Resting EEG power and coherence in children with autism, Williams’ Syndrome, and specific language impairment

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Introduction

EEG power and coherence analyses have emerged as a method to examine functional connectivity. Previous studies (Muir et al., 2007) have demonstrated that children with autism spectrum disorder (ASD) have abnormal patterns of EEG power and coherence, suggesting a pattern of underconnectivity of long-distance cortical areas, but spared or even excessive local connectivity. Functional connectivity studies of this type are not yet common in other populations, however. As part of an ongoing project to examine the neural and cognitive underpinnings of various developmental disorders, we recorded resting eyes-open EEG from typically developing (TD) children and children with ASD, specific language impairment (SL), or Williams Syndrome (WS). All children had normal or corrected auditory and visual acuity and English as their primary language. In addition:

- TD: Normal history, scores on standardized tests of intelligence, language & academic function, and neurological exam
- ASD: Meet DSM-IV criteria using ADOS and/or ADI-R
- SL: CELF-4 Expressive Language composite at least 1.5 standard deviations below average; nonverbal IQ ≥ 85
- WS: Meet AAP criteria, diagnosis confirmed by medical geneticist

Participants

Children between the ages of 7 and 12 were screened for inclusion in the following groups: typically developing children (TD), children with autism spectrum disorder (ASD), specific language impairment (SL), or Williams Syndrome (WS). All children had normal or corrected auditory and visual acuity and English as their primary language. In addition:

- TD: Normal history, scores on standardized tests of intelligence, language & academic function, and neurological exam
- ASD: Meet DSM-IV criteria using ADOS and/or ADI-R
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Method

- Participants were instructed to sit quietly and look at an idle computer monitor; one or two 3-minute stretches of continuous EEG from 66 scalp electrodes, sampled at 256 Hz, was collected per participant
- Data was high-pass filtered offline at 0.5 Hz, and the continuous EEG was segmented into 1-second epochs
- Epochs containing artifacts were rejected prior to analysis
- Spectro-temporal analysis, a Matlab-based function from the EEGLAB toolbox, was used to obtain power spectra at each electrode
- Visually, the coherence was calculated for each pair of electrodes at each frequency between 3-40 Hz
- Bootstrap distributions were calculated for the following comparisons: TD vs. ASD, TD vs. SL, TD vs. WS

Results and Conclusions

- ASD children showed reduced coherence in the low alpha band (7-10 Hz) when compared to TD children, with the difference concentrated over frontal, central, and parietal sites.
- ASD children showed increased coherence compared to TD children in beta and low gamma ranges.
- WS children showed increased coherence compared to TD children across a wide range of frequencies. Distribution differences in various frequency bands may indicate regional differences in connectivity.
- SL children showed coherence differences compared to TD children in only two narrow frequency bands. This finding may not be stable, however, due to the small sample size.