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## Introduction

Within the brain, music affects an intricate set of complex neural processing systems. Music has been shown to affect systems and structural components associated with sensory motor processing, as well as emotional and functional elements implicated in memory, cognition and mood fluctuation. Network science, based on graph theory, provides a method for studying the brain as a complex, dynamic system. Because of the vast complexity of music processing within the brain, it is an ideal candidate for network science. Using network science methods and entire songs, we were able to study music listening as people actually experience it. We investigated whether music preference influences connectivity within the brain.

## Study Population

- Volunteer group of adults (N=21, 13 male, 8 female)
- Age = 24 +/- 3.44 years
- Five Individuals were selected that each had a top preference for either classical, country, and rap/hip hop music and six that had a preference for rock music.

## Scanning Procedure

- Subjects with eyes closed were scanned at rest while listening to five (5) entire songs from pseudorandomly presented genres of classical, country, rock, rap, unfamiliar and a personal favorite
- 1.5T GE scanner using an 8-channel head coil (GE Med Systems, Milwaukee, WI).
- Anatomic imaging (3D BRAVO), and resting fMRI (EPI, TR2000, TE40, voxel size 3.75mm x 3.75mm x 5mm) was used to generate a 21,000 X 21,000 voxel matrix.

## Network Pipeline

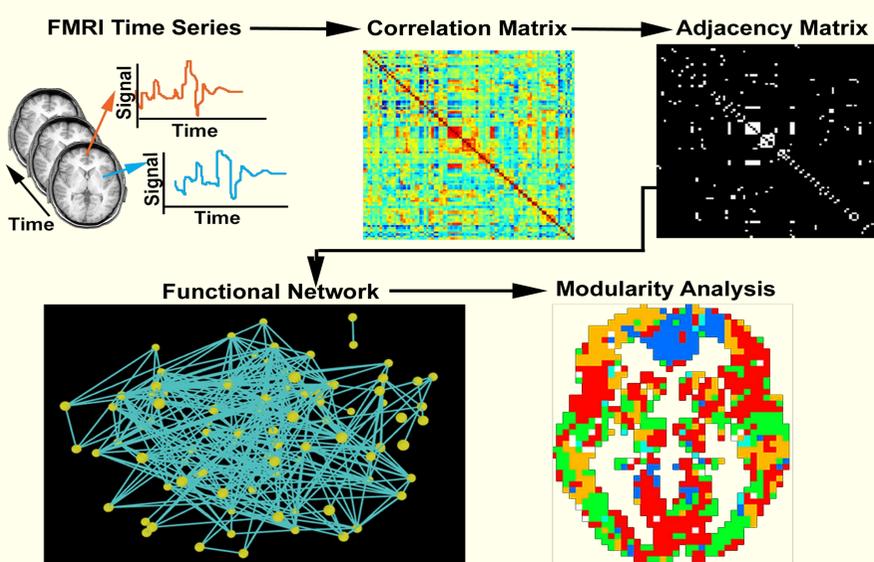
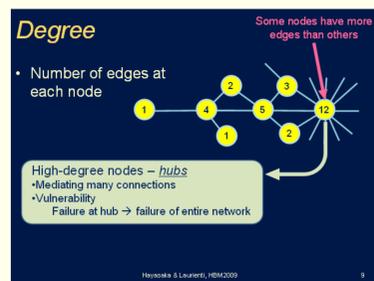
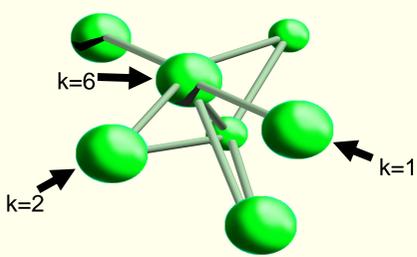


Figure 1. Processing stream for whole brain network analysis.

## Network Metrics

- Degree (k) measures the connectedness of a node
- Path length is a scaled measure of global efficiency. A short path offers more efficient, faster communication within a network.
- Hubs are the most connected nodes in a network. These nodes are critical for network stability and information flow.



Figures 2a and 2b. Degree

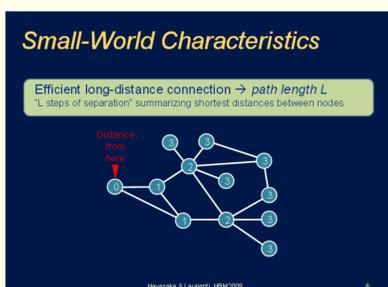


Figure 3. Path length for Global Efficiency

## Conclusions

- Music that is liked or disliked resulted in quite different connectivity in the precuneus/posterior cingulate, the core of the default mode network (DMN).
- While listening to preferred music the precuneus showed high degree (high connectivity).
- When listening to music that is not preferred the precuneus has a relatively high degree, but dramatically decreased global connectivity.
- The precuneus has differential connectivity between preferred and non-preferred music.
- This connectivity between the precuneus/posterior cingulate (of the DMN) and the superior frontal gyrus may be related to how individuals, either consciously or unconsciously, self-regulate the emotions they have and how they experience and express them.

## Network Measurements

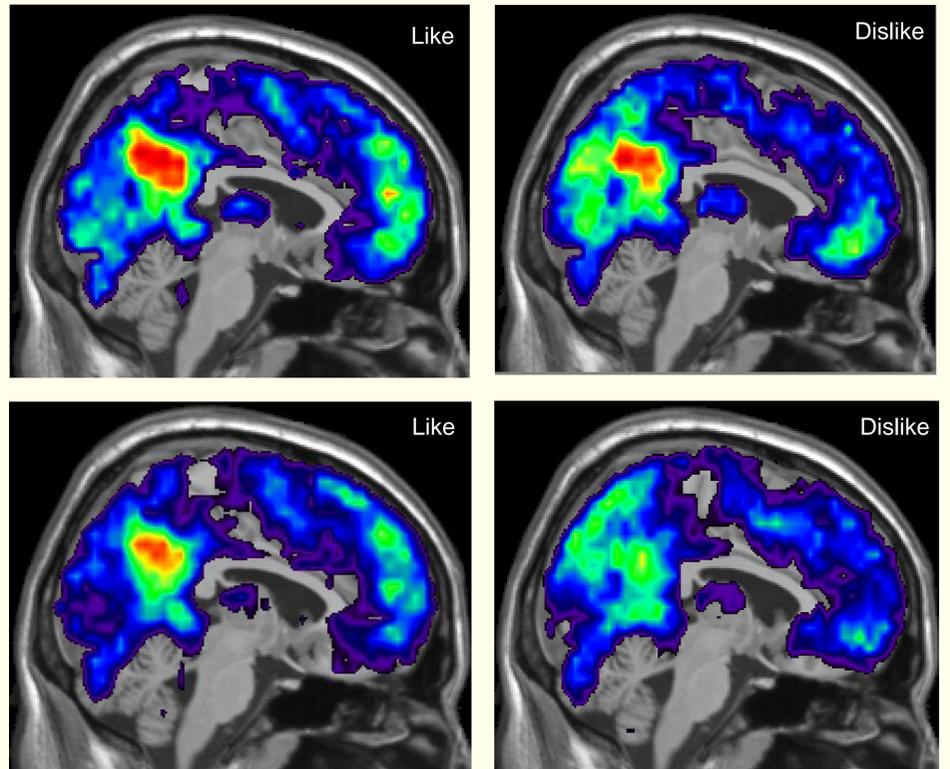


Figure 4a. Hub maps (degree) and global efficiency in the precuneus when music is preferred and not preferred.

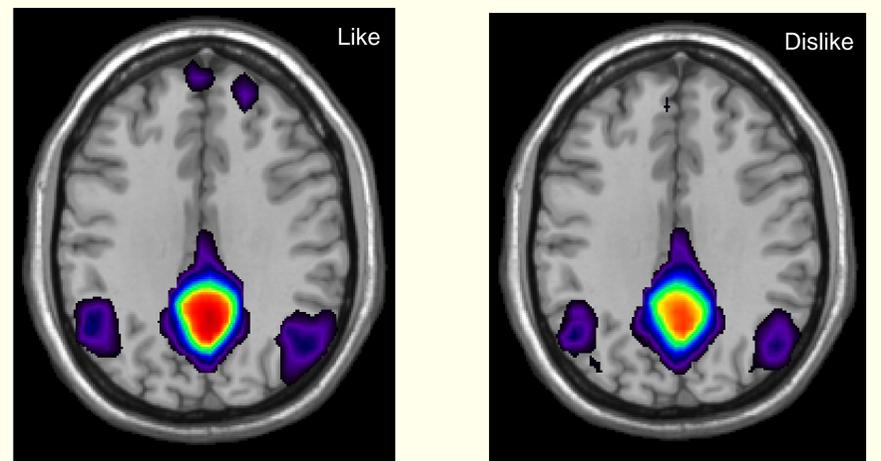


Figure 4b. Precuneus connectivity when music is preferred and not preferred.

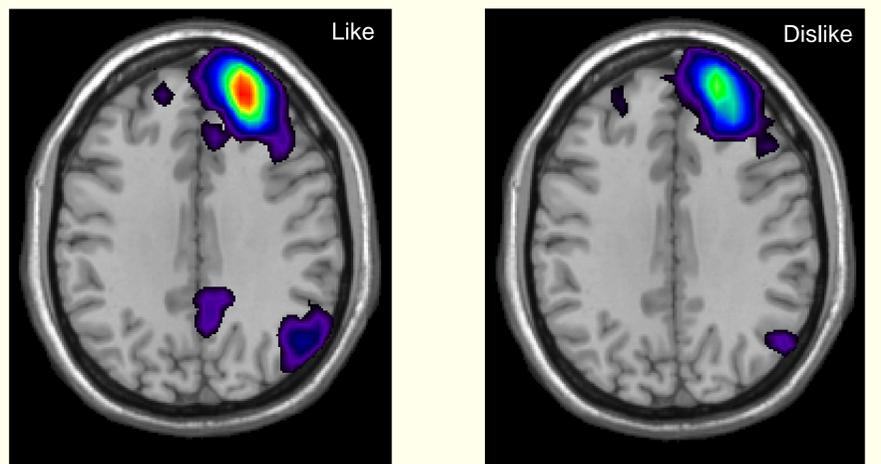


Figure 4c. Right frontal connectivity when music is preferred and not preferred.