The Effects of Auditory Integration Training (AIT) on Mismatch Negativity in Children with Autism

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Introduction & Background

➤ Autism is a neurological developmental disorder present in 1 of 88 children.
➤Visible symptoms of autism include lack of social interaction, communication , and restricted range of interests.
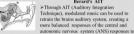➤ Children with autism have atypical psychophysiological reasponses both of central and autonomic nervous system activity.

Auditory Evoked Potentials (Mismatch Negativity)

➤ Children with autism are featured by sensory over-sensitivity including excessive reactivity to sounds
➤ Reactivity to sound can be measured using auditory evoked potentials recorded during presentation of the sounds of different frequency and recording EEG responses
➤ Mismatch Negativity (MMN) is one of the early auditory potentials reflecting differences of evoked potentials between rare (20%) and frequent (80%) sounds.
➤ MMN is typically recorded at the fronto-central EEG recording sites and represents a difference wave (rare-minus-frequent) occurring within 130 – 190 ms post-stimulus
➤ Along MMN other fronto-central evoked potentials (P2a and P3a) are related to processing auditory stimuli and detecting frequency differences
➤ The aims of the AIT part of the study was application of Berard's AIT techniques in children in autism and monitoring MMN, P2a, and P3a changes following AIT course.

Rationale behind Auditory Integration Training

Berard's AIT

➤Through AIT (Auditory Integration Technique), modulated music can be used to retrain the brains auditory system, creating a more balanced responses of the central and autonomic nervous system (ANS) responses to sounds.
➤Auditory integration training, as developed by French otolaryngologist Guy Berard and based on the work of his predecessor, Alfred Tomatis, typically consists of 20 half-hour sessions of listening to specially modulated music over a 10- to 20-day period. AIT has been reported to be beneficial in several conditions, including autism, ADHD, dyslexia, and hypersensitive hearing at certain frequencies.

Methods of EEG recording and AIT procedure

➤EEG data were acquired with a 128 channel Electrical Geodesics system (v. 200) consisting of Geodesic Sensor Net electrodes, Net Amps, and Net Station software (v. 4.0) [Electrical Geodesics Inc., OR]. EEG data are sampled at 500 Hz, 0.1-100 Hz analog filtered.
➤All stimulus presentation and behavioral response collection were controlled by a PC running E-prime software [Psychology Software Tools, PA].

Mismatch Negativity (MMN) is one of the early auditory potentials reflecting differences of evoked potentials between rare (20%) and frequent (80%) sounds. Test take 10 min to complete.

Administration of Bernard's Auditory Integration Technique (AIT)

➤_Patients were given MMN test pre and post Auditory Therapy
➤Patients were given Audiograms pre and post AIT.
➤ AIT was administered through the Earducator.
➤Patients listened to modulated music in association with audiogram results for 30 minute sessions, twice a day for 10 days.

Procedure for AIT with autonomic recording

Earducator

Methods: ANS Activity Measurements during AIT Audiometry and Behavioral Evaluations

Measurement of physiologic data from the therapeutic techniques

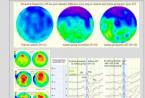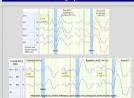➤The auditory evoked potentials were recorded pre and post-AIT course using EGI EEG system.

Audiometry was used to set filters

Measurement of Behavioral Changes

➤Comprehensive Performance Index (CPI) and Aberrant Behavior Checklist (ABC) behavior survey were administered to patients pre and post therapeutic sessions.

Subjects

➤ In this study, we investigated evoked potentials before and after AIT in children between the ages of 5 and 21 (N=12 in AIT, mean age 13.7 yrs, SD=4.2). There were 2 girls in in AIT group.
➤14 control subjects were used for evoked potential (EEG) measurements in Mismatch Negativity test (mean age 14.9, SD=3.3).
➤ Participants with ASD were recruited from across the U.S. through the Weiskopf Child Evaluation Center and FEAT and were evaluated by Dr. Lonnie Sears to confirm autism diagnosis (DSM-IV, ADI-R)
➤ Participants were both high and low functioning autistic children.
➤ Participating subjects and their parents (or legal guardians) were provided with all information regarding the study, and the consent and assent forms approved by the IRB were reviewed and signed.

Results: 2D topo plots and ERP changes post-AIT

Results: MMN changes post-AIT in autism

Aberrant Behavioral Changes after AIT

Results: Comprehensive Performance Index Changes after AIT treatment course in autism

Baseline and Post AIT MMN in autism, and controls

Summary of Results

Auditory Integration Training effects
➤ Berard's AIT resulted in significant decrease of Irritability, Hyperactivity, Lethargy scores, and improved Emotion, Behavior and Receptive Language Scores on CPI.
➤ AIT improved audiograms in most children enrolled in the study
➤ Auditory evoked potential test of Mismatch Negativity (MMN) conducted at baseline and after AIT showed lower MMN (F=5.29, p=0.035), and significant decrease of the frontal P2a component (F=4.71, p=0.041 and longer latency of P2a (F=5.53, p=0.028), while the frontal and fronto-central P3a component showed amplitude decrease (F=9.22, p=0.006) without any latency changes.
➤ Comparison of auditory MMN test results between typical children and children with autism showed significant differences in MMN amplitude (higher in autism, F=4.75, p=043), P2a amplitude (higher in autism, F=5.65, p=0.03), P2a latency (shorter in autism, F=4.98, p=0.039), and amplitude and latency of P3a (smaller and prolonged in autism, F=5.31, p=0.033).