

The 'thrill' of music and its possible implications in treatment of Parkinson's disease

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Abstract: This paper explores current literature regarding the pleasurable experience of 'chills' or 'thrills' in response to music. Neuroanatomical studies implicate regions nearly identical to those involved in reward/motivation and pleasant emotion – particularly the Nucleus accumbens. Interestingly, the type of musical selections which elicit such a response (those which are both familiar and unique to the listener, as well as consistently evoke a highly emotional response) have also been observed to decrease bradykinesia and akinesia in individuals with Parkinson's disease.

The Merriam-Webster dictionary defines a *thrill* as, "a shivering or tingling sensation in response to excitement or intense emotion." Largely related to a musical stimulus, many people describe thrills as 'shivers down the spine' or 'the chills.' A small number of researchers have attempted to describe these thrills, and determine their anatomical source through both PET and functional MRI (fMRI).^{1,2,5,13,14} Thrills typically originate in the upper spine, back of neck, and shoulders, and spread in a "radiating or sweeping pattern" over the scalp, shoulders, and arms, as well as down the spine. In addition, many individuals also note piloerection or 'goose-bumps.'⁵ Musical selections which elicit thrills are highly individualized and subjectively particular tunes, all capable of generating strong emotional responses in the listener. The emotional connection involved, however, does not usually correlate to a memory or personal association, but is rather a property intrinsic to the music itself.

Blood *et al.* utilized PET to explore the neuroanatomical correlates to thrills in a study of 10 university students, each providing a piece of classical music which evoked 'chills' for them. When compared to songs which did not elicit the thrill response, PET imaging revealed increased regional cerebral blood flow (rCBF) to the left ventral striatum (which houses the Nucleus accumbens [NAc]), dorsomedial midbrain, bilateral insula, and right orbitofrontal cortex. Decreases in rCBF were noted in the right amygdala and left amygdala/hippocampus during chills.² The NAc, dorsomedial midbrain, and amygdala findings correspond to studies regarding euphoria, pleasant emotion, and reward as observed during administration of cocaine to cocaine-dependant subjects, (as well as responses to food, chocolate, and sex).³ Using correlation between the cocaine study, and PET/fMRI studies, it has been determined that the decreased rCBF to the amygdala corresponds to the anticipation of the chills (comparable to cocaine craving), while the increased rCBF in left ventral

striatum and dorsomedial midbrain correspond to the experience of the chills (cocaine rush).^{1,2,13,14} Dopaminergic activity in NAc has been implicated in the response to rewarding stimuli, both natural and drug-induced.^{2,3,13} Furthermore, opioid efferents from the NAc project to receptors in the dorsomedial midbrain also associated with reward – particularly the periaqueductal grey (PAG) and pedunclopontine tegmental nucleus (PPT).² Although PET resolution cannot distinguish nuclei in the dorsomedial midbrain, the involvement of PAG and PPT can be assumed in that the thrill response is attenuated by the opioid antagonist naloxone.^{2,5} The NAc also plays a role in initiating movements in response to motivational and emotional activity.⁴

In seemingly unrelated studies, researchers have noticed that music can enhance basal ganglia function in Parkinsonian (PD) patients, thereby allowing freedom of movement.^{10,12} However, not all music works. The therapeutic effectiveness of music is specific to each patient and their emotional relationship with any particular musical piece, a characteristic not unlike that described above in eliciting a thrill response. Sacks and Tomaino describe a patient, Rosalie, an experienced pianist whose battle with PD left her motionless, stuck, and transfixed. However, the Parkinsonian symptoms would disappear when she played the piano. Furthermore, as she was very familiar with Chopin, the mere mention of “Opus 49” could relieve Rosalie’s motionlessness by ‘playing’ the piece in her head, just as if she were playing it on the piano.¹² Likewise, musical therapy has been proven more effective than physical therapy in improving bradykinesia in PD patients – a benefit attributed to activation of dopaminergic projections to the NAc.¹⁰ Degeneration of the substantia nigra (SN) in PD corresponds not only to decreased dopaminergic projection to the putamen, but also to the NAc – although less severe.^{8,6} Such dopaminergic loss in the NAc contributes to the bradykinesia and akinesia seen in PD, as well as depressed moods and a reduced ability to experience reward.⁸ The reversal of this process explains some effects of both musical therapy and L-DOPA treatment. Furthermore, over-stimulation of the NAc in PD patients has been implicated in choreoathetoid movements during Levodopa treatment, thereby illustrating the ability of the NAc to reverse akinesia and bradykinesia symptoms, albeit at the expense of inducing a hyperkinetic state.⁶

It is interesting that music, which is neither required for survival nor a pharmacological agent, can both elicit a physical manifestation of euphoria, as well as provide a therapeutic agent for Parkinson’s. It is even more intriguing that both mechanisms utilize dopaminergic activation of the NAc in mediating connections between pleasure/reward and movement/emotion. It would be interesting to discover if a song capable of eliciting a thrill in an individual diagnosed with PD early in the disease could also be used to relieve bradykinetic symptoms subsequent to PD progression. Likewise, studies exploring the extent to which thrills and Parkinson’s share common pathways could benefit development of an innovative non-pharmacological treatment with greater efficacy than current music therapy models.

Works Cited/Referenced

1. BLOOD, A.J., PETRE, V., WORSLEY, K.J., *et al.* (2000). fMRI Study Examining Neural Correlates of 'Chills' in Response to Subject-Selected Music. *NeuroImage* **5**:11.
2. BLOOD, A.J., ZATORRE, R.J. (2001). Intensely Pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. *Proc. Natl. Acad. Sci. USA.* **98**:11818-11823.
3. BREITER, H.C., GOLLUB, R.L., WEISKOFF, R.M., *et al.* (1997). Acute Effects of Cocaine on human Brain Activity and Emotion. *Neuron.* **19**:591-611.
4. COLLINS, R.C. (1997). *Neurology.* W.B. Saunders Company. 127-137.
5. GOLDSTEIN, A. (1980). Thrills in response to music and other stimuli. *Physio. Psych.* **8**(1):126-129.
6. GOLDSTEIN, M., LIEBERMAN, A., PEARSON, J. (1982). Relatively High Levels of Dopamine in Nucleus accumbens of Levodopa treated Patients with Parkinson's Disease. *J. Neural Transmission.* **54**:129-134.
7. HALPERN, A.R., ZATORRE, R.J. (1999). When That Tune Runs Through Your Head: A PET Investigation of Auditory Imagery for Familiar Melodies. *Cerebral Cortex.* **9**:697-704.
8. HORNYKIEWICZ, O. (1998). Biochemical aspects of Parkinson's Disease. *Neurology.* **51**(2):S2-S9.
9. NAIR, D.G., LARGE, E.W., STEINBERG, F., KELSO, J.A.S. (2002). Perceiving emotion in expressive piano performance: A functional MRI study. *Proc. Of the 7th Internat. Conf. on Music Perception and Cognition, Sydney, Australia.*
10. PACCHETTI, C., MANCINI, F., AGLIERI, R., *et al.* (2000). Active music therapy in Parkinson's disease: An integrative method for motor and emotional rehabilitation. *Psychosomatic Medicine.* **62**:386-393.
11. PLATEL, H., PRICE, C., BARON, J.C., *et al.* (1997). The structural components of music perception. *Brain.* **120**:229-243.
12. SACKS, O., TOMAINO, C.M. (1991). Music and Neurological Disorder. *Internat. J. of Arts Medicine.* **1**(1):10-13.
13. ZATORRE, R.J. (2003). Music and the Brain. *Ann. N.Y. Acad. Sci.* **999**:4-14.
14. ZATORRE, R.J. (2005). Music, the food of neuroscience? *Nature.* **434**:312-315.