1. Introduction

How do infants begin to use ToM to make inferences about other people’s mental states?

Preference for social engagement at birth indicates that social abilities emerge early and have a deeply seated biological basis (Grossmann & Johnson, 2007). Complex social cognition involving the attribution of mental states, beliefs, and desires is called theory of mind (ToM). Recent work by Kovácš, Téglás, & Endress (2010) suggests that by 7-months, infants are capable of ToM, previously thought to be immature until at least 3 years of age. Even with these recent advances, much remains unknown about how infants integrate and process complex social information. Here, a series of dynamic neural field (DNF) models were generated to describe the cognitive mechanisms involved in ToM across early infant development. Specifically, we are interested in how these mechanisms develop from 6 to 8 months of age.

Hypothesis 1 – ToM representation will require input from perception and memory fields. The ToM task involves perception of target object, and visual perception of the object shape and color, and perception of the actor’s emotion. It was hypothesized that these fields send input to short-term memory, which is connected to long-term memory of object characteristics (i.e., name, color, and shape).

Hypothesis 2 – A ToM field will receive input from emotion and short-term memory fields. We hypothesize that the ToM system will engage when 2 peaks are sustained, driven by visual perception and mental state integration. ToM representation occurs with the discrimination between conditions congruent and incongruent with mental state expectations. Excitatory Gaussian interaction peak strength is anticipated to increase with development (6 < m < 8 m). In addition, because incongruent conditions should engage both peaks, these excitatory Gaussian interactions were also adjusted (Congruent < Incongruent).

2. DNF methods

As a preliminary analysis, custom models were generated using COSIVINA (Institut für Neuroinformatik, Ruhr-Universität Bochum), a MATLAB toolbox designed to create DNF architectures. Fields were allowed to interact by sending preliminarily input to other fields. Model simulations were based on prior work using DNF as a class of bistable neural networks that modulate over time (Amari & Arbib, 1977; Erhagen & Schöner, 2002).

According to the spatial precision hypothesis (Schutte, Spencer, & Schoner, 2003), peak strength will become stronger over development. At early stages of development (dashed line), the strength of activation is weak and broad. During later stages of development, neural field peaks are narrow and stronger, which means the activation is more easily sustained.

Future directions

Dynamic interactions will be added to the preliminary models generated above. In this way, in addition to describing activation level, the stability (e.g., duration of above-threshold activation) of self-sustaining activation peaks will be measured.

Quantitative model fit

Infants participated in a longitudinal event-related potentials (ERP) and simultaneous eye-tracking (ET) study at both 6- and 8-months of age. Both brain and behavioral measurements will be used to assess quantitative fit at across development.