40 Hz ASSR in the left hemisphere is associated with language development in children with Autism Spectrum Disorder: An MEG study

Vardan Arutiunian[1], Giorgio Arcara[2], Militina Gomozova[1], Irina Buyanova[1], Elizaveta Davydova[3], Darya Pereverzeva[3], Alexander Sorokin[3,5], Svetlana Tyushkevich[3], Uliana Mamokhina[3], Kamilla Danilina[3], Olga Dragoy[1,4]
vardan.arutyunyan89@gmail.com

[1]Center for Language and Brain, HSE University, Moscow, Russia; [2]IRCCS San Camillo Hospital, Venice, Italy; [3]Federal Resource Center for ASD, Moscow State University of Psychology and Education, Moscow, Russia; [4]Institute of Linguistics, Russian Academy of Sciences, Moscow, Russia; [5]Haskins Laboratories, New Haven, United States of America

Introduction

- Abnormal language development occurs in most children with Autism Spectrum Disorder (ASD), although language impairment is not a core symptom of ASD.

- Neural mechanisms of language impairment in ASD are still poorly understood.

- Cortical gamma-band abnormalities are considered by some authors as one of the common pathophysiological mechanisms in ASD.

Objectives

- The goal of the present study is to investigate whether auditory gamma oscillations, measured with 40 Hz Auditory Steady-State Response (ASSR), is related to language development in children with ASD.

Methods

- 40 children participated in the study: 20 children with ASD (5 girls, age range 8–14), varying in non-verbal IQ (range 40 – 125), and a control group of 20 typically developing children, TD (9 girls, age range 7–12).

- Language abilities were measured with the Russian Child Language Assessment Battery; non-verbal IQ was screened with the Kaufman Assessment Battery for Children - II, and Wechsler Intelligence Scale for Children – Third Edition; the severity of autistic traits was measured with the Autism Spectrum Quotient: Children's Version, AQ.

- Stimulus: 1000Hz pure tone with 1000 ms duration and 40Hz amplitude modulation (90 repetition).

(b)

Time (ms)
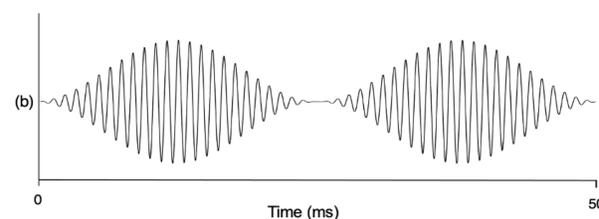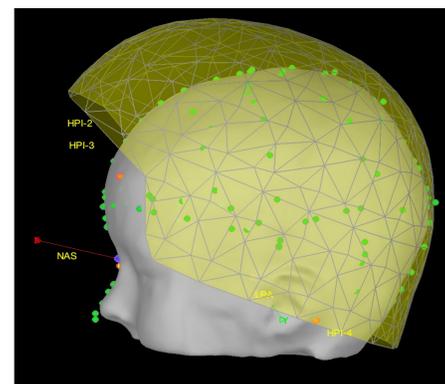
Results

- We estimated MNI coordinates of ASSR response (x, y, z) for 2 groups of children, and there were no any differences in the sources of response.

- Linear-mixed effects model with nested contrast (ASD vs. TD):
  mod <- lmer(ITPC ~ 1 + Hemisphere/Group + + (1 | ID), data = ASD, control = lmerControl(optimizer = "bobyqa")).

- Spearman's correlations (ITPC ~ Language, IQ, AQ, ADOS, Age) for both hemispheres.

- Only Language score correlated with ITPC and only in the left auditory ROI ($R = 0.56, p = 0.008$).

Left Hemisphere   **Right Hemisphere**

TD

ASD

TD

ASD
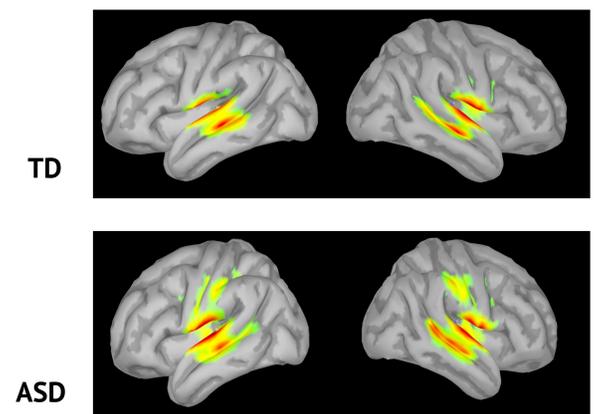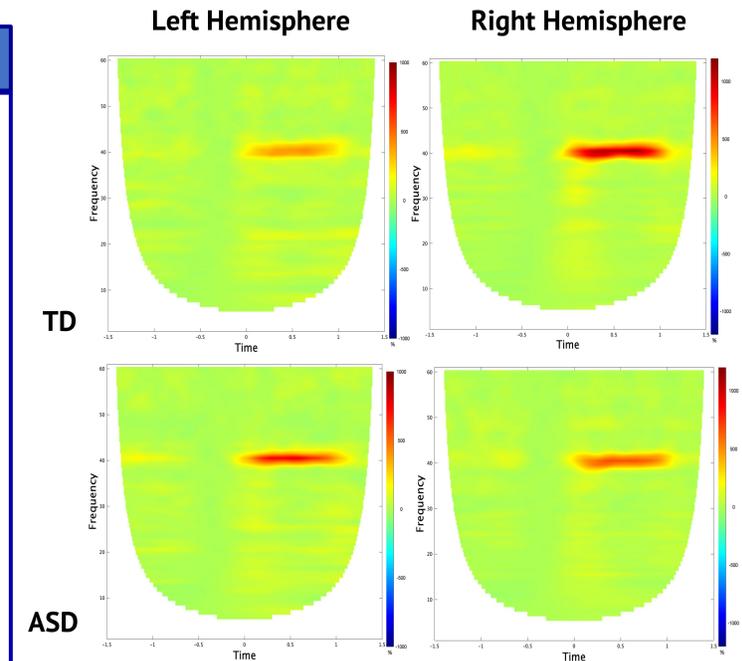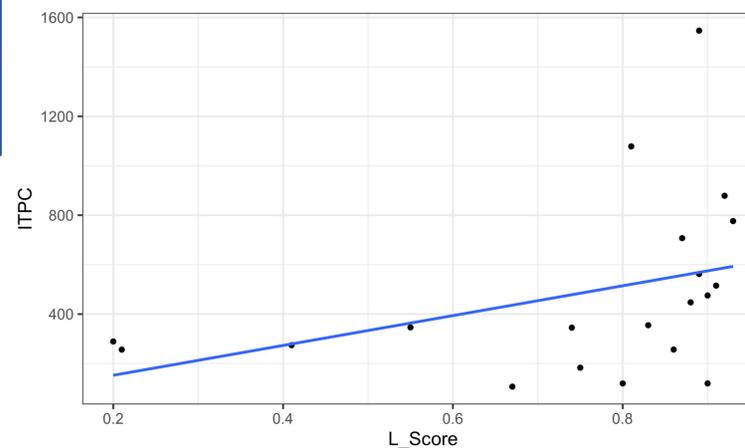
Fixed effects:

	Estimate	Std. Error	df	t value	Pr(>|t|)	
(Intercept)	499.05	59.84	38.00	8.340	4.1e-10	***
Hemisphere1	-17.17	38.07	38.00	-0.451	0.65462	
HemisphereLeft:GroupTD	-151.09	100.30	64.44	-1.506	0.13686	
HemisphereRight:GroupTD	285.91	100.30	64.44	2.850	0.00586	**

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1