

# The development of auditory gamma synchrony (40Hz ASSR) in typically developing children: An MEG study

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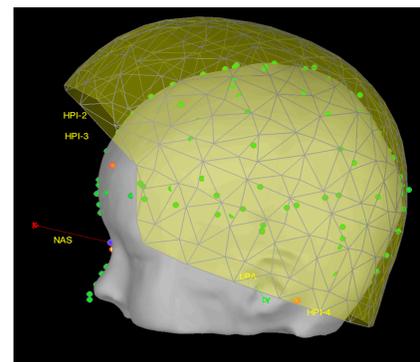
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## Introduction

- One of the reliable ways to register gamma synchrony in the primary auditory cortex is by listening to an amplitude-modulated sound at gamma frequency (~40Hz auditory entrainment or auditory steady-state response, ASSR). ASSR is an auditory evoked potential to modulated sounds.
- 40Hz ASSR is developing during childhood and matured by the early adolescents (Edgar et al., 2016), which is related to the maturation of GABAergic neurotransmission and the development of cortical excitation / inhibition mechanisms, regulated by GABAergic inhibitory interneurons (Bartos et al., 2007; Sohal et al., 2009).
- This mechanism is usually impaired in some neurodevelopmental disorders, such as autism (Rubenstein, Merzenich, 2003; Yizhar et al., 2011). However, Edgar et al. (2016) showed that 40Hz ASSR could not be registered until 11th year of life, concluding impossibility to use it as a biomarker for children with autism younger than 11-year-old.

## The aim of the study

- The aim of the present study was to register 40Hz ASSR in different age groups of children in the left and right Heschl's gyri.
- Here, we present the pilot data, including 6 typically developing children.



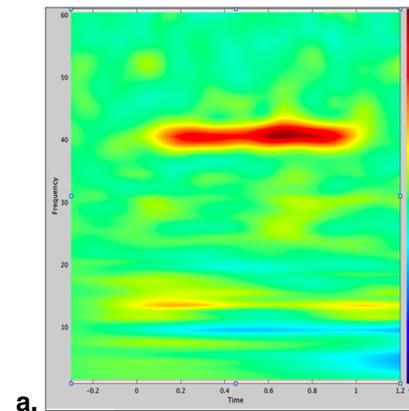
## Method

- 6 typically developing children (range 8–12) participated in the study: one 8-year-old, two 9-year-old, two 10-year-old, and one 12-year-old.
- Non-verbal IQ of children was measured with the Raven's Colored Progressive Matrices, all children were within the normal range.
- Stimulus: 1000Hz pure tone with 1000 ms duration and 40Hz amplitude modulation.
- 306-channel MEG (Elekta Neuromag) and individual MRI of each child for creating realistic head models.
- Source estimation was performed with minimum-norm imaging and normalized with z-score. Time-frequency analysis at the source level was performed with Morlet wavelets (central frequency = 40Hz, time resolution = 0.3 sec.).

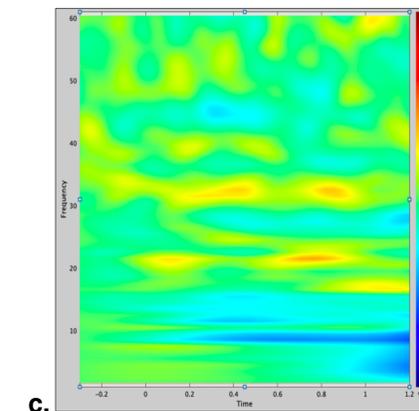
## Results and Conclusion

- We found a clear bilateral both induced and evoked 40Hz ASSR in 10-year-old and 12-year-old children and the absence of this response in younger children (Figure 1).
- This type of auditory gamma cannot be a reliable biomarker of autism for young children. At the same time, in comparison to Edgar et al. (2016), we showed that the clear 40Hz ASSR is already presented in 10-year-olds.

### Left Heschl's gyrus

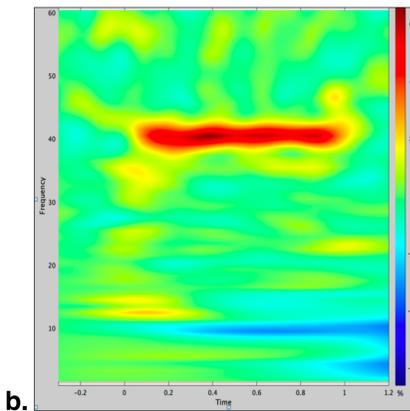


a.

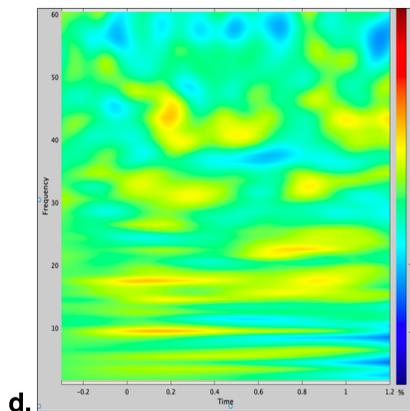


c.

### Right Heschl's gyrus

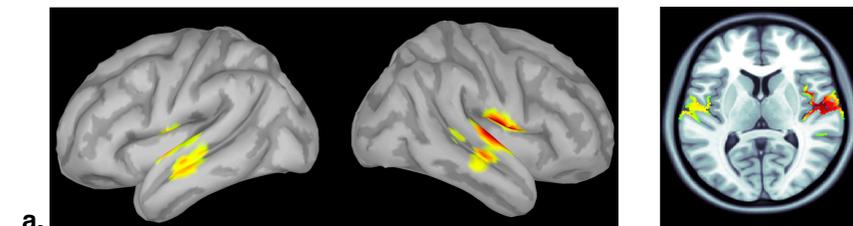


b.

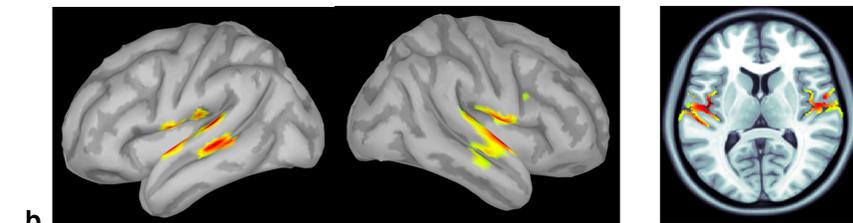


d.

**Figure 1.** Average time-frequency maps for the left and right Heschl's gyri: a) and b) for 10-12-year-old children, c) and d) for 8-9-year-olds.



a.



b.

**Figure 2.** Distribution of cortical activity: a) 10-12-year-old children; b) 8-9-year-olds.