Increased Connectivity in Default Mode and Salience Networks in Video Game Players: A rsfMRI Study Using Task-Based (tfMRI) Data

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Introduction

Video games have become an increasingly popular past time and with its growing popularity it's important to study the long-term impacts of video game play on our brains. While previous works have shown that habitual game play leads to changes in the Default Mode Network (DMN) and Salience Network (SN) [1], our study aims to expand this scope to include 165 brain networks and atlases to determine how the brain connectivity of gamers compare to control groups. Changes in the connectivity can indicate functional differences in the brain and can be used to explain why video game players perform better at certain tasks.

Subjects & Methods

Data was acquired from freely available online databases containing 3 studies using task-based fMRI (tfMRI) and resting state fMRI (rsfMRI). Data was categorized into 4 groups:

I. gamers: 10 sets of tfMRI data [2]
II. non-gamers: 10 sets of tfMRI data [2]
III. rs-control: 10 sets of rsfMRI data [3]
IV. t-control: 8 sets of bilateral left/right hand alternating finger tapping

Mean subject age was 25 years. MRI data was acquired in each study using similar acquisition protocols and a 3T MRI system [2,3]. CONN: Functional Connectivity Toolbox v.19.C was used for data analysis and preprocessing. Using the default preprocessing pipeline, first and second level analysis was preformed for seed-based (SBC) and ROI-to-ROI (RRC) connectivity metrics to examine patterns in the 4 groups.

Results & Discussion

To the best of our knowledge, freely available fMRI scans of gamers only contain elaborate task-based data. Still, we performed resting state-based analysis knowing differentiation of groups could still be possible. Figures 1A and 1B show the SBC map of the correlation coefficients for the DMN and SN and the connectivity pattern of each seed. The DMN for gamers, non-gamers and the rsfMRI-based control group showed similar patterns of connectivity compared to the tfMRI-based control group which showed lower activity levels. The SN of gamers showed greater connectivity compared to non-gamers and the two control groups, with the tfMRI-control group showing the least activation of all groups. The increased SN activity can be explained by gamers needing to quickly process and determine important information from environmental stimuli found in fast-paced video games. Using a FDR corrected p-level of 0.05, figures 2A and 2B show that gamers have increased connectivity in both the DMN and SN to other atlases and networks in the brain. When performing RRC analysis, the SN of gamers was found to have more connectivity to the different atlases and networks than the other groups. Increased connectivity may indicate greater filtering of information from different regions and may therefore explain gamer's faster response times.

References

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Figure 1A: Seed-based Analysis Of Default Mode Network (Seed = mPFC)

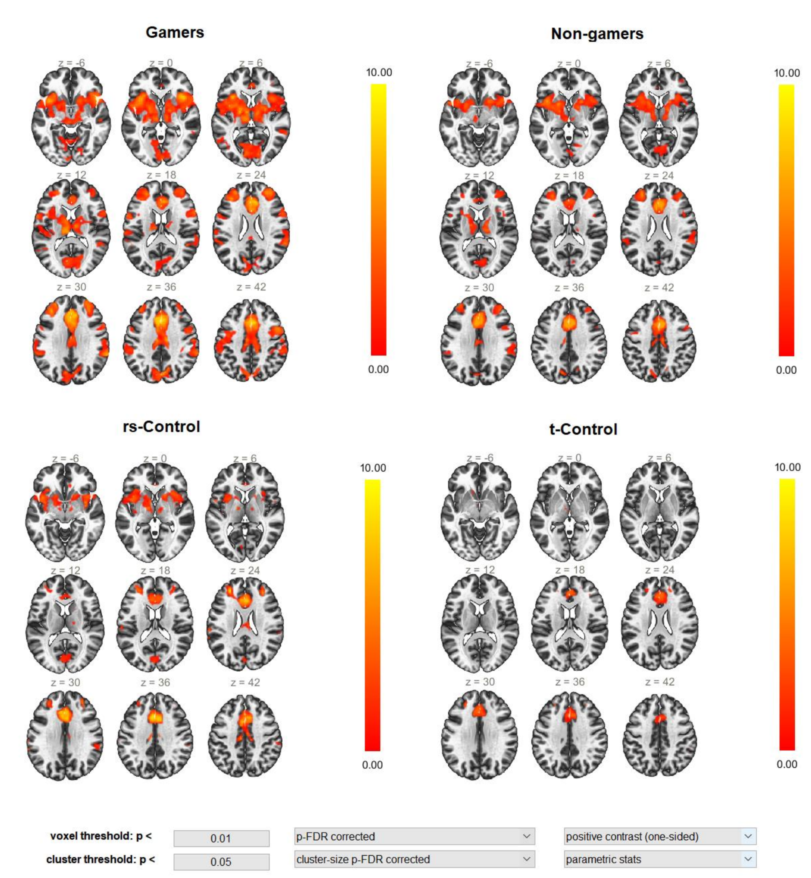


Figure 2A: : ROI-to-ROI Connectivity Of Default Mode Network

Figure 1B: Seed-based Analysis Of Salience Network (Seed = mPFC)

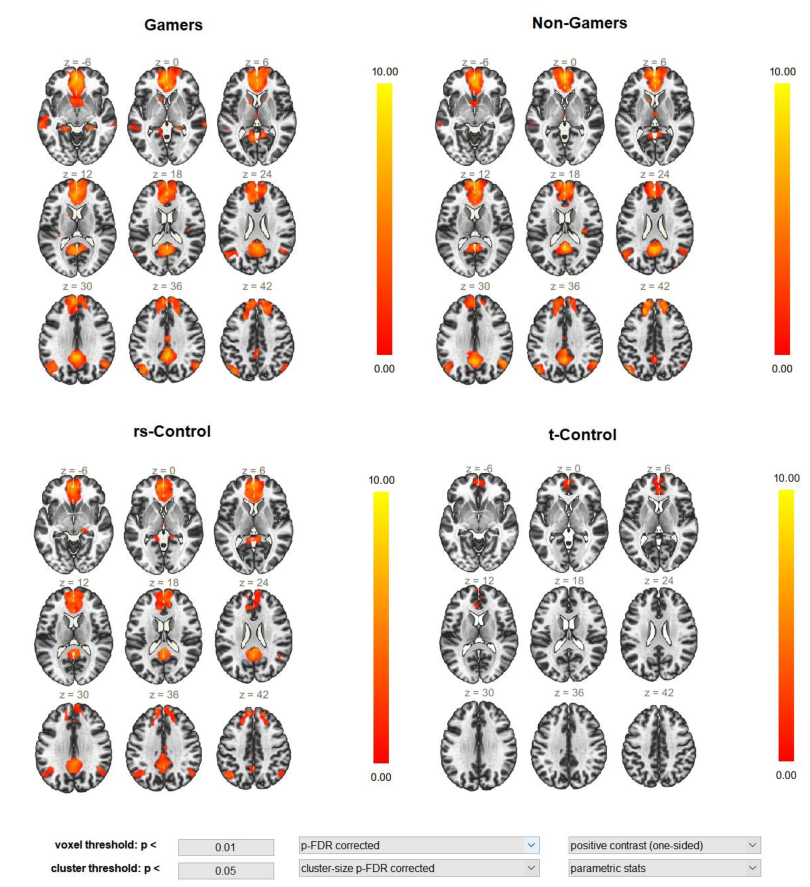
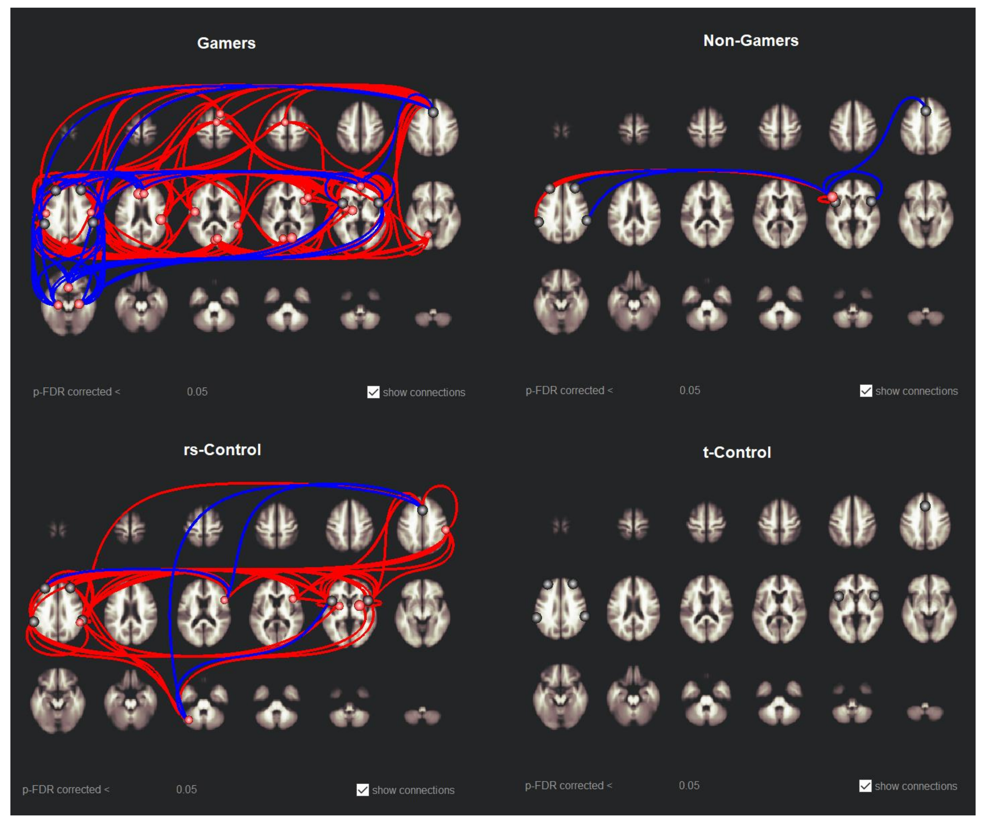


Figure 2B: : ROI-to-ROI Connectivity Of Salience Network



Conclusion

Gamers are found to have increased connectivity in both the DMN and SN to other atlases and networks in the brain, which may result in functional differences including faster response times and greater cognitive control. By using rs-fMRI techniques for both resting and task-based data, rs-fMRI analysis is a versatile and powerful technique to examine connectivity in the brain.