The neurodevelopmental basis of humor appreciation: a fNIRS study of young children

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Introduction

- Humor and a sense of humor is crucial for social development of children
- Given humor's role in development, it is especially important to understand its underlying neural basis and developmental profile
- This study investigated humor appreciation in 6-8 year old children using functional near infrared spectroscopy (fNIRS).

Methods

Participants: 38 typically developing children (18 females, between the ages of 6.1 and 8.7 years.

Task: humor appreciation and comprehension task. 64 short color video clips chosen from two categories: either funny (32 clips) or neutral (32 clips) (Neely et al. (2012) and Vrticka et al. (2013))

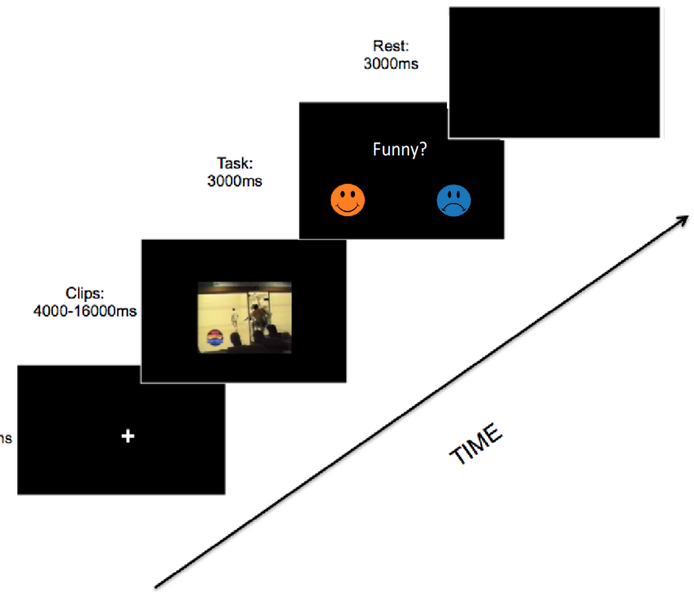
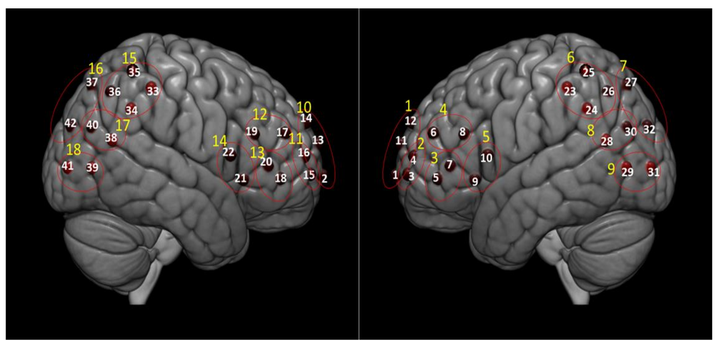


Figure 1. Experimental timeline. Participants viewed short humorous or neutral video clips (4000–16,000 ms) and were given 3000 ms following the clip to indicate with a button press whether they liked or did not like the video clip. Intertrial interval ranged from 500 to 13,000 ms.

fNIRS: 42 channel NIRScout (NIRx Medical Technologies) fNIRS device was used and positioned over left and right PFC, frontal and parietal regions. Functional localization resulted in 18 regions of interest (Sagiv et al., 2019). See Figure 2.

Statistical Analysis: 1-sample t tests to determine whether there was significant brain activation (increased HbO and decreased HbR) in each localization cluster for our contrast of interest (Funny vs. Neutral, FDR corrected for multiple comparisons).

Connectivity analysis: Wavelet Transform Coherence (WTC) was used to assess coherence between regions.



Results

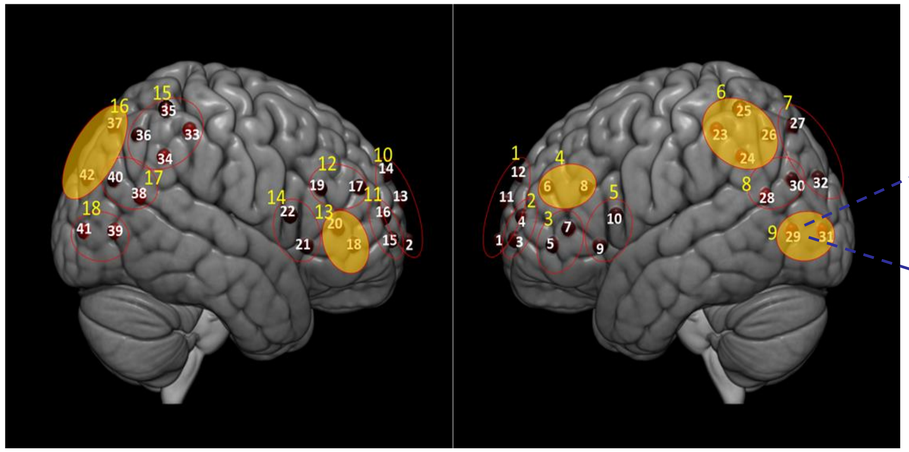


Figure 2. fNIRS channel locations and functional localization into 18 ROIs based on proximity of channels and anatomy. White numbers represent channels and yellow numbers represent ROIs.

fNIRS **funny>neutral** contrast significant results (p<0.05 FDR corrected). ROIs that exhibited both HbO and HbR significant changes for funny>neutral (p<0.05 FDR corrected) included:
left DLPFC (ROI 4)
left IPL (ROI 6)
left TOPJ (ROI 9)
right IFG (ROI 13)
right SPL (ROI 16).

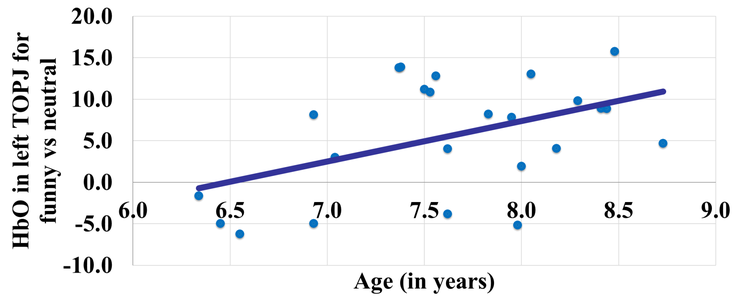
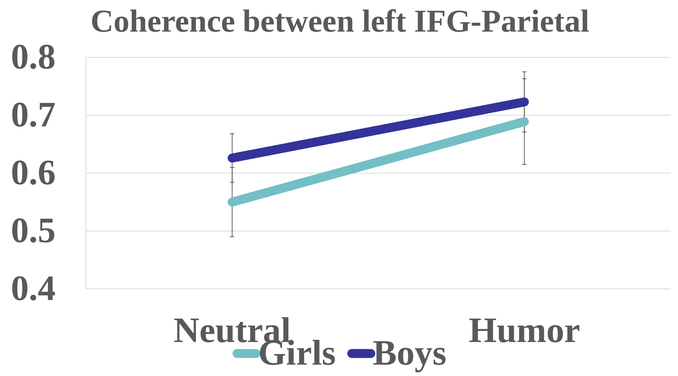
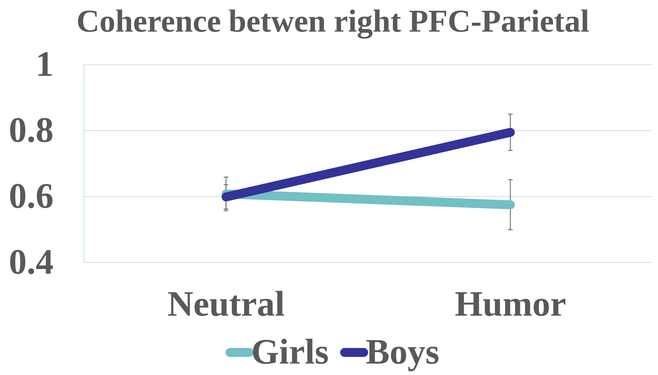


Figure 3. HbO in left TOPJ positively correlated with age

One of the most consistent findings in humor research is observation of TOPJ activation in many types of humor processing in both adults and children. We extend previous results by showing age related changes

Connectivity Results in frontal-parietal network





We also observed different coherence patterns for boys and girls in the right frontal-parietal network. Girls did not show a difference between conditions in connectivity between frontal and parietal regions, while boys exhibited stronger coherence between frontal and parietal regions for the humor condition

Conclusions

The primary aim of the current study was to better understand neurodevelopmental trajectories of humor comprehension and appreciation in young children. Using fNIRS we were able to both replicate previous findings of TOPJ and IFG involvement in humor appreciation in children obtained with fMRI and emphasize the association with age and gender differences in development.