Neuroimaging Predictors of Response to Pivotal Response Treatment

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Children with ASD can have difficulty developing language or communication skills.

Children with ASD may:
- be non-verbal or minimally verbal
- use scripted language
- exhibit delays in using and understanding language
- show deficits in social and non-verbal communication

Therapies to target language development and communication skills exhibit variable effects across individuals.
- Treatment prediction markers could help clinicians determine the most appropriate intervention and reduce the time until patients receive the most beneficial treatment.
Pivotal Response Treatment

- PRT uses core “pivotal” areas, such as motivation, to target skill development (Koegel, 2011)

- Targeting pivotal areas is accomplished with the combination of:
  - 1) ABA based behavioral strategies
  - 2) Motivational techniques such as reinforcement
  - 3) Child-directed/play-based approaches

- Parents/caregivers can be trained to apply PRT in natural settings, resulting in increased treatment intensity during daily routines (Minjarez et al., 2011)
PRT to Target Language Development and Improve Communication

- PRT can improve language abilities and communication skills in young children with ASD (Koegel et al., 1998; Koegel et al., 2014)
  - improved speech intelligibility, increased question asking/conversation, and more play/social initiations

(Mohammadzaheri et al., 2014)

<table>
<thead>
<tr>
<th></th>
<th>ABA group</th>
<th>PRT group</th>
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<tbody>
<tr>
<td></td>
<td>MLU</td>
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<td>Pre-intervention</td>
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<tr>
<td>Post-intervention</td>
<td>2.79</td>
<td>.5</td>
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Language Regions in the Brain and ASD

- Language regions, such as the IFG (Broca’s) and STS (Wernicke’s), and connections between them (arcuate) are affected in ASD (Amaral et al., 2008)

- Properties of language regions in the brain may be related with an individual’s response to treatments targeting language
Neuroimaging Predictors of Treatment Response
Preliminary Studies

- Young children with autism were recruited from trials of PRT
  - Participants exhibited significant language delay (not HFA)

- Structural MRI scans were obtained before PRT treatment

- Size of language regions and measures of white matter quality between language regions were examined

<table>
<thead>
<tr>
<th>Demographics</th>
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<tbody>
<tr>
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<tr>
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<td>45.8</td>
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<td>67.5(36.3)</td>
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<td>5.3</td>
<td>Post-PRT</td>
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<tr>
<td>&lt;0.001**</td>
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Table 1. Pilot Sample
Size of Broca’s area

- Smaller left IFG at baseline was associated with a greater increase in the number of utterances following PRT.
Smaller STS at baseline was associated with a greater increase in the number of words the child could understand/produce following PRT.

![Graph showing the relationship between left STG volume and change in number of words](image)
Lateralization of Broca’s area

- Language function is (typically) localized more in the left hemisphere & reduced/reversed. ‘lateralization’ is associated with language impairments (Szaflarski et al., 2005)

- Lateralization of language regions was associated with a greater increase in the number of utterances following PRT
Quality of WM Connections

- Better white matter quality connecting language regions was associated with a greater increase in the number of utterances following PRT.

![Graph showing the correlation between left SLF fractional anisotropy and change in number of utterances. The correlation coefficient is r = 0.75*.](attachment:graph.png)
Summary

- The size of language regions could help indicate who is most likely to respond to treatments targeting language development
  - *Children with ASD may exhibit hyper-expansion of the brain early in development* (Carper & Courchesne, 2005)
  - *Children with ASD may show abnormal lateralization of language regions* (Lindell & Hudry, 2013)

- Quality of connections between regions could help indicate who is most likely to respond to treatments targeting language development
  - *Children with ASD may have reduced quality of connections between brain regions* (Fletcher et al., 2010)
Take Home Message

- Non-invasive (no radiation) neuroimaging may be able to help predict which children will most benefit from specific interventions
  - Early intervention is very important because the brain is most responsive to change
  - Can these techniques be applied for other treatments or symptoms?

- More research is necessary to further examine these relationships
  - We are currently recruiting for an MRI study
    pick up a flier in the lobby or
    email: autismresearch@stanford.edu
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