

THE ATYPICAL GAMMA RANGE EEG IS NOT EXPLAINED BY DEVELOPMENTAL DELAY IN YOUNG CHILDREN WITH AUTISM SPECTRUM DISORDER

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Background

It has been suggested that the cortical brain activity of children with autism spectrum disorder (ASD) would show an imbalance between excitation and inhibition, which may be reflected in atypical gamma activity in EEG. The previous research have showed abnormalities in gamma band activity in children with ASD when compared with typically developing children. However, there seems to be age-related changes in gamma band activity during the development, and the developmental level of children with ASD has been shown to correlate with abnormalities in gamma band activity. Thus, it is not clear, whether the abnormalities found in previous studies could be better explained by developmental delay than ASD.

Methods

20 children with ASD, 20 typically developing children (TD) matched with chronological age and 18 children with developmental delay (DD) matched with developmental age were recruited for the study. The final sample consisted 15 with ASD, 16 TD, and 14 DD children (tables 1 and 2). The rest were rejected due to refusal (1 ASD and 1 TD child) or excess of motor movements.

Baseline EEG was recorded with *HydroCel Geodesic Sensor Net* with 128-channels while the children were watching a 3 minute video (figure 1).

Based on a visual video analysis, all children watched mostly the hands and blocks during the measurement. The children with ASD looked less the face of the person than TD ($U = 25.00, p < .001$) or DD children ($U = 60.00, p = .050$), but no correlation between looking at the face and gamma-activity was found ($r_s = -.21, p = .172$).

Only segments without movements or other distractions were analyzed. The gamma band activity (24.4.- 44.0 Hz) was analyzed in central and parietal areas, which are least likely to be contaminated by myogenic artefacts. The similar analysis was also run for beta (13.2 – 24Hz) and gamma 2 (56.0 - 70.0Hz) range. The level of autistic symptoms was measured with ADOS-2 and ADI-R in children with ASD. The ADOS-2 comparison score and the SUM of ADI-R domains was used in the analysis.

Objectives

This study aimed at investigating whether the baseline gamma band EEG is atypical in children with ASD, and whether the abnormalities are related to developmental delay or autistic symptoms.

Children with ASD were compared to typically developing children as well as children with developmental delay without ASD. In addition, we investigated whether the level of autistic behaviour correlates with gamma band EEG.



Fig 1: During the measurement the child watched a video with a female building and unbuilding a block tower.

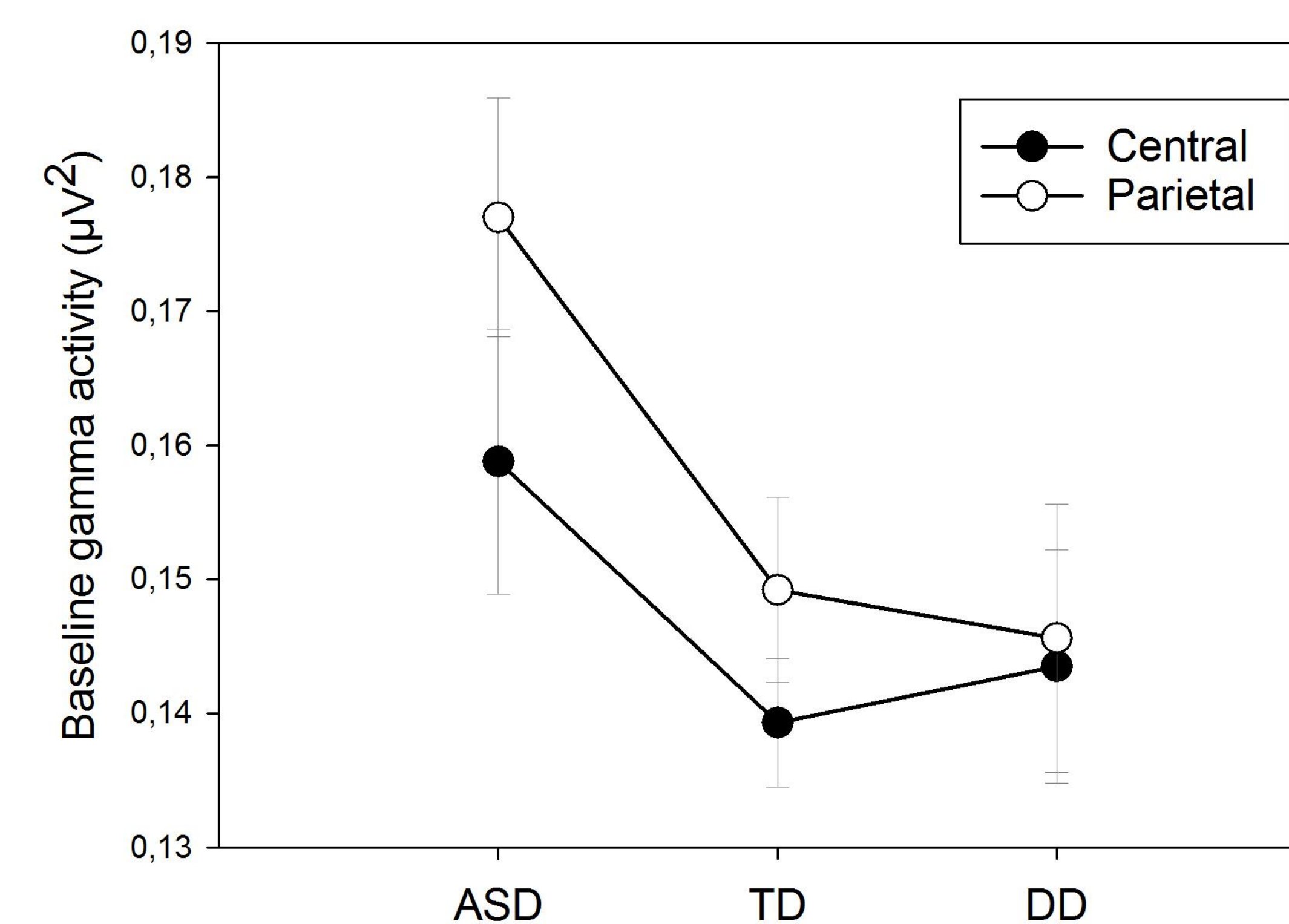


Fig 2. Baseline gamma activity

Results

The split-plot ANOVA [Brain area (2) x Group (3)] on gamma activity showed a significant main effect of Group [$F(2,42)=3.276, p=.048, \eta p2=.135$]. The gamma activity was significantly higher in ASD Group, when compared to TD ($p=.029$) or DD group ($p=.036$). The gamma activity between TD and DD groups did not differ. Activity was higher on parietal than on central areas [$F(1,42)=5.709, p=.021, \eta p2=.120$], but there was no interaction between brain area and the Group. There were no effects of the group for beta or gamma 2 -activity. The correlation between gamma activity on central brain areas and ADOS-2 comparison scores in ASD group was marginal ($r_s = .487, p=.066$). The more autistic symptoms the child exhibited in ADOS-2, the higher was the gamma activity. No significant correlations were found between gamma activity and ADI-R scores.

Table 1: Participant characteristics

	ASD	TD	DD
Gender (boys/girls)	13/2	13/3	11/3
Chronological age	3.9 (2.5-5.3)	4.2 (2.4-5.8)	4.6 (3.5-6.2)
IQ	64 (45-88)		61 (50-79)
SCQ (cut-off 15)	18 (5-27)	3 (0-7)	8 (2-18)

Table 2: ADOS-2 and ADI-R scores in ASD group

	ASD
ADOS-2 comparison score (high level of symptoms 8-10)	8 (6-10)
ADI-R: Reciprocal social interaction (cut-off 10)	20 (10-28)
ADI-R: Communication: Verbal (cut-off 8)	17 (15-20)
Nonverbal (cut-off 7)	11 (7-14)
ADI-R: Restricted, repetitive & stereotyped patterns (cut-off 3)	7 (3-12)

Conclusions

The present study supports previous studies by showing that the gamma band activity is higher in children with ASD than in typically developing children. Moreover, this finding seems to be specific to autistic psychopathology and not related to developmental delay per se. According to our results, the children with ASD showed higher gamma activity also when compared to children with developmental delay but without ASD. Some indications were found that the severity of autistic symptoms might be associated with gamma band activity. These findings suggest that the gamma band activity could be considered as one of the potential diagnostic markers for autism.