

Neurodevelopmental Correlates of Perspective Taking During Role Play



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TAKEAWAY: In a novel task, many children show evidence that they take the perspective of the characters they are pretending to be during role play. The extent to which they do so is associated with baseline neurobiological activity attributable to the frontal and parietal cortices.

INTRODUCTION

Role play is an elaborate form of pretend play in which children appear to project an imagined character onto themselves.

Some researchers suggested that role play can be considered an early emerging manifestation of Representational Theory of Mind (RTM) (e.g., Friedman & Leslie, 2007).

Other researchers argue that children understand role play in more behavioral terms (e.g., Stich & Tarzia, 2015).

Current measures test what children can express about role play, rather than what they actually do during role play.

1. We present a measure for directly testing children's tendencies to take perspectives during role play.

- PREDICTION #1: if children are "thinking-as-if" during role play, they will **respond to a photograph of themselves using a 3rd person label** while role playing a character.

2. We explore the extent to which individual differences in perspective taking during role play may be related to individual differences in baseline neurobiological activity and development.

- PREDICTION #2: individual differences in **right IPL** activation during baseline EEG measurement will be associated with 3rd person responses to self photograph.

PARTICIPANTS & MEASURES

Participants

- 69 typically developing 4-year-olds (26 in sLORETA analyses)

- 2 Conditions:
 - (1) Pretend – child role played a character of their choosing
 - (2) Control – child did *not* role play

Materials & Design

RTM Battery: (1) Contents False Belief, (2) Knowledge Access, (3) Location Change False-Belief, and (4) Appearance-Reality

Executive Function Battery: (1) Grass/Snow, (2) Dimensional-Change Card Sort, and (3) Less is More

Pretense Understanding: Moe Task

Peabody Picture Vocabulary Test (PPVT)

Materials & Design, Continued

Pretend Self-Recognition (PSR) Task:

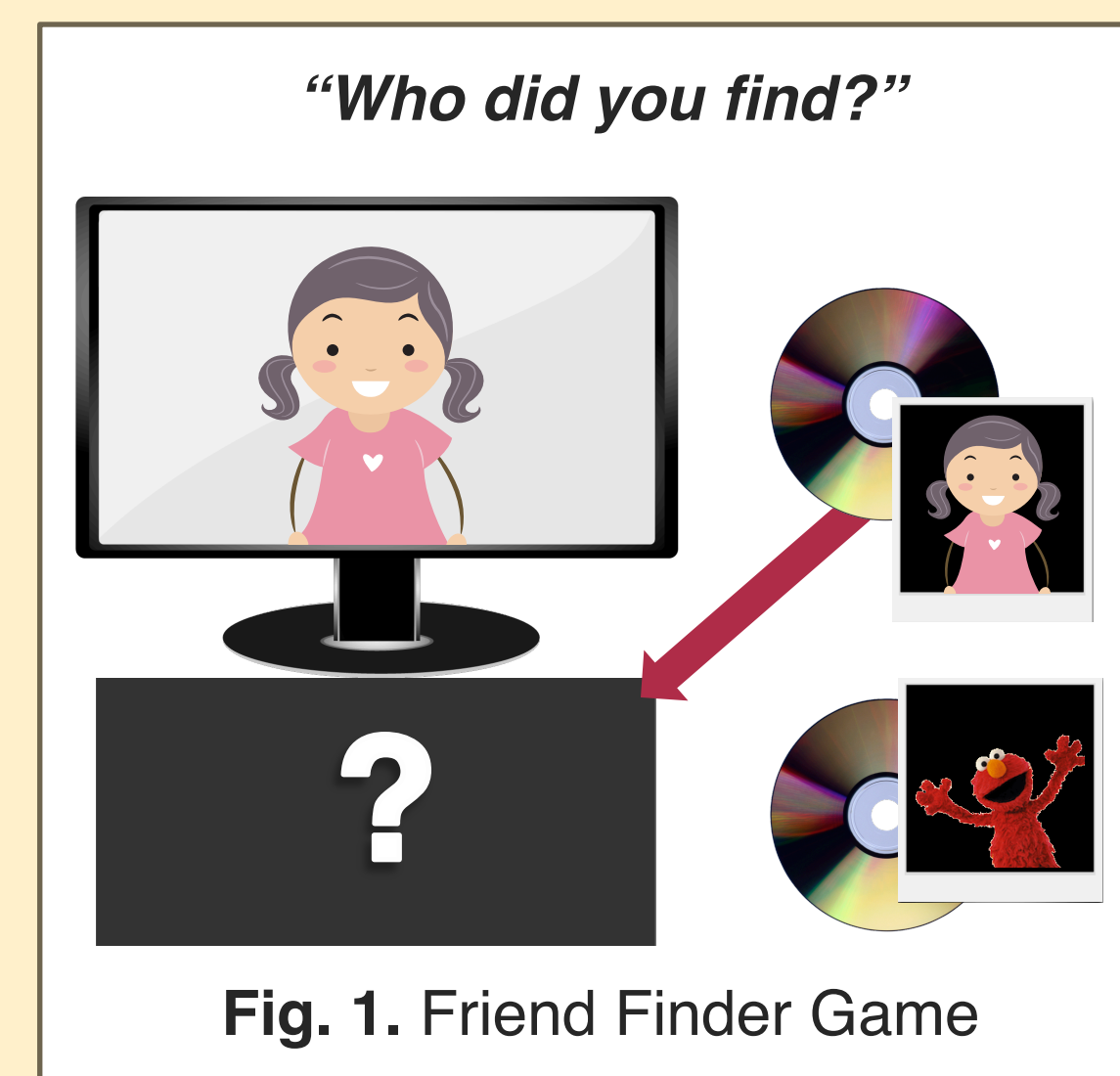
- Take a picture of child (for later)
- Induce the child to pretend to be a character
- Play Friend Finder game
- Find picture of the child taken earlier and ask, "Who did you find?"

EEG Recording:

- Baseline/resting EEG alpha
- Sit still during rocket ship presentation, allowed to move during spiraling line (Fox et al., 1995)

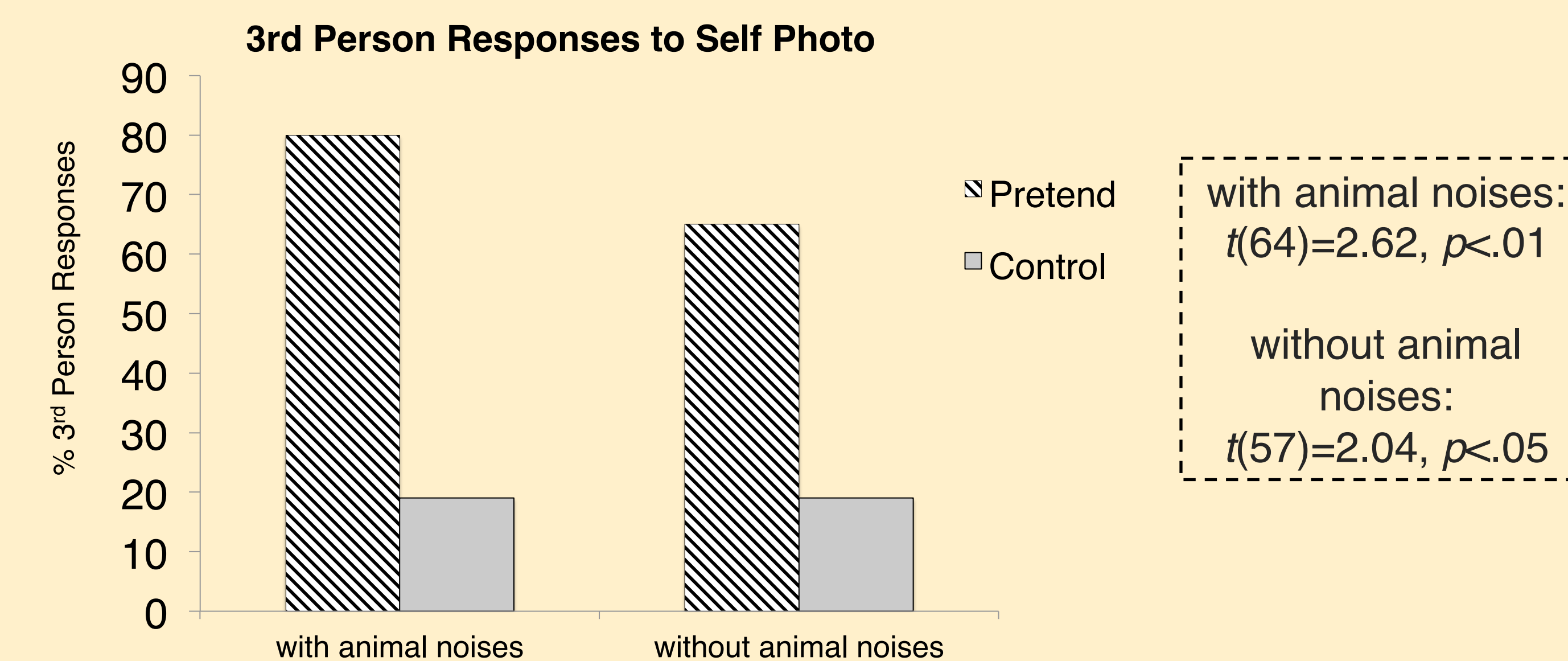


- Use Standardized Low Resolution Electromagnetic Tomography (sLORETA) to determine neural correlates (Pascual-Marqui, Esslen, Kochi, & Lehmann, 2002).



RESULTS

Behavioral Analyses



sLORETA Analyses

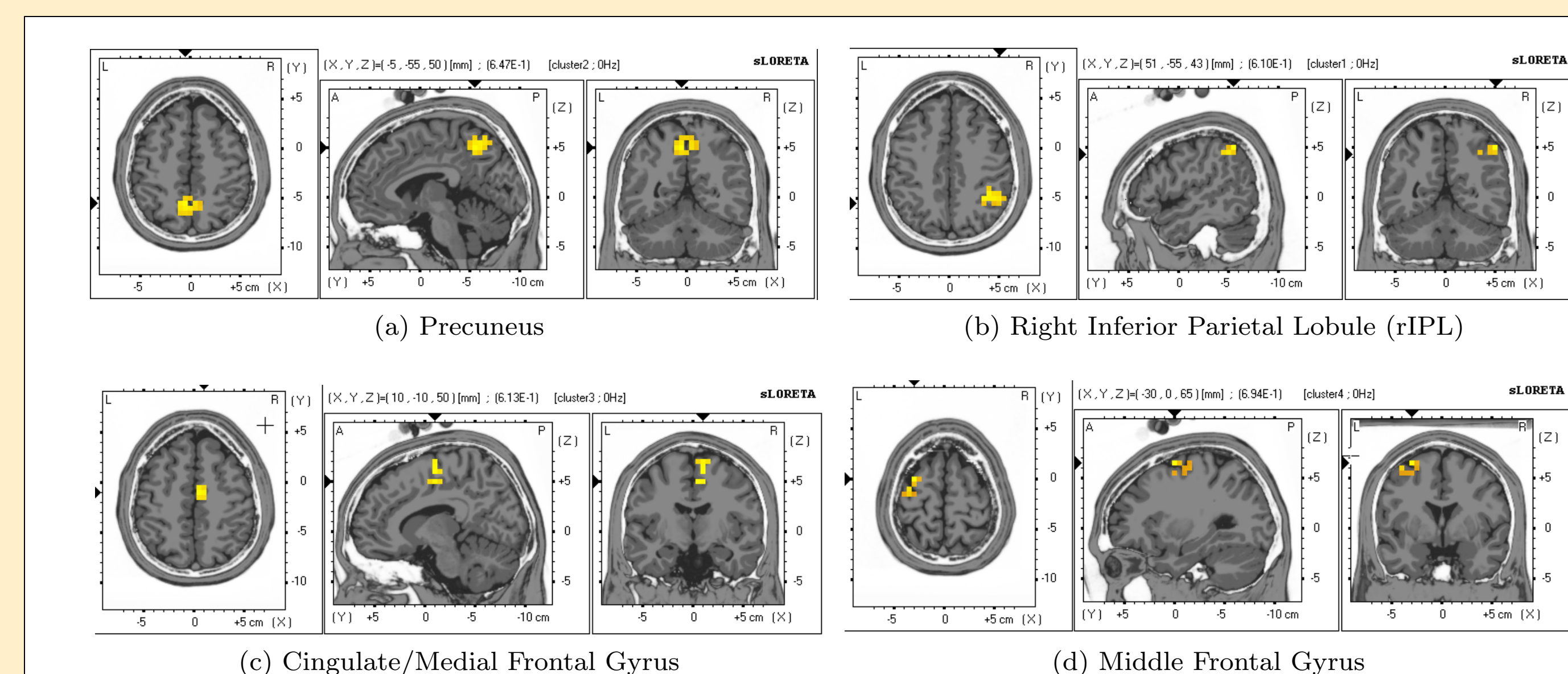


Fig. 2. Thresholded statistical maps measuring the relation between "thinking-as-if" responses to the self photograph of the PSR task and sLORETA estimates of current density. Voxels in all figures are shown projected onto a template structural MRI to illustrate neuroanatomical locations.

sLORETA Analyses, Continued

Table 1. Brain regions where sLORETA current density estimates predicted third person response to self photo of the PSR Task

Region (MNI coord. of max. r)	L/R	Included BAs	Size (voxels)	Max $t_{partial}$	Aggregate $t_{partial}$
IPL (51, -54, 50)	R	40	20	.665***	.623**
Precuneus (-5, -55, 50)	L/R	7	52	.647***	.602**
Cingulate/MFG (10, -10, 60)	R	4	13	.622***	.601**
Middle Frontal Gyrus (-30, 0, 65)	L	6	24	.694***	.611**

** $p < .01$, L/R = Left/Right, BAs = Brodmann Areas, MNI = Montreal Neurological Institute, IPL = Inferior Parietal Lobule, MFG = Medial Frontal Gyrus

Stepwise Regression final model, $F(2, 23) = 12.038, p < .001, 53.4\%$.

Table 2. Regression coefficients for final model predicting third person responses on the self photo of the PSR task from current source density estimates.

Variable	Beta	t	p
Right IPL	0.454	2.57	0.018
Cingulate/MFG	0.379	2.15	0.042

DISCUSSION

Precuneus:

Often involved in Theory of Mind studies with adults (Cavanna & Trimble, 2006)

Maintaining representations of the self (Ruby & Decety, 2003)

Right IPL:

Not usually involved in theory of mind, but usually involved in perspective taking (Farrer et al., 2003)

CONCLUSIONS:

In development, there may be a dissociation between the neurodevelopmental factors that are critical for:

- reflective reasoning about mental states
- active, in-the-moment, perspective taking

These systems may converge, at least somewhat, with development.

Understanding the real-world interplay between these more reflective and active processes is important for understanding the development of social cognition through the preschool years.

References:

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Research supported by an NSERC Discovery Grant to Mark A. Sabbagh.

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