Scalp Locations Projected to Cortical Locations for Infant NIRS

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What cortical regions are the fNIRS channels measuring?
Structure of This Talk

1. Find A MRI for Localization & Projection
2. Localize the Channels
3. Projections to the Cortex
4. Stereotaxic Atlas Categorizes Cortex
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

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<td>Y</td>
<td>Z</td>
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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)

<table>
<thead>
<tr>
<th>NIRS Channels</th>
<th>Lobar atlas</th>
<th>Macro-anatomical atlas (LPBA40)</th>
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<tbody>
<tr>
<td>Left lateral NIRS array</td>
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<tr>
<td>1</td>
<td>Frontal (93)</td>
<td>Inferior frontal gyrus (82)</td>
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<td>Frontal (100)</td>
<td>Inferior frontal gyrus (100)</td>
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<td>3</td>
<td>Frontal (100)</td>
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<td>Frontal (87)</td>
<td>Inferior frontal gyrus (76)</td>
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<td>Temporal (76) Frontal (24)</td>
<td>Superior temporal gyrus (66) Inferior frontal gyrus (20)</td>
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<td>Inferior frontal gyrus (44) Precentral gyrus (38)</td>
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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]
Our Collaborators: Sarah Lloyd-Fox, Lauren Emberson, Richard Aslin, Kang Lee, Xiaopan Ding, and others
Questions