Age-Specific Effects of Music Encoding on Reward and Memory Systems in Healthy and Cognitively Impaired Aging

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Background

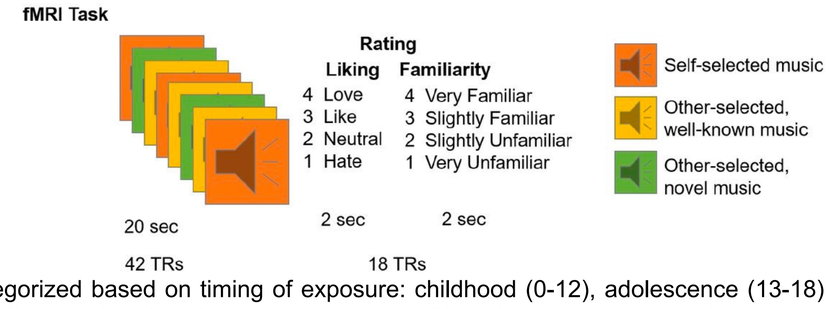
Older adults recall the most autobiographical memories from when they were between the ages of 10-30 years (the "reminiscence bump" effect)[1]. Music-evoked autobiographical memories are most common in response to music from this time period in cognitively healthy[2] and impaired populations[3]. Older adults also show lifelong preferences for this music[4], suggesting music from adolescence and young adulthood may be most effective at engaging reward and memory systems in aging populations.

Pleasurable music listening experiences involve interactions between the auditory and reward systems[5]. Adolescents show heightened sensitivity to reward cues due to the functional development of the reward system[6]. Thus, listeners' lifelong preferences for adolescent music might be a result of heightened reward responses to music during this time[7] and autobiographical associations listeners have with this music[8].

Hypothesis: Music first encoded during adolescence will optimally engage the activity and connectivity of memory and reward systems compared to other developmental time-points, resulting in a neural "reminiscence bump" effect.

Methods

Thirty-five older adults (ages 50-85; *M*=65) who were either cognitively healthy (n=27) or cognitively impaired (mild cognitive impairment [MCI] or subjective cognitive decline [SCD], n=8) completed a music-listening fMRI task[12].



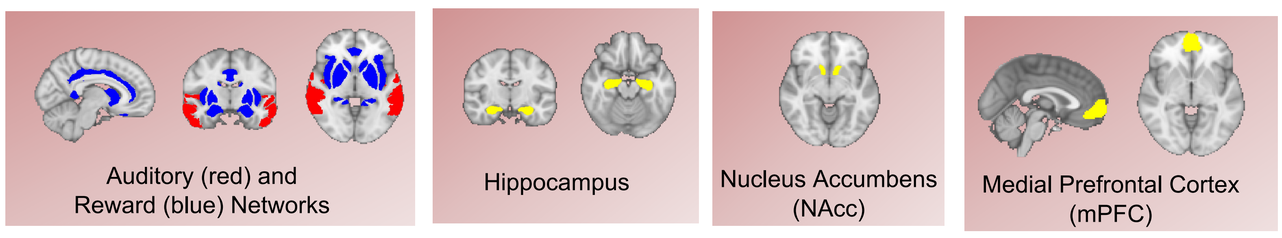
Clips were categorized based on timing of exposure: childhood (0-12), adolescence (13-18) or adulthood (21-45) using Song-Specific Age (SSA), a measure of how old participants were when the music was released:

SSA = Music Year of Release – Participant Year of Birth.

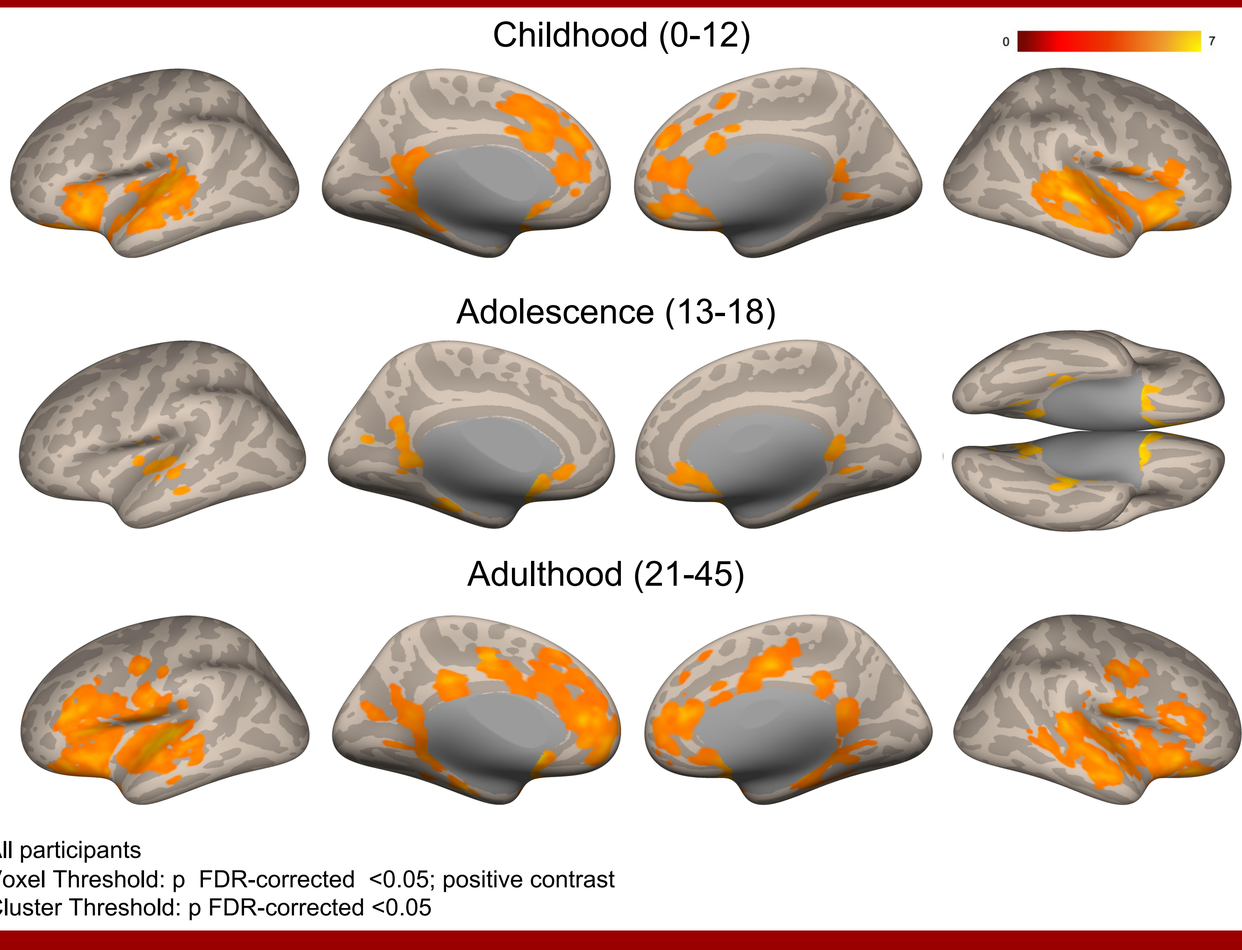
Only trials rated as being familiar (familiarity rating > 2) with positive SSAs were included in these analyses.

FMRI Data Acquisition & Regions of Interest

MRI data were acquired using a Siemens Magnetom 3T MR. Continuous acquisition was used for 1440 volumes with a fast TR of 475 ms. Forty-eight axial slices were acquired as echo-planar imaging (EPI) functional volumes covering the whole brain (voxel size = 3 mm³). Data were preprocessed and analyzed using SPM12 (Statistical Parametric Mapping) software[9] and the CONN Toolbox[10]. For univariate time series activation analyses, we seeded the hippocampus[11] and nucleus accumbens[11]. For seed to whole brain functional connectivity analyses, we seeded the nucleus accumbens[11]. For ROI-ROI connectivity analyses, we seeded the Reward and Auditory Networks[11] along with the mPFC as defined by the CONN Toolbox.

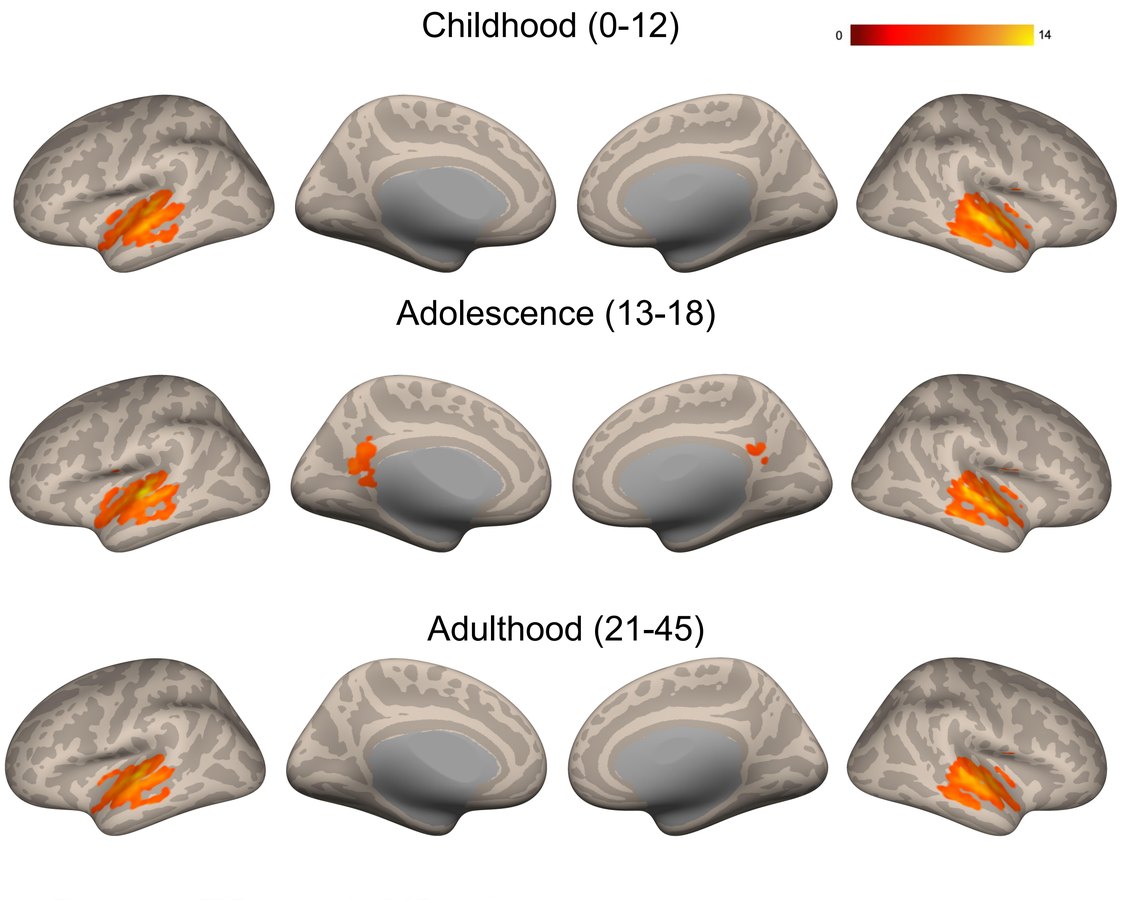


Seed-Based Connectivity from NAcc



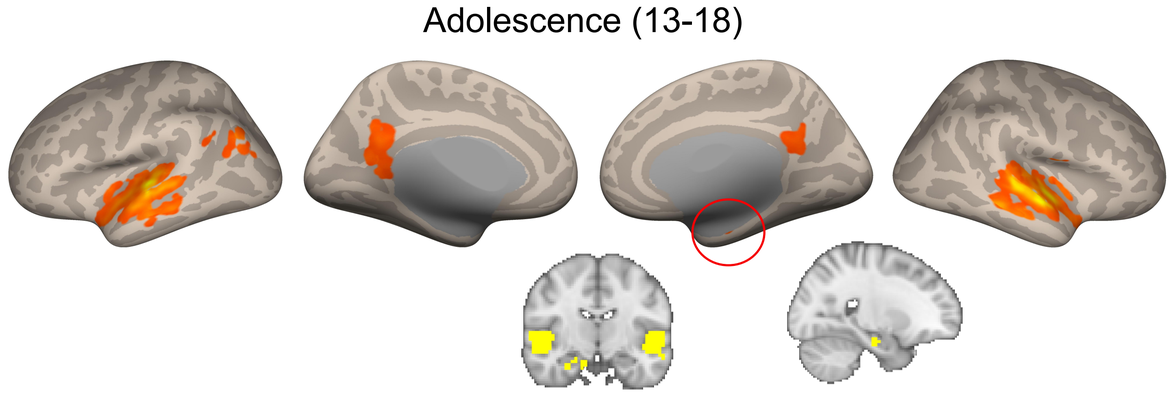
All participants
Voxel Threshold: p FDR-corrected <0.05; positive contrast
Cluster Threshold: p FDR-corrected <0.05

Univariate Main Effect of Age of Exposure: All Participants



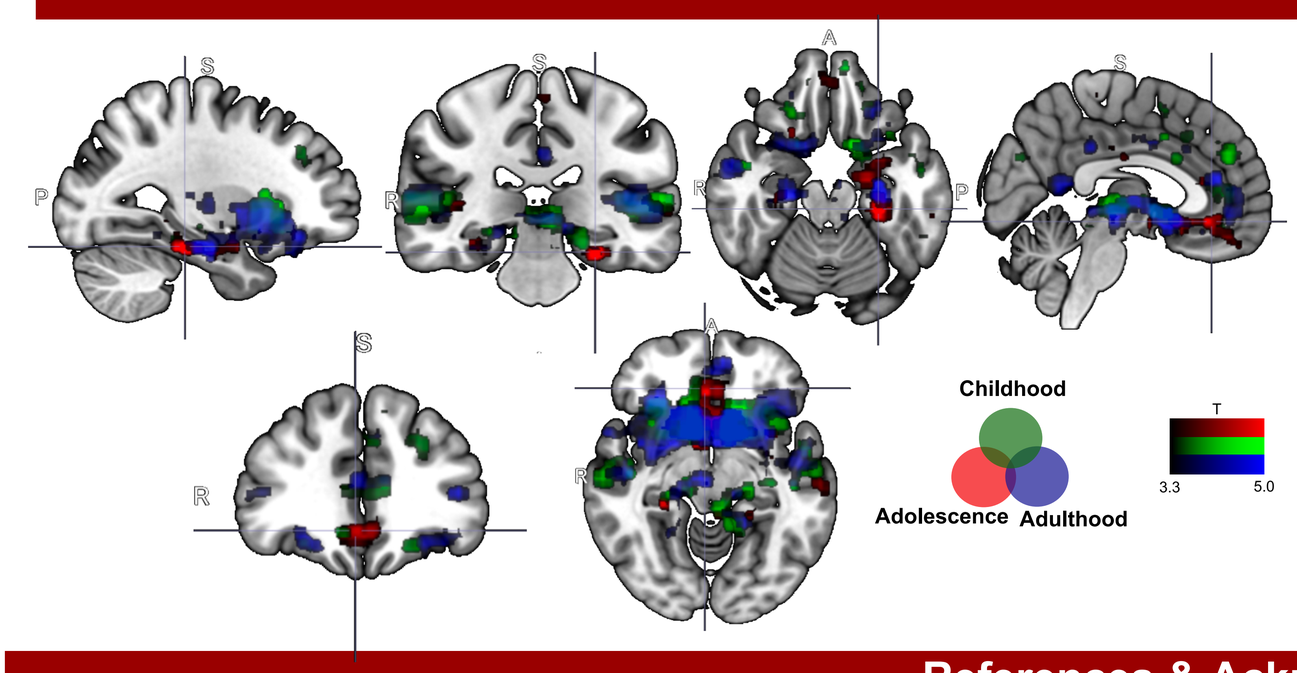
Voxel Threshold: p FDR-corrected <0.05; positive contrast
Cluster Threshold: p FDR-corrected <0.05

Cognitively Healthy Participants Only:

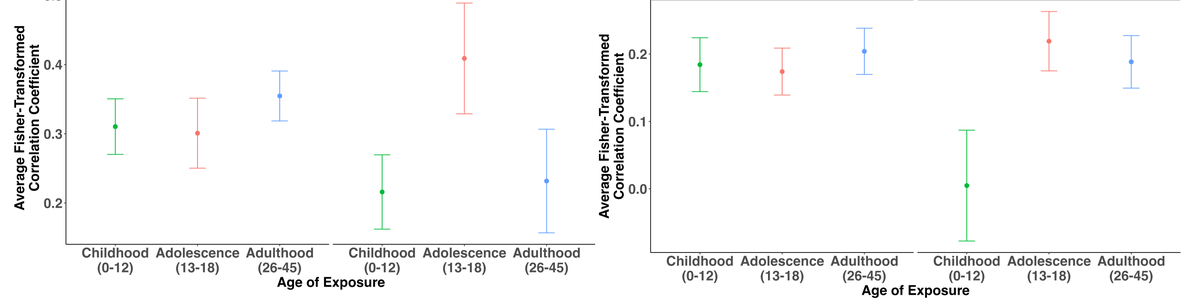


No univariate main effects for the MCI/SCD group survived corrections for multiple comparisons

Heightened NAcc Connectivity to Hippocampus and mPFC During Music from Adolescence



Reward-Network and Auditory-Reward Network Connectivity



Discussion

Our results provide neuroscientific evidence that parallels the "reminiscence bump" effect in older adults. Adolescent music elicited activation of the hippocampus in cognitively healthy adults, while this music more generally elicited greater connectivity of the reward system with itself and with the auditory network in those with MCI/SCD. Music experienced during adolescence may be particularly emotionally salient, leading to both increased lifelong consolidation of associated memories and heightened coactivation of memory and reward systems. This offers insight as to why music-evoked memories may be protected against neurodegeneration and highlights the utility of music from early development in both clinical and everyday settings..

References & Acknowledgements

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