

Sticky mittens reaching experience: Linking behavioral changes to potential neural correlates

Background

- Scaffolded reaching experience at 3 months using Velcro covered mittens (i.e., “sticky mittens”) can have cascading effects on grasping, object manipulation, and face preference^{1,2}.
- Individual differences in other motor skills, such as crawling³ or walking⁴, are related to differences in EEG coherence (a measure of synaptic connectivity between neural regions)⁵⁻⁷. Specifically reduced coherence is associated with greater motor experience.
- The development of reaching and grasping alters infants attention to faces^{2,8}. Neurally, enhanced processing of face related stimuli has been associated with increased amplitude of the negative central (Nc) ERP component measured via EEG^{9,10}.
- Aim:** Investigate the cascading effects of infant motor experience at the neural level using the sticky mittens paradigm with EEG coherence and Nc ERP as measures of neural reorganization and processing of social stimuli.

Methods

- Participants:** 9 non-reaching, typically developing 3-month-old infants.
- Study Design:** Infants participated in an initial lab visit, completed behavioral and EEG tasks, and were randomly assigned to a reaching experience group. Participants then returned for a follow up visit. EEG data was collected using a 64-channel Geodesic Sensor Net (Electrical Geodesics Inc., Eugene, OR). See **Figure 1** for study design.

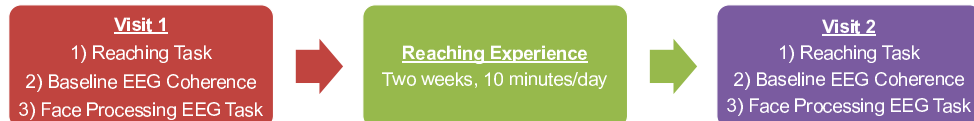


Fig.1. Study design.

- Reaching Task:** Participants completed a 4 step reaching task¹¹. Videos were coded offline and evaluated for percent of time looking at the experimenter in Step 1, and number of looking episodes to the toy in Step 4 in accordance with previous studies¹¹.
- Baseline EEG Coherence:** 1 minute baseline where experimenter blows on a pinwheel while participant observes. Power for the 3-5 Hz frequency band was computed and coherence between left frontal to central sites was analyzed. Higher coherence (closer to 1.0) indicates greater synaptic connectivity between regions, lower coherence (closer to 0) indicates greater neural efficiency or regional differentiation⁵⁻⁷.
- Face Processing EEG Task:** Infants were presented with static images of 3 female faces from the NimStim database¹² presented 500ms for 60 trials (1000 ms interstimulus interval). Mean amplitude of the Nc ERP was examined at fronto-central sites within a 300-600-ms time window.
- Reaching Experience:** Infants were randomly assigned to different reaching groups: active training (AT, **Figures 2 and 3**) or passive training (PT, **Figure 4**).



Fig.2. Example of AT mittens and toys.



Fig.3. Example of AT mittens sticking to toys.



Fig.4. Example of PT mittens and toys.

Preliminary Results & Discussion

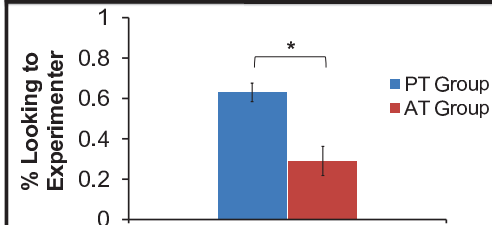


Fig. 5. Reaching Task Step 1 Replication

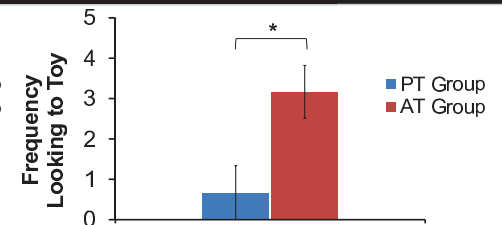


Fig. 6. Reaching Task Step 4 Replication

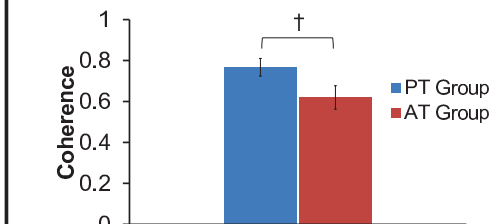


Fig. 7. Post-training left hemisphere frontal/central coherence
† $p = .07$

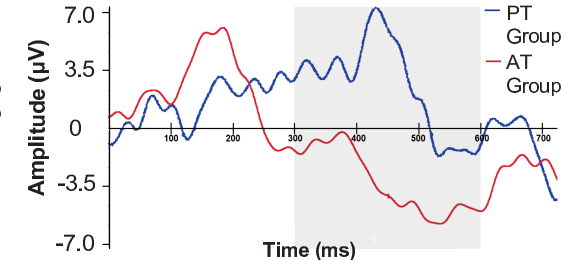


Fig. 8. Post-training Nc Response to Faces

- Reaching Task:** The AT Group spent less time looking at the experimenter than the PT group during Step 1. The AT Group looked more frequently at the toy compared to PT Group during Step 4 (**Figures 5 and 6**, $ps < .05$).
- Coherence:** AT Group infants had lower levels of left-hemisphere frontal/central coherence compared to the PT Group post training (**Figure 7**, $p = .07$).
- Nc amplitude:** AT Group infants displayed reduced mean Nc amplitude between 300 and 600 ms over the fronto-central sites (**Figure 8**, shaded region) compared to PT Group infants when viewing neutral faces.

Take-Home Points

- ✓ Preliminary results replicate behavioral data from previous sticky mittens studies⁷, suggesting initial behavioral differences between groups following training.
- ✓ Initial data indicate decreased synaptic connectivity between frontal and central regions for the AT Group compared to the PT Group post-training suggesting greater neural efficiency or regional differentiation.
- ✓ Decreased Nc amplitude from preliminary results suggests that social stimuli (i.e., faces) maybe more salient and processed at a greater level in the AT Group compared to PT Group.
- ✓ **Future Directions:** Data collection is ongoing, with future analyses including additional EEG measures such as mu-desynchronization.

References and Acknowledgements

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¹⁰ Parise et al. (2010), DOI: 10.1016/j.neuropsychologia.2009.10.012
¹¹ Libertus & Needham (2011), DOI: 10.1111/j.1467-7687.2011.01084.x
¹² Tottenham, N. et al. (2009), DOI: 10.1016/j.psychres.2008.05.006

Supported by NIH/NIGMS R25GM061347 to SLG and CCF Intramural Awards to ELN and BRS. We would like to thank the families who have participated in this study for their time. For more information about our studies visit: hands.fiu.edu and bbdl.fiu.edu
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