


Sign and Spoken Language Interface: Applied Brain Language Research



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Northeastern University
M.A. & Ph.D., Developmental Psychology/ Cognitive
Sciences & the Neurobiology of Language: *University of Connecticut*

Research Questions:

- How do children influence the language they learn?
- What aspects of the human experience require having a language? What aspects do not?

Jessica Contreras



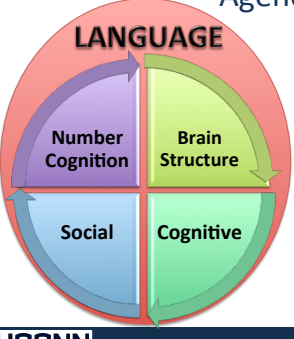
B.S., & M.S. Experimental Psychology: *Rochester Institute of Technology*
2nd year Ph.D., Developmental Psychology/ Cognitive Sciences &
Neurobiology of Language: *University of Connecticut*

Research Questions:

- Does early language experience shape cognitive development?
 - Sign Language
 - Spoken and Sign Language (Bilingualism)
 - 2 Signed Languages (Bilingualism)
 - 2 Spoken Languages (Bilingualism)




Agenda



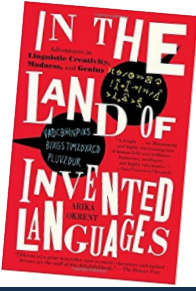
- What is Language?
- Physical Structure
- Cognitive Abilities
- Social Abilities
- Number Cognition
- Questions / Discussion

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What do we mean by Language?

- I. Emerge *spontaneously and organically* by a community of people
- II. Cohesive grammar at all levels
Words/signs -> sentences -> dialogue
- III. Acquired easily by children

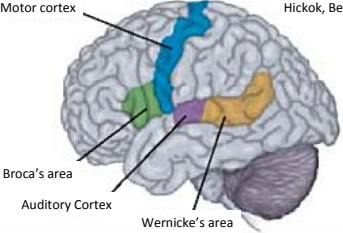


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1. Defining Language

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Language Areas of the Brain:



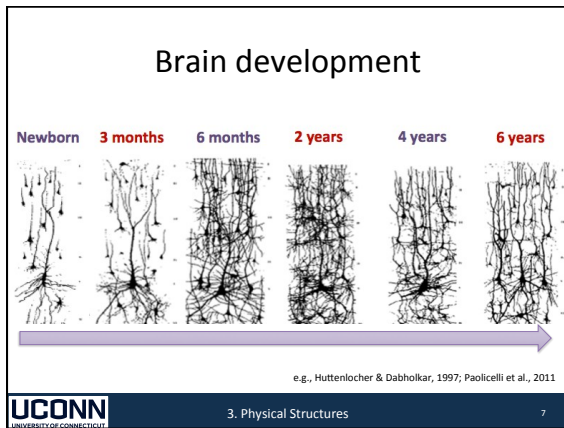
Hickok, Bellugi & Klima, 2001

All languages (spoken or signed) are processed in the same places

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3. Physical Structures

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Physical: Brain Structure

In *all* children:

- *Pruning* begins at about 2 years of age
- Related to the *Critical Period Hypothesis*

Deaf individuals with little to no language exposure show less *physical* brain growth (**smaller brain volume**) as compared to those who had language

Lenneberg, 1967; Pénicaud et al. 2013

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3. Physical Structures

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Bilingual Advantage

Bialystok, 2011; Bialystok & Martin, 2004

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4. Cognitive Abilities

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Executive Function

Complex set of integral processes that are developed throughout one's life and are shaped by experience.

EF is important for learning and behavioral regulation.

1. Inhibition
2. Working Memory
3. Cognitive Flexibility



Diamond, 2013



4. Cognitive Abilities

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EF Processes

Inhibition

Working
Memory

Cognitive
Flexibility



4. Cognitive Abilities

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EF Model

Higher-Level Executive Functions

Reasoning

Problem
Solving

Planning

Inhibition

Working
Memory

Cognitive
Flexibility

Adapted from Diamond, 2013

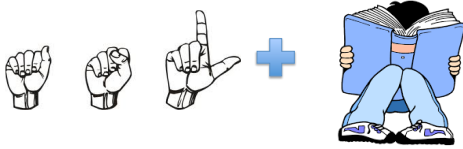


4. Cognitive Abilities

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Research Question

Is there a bilingualism advantage for deaf individuals who are fluent in American Sign Language and English?



Hauser, P.C. & Contreras, J. In Progress

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Language Assessments



Peabody Individual
Achievement Test-Revised

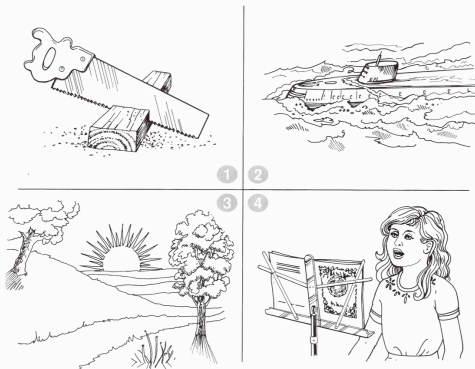


American Sign Language-
Sentence Reproduction Test

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4. Cognitive Abilities

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Groups				
✓ ASL	Top 50%	}	"ASL-English" Group <i>ASL-English Bilinguals</i>	
✓ English	Top 50%			
✓ ASL	Top 50%	}	"ASL" Group <i>ASL-dominant</i>	
✗ English	Bottom 50%			
✗ ASL	Bottom 50%	}	"English" Group <i>English-dominant</i>	
✓ English	Top 50%			

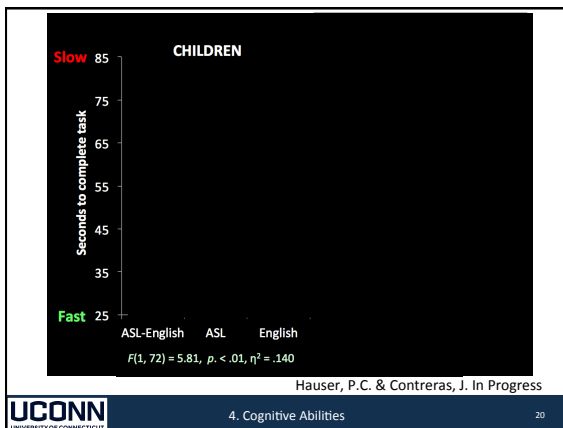
Participants				
Groups	ASL	English	Deaf Children n= 78	Deaf Adults n= 36
ASL-English	✓	✓	33	13
ASL	✓	✗	16	16
English	✗	✓	29	7

Executive Function Task

Trail 1

Trail 2

4. Cognitive Abilities
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Impact of Executive Function Development

Diamond, 2013

4. Cognitive Abilities
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Social Abilities



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4. Social Abilities

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Socio-Cognitive Abilities

Understanding that someone can have a
False Belief



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4. Social Abilities

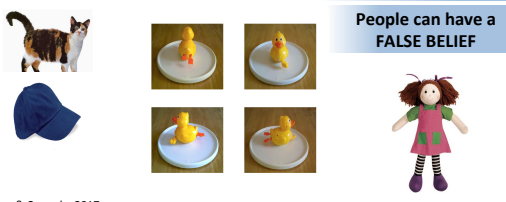
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The Trajectory of Social Cognition

2 years 4 years 5 years

WHAT do others see? HOW do others see it? The world **CHANGES**

People can have a
FALSE BELIEF



Gagne & Coppola, 2017

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4. Social Abilities

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The Trajectory of Social Cognition

2 years 4 years 5 years →

WHAT do others see? **HOW** do others see it? The world **CHANGES**

Others' FALSE BELIEFS

	WHAT	HOW	CHANGES	False Belief
Spanish Speakers	✓	✓	✓	✓
Deaf - NSL	✓	✓	✓	✓
Deaf Homesigners	✓	✓	✓	✗


Gagne & Coppola, 2017

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4. Social Abilities 25

Numerical Cognition

What do babies know about numbers?



Few



Many


Xu & Spelke, 2000

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5. Number Cognition 26

Counting

Can babies count?




Not when differences are small

Xu & Spelke, 2000

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5. Number Cognition 27

Research Questions

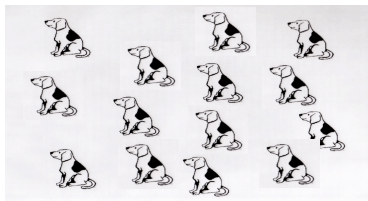
1. Can deaf adult homesigners not exposed to any formal language count?
2. Can deaf adult homesigners use their fingers as a count system?

Tactile Matching Task



http://youtu.be/FvARCP_l65M
Spaepen et al. 2011

Target	4	1
Response	5	1



What's On this Card?



Target	14	2
Response	12	2

http://youtu.be/r_caetYLxkE
Spaepen et al. 2011



5. Number Cognition

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Research Questions

1. Can Adult homesigners not exposed to any formal language count? **NO**

Language provides a system for counting.

2. Can Adult homesigners use their fingers to count? **NO**

Fingers are not representation of numbers, you need language.

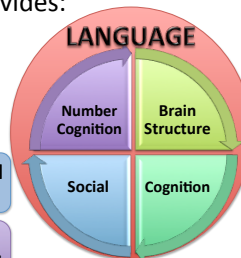
Spaepen et al. 2011



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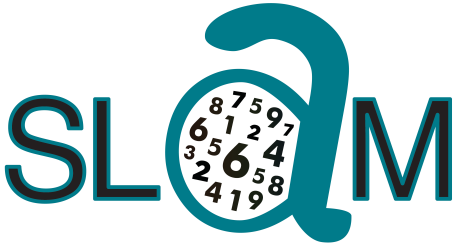
Early exposure *to natural, organic language* provides:

- Stimulation for proper brain **growth and development**
- The groundwork for **behavior regulation**
- A foundation for successful **social interactions**
- The infrastructure for understanding and using **number and quantity**



6. Recap

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SLAM

Study of Language and Math

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Thank you!

AMERICAN
SOCIETY for
DEAF
CHILDREN

This material is based upon work supported by the National Science Foundation under Grant Numbers NSF #1553589 and DGE-1247393. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



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