Parent-Child Interaction Study: A Preliminary Report

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INTRODUCTION

➤ Children with autism spectrum disorder (ASD) have significant social communication impairments that interfere with everyday life skills [1].

➤ There is limited research regarding the role of parent-child interaction on extrinsic emotional regulation in autistic children.

➤ The goal of this project is to identify neurobiological differences between two groups of dyads (autistic children and their parents versus typically developing children and their parents) during a free-play session.

MATERIALS & METHODS

➤ **Participants**: 27 parent-child pairs with children between the ages of four and eight (15 neurotypical children and 12 children with autism). Each pair participated in one visit.

Figure [1]
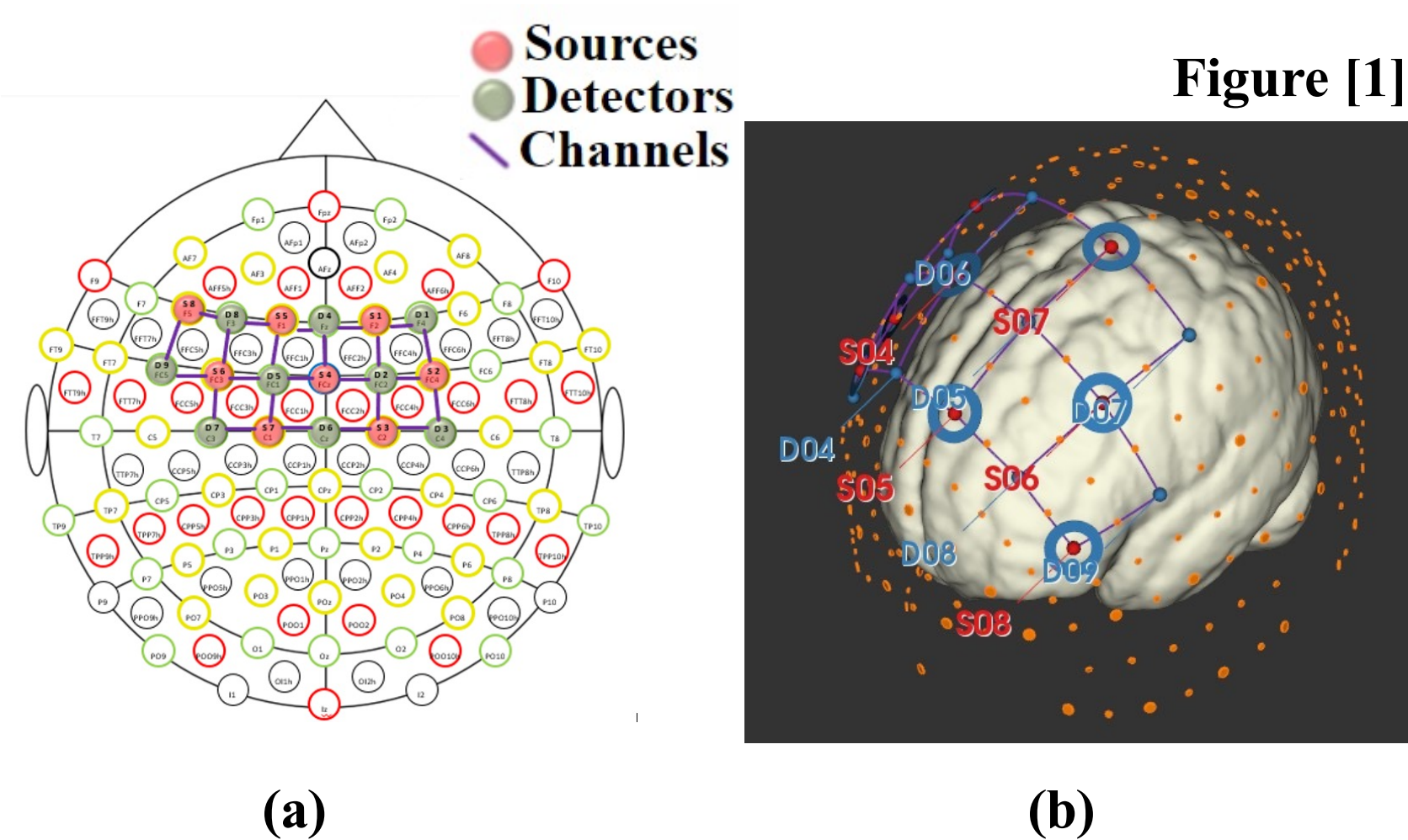
(a)   **(b)**

Figure 1 (a) shows the montage of 8 sources represented by light red circles, 10 detectors represented by green circles, and 25 channels of interests represented by purple lines; (b) shows the three-dimensional (3D) layout of sources and detectors on a 3D rendered ICBM-152 MNI head model.

➤ **FNIRS Design**: The montage was generated for 8 sources and 10 detectors (**Figure 1**). Easycap spring loaded grommets were used to secure sources and detectors. The properly fitting Easycap was placed on the participant's head while they were seated comfortably, prepared to play with their child (**Figure 2**).
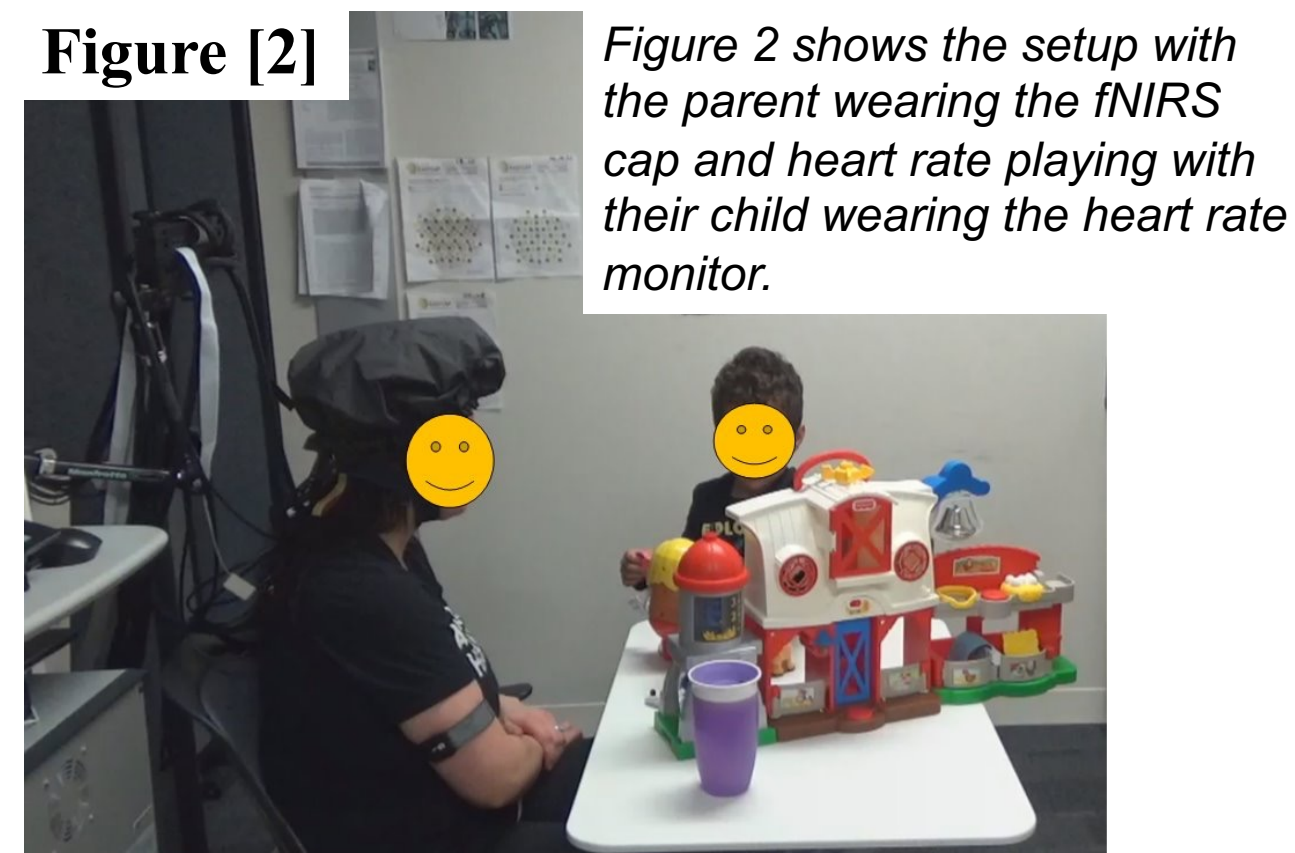
Figure [2]

Figure 2 shows the setup with the parent wearing the fNIRS cap and heart rate playing with their child wearing the heart rate monitor.

➤ **FNIRS Device:** FNIRS utilizes near-infrared light to measure changes in blood oxygenation due to neurovascular coupling in the brain [2].
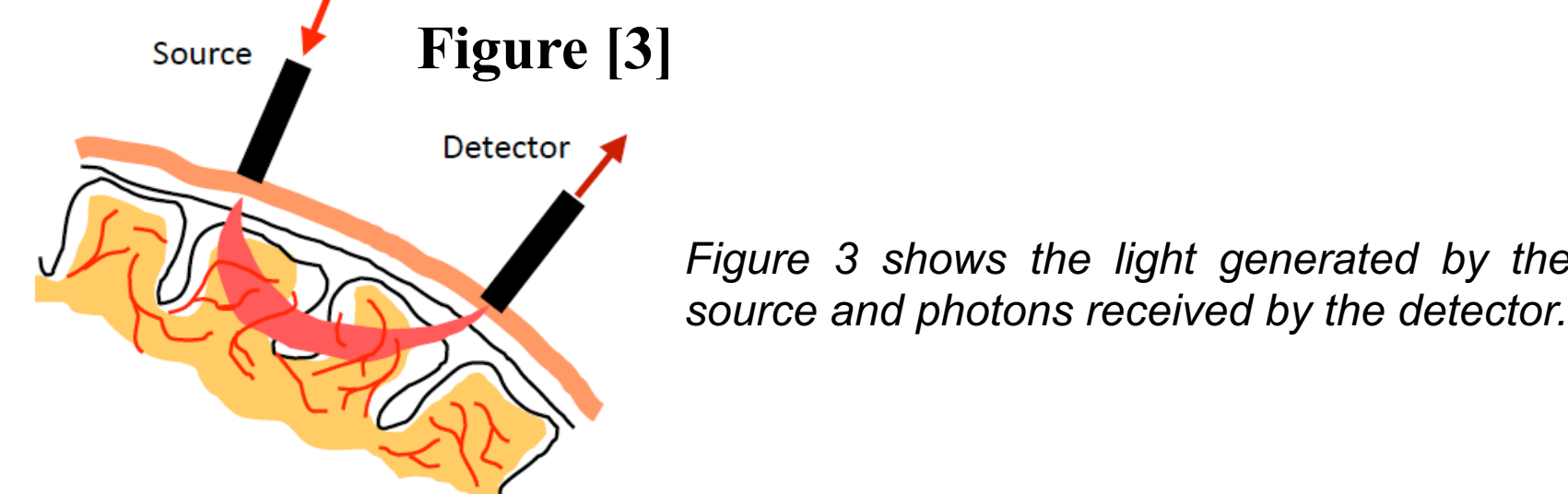
Figure [3]

Figure 3 shows the light generated by the source and photons received by the detector.

➤ **Procedure**: The parent and child wore the Polar Verity Sense optical heart rate monitor on their upper arm or forearm before the free-play session started. Only their parents wore the fNIRS cap during the free-play session, which lasted about twenty-five minutes. After the play session, the parents watched a fixation cross on a computer screen for ten minutes while their resting-state fNIRS data were collected.
All parents filled out a list of questionnaires, including a basic demographics form, Children's Behavior Questionnaire (CBQ), Coping with Children's Negative Emotions Scale (CCNES), and Caregiver Strain Questionnaire (CSQ). The parents with autistic children also completed the Cambridge University Behavior and Personality Questionnaire For Autistic Children [3].
For all children, the Kaufman Brief Intelligence Test 2nd edition (KBIT-2) [4] was administered.

➤ **Data Analyses**: All behavioral data were scored and summarized using descriptive statistics. The heart-rate data were averaged for each group. The raw fNIRS data were first preprocessed. Figure 4 shows the preprocessed waveform in orange versus the raw data in blue. All videos were coded for parental sensitivity/responsiveness [5].
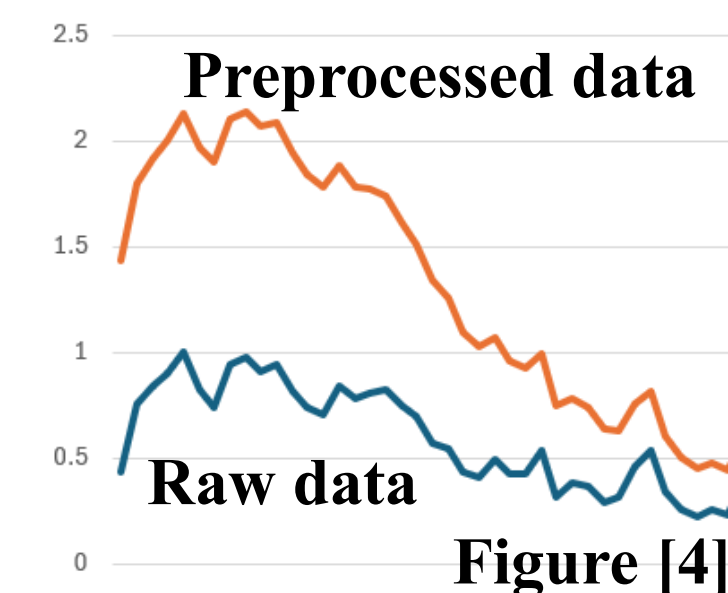

Preprocessed data

Raw data

Figure [4]

Figure 4 shows an example of raw versus preprocessed fNIRS time series data.

➤ **Plan for Further Analyses:** (1) Heart-rate data analyses (e.g., variability between dyads and between groups, entropy measures). (2) FNIRS data group level analyses: oxygenated hemoglobin changes (HbO) and functional connectivity analyses among all pairs of channels. (3) Brain-behavior correlation (e.g., behavioral measures of parents correlate to HbO data, behavioral measures of children correlate to parents' brain data. (4) Video coding for children's behavior (e.g., engagement).

RESULTS

Table 1	Age	Sex	KBIT2	CBQ_AN	CCNES_DR	CSQ_GS	Parental Sensitivity
Parents in Autism group (**N = 12**)	39.9	2 males	N/A		2.3 *	6.8 *	4.3
Parents in Control group (**N=15**)	37.9	4 males			3.0 *	4.4 *	4.0
Children in Autism group (**N=12**)	6.94	8 boys	107.8 *	5.3 *	N/A		
Children in Control group (**N = 15**)	6.51	8 boys	83.8 *	4.4 *			

Both groups of parents and children didn't show significant differences in age or sex ($p > 0.05$). KBIT2 in Table 1: composite standardized scores, two children in the autistic group could not complete the assessments. Autistic children had significantly lower KBIT2 composite IQ scores than their peers ($p = 0.007$). * denotes significant group differences. CBQ_AN: Amount of negative affect related to interruption of ongoing tasks or goal blocking ($p = 0.028$), CCNES_DR: reflect the degree to which parents experience distress when children express negative affect ($p = 0.005$). parents CSQ_GS: quantify parents' strain level ($p = 0.012$). Parental sensitivity: ($p = 0.279$).

CONCLUSION

➤ This is an ongoing study. Data collection and analyses are still in progress. The neurobiological data were successfully collected, and the feasibility of using fNIRS and heart rate data to track physiological changes during a free-play session was demonstrated in this poster. At this moment, we don't want to draw any conclusion yet since all results are preliminary.

➤ Future work will focus on testing the following hypotheses: (a) parents with autistic children had higher cognitive load than parents with typically developing children during free play. (b) autistic children had higher heart rate variability than their typically developing peers. (c) autistic children's engagement with parents is lower than their peers.

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