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For both spoken and signed languages

Successful acquisition = Efficient pattern finding



Natural human languages are organized in complex patterns that infant brains recognize.



Linguistic patterns in bilingual input is complex, yet babies are equipped to manage them, as long as their input is good.



Even a modest delay in L1 exposure has a serious effect on how efficiently a deaf person can process linguistic patterns.



It's possible to enrich quality of sign language input, even for deaf children whose parents are new signers.

GENERAL OBSERVATION 1



Natural human languages are organized in complex patterns that infant brains recognize, long before they are speaking or signing.

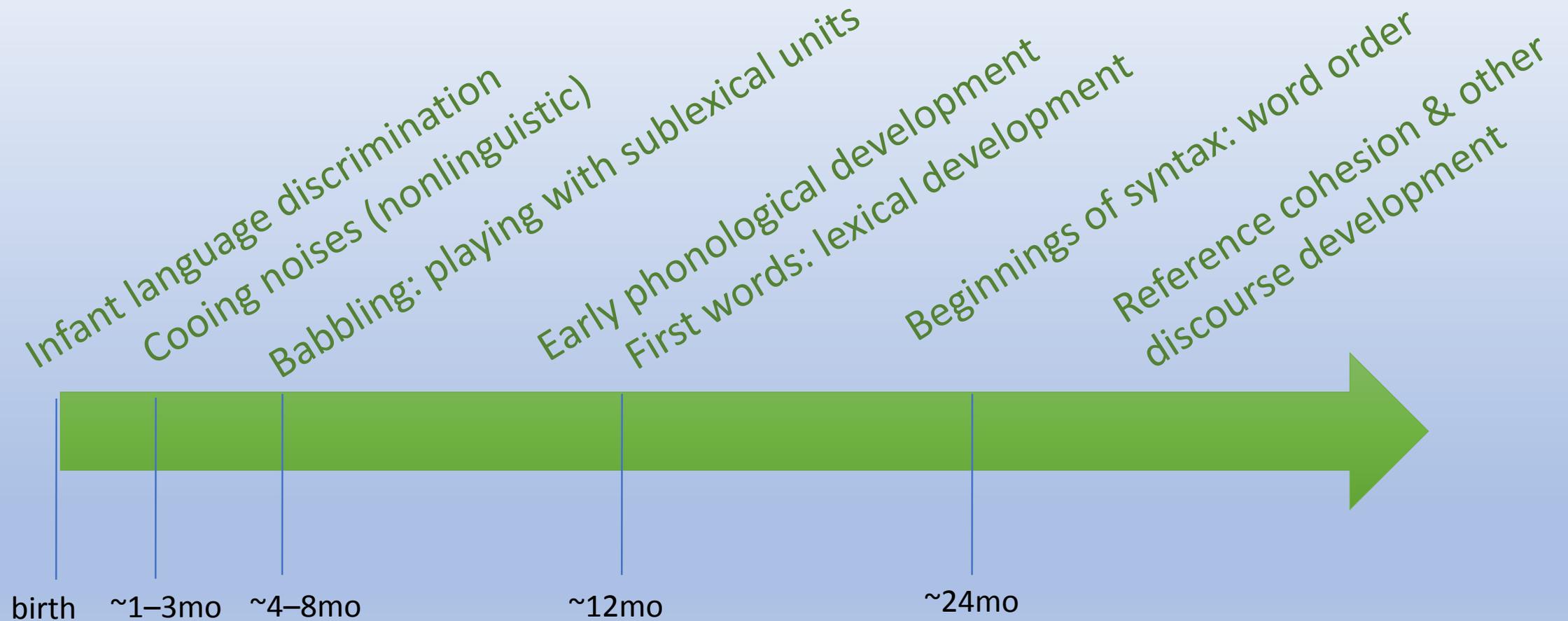
Different levels of language (simplified)



Linguists often talk about language at different levels. These are the five we will deal with today.

Rough Milestones for L1 Acquisition

Strikingly similar for signed and spoken languages



Babies as pattern seekers

Example: Segmenting the speech stream

Hearing babies use various linguistic cues to break the speech stream into smaller chunks.



Don't break my glasses, Lea!

English does not start words with clusters t+b or k+m.
(phonotactic cues)

Intonation drop and pause at end of phrase (prosodic cues)

Child's name or other familiar words (lexical cues)

What do babies know about visual prosody?

Brentari et al. (2010)

Familiarization phrase: Hearing 9-month olds watched repeated video of a woman signing a string of words produced as either:

- a) a single prosodic phrase
[GREEN VEGETABLES RABBITS EAT THEM] or
- b) two separate prosodic phrases
[GREEN VEGETABLES] [RABBITS EAT THEM]



What do babies know about visual prosody?

Brentari et al. (2010)

Experimental phrase:

Baby sees a two signed statements. Both include the familiar string of words, but only one groups the words together in the same prosodic pattern as the Familiarization phase.

FOOD WITH COLOR MANY
ANIMALS PREFER. [GREEN
VEGETABLES RABBITS EAT THEM].
TASTE-SO-GOOD. WOW!

FATHER'S GARDEN HAVE MANY
GREEN VEGETABLES] [RABBITS
EAT THEM TASTE-SO-GOOD.
WOW!

What do babies know about visual prosody?

Brentari et al. (2010)

“...sensitivity to the cues relevant to sign language ...is not language-specific [and] may persist until infants are 9 months old when infants are not in a signing environment.”



Diane Brentari

GENERAL OBSERVATION 2

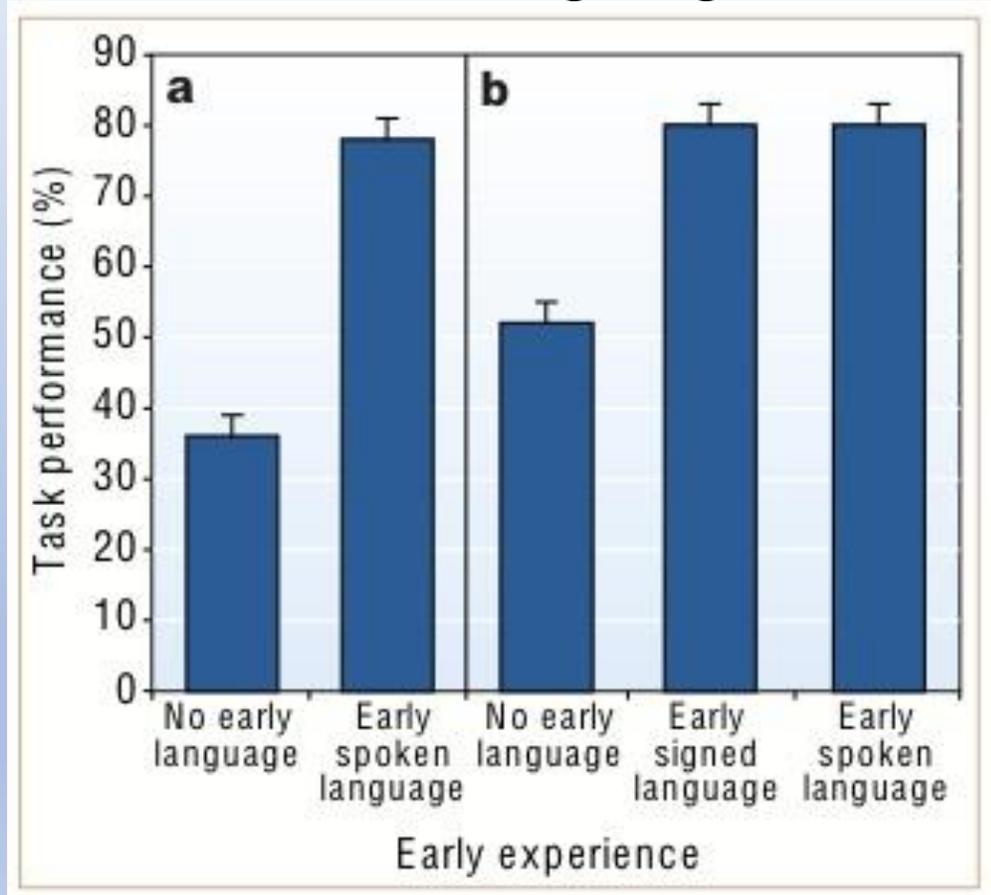


Even a modest delay in first language exposure has a serious effect on how efficiently a deaf person can process linguistic patterns.

Late exposure affects both L1 ASL and L2 English

Mayberry et al. (2002); Mayberry (1993); Mayberry & Lock (1998)

ASL recall test English grammar test



- a. Late-deafened adults performed better repeating complex ASL sentences than late-exposed (L2) Deaf (all 20+ years of ASL experience)
 - b. Both native Deaf and hearing immigrant L2 scored higher than late-exposed Deaf on grammaticality judgment of complex English (12+ years experience)
- Early L1 (signed or spoken) is crucial for successful L2 learning.

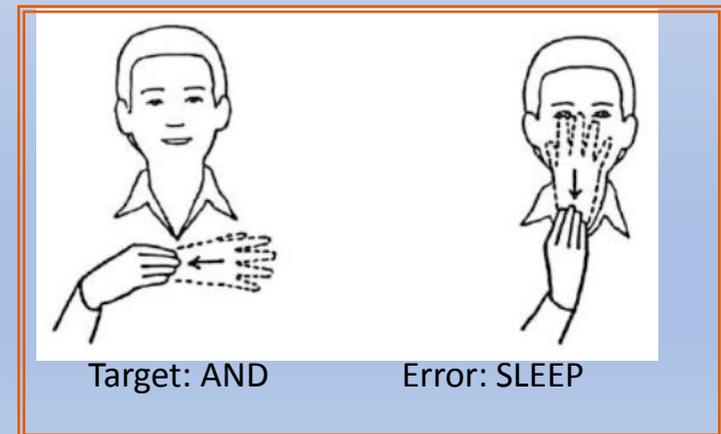
Late exposure slows down sign processing

Mayberry & Eichen 1991; Mayberry 1993

Accuracy in ASL shadowing task

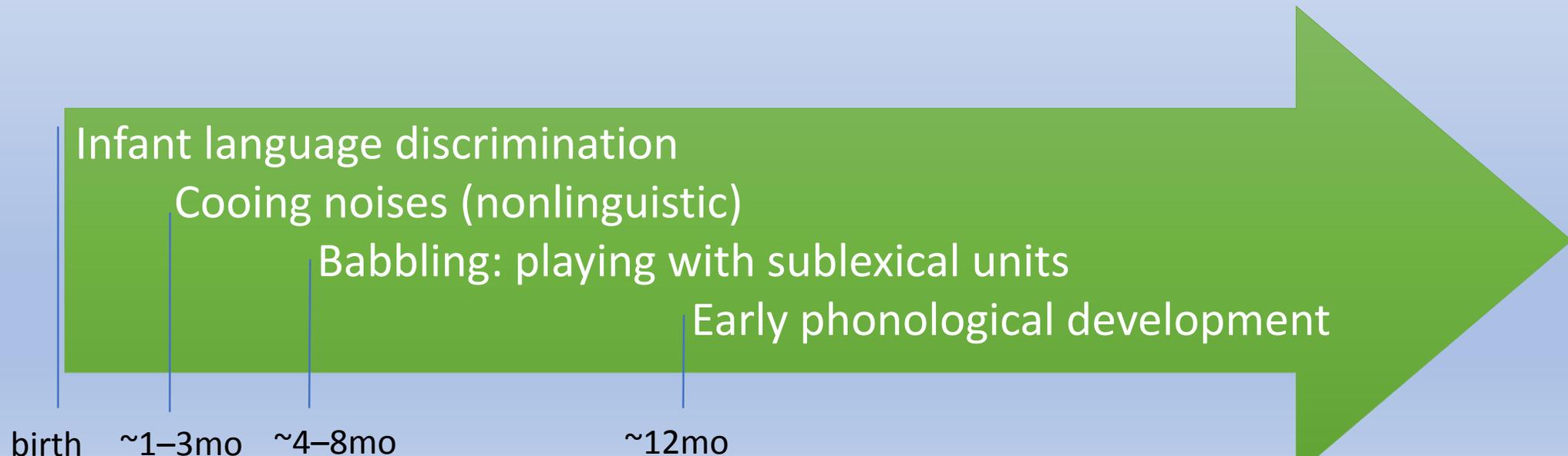
Signers watched another signer on video and tried to immediately copy signer as quickly and accurately as possible. Everyone made errors, but:

- Early/native signers had fewer omissions and substitutions overall
- Late learners substituted based on phonological similarities (AND vs. SLEEP) rather than grammatical or semantic appropriateness (OLD vs. NEW)
- Error patterns suggest that when under stress, late-exposed signers get “stuck” processing at superficial phonological level.



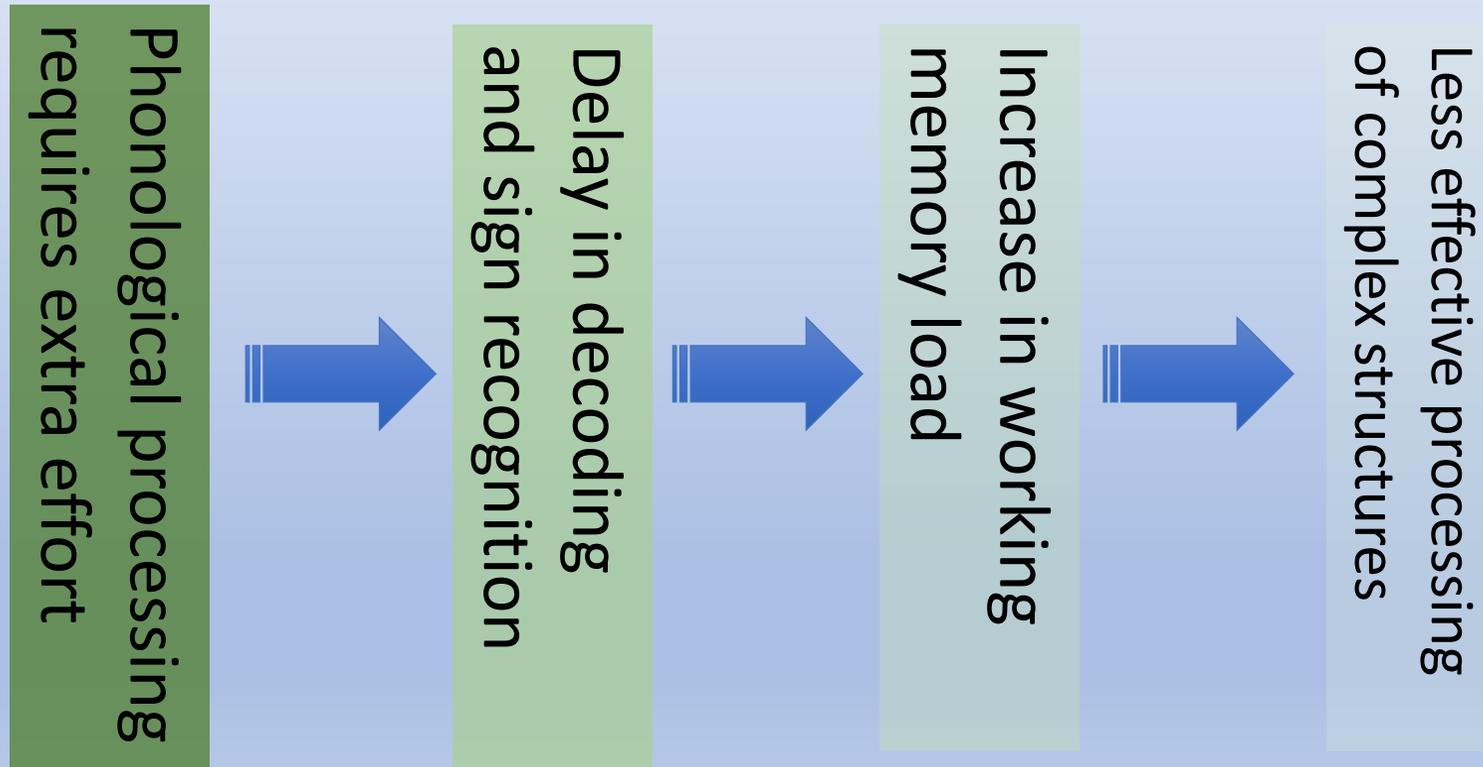
What's at the source of these performance differences?

Morford and Mayberry (2000) suggest that the critical period effects observed for late-exposed Deaf signers reveal a **weak or incomplete phonological foundation.**



Domino effect of weak phonological development

A weak and/or incomplete phonological foundation has cascading effects on other levels of language processing.



Countering a pervasive myth: Early exposure is critical for acquisition of ANY language.

For spoken language, it's very important to train and give the child exposure to language as soon as possible; but, for sign languages, we have a lot more time, we can afford a delay.

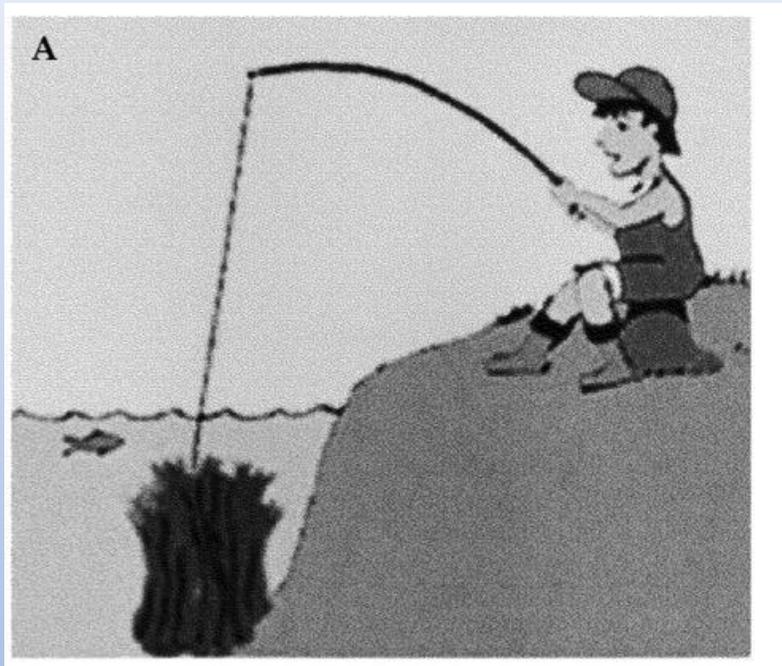
NOT TRUE. Babies need early exposure to an accessible L1, no matter what the modality.

Early language exposure supports normal cognitive development also.

- **The False Belief component of Theory of Mind (ToM)**
 - Refers to the ability of a person to understand that others may have beliefs and perspectives that differ from his/her own.
 - Typically develops by around 4 years of age.
- Many studies report delays in ToM development for deaf children. But these studies tested deaf children from hearing families.
- Woolfe et al. (2002) tested both native and late-exposed BSL children (2-4 years old).

Testing Theory of Mind in sign language

Fisherman test (Woolfe et al. 2002)



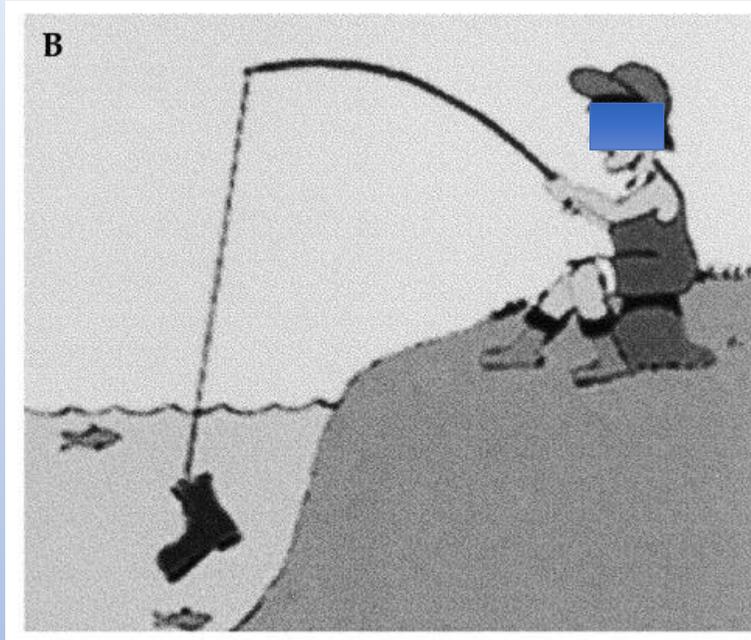
Step 1. "Describe picture (A)"

A man is fishing.



Testing Theory of Mind in sign language

Fisherman test (Woolfe et al. 2002)



Step 2. “Cover the fisherman’s eyes with your hand. Now remove the object blocking the end of the fishing line. What has the man caught?”

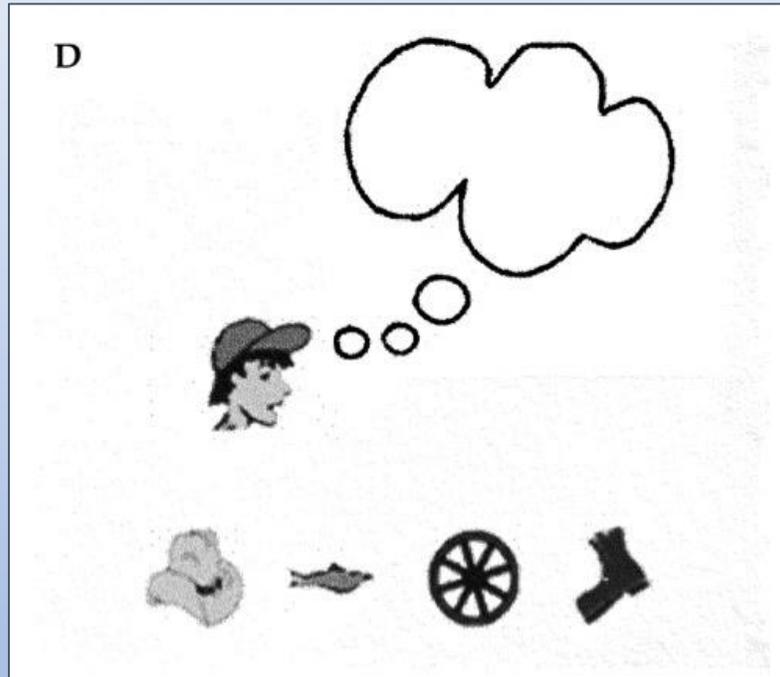


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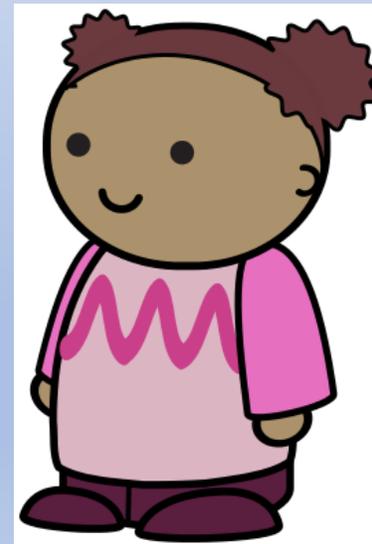
He has caught
an old boot.

Testing Theory of Mind in sign language

Fisherman test (Woolfe et al. 2002)



Step 3. “Which of these items does the man *think* he has caught?”



A fish.
(child has ToM)

A boot.
(child lacks ToM)

Optimizing child's development of ToM

Morgan, Meristo and Hjelmquist (to appear); Morgan et al. (2014)

- ToM development is tied to language development, triggered by exposure to:
 - talk about other people's mental states, what people *think* and *know*
 - talk about past events, removed from here & now
- Deaf children need rich conversations to support ToM development.
 - Morgan et al. (2014) hearing controls received 2-5% exposure to cognitive mental states in parent sample. Deaf children received less. But even a small increase could make a big difference!

GENERAL OBSERVATION 3



Linguistic patterns in bilingual input is complex, yet babies are equipped to manage them, as long as their input is good.

Another dangerous myth: Sign language does NOT obstruct CI effectiveness

“...children who solely utilize listening and spoken language, rather than a combination of this with ASL, demonstrate better listening and spoken language skills...”

-- Meredith Sugar

NOT TRUE. Babies need early exposure to an accessible L1, no matter what the modality.

Bimodal Bilingual Grant Project

Lillo-Martin, Chen Pichler & Quadros
(bibibi.uconn.edu)



What constitutes “sign” exposure in the traditional cochlear implant studies? (Fitzpatrick et al. 2017)

Study	Type of “sign” exposure
Miyamoto et al. (1999)	Total Communication
Robins et al. (1999)	Total Communication
Osberger et al. (1999)	Total Communication
Kirk et al. (2000)	Total Communication
Kirk et al. (2002)	Total Communication
Janjua et al. (2002)	Optional weekly BSL activities
Nicholas & Geers (2003)	Simultaneous Communication
Connor & Zwolan (2004)	Total Communication
Jiménez et al. (2009)	“bilingual spoken + sign language,” but no description
Nittrouer (2010)	Baby signs from SEE and ASL
Percy-Smith et al. (2010)	“spoken + sign”, no description

Where are the children with *true* bilingual input in two natural languages?

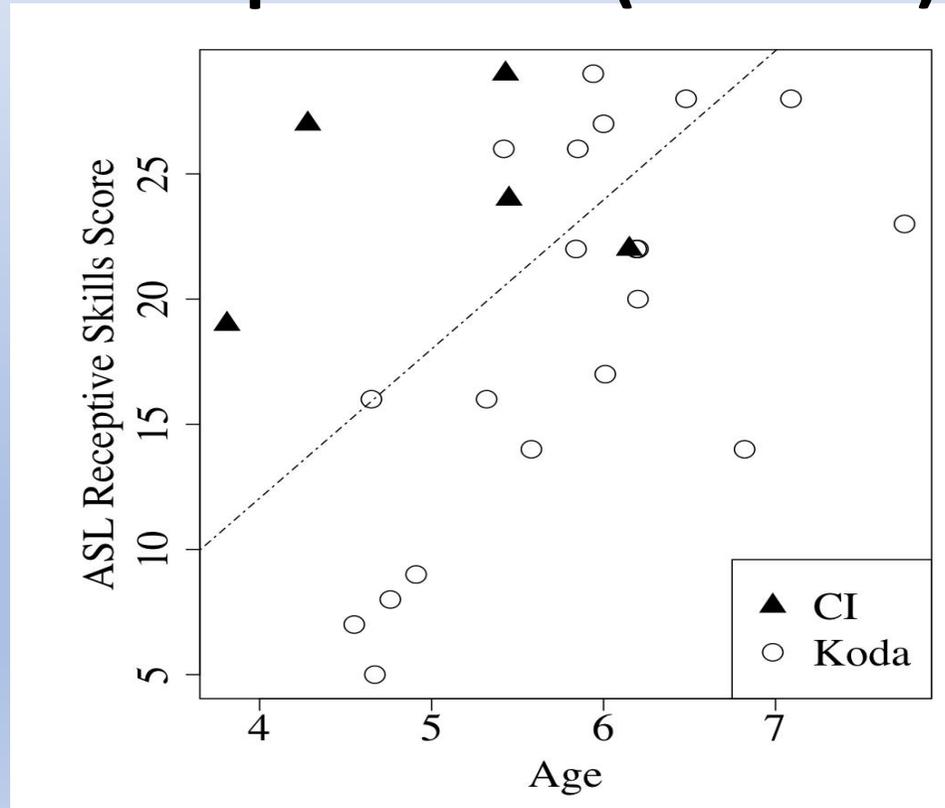
Davidson et al. (2014) participants

	Participant	Age of first English testing	Age at first implant	Years since CI	Mother's Education (level)
Native signers with CIs	PAM	4;00	2;11	1;01	College
	NIK	5;05	1;04	4;01	College
	GIA	5;07	1;06	4;01	College+
	FIN	5;08	1;07	4;01	College+
	MAX	6;04	1;08	4;08	College
Hearing native signers ("kodas") n=20	Mean	6;00	N/A	N/A	College
	Range	4;09-8;02	N/A	N/A	12-21 yrs
Non-signers with CIs	As reported in previous literature				

ASL Receptive Skills: Results

Davidson et al. (2014); Palmer (2015); Enns & Herman (2009, 2011)

- **All the DDCI and most Kodas scored near or above the published (normed) means for Deaf children.**



- Comprehend ASL at or above the level of native Deaf children without CI
- Bilingualism with English does not prevent ASL development.

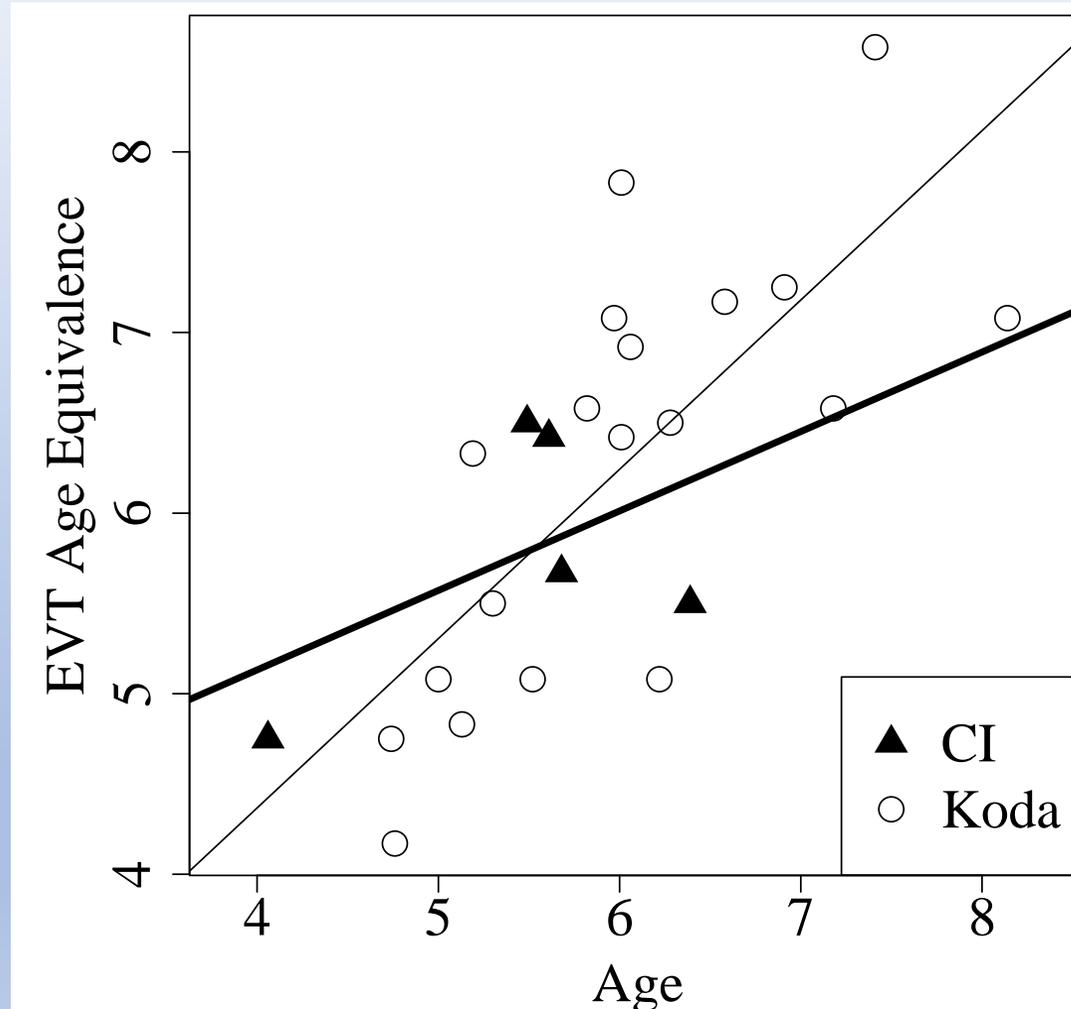
Preschool Language Scales: Predicted standard scores by age of implantation

Participant	Age at implant (months)	Predicted Score EC	Actual Score EC	Predicted Score AC	Actual Score AC
PAM	35	60		68	
NIK	16	89		93	
GIA	18	83		88	
FIN	19	80		86	
MAX	20	77		85	

Predicted scores based off combination of children's age of implantation and years of language use, data from 188 participants (Nicolas and Geers 2008)

Expressive Vocabulary (EVT)

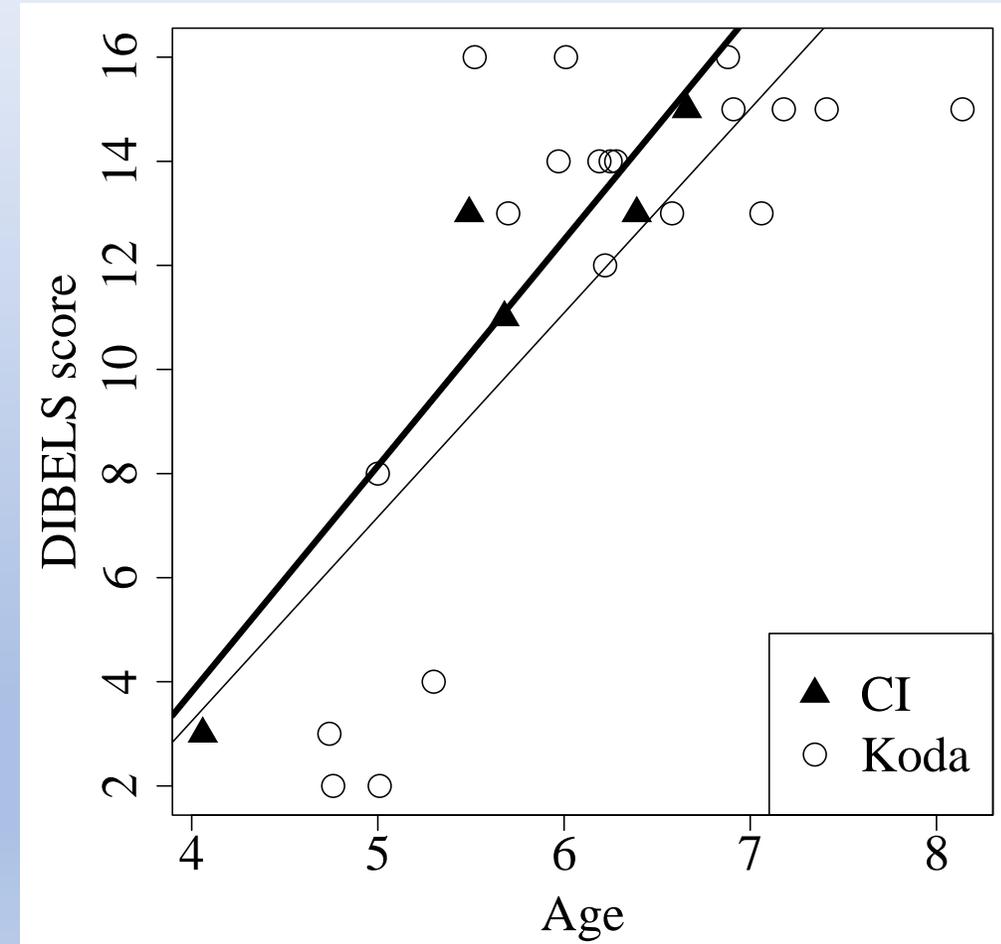
Davidson et al. (2014)



Both Kodas and DDCI scored similarly to monolingual English peers, **at or above scores published for oral deaf children with CIs (Geren & Snedeker 2009; Geers et al. 2009) → early ASL does NOT impede English vocabulary development.**

Dynamic Indicators of Early Literacy Skills (DIBELS): Phonological awareness Davidson et al. (2014)

- Measures early literacy and early reading skills; short tests on key skills (phonemic awareness, reading comp, vocabulary)
- Kodas and DDCl very similar on this test.



Articulation: Goldman-Fristoe

Davidson et al. (2014)

- Tests ability to produce various sounds of English; most widely used test for speech pathology
- Previous studies of children with CI showed fairly poor scores for both children in oral and TC school programs (Spencer & Guo 2013): only 50-65% in normal range.

Participant	Age	GFTA Standard Score
NIK	5;05	109
GIA	5;07	112
FIN	5;08	100
MAX	6;04	102

All four DDCl that we tested scored in the normal range, and were 1 standard deviation above or below the Koda mean

Index of Productive Syntax (IPSyn)

Davidson et al. (2014)

- Measures syntactic complexity based on a sample of child's natural speech
- Previous reports of deaf children with CI (Geers 2004)
 - Implanted <2;0: 53% scored above 75
 - Implanted <3;0: 48% scored above 75
- **All 4 DDCI that we tested scored above 75**

Participant	Age	IPSyn Score
PAM	4;00	93
NIK	5;04	83
GIA	5;07	83
FIN	5;08	76

Important take-home messages

Davidson et al. (2015)

1

On all of the English measures, DDCI performed within the typical range for hearing children

2

DDCI English is developing normally. there is no evidence that ASL is hindering that development.

3

DDCI consistently score higher on these English tests than previously reported oral Deaf children with CI

4

No evidence that ASL exposure obstructed English development for these CI users.

Other recent studies reporting successful spoken language development for DDCI

- Rinaldi & Caselli (2009; Italy)
- Rinaldi & Casello (2014; Italy)
- Hassanzadeh (2012; Iran)
- Giezen (2011; Netherlands)
- Giezen, Baker & Escudero (2014; Netherlands)
- Mouvet (2012; Flanders/Belgium)
- Quadros, Cruz & Pizzio (2012; Brazil)

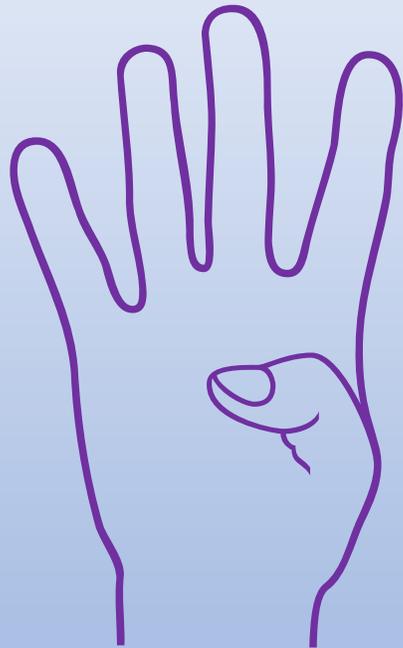
Early exposure to natural sign language can help avoid dangerous effects of language deprivation, supporting L1 acquisition before cochlear implantation.

Deaf children with cochlear implants: Challenge to the traditional view

“....[Signed] input should not be withheld from children with a CI, especially given its importance in stimulating early social and cognitive development, in the case of implant malfunctioning and in facilitating interactions with deaf peers without a CI. In fact, this speaks for bilingualism in a spoken and a signed language as the ultimate goal in the rehabilitation and education of children with a CI.” (Marcel Giezen, 2011)



GENERAL OBSERVATION 4



It's possible to enrich the quality of sign language input, even for deaf children whose parents are new signers.

Child-directed speech/sign (CDS)

- CDS is a modified style of speaking or signing that tells baby, “This talk is for you.”
- Use of CDS varies according to language, culture, social class or personal preference.
- It is not *required* for successful L1 acquisition, but it makes language more attractive and accessible to infants, which clearly facilitates L1 acquisition.



Structure of child-directed sign (CDS)

Masataka (2000); Holzrichter & Meier (2000)

- Child-directed signing by Deaf mothers preferred by infants over adult-directed signing from as early as 2 days old
 - emphasizes prosodic patterns of the language
 - wide angles of articulation (proximalization)
 - slow and repetitive signing
 - Exaggerated nonmanuals
- Includes signing modifications that
 - increase perceptual salience (increased cycles; displacing signs into child's sight line, often at face)
 - Regularize input (favored signs with clear path movement for DOG and MOTHER).

Child-directed sign for social development

- CDS also facilitates infant's development of *social* aspects of language:
 - actively involve babies in “dialogues,” even before baby can produce or understand much
 - lays foundation for turn-taking behavior
 - focuses on *joint-attention*

Joint attention



Joint attention involves following the eye gaze or pointing gestures of interlocutor.

- Joint-attention is a state in which parent and child share the same object as focus of attention, which is important for word learning.
- Hearing child can look at object while parent provides label verbally, but **deaf child must shift focus between parent and object.** If timing is off, deaf child will not see signed label.

Importance of timing of joint attention for a deaf child

- In ASL, as in spoken language, periods of joint attention are prime moments for children to learn new vocabulary (Pizer et al. 2008)
 - During joint attention periods, parents sign more, and make more CDS modifications to their signing
- Older studies report that hearing parents are less effective in using joint attention with deaf children (Kyle, Ackerman and Woll 1987; Waxman & Spencer 1997) but those parents likely were not very proficient in a natural sign language.

Quality input is key for successful acquisition



- Quality input is:
 - EARLY; as soon as possible. Even a year of language deprivation is already too long!
 - NATURAL LANGUAGE; displaying the organization patterns of human language.
 - OPTIMIZED; making effective use of joint attention and child-directed language, with opportunities for rich conversation.
- Research on optimized sign practices and L2 sign acquisition must inform hearing parents as they learn ASL to provide quality input for their deaf children.

Quick summary

- All natural human languages, signed or spoken, are full of complex but systematic patterns.
- Babies' brains automatically seek out linguistic patterns, then form rules based on them.
- Babies can extract prosodic and phonological patterns very early in infancy, but they need good language input to do this.
- A weak phonological foundation impairs pattern-finding at higher levels of language, leading to less efficient language processing overall.
- Linguistic patterns in bilingual input may seem complex, but babies' brains are up to the task.
- **Optimal language input is crucial for successful language acquisition!**

Thank you!

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Joint attention, Theory of Mind, parental signing

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