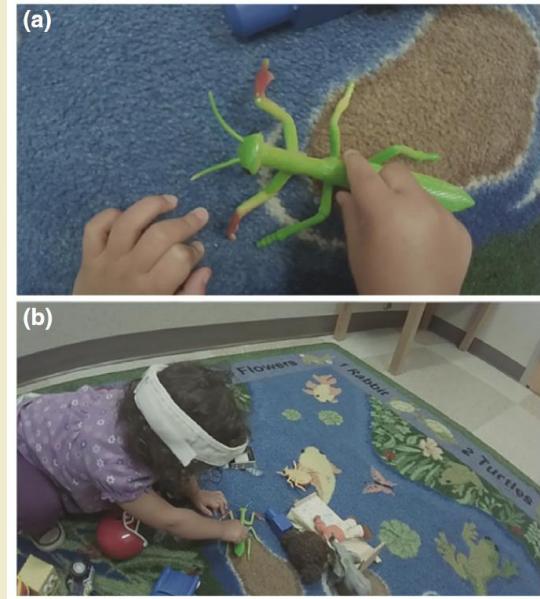
# Perceptual biases

- › Preference for speech over non-speech
- › Preference for native language
- › Attentional Biases
  - › Novel objects
  - › Things in mom's hands
  - › Things in their limited visual field

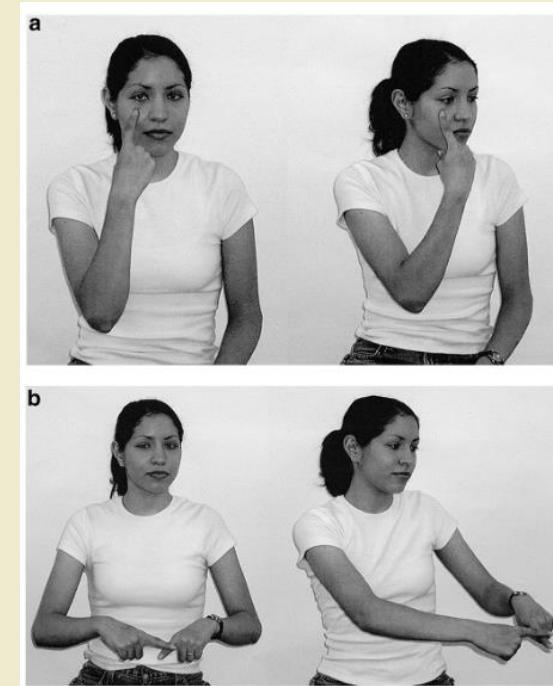
# Bootstrapping strategies

- › Phonological and prosodic cues
- › Statistical learning

A child's view of its environment vs. that of their caregiver.



Example of strong, generative biases:  
The emergence of Nicaraguan sign language



## Example

# Statistical learning

*Tracking statistical probabilities  
to detect regularities.*

pre tty ba by

pre tty boy

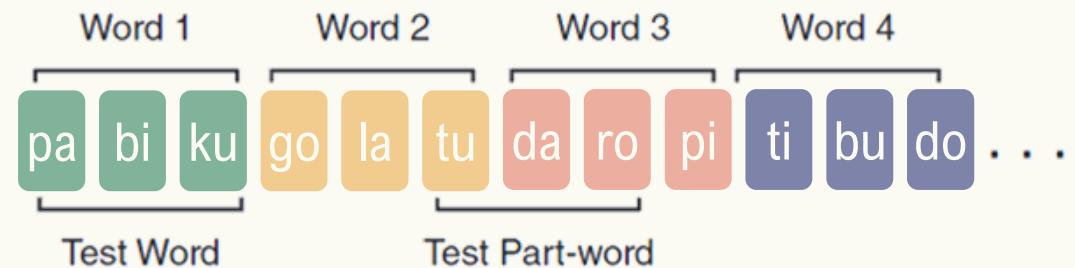
pre tty pic ture

High transitional  
probabilities  
within words

Low transitional  
probabilities  
between words



Artificial language learned by 6-month-old babies (Saffran, 1996)





# Child-caregiver interactions

*Language input must be **child-directed** and **child-appropriate***

- › delivered in the context of **social interactions**
- › rich in **quantity and quality**

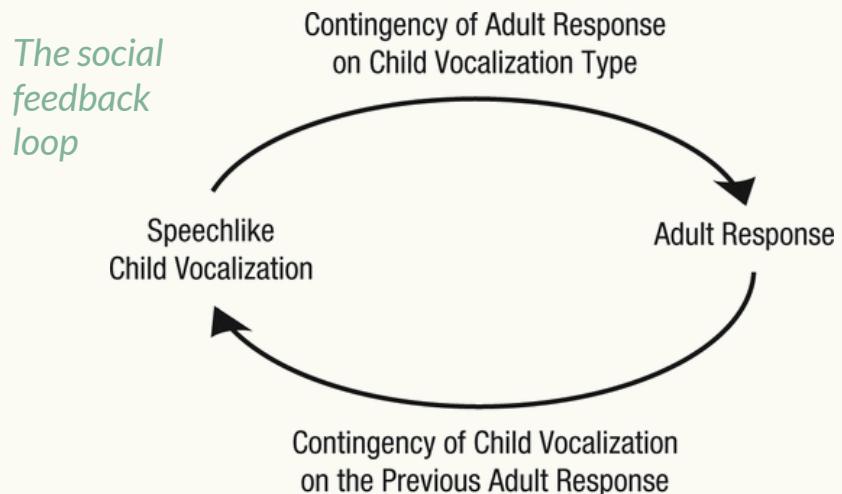
A photograph of a man with a bun hairstyle and a grey patterned sweater crouching in a lush green forest. He is looking down at a small child wearing a yellow beanie and grey overalls, who is also looking at something on the ground. They appear to be examining a fallen branch or leaf. The background is filled with dense green foliage and trees.

# Triadic interactions

- › joint attention
- › highlight linguistic structures
- › facilitates understanding of language as a social tool

# Contingency

- Following the child's lead,  
Commenting, recasting, expanding
- Responsive, reciprocal, coordinated



A Foreign-Language Exposure

Live Exposure



TV Exposure

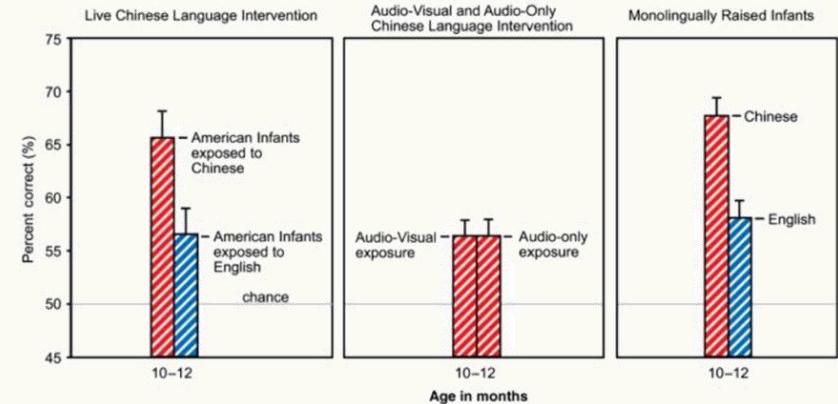


B Phonetic Perception Test



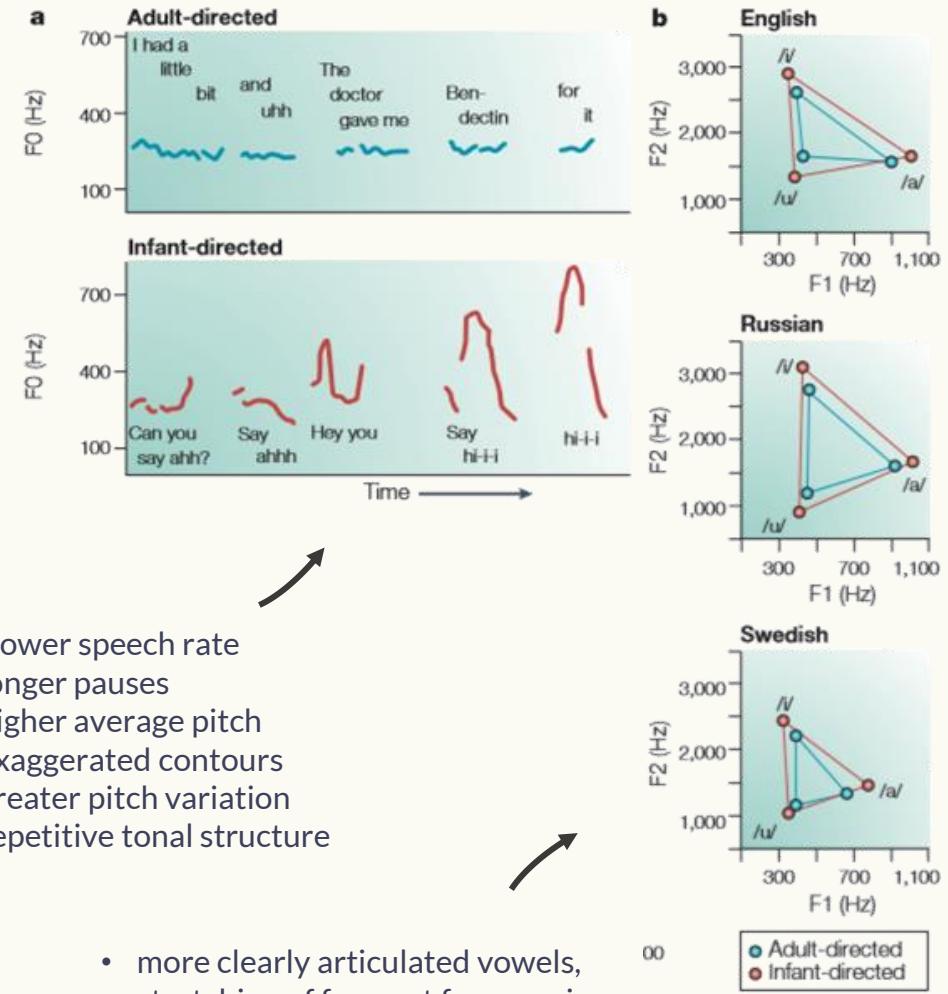
C

Mandarin Chinese Phonetic Discrimination



# Infant-directed speech ("Motherese")

*Adjusting speech to  
the child's needs.*



- slower speech rate
- longer pauses
- higher average pitch
- exaggerated contours
- greater pitch variation
- repetitive tonal structure

- more clearly articulated vowels,
- stretching of formant frequencies
- larger vowel triangle,
- articulation more visible

# Other important aspects of caregiver language

- › Directiveness
- › Parenting/teaching skills & self-efficacy beliefs
- › Lexical diversity
- › Complexity of speech
- › Use of gestures
- › Quantity and quality of language input



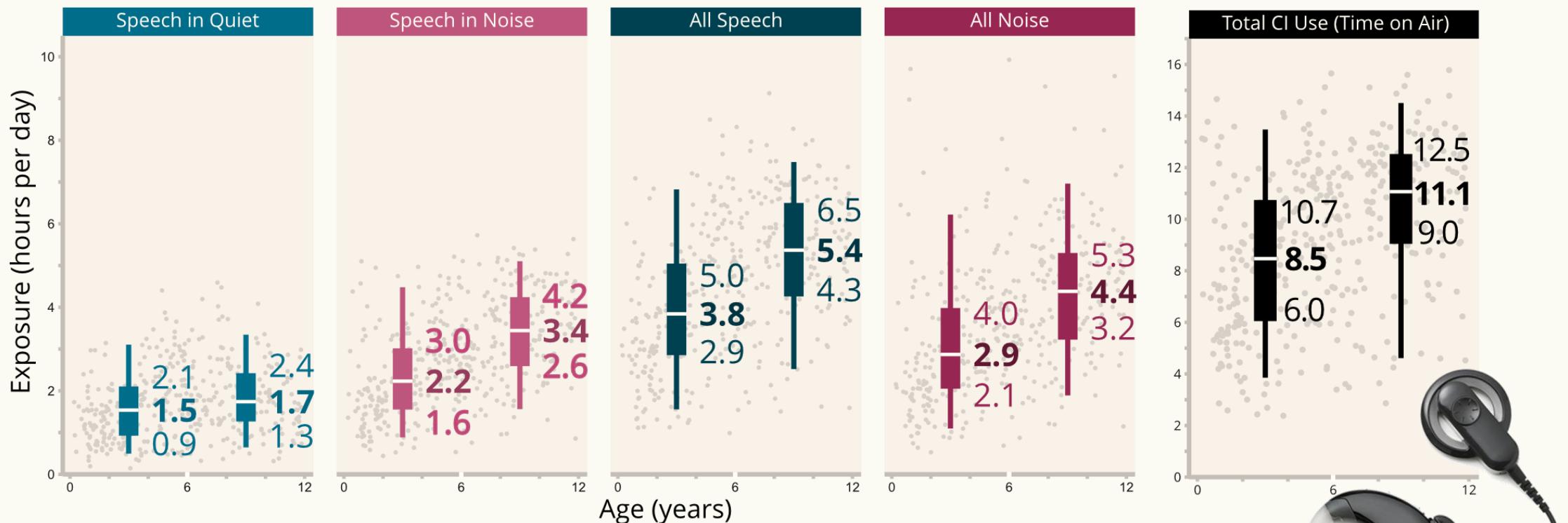
# Large variation in quantity and quality of caregiver language input

- › Hart & Risley (1995):  
The 30 million word gap
- › Weisleder & Fernald (2013):  
670 - 12,000 words per 10 hrs
- › Rowe (2012):  
360 – 9,200 words per 90 mins  
95 - 714 word types
- › Ambrose (2014), children with HL:  
~ 500 – 2500 words per hour  
~15 – 100 conversational turns
- › Ambrose et al. (2015):  
linguistic input at 18mo related to language abilities at 3 years, with *directing utterances* accounting for significant unique variance
- › Gilkerson et al. (2017):  
conversational turn count at 18-24 mo.  
explained 9-14% of variation in language and cognition 10 years later

The language environment analysis (**LENA**) recorder can capture and analyze the environment automatically



# Large Variation in Quantity and Quality of caregiver language input



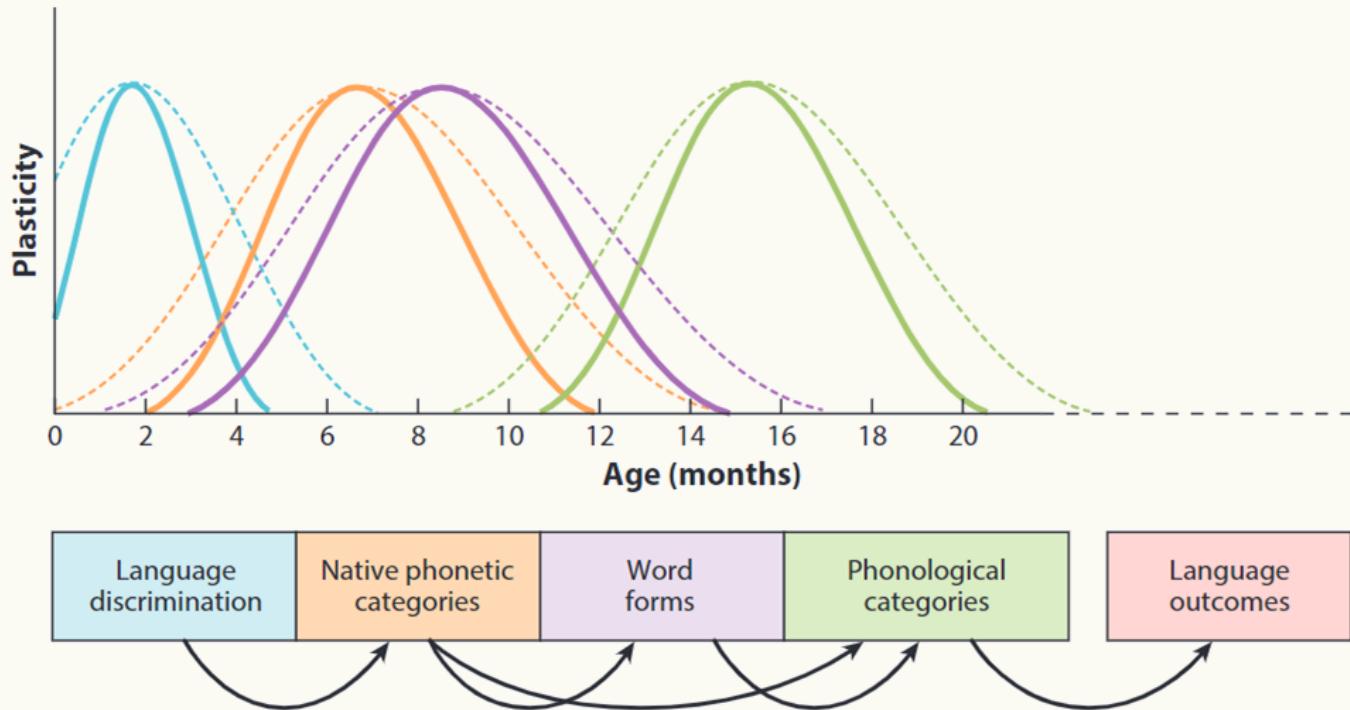
Many modern hearing devices also have features to track their use and the user's sound environment (**data logging**)

# FEARING LOSS

A S A R I S K F A C T O R

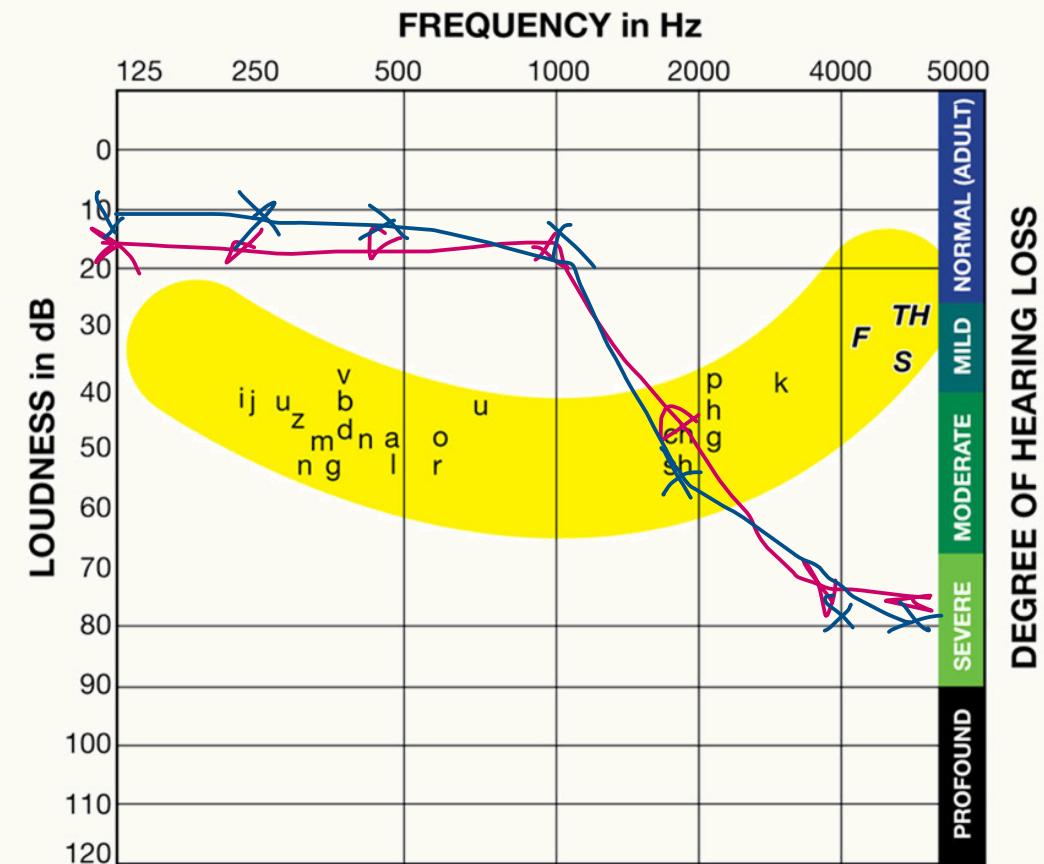


# Critical windows, sensitive periods



# Degraded signal quality

- › Limited access to speech
- › Poor representation of fine spectrotemporal detail
- › Poor representation of pitch
- › Wide-ranging effects on all aspects of language



# Challenging acoustics

- › Struggle with speech in noise
- › less learning from overheard speech
- › Exhaustion, listening effort
- › Assistive listening devices can help,  
but they are not always used



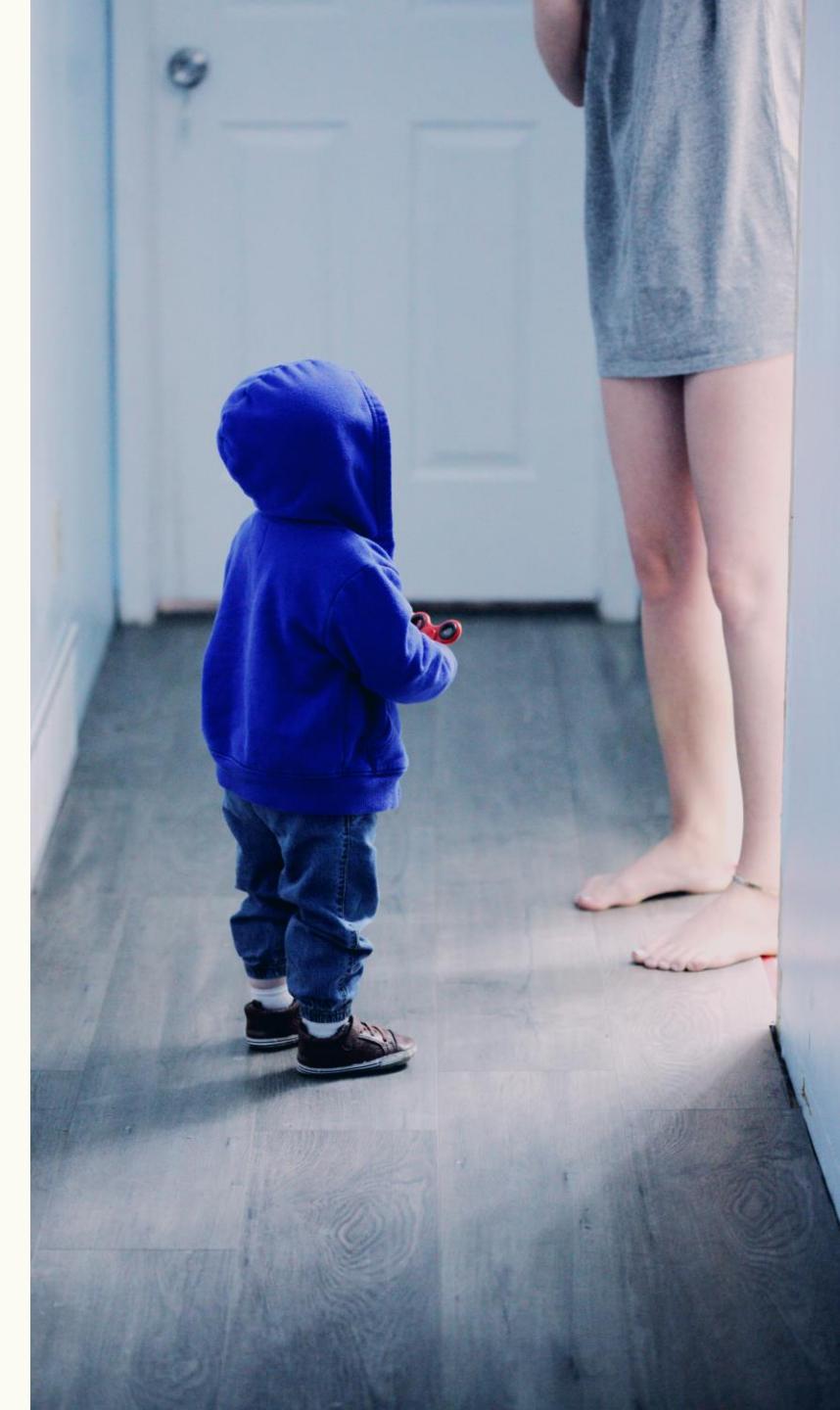
# Non-compliance

- › Stigmatization
- › Limited benefit
- › Exhaustion from listening
- › Technical problems, difficult device management



# Disrupted social interactions

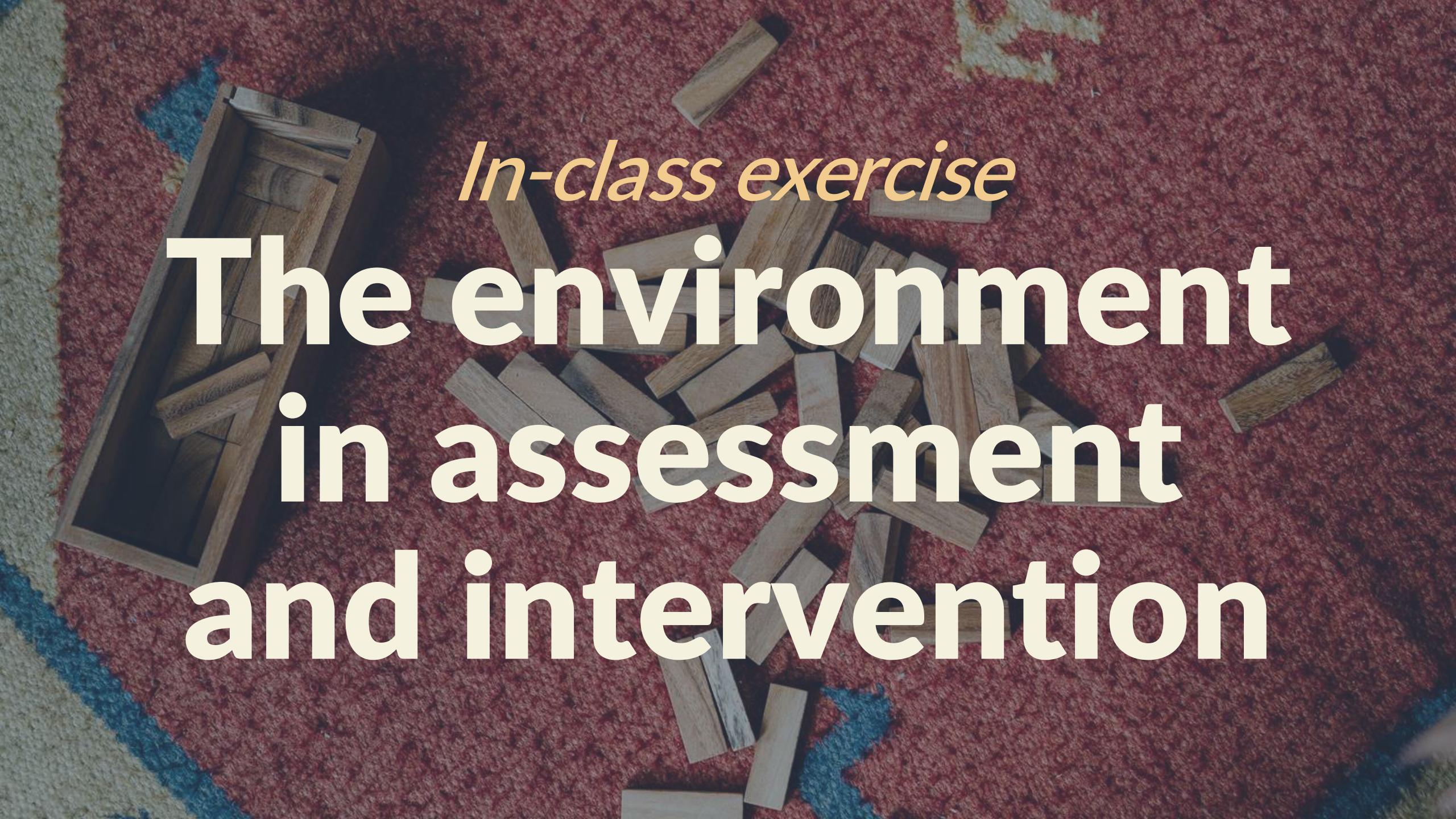
- › difficulties providing meaningful interactions, increased risk of harmful communication patterns, communication lower in quality
- › Disrupted communication and social-affective processes affect child behavior
- › Problems with communication and child behavior increase parental stress
- › Moreover: dealing with hearing devices & medical services, worries about the future, uncertainty regarding their role in the rehabilitation
- › Increased parental stress affects interactions



# Take Home Messages

- › Children have innate language learning mechanisms; the environment provides the “data”.
- › Children learn language through child-appropriate and child-directed interactions with caregivers.
- › HL reduces access to the environment, jeopardizing language, cognition, and social-emotional development.
- › Audiological interventions do not cure hearing loss. Children with hearing devices struggle in adverse listening situations.



The background of the slide features a close-up photograph of a textured red carpet. Scattered across the carpet are numerous small, rectangular wooden blocks of various sizes and shades of brown. In the upper left corner, there is a portion of a chalkboard with some faint, illegible markings. The overall composition is slightly grainy and has a warm, earthy feel.

*In-class exercise*

# The environment in assessment and intervention

## Group discussion

# Review Lecture Content

- › How does the environment assist children with learning language?
- › Why should we target the environment in intervention for children with hearing loss?
- › What are malleable environmental factors?



# Activity 1: Counselling parents

- › What things about the child's environment are you going to ask about? Which risk factors and challenges in the child's daily environment do you need to know about?
- › What are the key messages for the parents? What strategies do you recommend to the parents?
- › How can you stimulate knowledge transfer? Which behavior change techniques could you implement to change the child's daily environment?



## Activity 2: Design a data logging intervention

- › Technology lets you capture and analyze a child's sound environment automatically:
- › CI/HA data logging counts duration of use, exposure to speech, speech in noise, noise, music, quiet, accessory use, device diagnostics
- › LENA estimates adult word count, child vocalization, conversational turns
- › Design an intervention using such tools. How could you use the information they provide?
- › Is there something that these tools don't do? Invent your own tool!





# That's it for today!

Please see the lecture notes for a list of references.

## Attributions

- › Hiking boot from vectorHQ.com
- › Boy holding magnifying glass from freepik.com
- › Father's day festivity characters, take out wok by vecteezy.com
- › Speech banana image from Wikipedia
- › Photos from pexels.com and unsplash.com
- › EMA glasses from Kowalk et al. (2018)
- › Baby in scanner from Kuhl (2007)
- › Product images from Cochlear Ltd. and LENA Foundation