Exploring Perceptual Sensitivity in Deaf and Hearing Infants

Discrimination of Linguistic Input in the Signed Modality

Shane Blau

Dissertation Defense

Department of Linguistics, Gallaudet University

Chair: Dr. Deborah Chen Pichler

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Positionality

I am a hearing researcher working and earning a living within a community that is not my own. D/deaf communities have been marginalized by hearing people, including the many hearing researchers who have tried to do research on D/deaf people instead of with them.

I have attempted to design my research to address questions of primary concern to D/deaf individuals, and not simply questions of personal or scientific interest. I hope that this research will serve to give back in some small measure to the communities that have given me so much.

Context | Lit Review | Methodology | Results | Conclusions

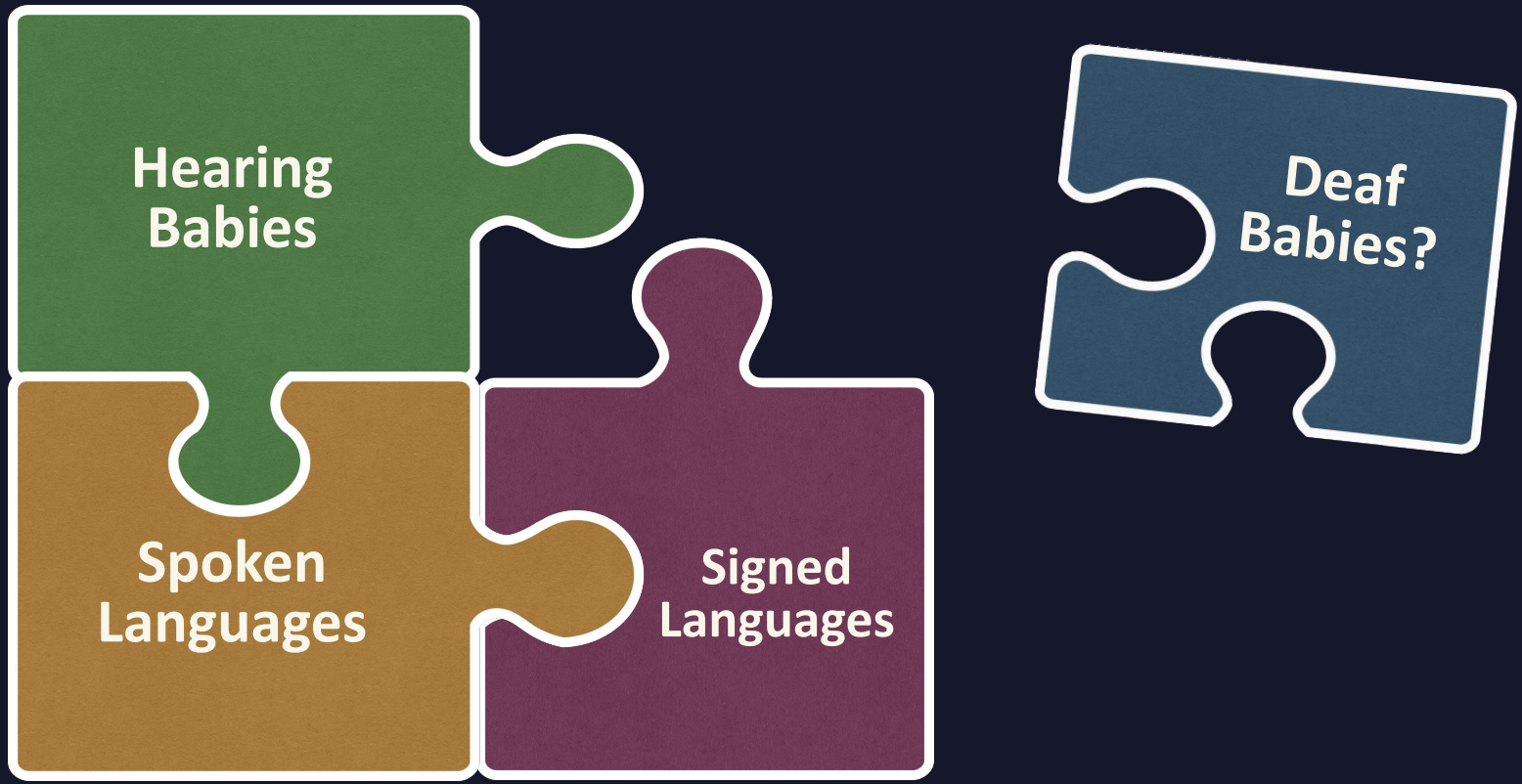
- Infant language perception
- Knowledge gaps
- Research questions

A Privileged Time for Language Acquisition

By age 1, hearing infants have acquired language foundations by attuning to linguistic patterns in their world.

Their **perceptual** skills and biases guide this development.

Knowledge Gaps



Research Questions

RQ1. Do infants discriminate between unknown signed languages?

RQ2. Do infants show a preference for a signed language over an invented sign system?

RQ3. Do we see evidence of different sensitivities in deaf versus hearing infants?

RQ4. What linguistic features do infants attend to when watching signed languages?

RQ5. Do we see evidence of change in sensitivity at different ages?

- Infant language perception
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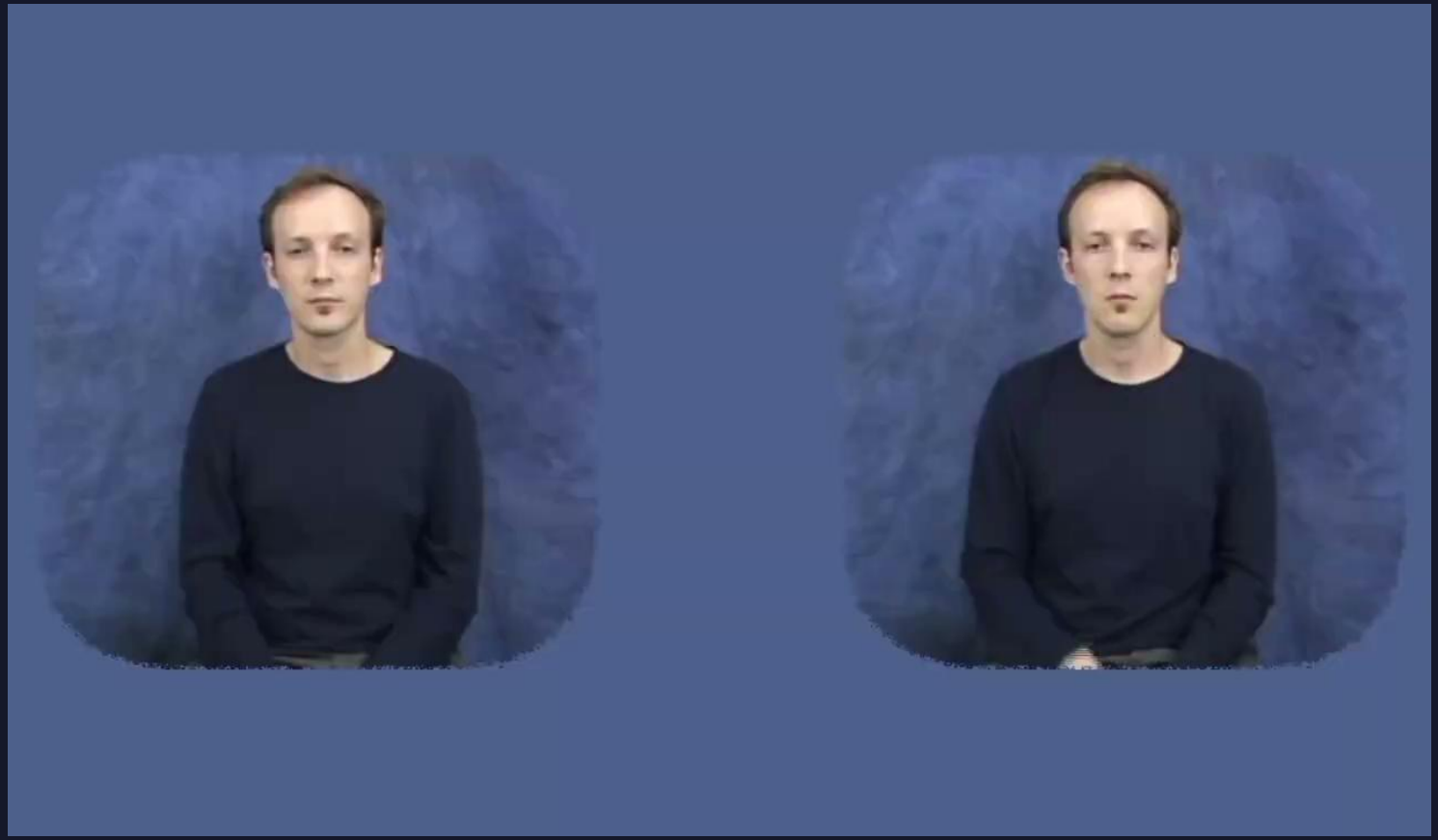
- **Language discrimination**
- **Perceptual reorganization**
- **Critical Periods (CPs)**
- **Previous infant research with SLs**

Language Discrimination



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Language Discrimination

1. Discrimination is based on contrastive linguistic features.
2. Infants are so sensitive to linguistic patterns that they can detect subtle differences that adults cannot.

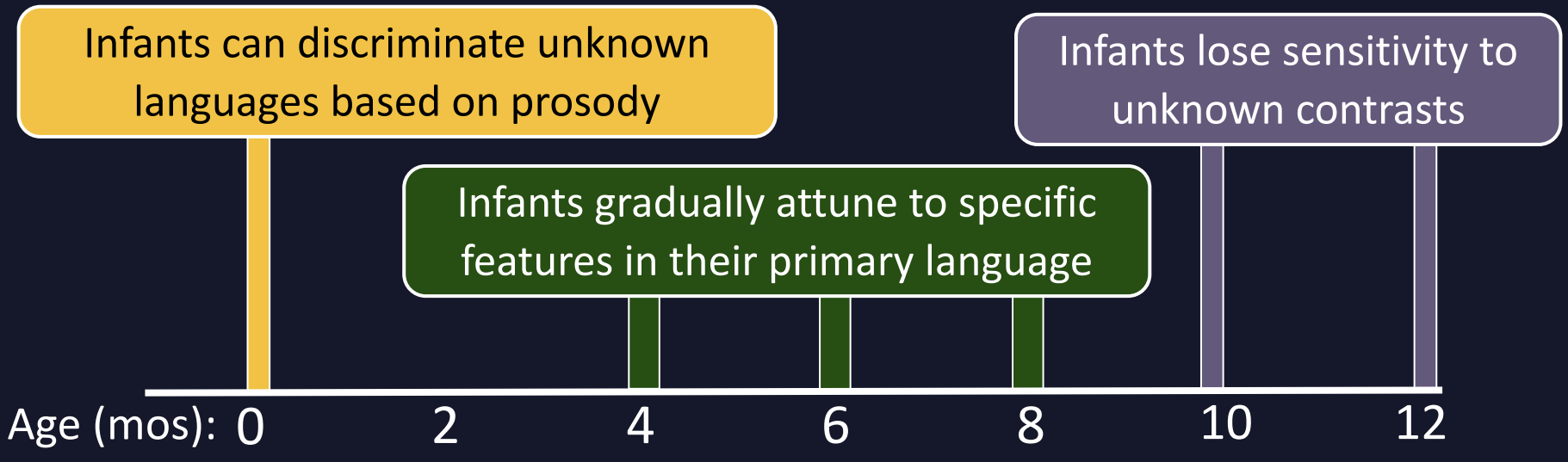
Can detect all contrasts until around 12 mos

Can only detect known contrasts

Nazzi et al. 1998; Kuhl et al. 2007

Perceptual Reorganization

A developmental process where infants move from broad, non-specific perception to more specialized perceptual skills.

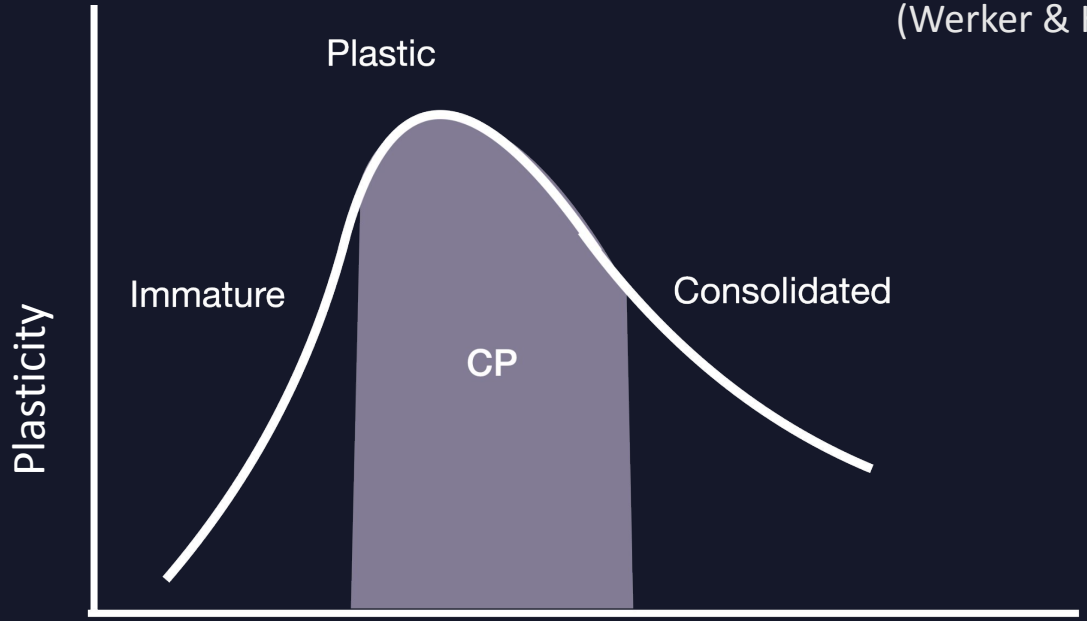


Johnson & Jusczyk, 2001; Kuhl, 2007; Nazzi & Ramus, 2003

Critical Periods (CPs)

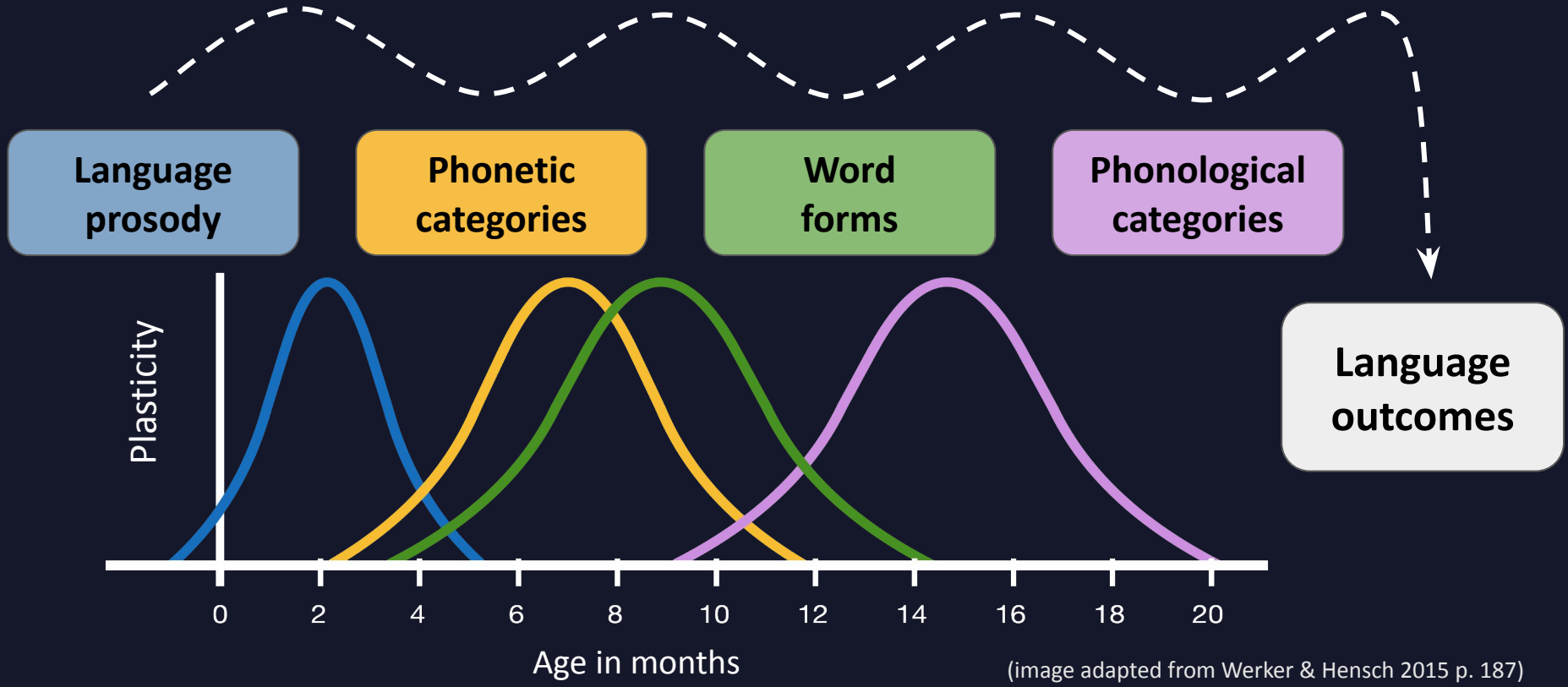
"A window, typically in early development, during which a system is open to structuring or restructuring on the basis of input from the environment."

(Werker & Hensch, 2015, p. 175)



(image adapted from Werker & Hensch p. 177)

Cascading Critical Periods



(image adapted from Werker & Hensch 2015 p. 187)

Preferential Looking Paradigms (PLP)

1. Present linguistically contrastive input

2. Measure looking time (LT) to each option
3. Longer LT indicates discrimination and preference
    a. Familiarity preference (monolingual)
    b. Novelty preference (bilingual)

Singh, 2021

Selected Studies

Study	D or H	Age	N	Contrast	Paradigm Stimulus
Masataka (1996)	**D**	**6 m**	**12**	Child-Directed Adult-Directed	PLP Whole language
Krentz & Corina (2008)	**H**	**6 m** **10 m**	**34** **37**	Sign Pantomime	PLP Whole language
Stone et al. (2017)	**H**	**6 m** **12 m**	**16** **13**	Well-formed Ill-formed	PLP Fingerspelling hands

Selected Studies

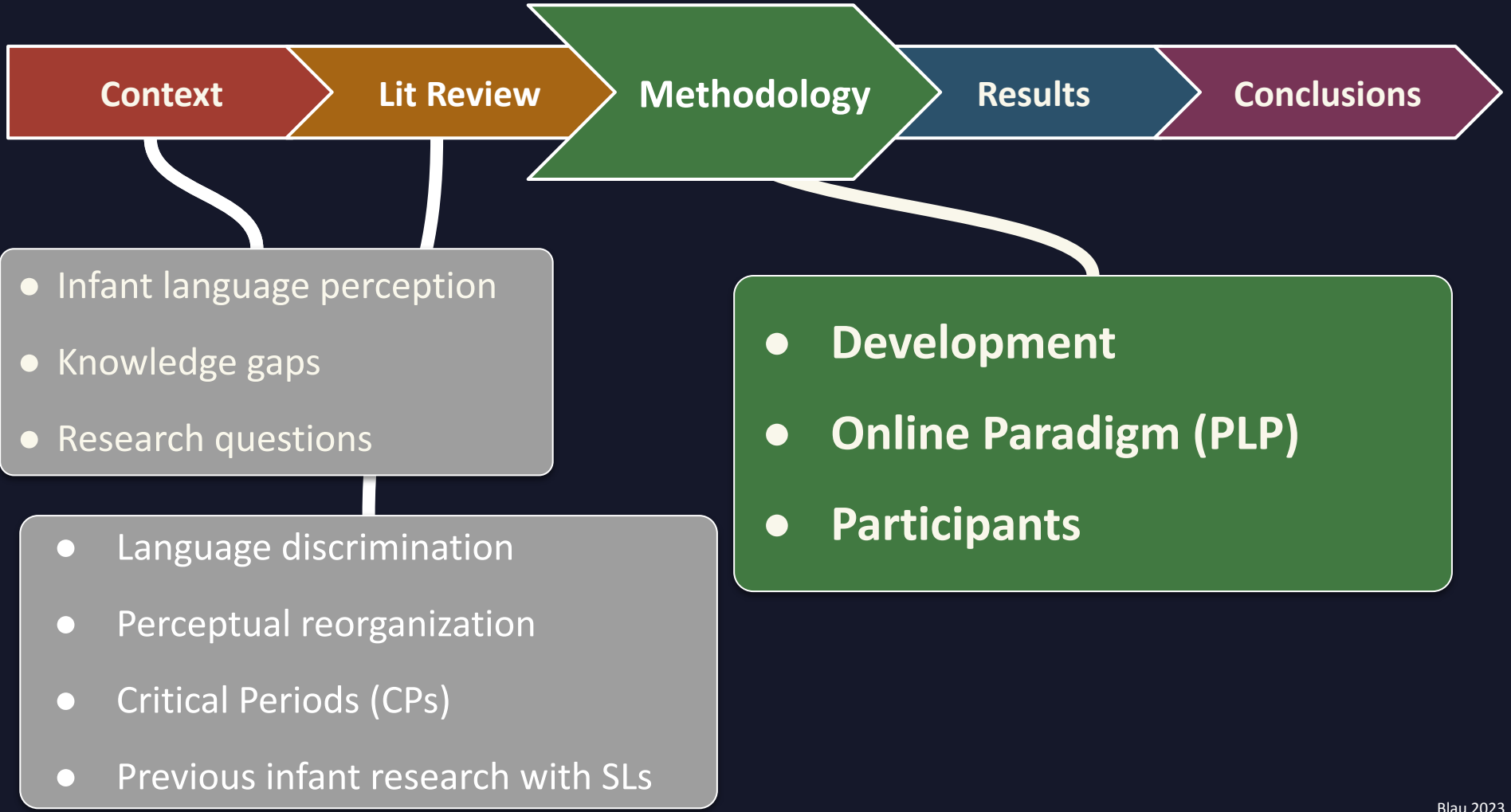
Nácar et al. (2017)	H 7-8 mo	JSL/BSL	Results: Infants could discriminate

Hearing infants attend to unknown signed languages.

Emmorey lab (SDSU)	Deaf adults	RSL/DGS	Results: Adults could discriminate (58% accuracy) with full video and body blur, not face blur

Deaf adults can discriminate RSL/DGS but not easily.

Face/mouth is important for discrimination in adults.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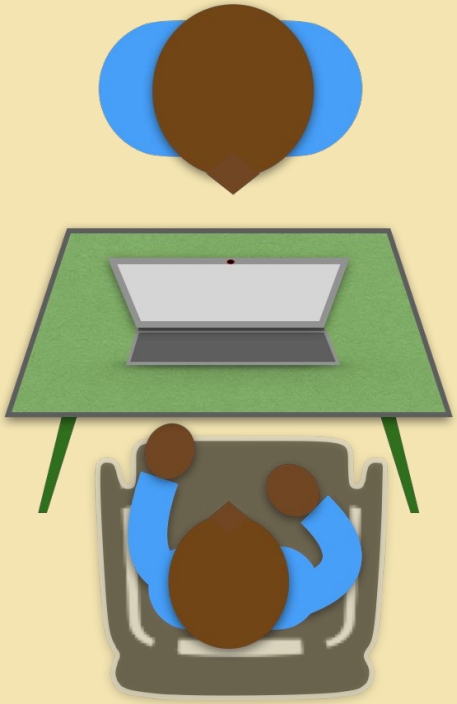
Novel Online Paradigm

Cons

1. Loss of control
2. Tech issues
3. SES bias



Pros

1. Familiar place
2. More locations
3. Low resource

Different Language Contrasts

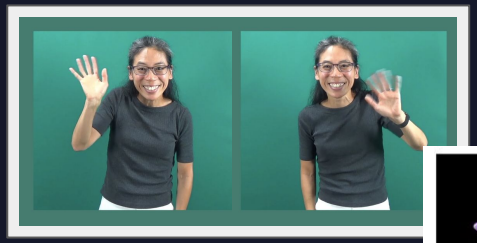
Discrimination & Preference

- Adult-directed
- Separate sentences
- Unknown to all infants

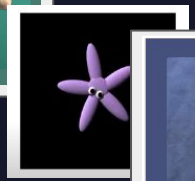
Preference

- Child-directed
- Prosodically intact passages
- Mixed familiarity

Video Presentation



1. Training



2. RSL/DGS

3. ASL/SEE

Attention-getter between each trial

(draws gaze to center)

Trials 10-12 seconds

Counterbalanced

Data Collection

Deaf (N=14) and hearing (N=29) infants ages 5-18 months

Mean # trials = 10

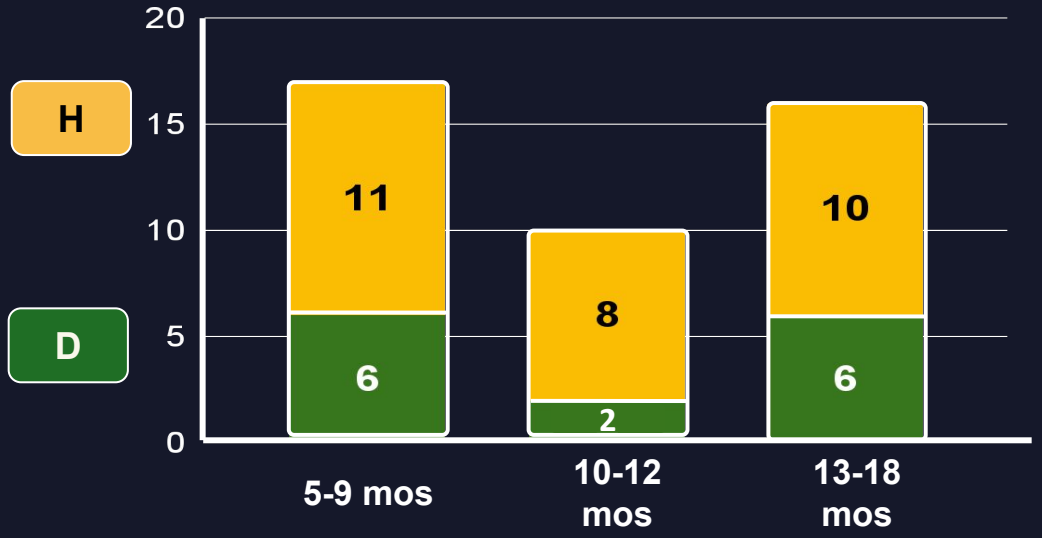
Mean # trials = 11

Stimuli Video Examples: ASL/SEE

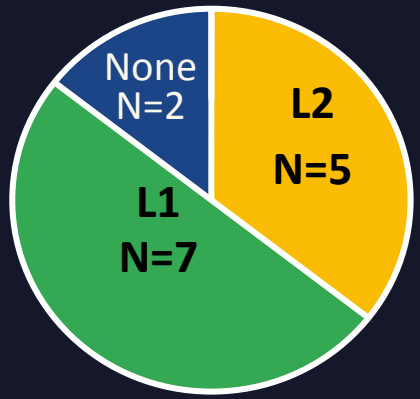
Deaf 9 month old infant watching DGS/RSL

Participants

Age Distribution



Family ASL Experience (Deaf Infants)



Predominantly white, middle-class families

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- Development
- Online Paradigm (PLP)
- Participants

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- Previous infant research with SLs

- **Stimuli video analysis**
- **Infant discrimination & preference**

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Prosodic Analysis of Stimuli Videos

100 consecutive words from each video* were analyzed

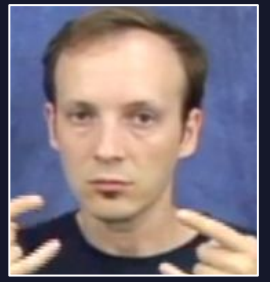
DGS **RSL** **ASL** **SEE**

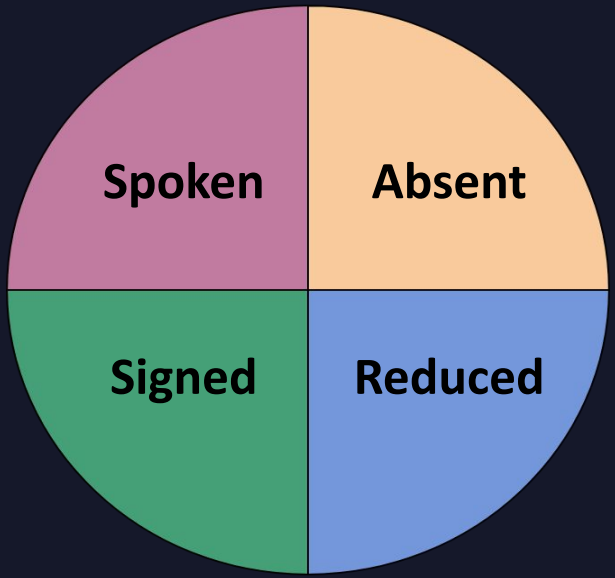
Samples showed many prosodic differences, including:

1. Intonational phrases (IPs)
2. Timing units
3. Mouth movements

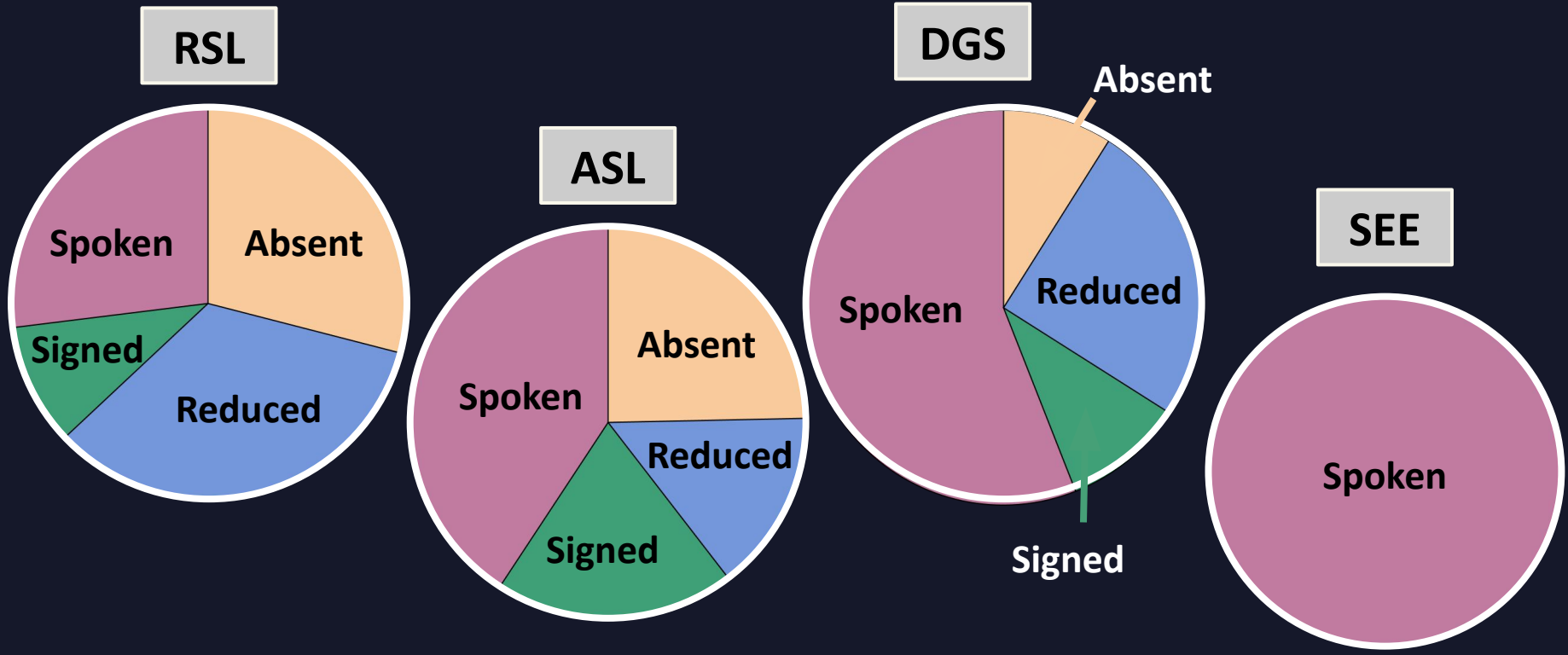
* Not representing the full range of language use

Mouth Movements

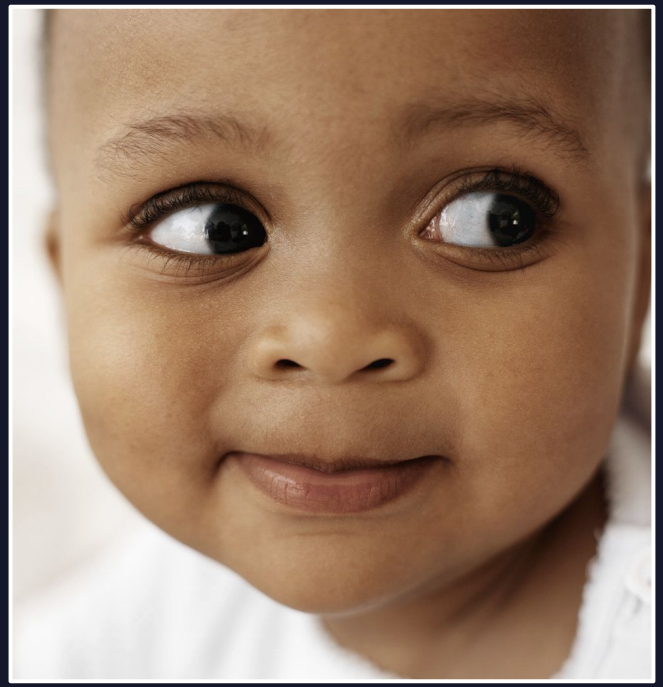




Mouth Movements

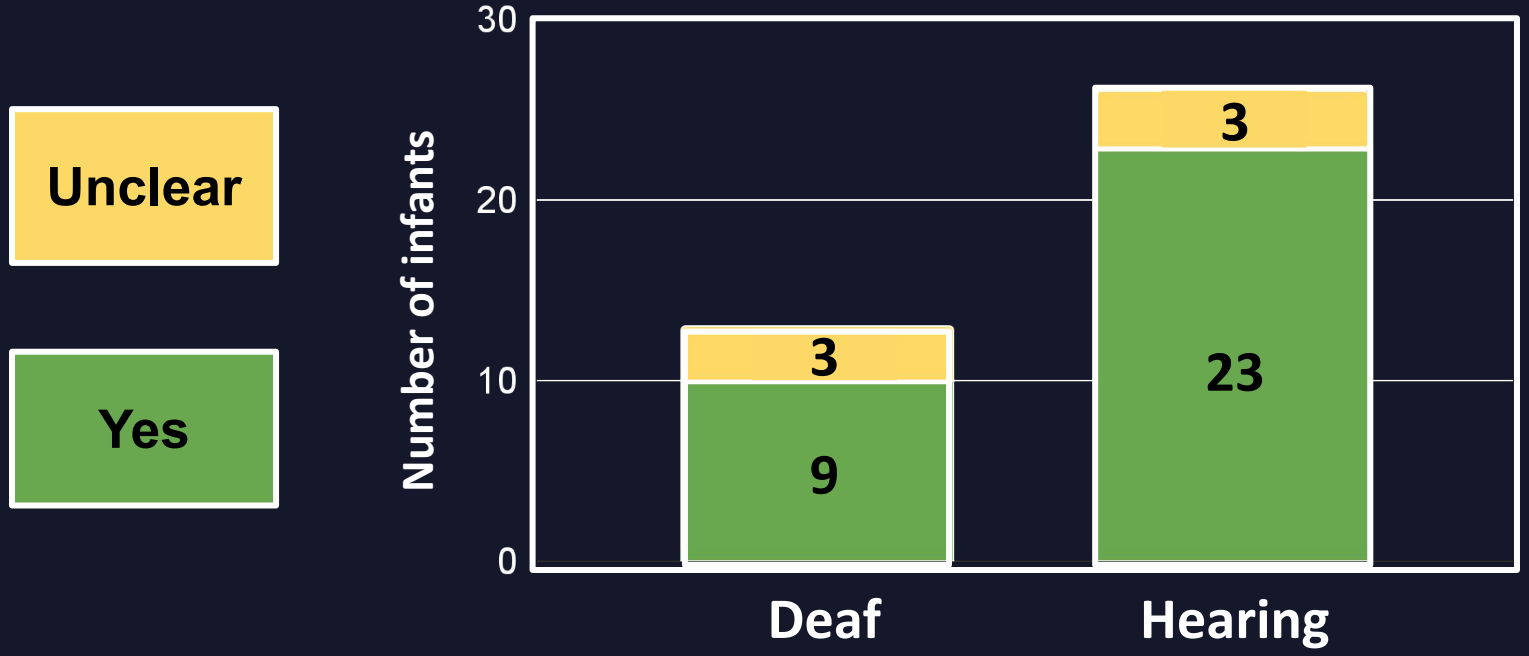


Infant Eye Gaze Results

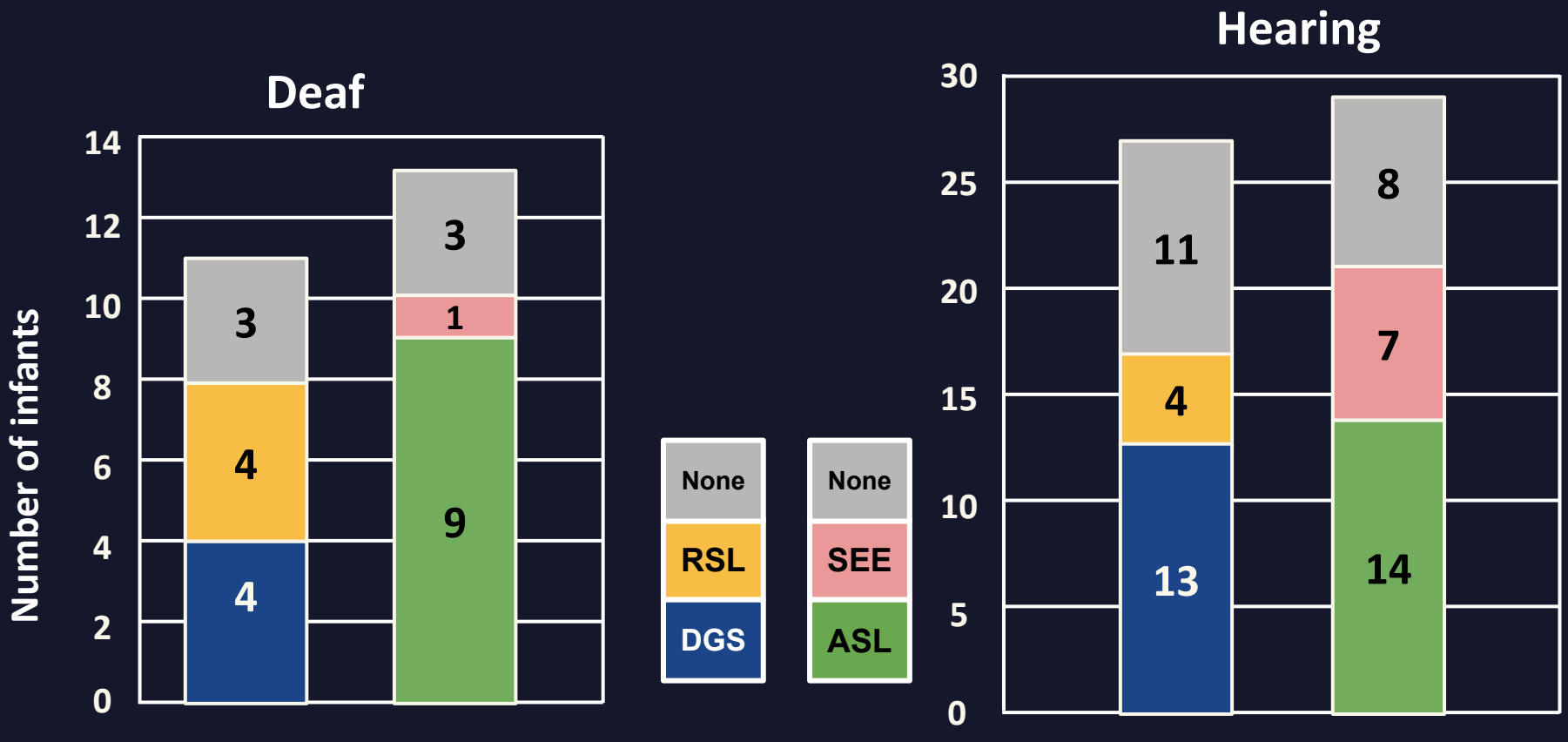


Discrimination of RSL/DGS

Determined by 5% longer looking time (LT) to one over the other



Preferences



Response to Research Questions

RQ1: Do infants discriminate between unknown signed languages?

Yes, deaf & hearing

RQ2: Do infants show a preference for a signed language over an invented system?

Yes, overall preference for ASL

RQ3: Do we see evidence of different sensitivities or preferences in deaf versus hearing infants?

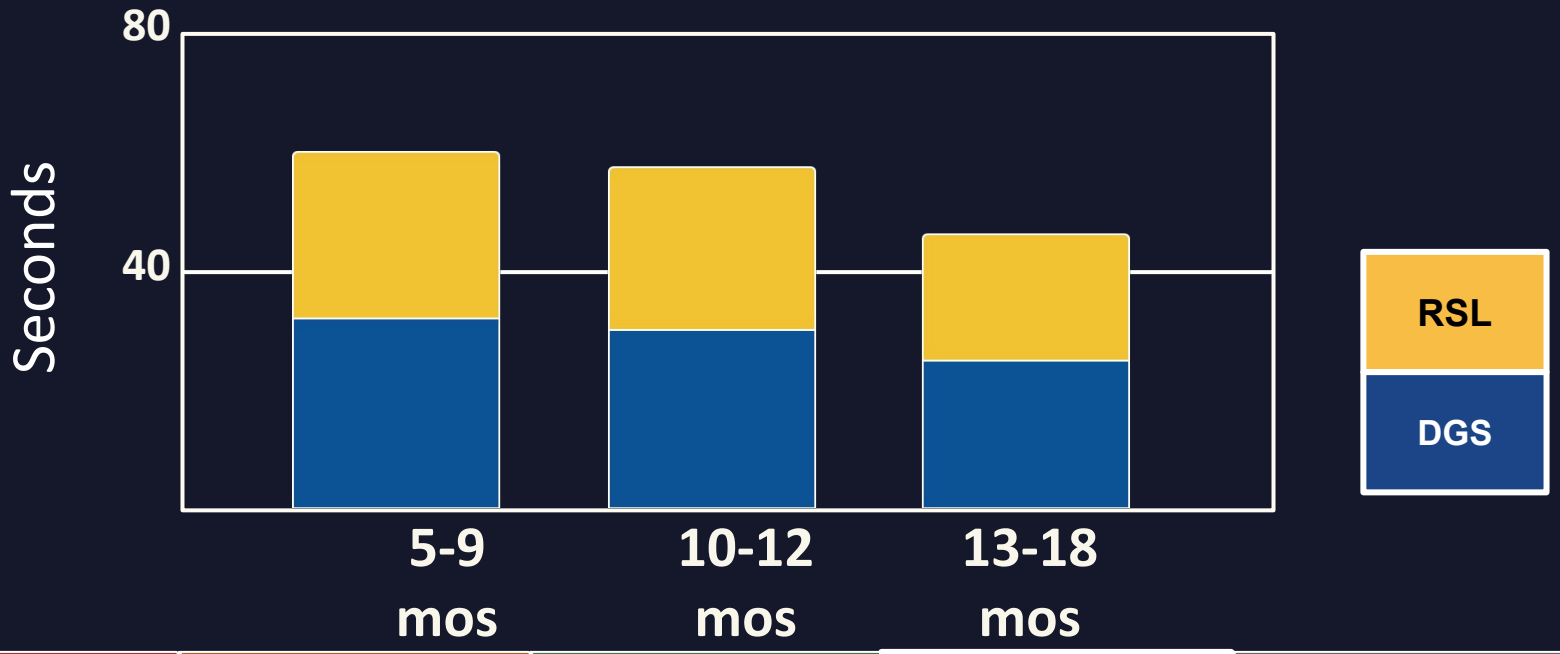
	Deaf	Hearing
DGS/RSL	Different preferences	DGS preference
ASL/SEE	ASL preference	Different preferences (more ASL)

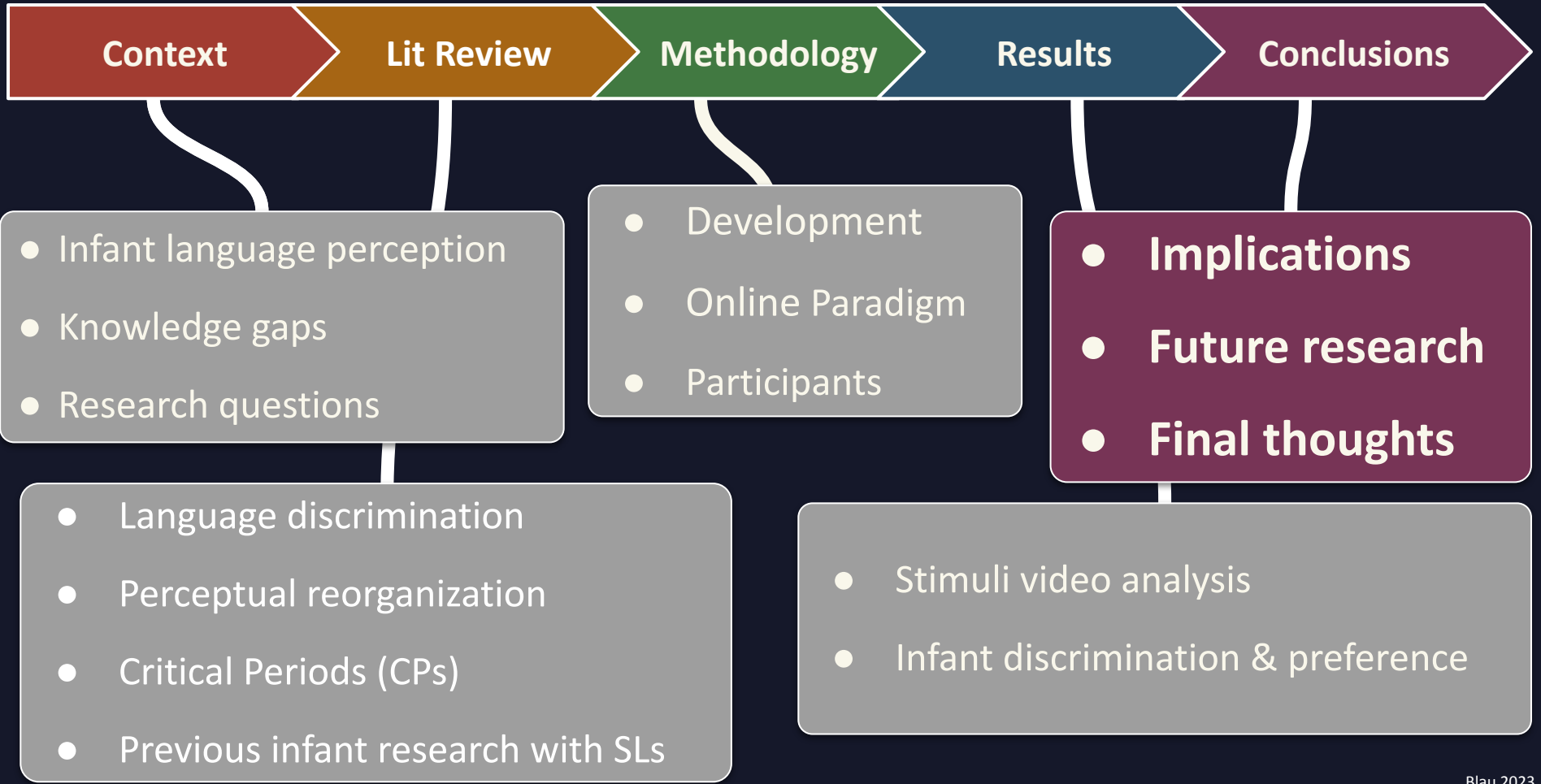
RQ4: What features do infants attend to in signed languages?

	Deaf	Hearing
DGS/RSL	Different preferences	More mouthing
ASL/SEE	Less mouthing	Different preferences
Possible explanation	**Other prosodic cues are more compelling than mouthed spoken language**	**Mouthing can drive a preference even if the spoken language is unknown**

RQ5: Do we see evidence of change in sensitivity at different ages?

Hearing Infants: Mean total time attending to DGS/RSL

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Future research
Final thoughts
Stimuli video analysis
Infant discrimination & preference

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Implications

Proof of concept:

1. Online visual paradigm was successful at gathering meaningful data
2. Deaf infants discriminated and showed preferences, indicating similar developmental trajectories as those seen in hearing infants

Supporting:

1. Signed languages are universally processed as linguistic input
2. Preferences may be affected by early experience

Limitations

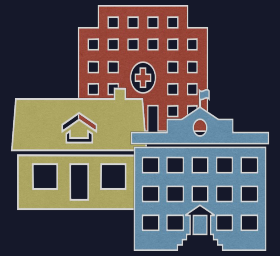
Future work

More infants & more language contrasts

International collaboration with D/deaf researchers

New tech to investigate contrastive features of signed languages

More about early experience



Images from https://vimeopro.com/mocaplab/mocaplab-and-sign-language-avatars/video/89629973 & https://signbank.cls.ru.nl/

Final Thoughts

1. CPs guide language acquisition even before birth, helping infants attend to relevant input at the right time.

2. Hearing babies are regularly exposed to accessible language from birth. Deaf babies are not.

3. Waiting until after spoken language interventions puts deaf children at risk of not receiving enough language input during foundational CPs. We do not know the full story but we see downstream effects.

Thank you Committee Members

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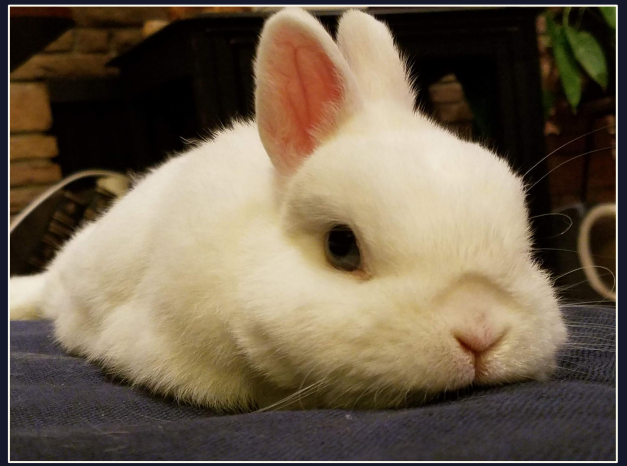
The End

And finally to Henry, my dissertation support rabbit, who has literally been by my side the whole way.



Selected References

*Included sign language stimuli

*Baker, S. A., Idsardi, W. J., Golinkoff, R. M., & Petitto, L. A. (2005). The perception of handshapes in American Sign Language. *Memory & Cognition*, 33(5), 887-904.

*Bosworth, R. G., Hwang, S. O., & Corina, D. P. (2022). Visual attention for linguistic and non-linguistic body actions in non-signing and native signing children. *Frontiers in Psychology*, 4977.

*Bosworth, R. G., & Stone, A. (2021). Rapid development of perceptual gaze control in hearing native signing Infants and children. *Developmental Science*, 24(4), e13086.

*Brentari, D., Gonzalez, C., Seidl, A., & Wilbur, R. B. (2011). Sensitivity to visual prosodic cues in signers and nonsigners. *Language and Speech,* (54), 49–72.

*Krentz, U. C., & Corina, D. P. (2008a). Preference for language in early infancy: the human language bias is not speech specific. *Developmental Science,* 11(1), 1–9.

Selected References

*Included sign language stimuli

Kuhl, P. K. (2007). Cracking the speech code: How infants learn language. *Acoustic Science and Technology*, 28(2), 71-83.

Johnson, R. E., & Liddell, S. K. (2011a). Toward a phonetic representation of signs: Sequentiality and contrast. *Sign Language Studies*, 11(2), 241-274.

*MacDonald, K., LaMarr, T., Corina, D., Marchman, V., & Fernald, A. (2018). Real-time lexical comprehension in young children learning American Sign Language. *Developmental Science*, *21*(6), e12672.

*Masataka, N. (1996). Perception of motherese in a signed language by 6-month-old deaf infants. *Developmental Psychology*, 32(5), 874.ogy, 34(2), 241.

*Masataka, N. (1998). Perception of motherese in Japanese sign language by 6-month-old hearing infants. *Developmental Psychology,* 34(2), 241.

Selected References

*Included sign language stimuli

*Nácar, L., Woll, B., Giezen, M.R., Adam, R., Werker, J., Emmorey, K., Sebastian-Galles, N. (no date). Can you see the difference? The bilingual advantage in visual language discrimination is not speech-specific. *Unpublished.*

Nazzi, T., Bertoncini, J., & Mehler, J. (1998). Language discrimination by newborns: Toward an understanding of the role of rhythm. *Journal of Experimental Psychology. Human Perception and Performance*, 24(3), 756–766.

*Novack, M. A., Brentari, D., Goldin-Meadow, S., & Waxman, S. (2021). Sign language, like spoken language, promotes object categorization in young hearing infants. *Cognition*, 215, 104845.

*Palmer, S. B., Fais, L., Golinkoff, R. M., & Werker, J. F. (2012). Perceptual narrowing of linguistic sign occurs in the 1st year of life. *Child Development*, 83(2), 543-553.

Selected References

*Included sign language stimuli

Singh, L. (2021). Evidence for an early novelty orientation in bilingual learners. *Child Development Perspectives*, 15(2), 110-116.

*Stone, A., Petitto, L. & Bosworth, R. (2017). Visual sonority modulates infants' attraction to sign language. *Language Learning and Development*, 1–19.

Werker, J. F., & Hensch, T. K. (2015). Critical periods in speech perception: New directions. *Annual Review of Psychology*, 66.

Family Resource Website

https://www.deafkidsandparents.com/

Contact me

shane.blau@gmail.com