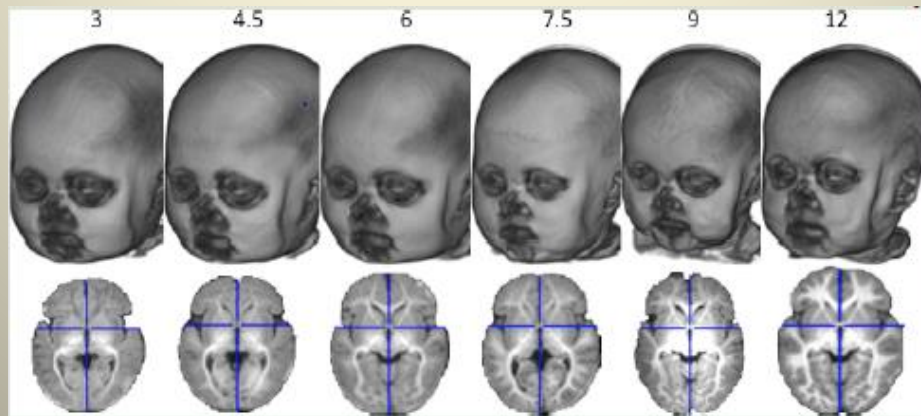
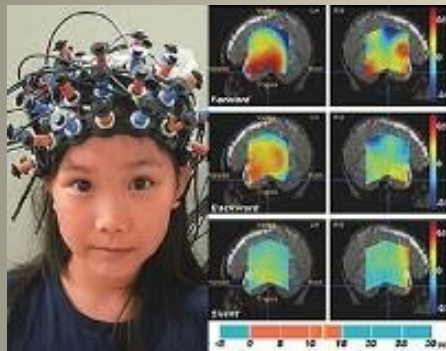


Scalp Locations Projected to Cortical Locations for Infant NIRS

Wanze Xie

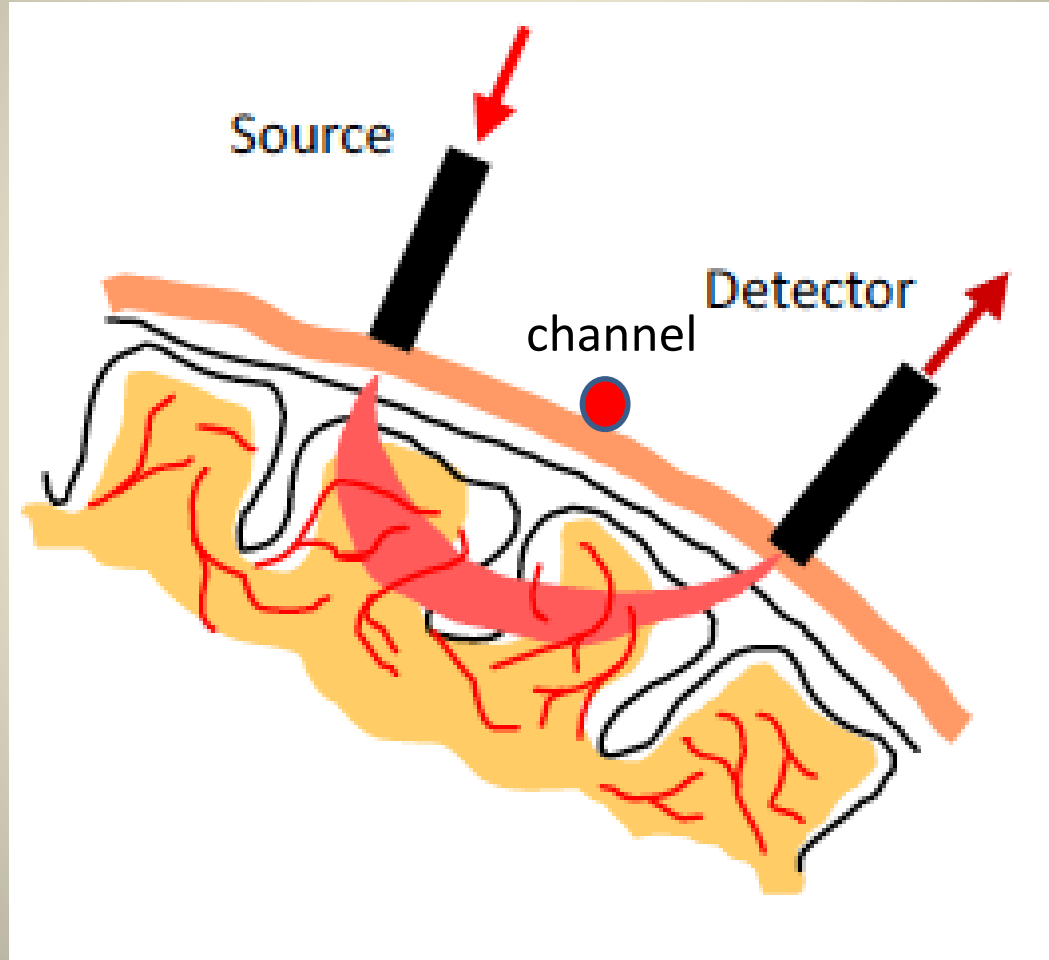
John Richards

University of South Carolina





What cortical regions are the fNIRS channels measuring ?

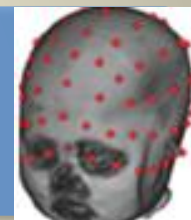


Structure of This Talk

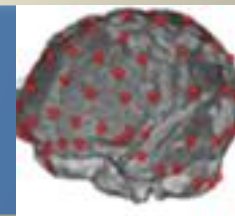
Find A MRI for Localization & Projection



Localize the Channels



Projections to the Cortex



Stereotaxic Atlas Categorizes Cortex



References

Lloyd-Fox et al. (2015)

Cortical Activation to Action Perception is Associated with Action Production Abilities in Young Infants

Sarah Lloyd-Fox¹, Rachel Wu², John E. Richards³, Clare E. Elwell⁴ and Mark H. Johnson¹

Lloyd-Fox et al. (2014)

Coregistering functional near-infrared spectroscopy with underlying cortical areas in infants

Sarah Lloyd-Fox^{a,*}, John E. Richards^b, Anna Blasi^a, Declan G. M. Murphy^c, Clare E. Elwell^d, and Mark H. Johnson^a

Richards & Xie (2015)

Chapter One – Brains for All the Ages: Structural Neurodevelopment in Infants and Children from a Life-Span Perspective

Two ongoing projects: One with Dr. Lauren Emberson and the other one with Dr. Kang Lee

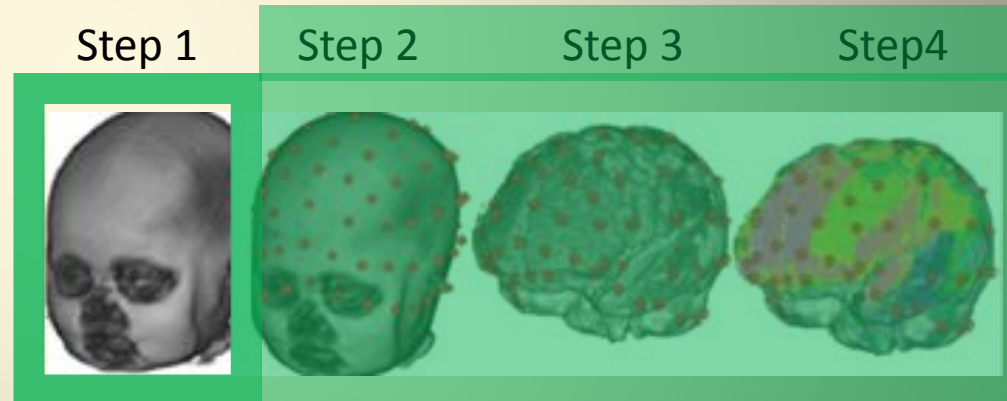
1-Structural MRIs of whole head



What is the best representation of my head/brain?



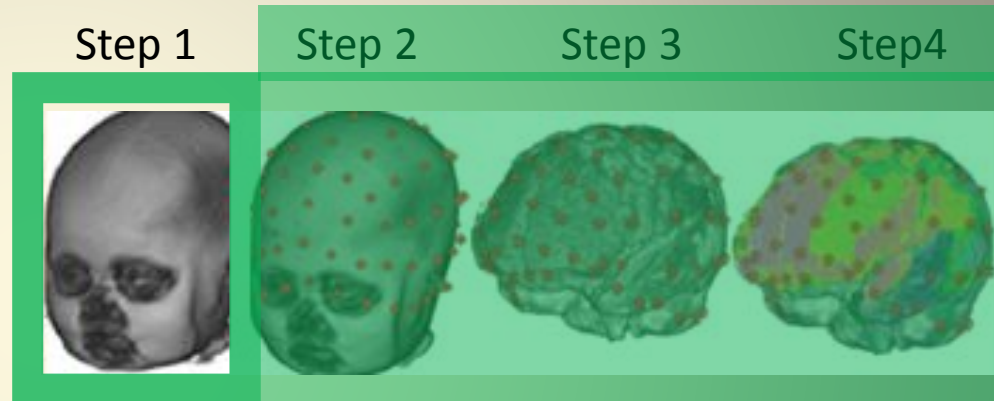
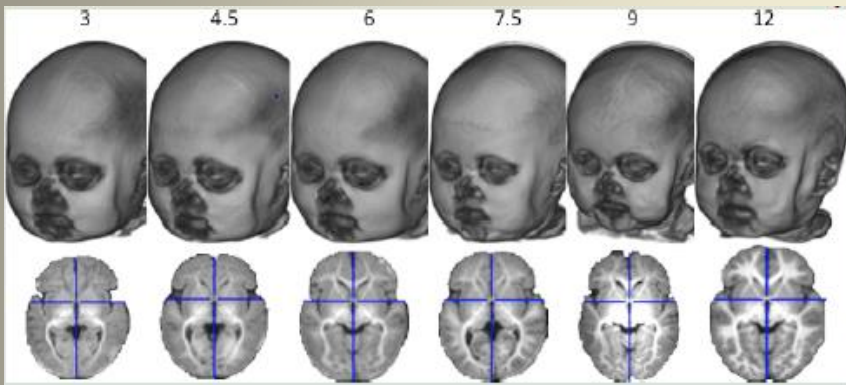
- Individual Own MRI



- Examples: Lloyd-Fox et al. (2014, 2015)

1-Structural MRIs of whole head

- Average or Close MRI



Sanchez et al., 2012a, b; Richards & Xie, 2015

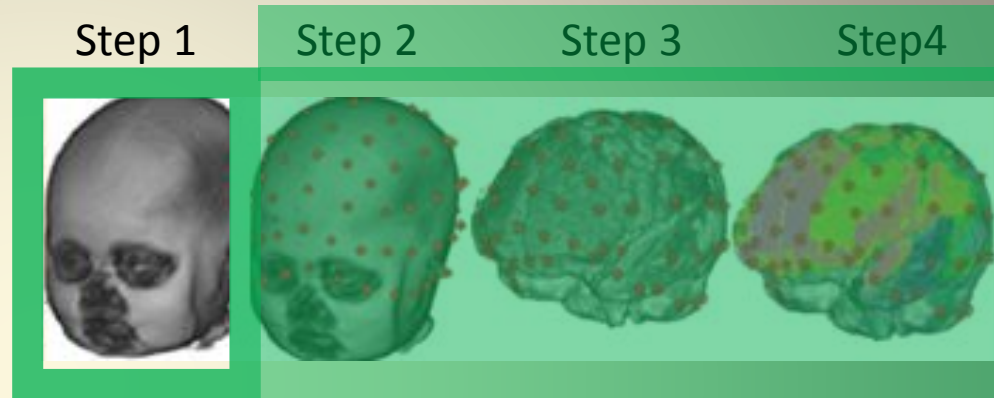
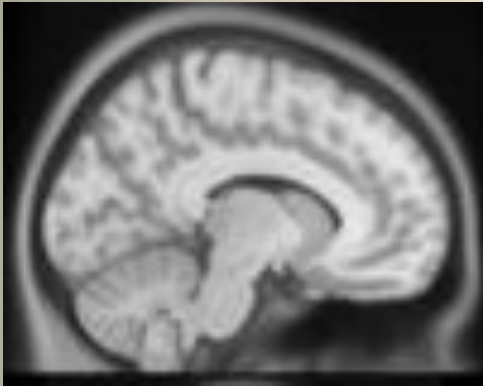
- Examples: Ongoing projects

What if there is no age-appropriate MRI available?

1-Structural MRIs of whole head

- Adult MRI

MNI-152 adult template



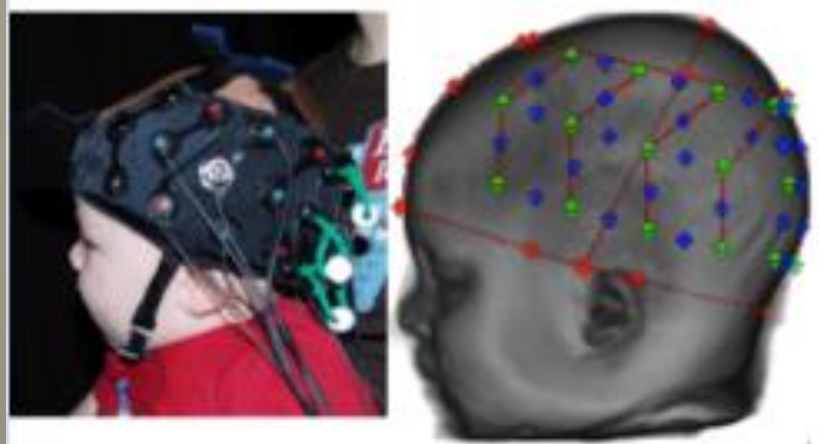
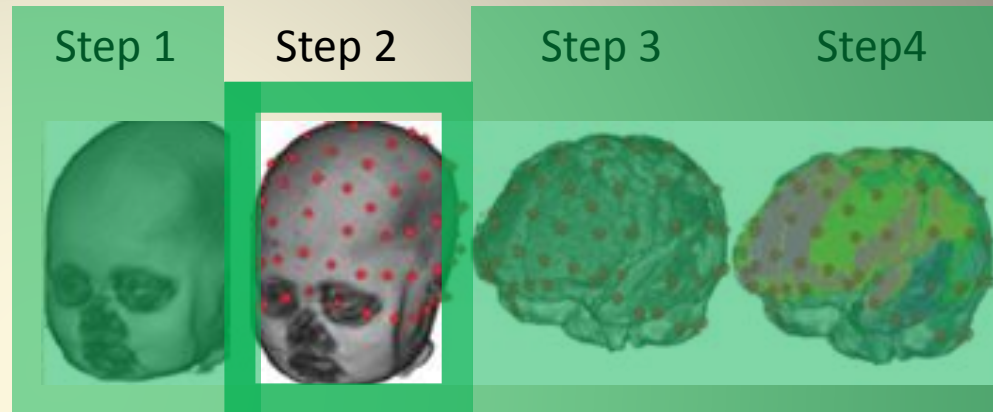
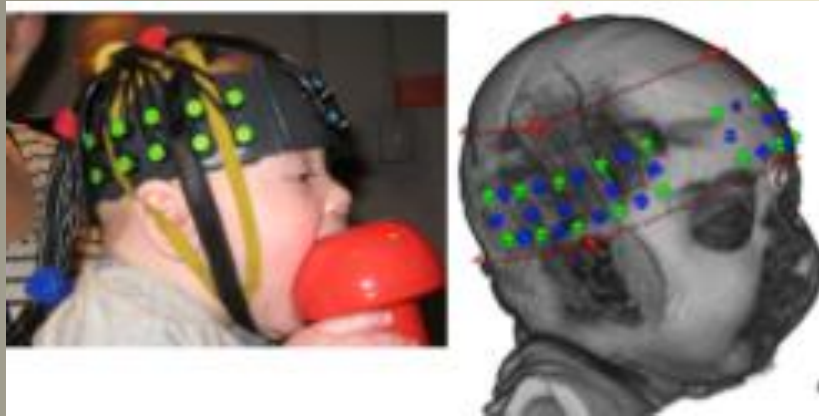
Q1. Are adult MRIs good representations for infant head and brain?

Q2. Will it affect the projections of the fNIRS channels?

- Kabdebon et al. (2014); O1-O2, T5-T6

2-scalp locations on MRI

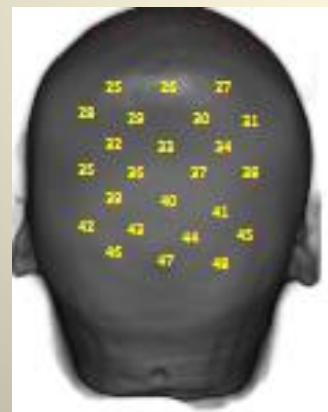
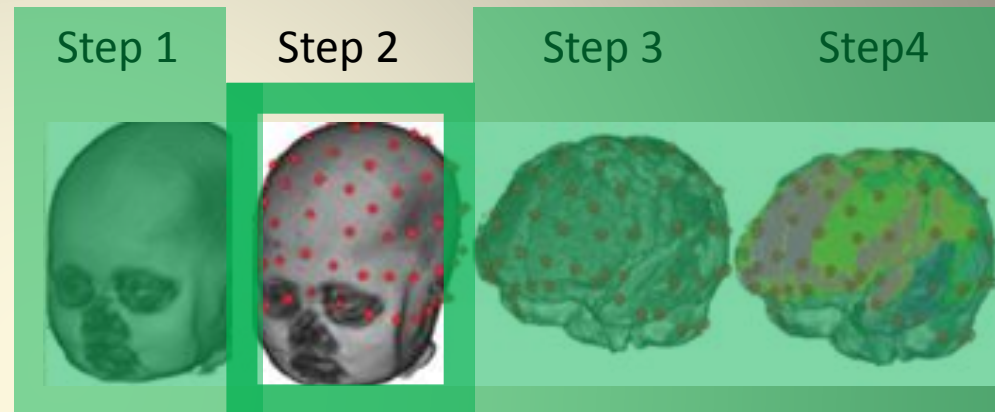
- Pictures + Fiducials



2-scalp locations on MRI

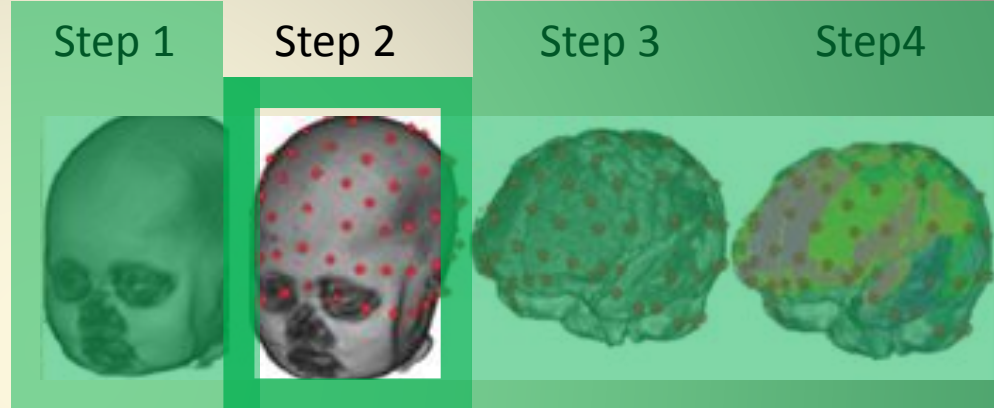
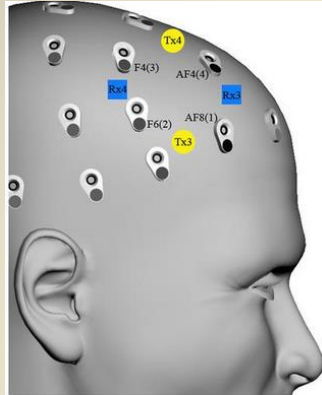
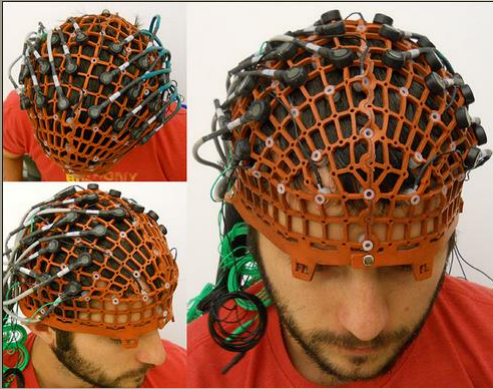
- Coordinates of Optodes and Fiducials

	A	B	C	D
1	Label	X	Y	Z
2	NzHS	0	-72.19	0
3	IzHS	3.6	81.16	16.15
4	ARHS	-66.05	0	0
5	ALHS	62.08	0	0
6	CzHS	1.26	9.57	139.72



2-scalp locations on MRI

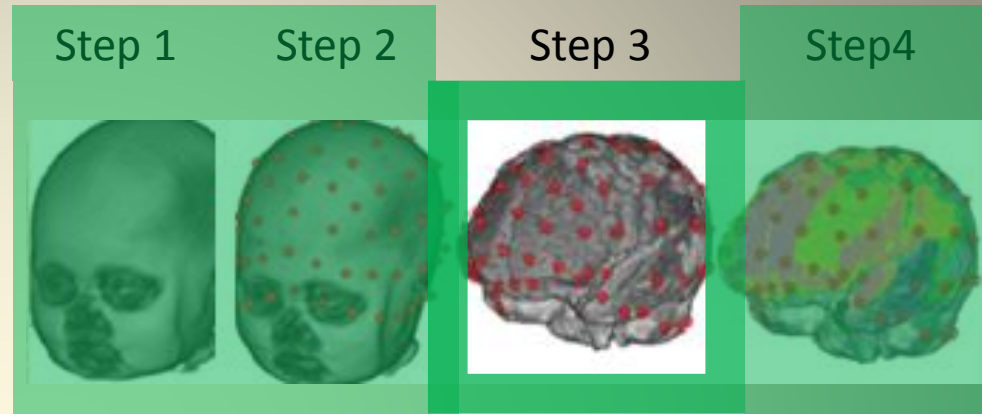
- 10-20 or 10-10 System



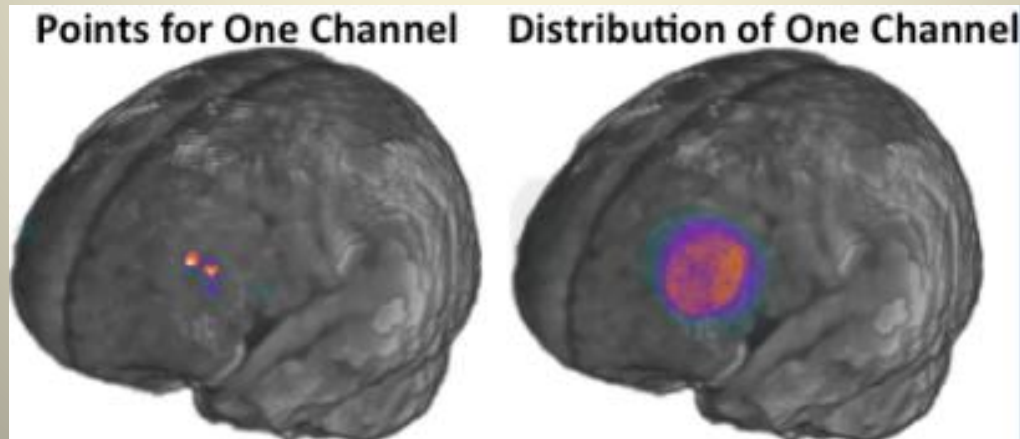
Computer Programs: HOMER2 and Atlas Viewer GUI

3- Projections between the scalp locations and cortical locations

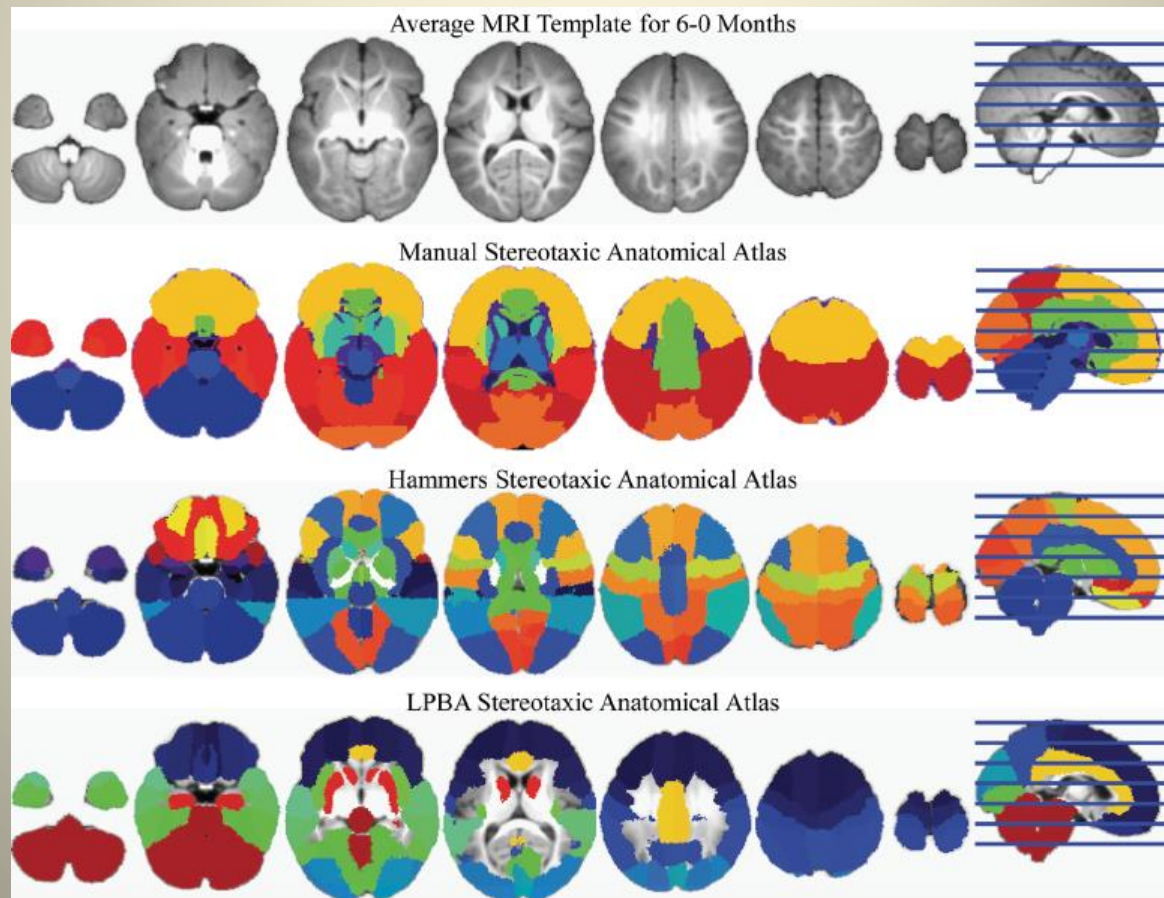
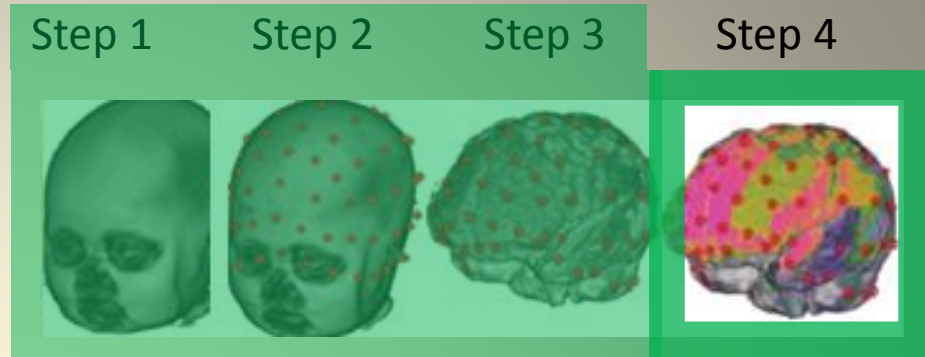
- **Scalp shrink**
- **Brain expand**
- **“Balloon” method**
Okamoto & Dan, 2005.



What do we get?

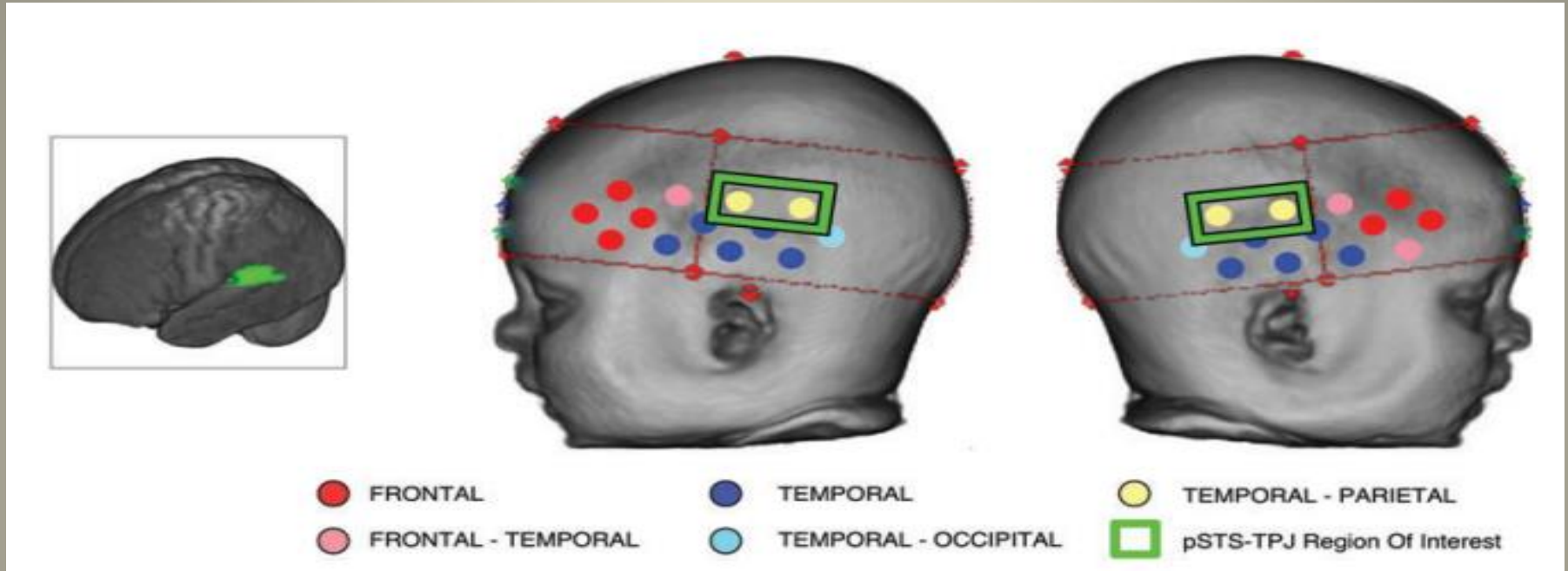


4- Use stereotaxic atlas to categorize cortex



Results from procedures 1 - 4

- Example 1. Individual results, Lloyd-Fox et al. (2015)



Results from procedures 1 - 4

- Example 2. Group results, from Lloyd-Fox et al. (2014)

NIRS Channels	Lobar atlas	Macro-anatomical atlas (LPBA40)
<i>Left lateral NIRS array</i>		
1	Frontal (93)	Inferior frontal gyrus (82)
2	Frontal (100)	Inferior frontal gyrus (100)
3	Frontal (100)	Inferior frontal gyrus (95)
4	Frontal (87)	Inferior frontal gyrus (76)
5	Temporal (76) Frontal (24)	Superior temporal gyrus (66) Inferior frontal gyrus (20)
6	Frontal (84)	Inferior frontal gyrus (44) Precentral gyrus (38)
7	Temporal (65) Frontal (33)	Superior temporal gyrus (66) Precentral gyrus (20)
8	Temporal (100)	Middle temporal gyrus (73) Superior temporal gyrus (24)
9	Parietal (53) Temporal (25) Frontal (21)	Superior temporal gyrus (42) Postcentral gyrus (40)
10	Temporal (98)	Superior temporal gyrus (67) Middle temporal gyrus (31)
11	Temporal (100)	Middle temporal gyrus (86)
12	Temporal (87)	Superior temporal gyrus (71) Middle temporal gyrus (20)
13	Temporal (93)	Middle temporal gyrus (78)

Conclusion 1

The combination of these methods is flexible

Find a MRI (3)

- Individual Own MRI
- Average or Close MRI
- Adult MRI

Localize Channels (3)

- Pictures + fiducials
- Coordinates by digital localizer
- 10-20, 10-10 System

Projection to the cortex (3)

- Shrink the scalp
- Expand the brain
- Balloon

Categorize the cortex (3)

- Manual lobar atlas
- Hammers atlas
- LPBA atlas

Conclusion 2

- Neurodevelopmental MRI Database
 - JERLab, University of South Carolina
- <http://jerlab.psych.sc.edu/NeurodevelopmentalMRIDatabase/>
- References
 - Sanchez et al. (2011, 2012b) [Infants, children]
 - Richards & Xie (2015) [Review]
 - Xie et al. (2014) [Chinese children]; Fillmore et al. (2015) [Adults]; Phillips-Meek et al. (2013) [Adults]

Acknowledgement

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Michael Stevens



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Questions

