

**The 2014 Symposium on
Sign Bilingualism and Deaf Education**

How Early Language Prepares the Child's Brain for Reading

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Reading & Language Development

- Literacy is crucial to participate in society
 - Academic success
 - Access to information
- Children with hearing impairment
 - High risk for reading failure
 - Illiteracy increases the handicap of deafness
- Reading is a language task
 - Hearing children
 - Deaf children



Early Language → Later Language

1) Age of acquisition affects outcome

- Language ability
- Brain language processing



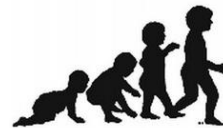
2) Late language acquisition

- Language development
- Brain language processing

Early Language → Later Language

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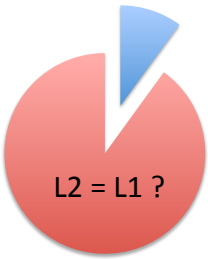
2) Late language acquisition


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Age of Sign Language Acquisition


■ Infancy

■ Older ages






Infant L1




Sparse language in Childhood: L1

↓

Adult L2



Adult L1



How to study critical period effects on sign language development

Early Language → Later Language

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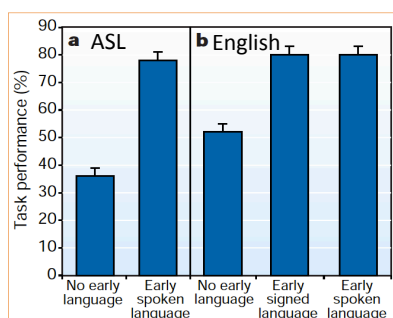
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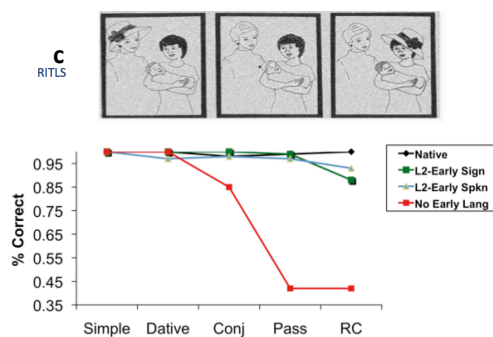


AoA L2 ≠ L1 Effects on Language & Brain



a) Memory for Sentences
b) Grammatical Judgment

Mayberry, Lock & Kazmi, 2000 *Nature*
Boudreault & Mayberry, 2006 *Lang & Cog Processes*
Cormier et al, 2012 *Cognition*



c) Sentence-to-Picture Matching
Reading English sentences

Mayberry & Lock, 2003 *Brain & Language*

Early Language → Later Language

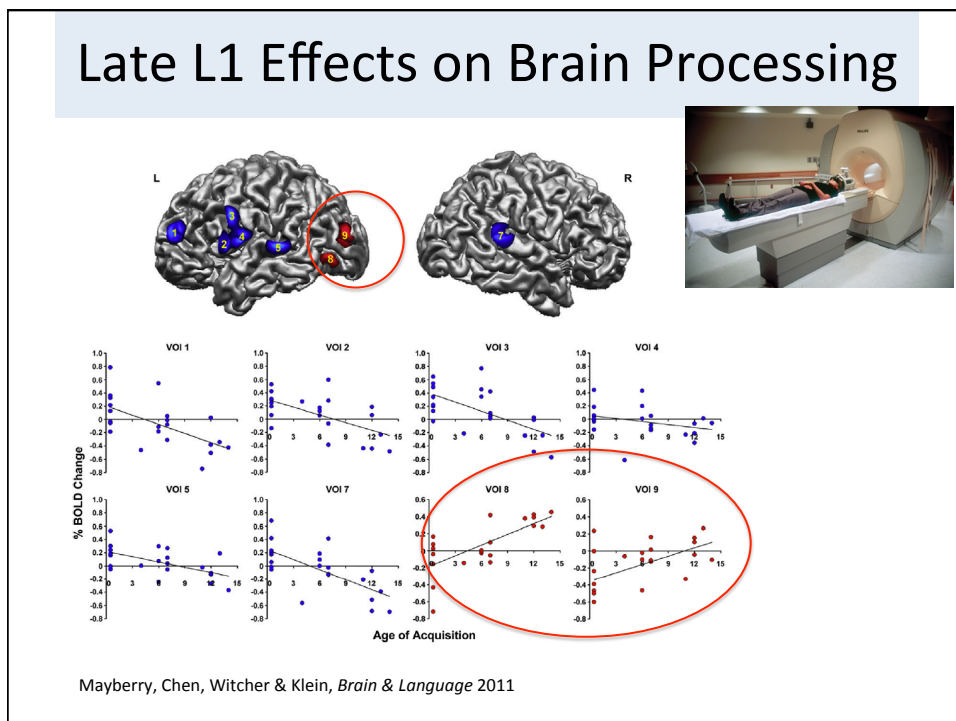
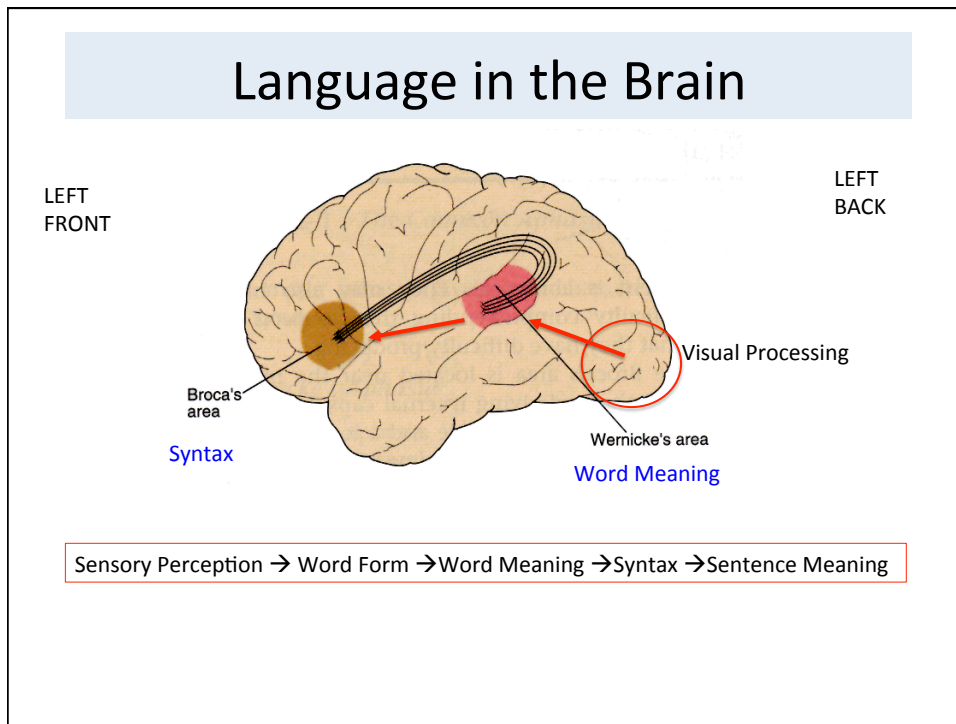
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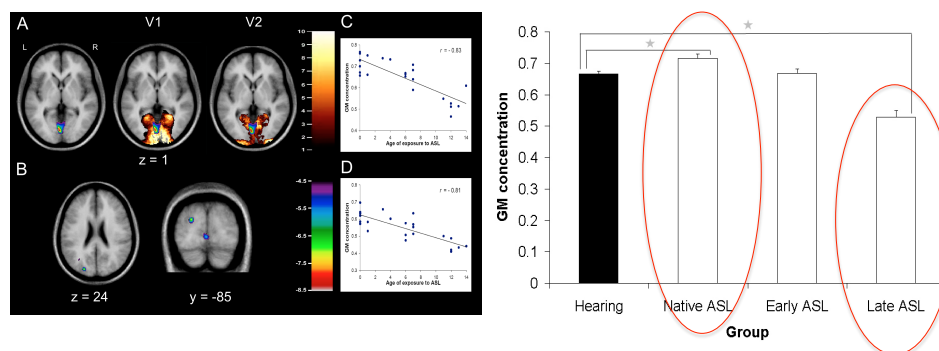
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Early Language Effects in Occipital (Visual) Cortex



Pénicaud, Klein, Chen, Hyde, Witcher, Zatorre & Mayberry, 2013 *Neuroimage*

Early Language → Later Language

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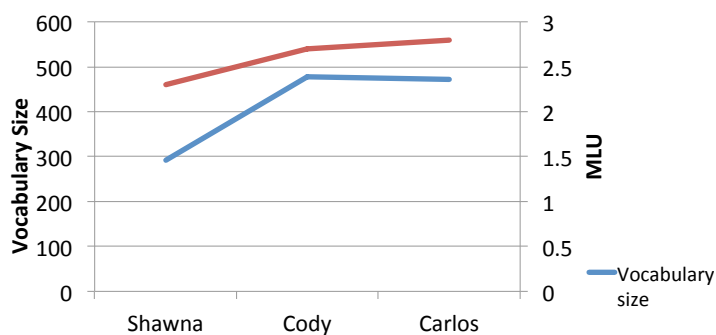
Learning Language for the First Time in Adolescence

Name	AoA	Mos ASL	Prior language knowledge
Shawna	14;7	12	No ASL signs, no English, illiterate
Cody	14;8	18	Some ASL signs, no English, illiterate
Carlos	13;8	24	Some ASL signs, no English, illiterate

- Prior to ASL immersion: used pantomime and gesture to communicate
- Limited schooling until receipt of special services at age ~14
- Lived together in a group home
- Immersed in ASL at home and at school
- LONGITUDINAL LANGUAGE SAMPLING

Ferjan Ramirez, Lieberman, Mayberry, 2012 *Journal of Child Language*

Utterance Length & Estimated Vocabulary Size

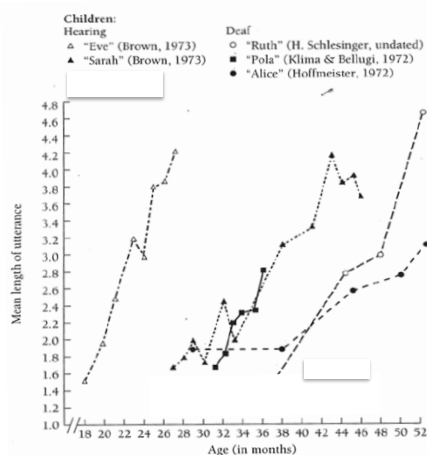


- MLU related to estimated vocabulary size
- Vocabulary between 300 and 490 words; mostly nouns, few closed class items

Ferjan Ramirez, Lieberman, Mayberry, 2012 *Journal of Child Language*

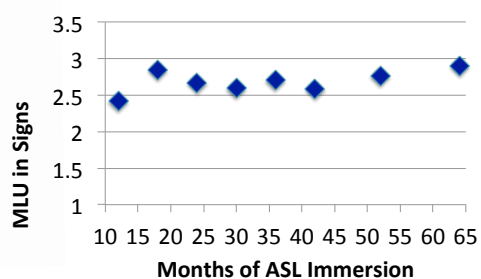
Berk & Lillo-Martin, 2013 *Cognitive Psychology*
Morford, 2003 *Linguistics*

Sentence Growth in Children with Early Language Input



Modified from Hoff, 2001 (Fig. 2.10 from Terrace, 1979)

Sentence Growth in Adolescents with No Early Language



Ferjan Ramirez, Lieberman, Mayberry, 2012
Journal of Child Language, and in prep

Early Language → Later Language

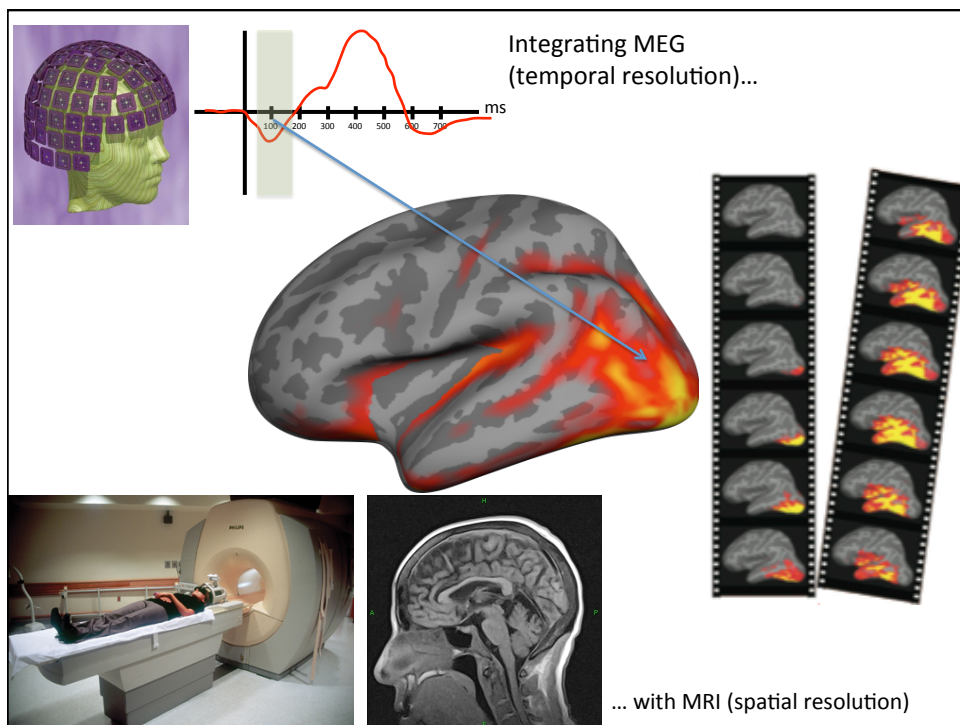
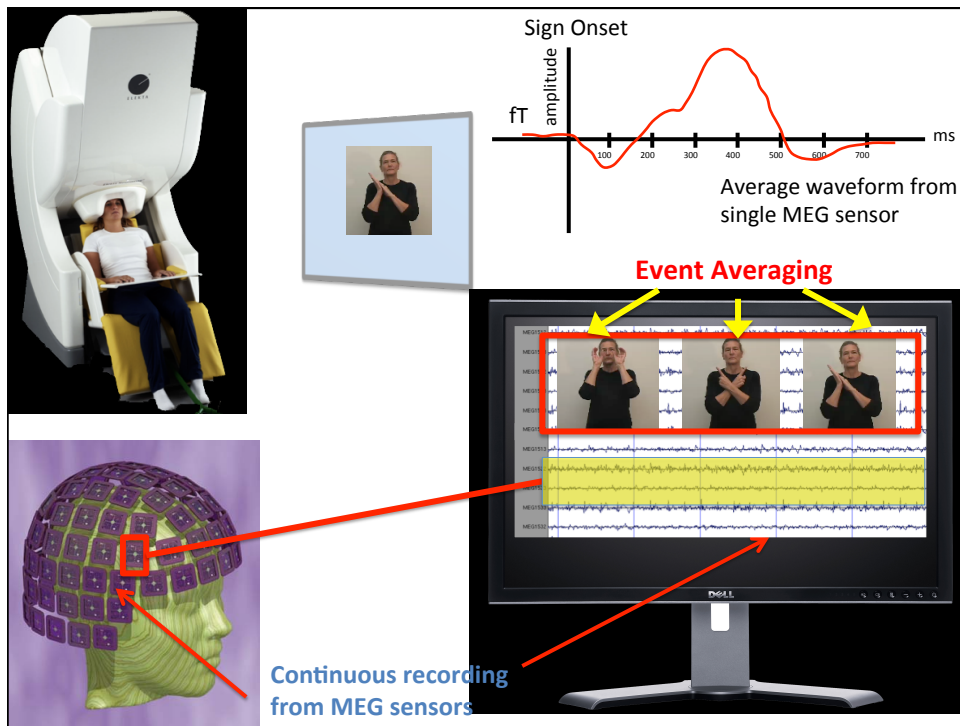
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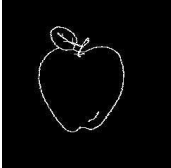
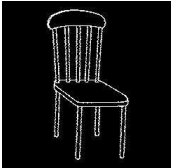


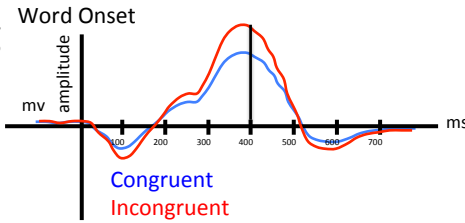
Lexico-semantic processing

- N400: Kutas & Hillyard, 1980
*He spread the warm bread with **butter**.*
*He spread the warm bread with **socks**.*

- In MEG: N400m

- Picture-word priming

	apple	Congruent
	apple	Incongruent

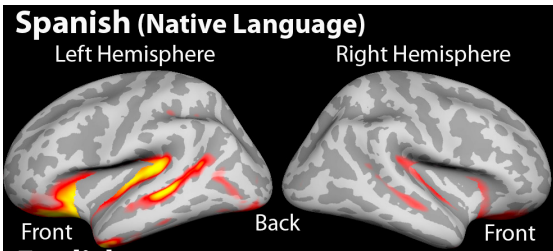


Word Onset
 amplitude
 mv
 ms
 Congruent
 Incongruent

Bilingual Brain Language Processing

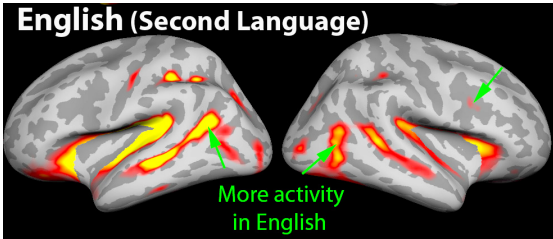
Spanish (Native Language)

Left Hemisphere Right Hemisphere




Front Back Front

English (Second Language)

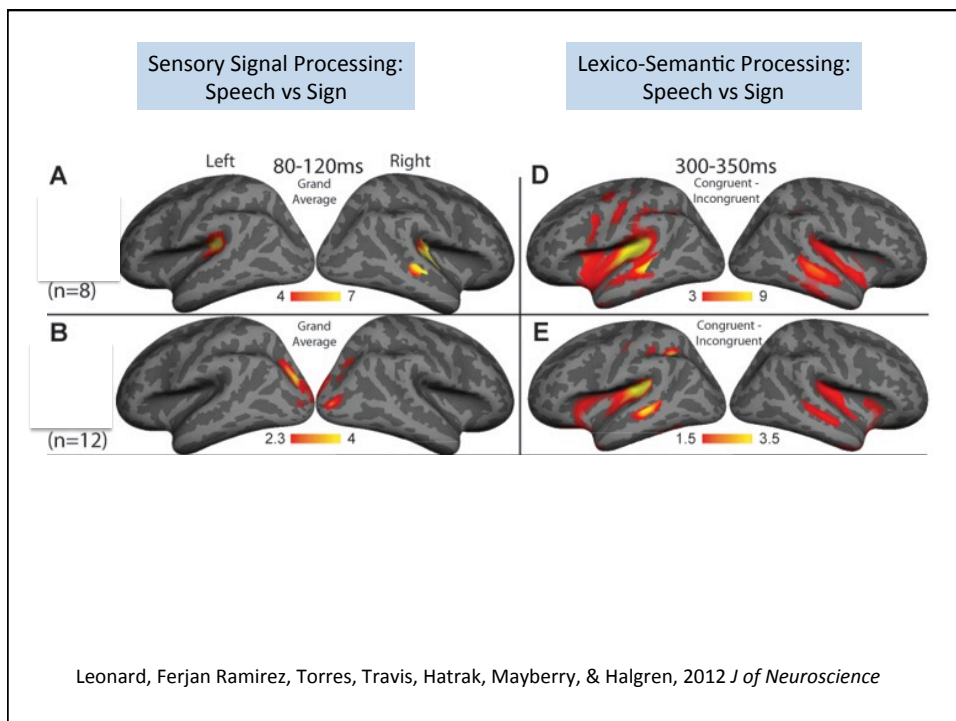


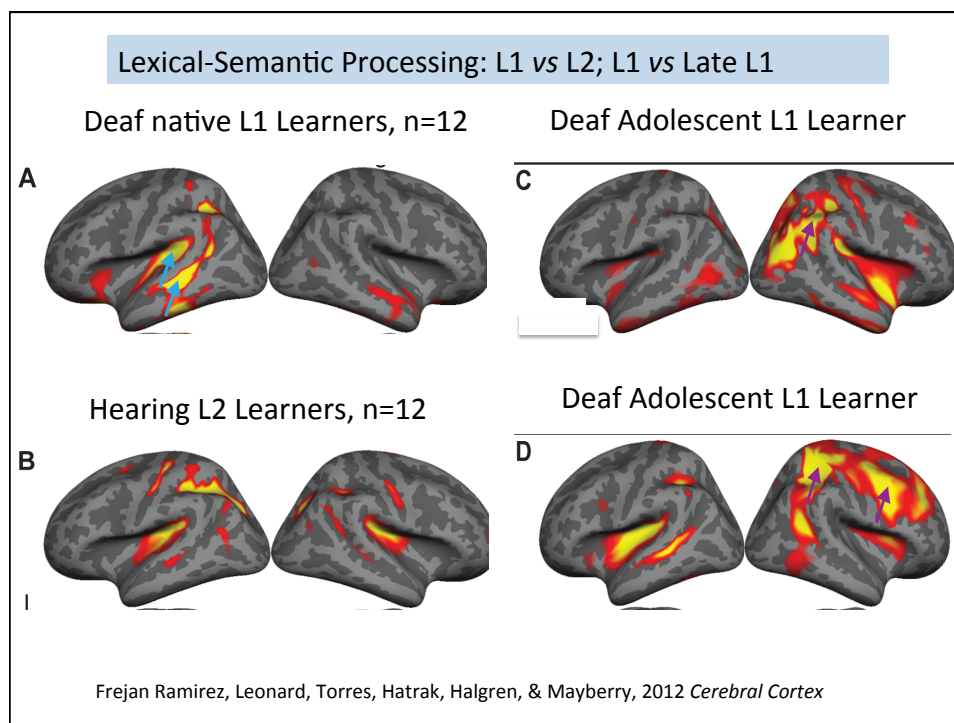
More activity in English



Leonard, Brown et al, 2010 *Neuroimage*
 Leonard, Torres et al, 2011 *PLoS One*

Brain Sign Language Processing





Early Language → Later Language

1) Age of acquisition affects outcome

- Language ability
 - Lack of complex syntax
- Brain language processing
 - Atypical processing



2) Late language acquisition

- Language development
 - Looks child-like appears to level off
- Brain language processing
 - Looks atypical – does not look bilingual

Acknowledgements



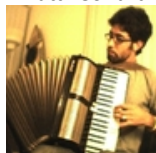
UCSD Chancellor's Collaboratories Award
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NIH 1R01 DC012797

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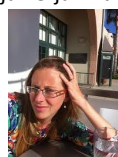
Eric Halgren



Matt Leonard



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Marla Hatrak



<http://grammar.ucsd.edu/mayberrylab>