

Simultaneous Electroencephalography (EEG) Measurements in Children with Neurodevelopmental Disabilities, their Mothers, and Music Therapists

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Introduction

Background / Rationale

- Child/youth with disabilities encounter difficulties in communication which may lead to social isolation as well as limited independence throughout their lifetime.¹
- Research using Electroencephalography (EEG) has investigated the idea that empathy, the essential emotion for social interaction, may be reflected in interpersonal brainwave synchronizations.^{2,3,4,5}
 Research using EEG has suggested that music, particularly music preference influences non-verbal individuals in terms of awareness and emotion arousal.^{6,7}

Methods

Procedure

- 15 mins music session
- Music Therapists played guitar and sang child's favorite songs

Results

RQ1. Frequency bands



Research Questions

- 1) Are there significant differences in the strengths of brainwave synchronization in frequency bands (delta, theta, alpha, beta, gamma)?
- 2) Are there significant differences in the strengths of brainwave synchronization in brain regions (frontal left, frontal right, central left, center, central right, posterior left, and posterior right)?



EEG Data Collection

- Child-Mother (CM) Dyads: 32 channels
- Child-Music Therapist (CT) Dyads: 20 channels

Data Analysis Process

- CM Dyads
- No significant differences between frequency bands, F (1.052, 6.314) = 3.62, p = .10
- Delta bands (M = .28, SD = .05) were higher than other frequency bands.
- > CT Dyads
- Significant differences in frequency bands, F (1.377, 8.263) = 491.73, p < .001
- Post-hoc test with Tukey HSD adjustment:
- Beta (*M* = .15, *SD* = .001) and gamma (*M* = 0.14, *SD* = .001) was significantly lower than delta (*M* = .21, *SD* = .006), theta (*M* = .22, *SD* = .005), and alpha (*M* = .22, *SD* = .006), all *p* < .001.

0.25

RQ2. Brain regions

Posterior right -	0.237183
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* The parents were sitting in a partitioned area during the sessions

Participants

Child / Youth participants (Age: M = 13.14, SD = 2.73)

Statistical Analysis

- RQ1: One-way repeated ANOVA for differences in frequency bands (delta, theta, alpha, beta, and gamma)
- RQ2: One-way repeated ANOVA for differences
 in brain regions
- Post-hoc test with Tukey's HSD correction

- CM Dyads: Significant differences, F (6, 36) = 3.07, p = .02, but no significant differences in post-hoc tests.
 - High PLV values in frontal areas
- CT Dyads: No significant differences in brain regions, F (6, 36) = .87, p = .53
 - High PLV values in front left and central left

Conclusions

- This is the first study to investigate EEG interbrain synchrony as a potential physiological signature of empathy among children with neurodevelopmental disabilities, their parents and the therapists during music-based interventions.
- May provide therapists/parents to tailor and design appropriate session/care contents based on interbrain synchronization as an objective measurement of the empathy level.

P01	18 (F)	CP	Non-verbal
P02	11 (M)	CP	Non-verbal
P03	11 (F)	ASD	Verbal
P04	12 (M)	ASD	Non-verbal
P05	12 (M)	ASD	Non-verbal
P06	16 (F)	ASD	Verbal
P07	12 (M)	ASD	Verbal

- Parents and Neurologic Music Therapists
- No known history of neurological or psychological illness

- CM: 1 (frontal right): Fp1, AF2, F3, F7); 2 (frontal left): Fp2, AF4, F4, F8); 3 (central left): FC5, C3, T3, Cp1, Cp5, Tp9); 4 (center): Fz, Cz, Pz, Poz; 5 (posterior left): P3, T5, Po7, O1); 7 (posterior right): P4, T6, PO8, O2
- CT: 1 (frontal right): Fp1, F3, F7; 2 (frontal left): Fp2, F4, F8; 3 (central left): C3, T3; 4 (center): Fz, Cz, Pz, Poz; 5 (central right): C4, T4; 6 (posterior left): P3, T5, O1; 7 (posterior right): P4, T6, O2

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