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Temporal Entrainment of Cognitive Functions: Musical Mnemonics Induce Brain Plasticity and Oscillatory Synchrony in Neural Networks Underlying Memory

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In a series of experiments, we have begun to investigate the effect of music as a mnemonic device on learning and memory and the underlying plasticity of oscillatory neural networks. We used verbal learning and memory tests (standardized word lists, AVLT) in conjunction with electroencephalographic analysis to determine differences between verbal learning in either a spoken or musical (verbal materials as song lyrics) modality. In healthy adults, learning in both the spoken and music condition was associated with significant increases in

oscillatory synchrony across all frequency bands. A significant difference between the spoken and music condition emerged in the cortical topography of the learning-related synchronization. When using EEG measures as predictors during learning for subsequent successful memory recall, significantly increased coherence (phase-locked synchronization) within and between oscillatory brain networks emerged for music in alpha and gamma bands. In a similar study with multiple sclerosis patients, superior learning and memory was shown in the music condition when controlled for word order recall, and subjects were instructed to sing back the word lists. Also, the music condition was associated with a significant power increase in the low-alpha band in bilateral frontal networks, indicating increased neuronal synchronization. Musical learning may access compensatory pathways for memory functions during compromised PFC functions associated with learning and recall. Music learning may also confer a neurophysiological advantage through the stronger synchronization of the neuronal cell assemblies underlying verbal learning and memory. Collectively our data provide evidence that melodic-rhythmic templates as temporal structures in music may drive internal rhythm formation in recurrent cortical networks involved in learning and memory.

Key Words: multiple sclerosis • music • memory • EEG • brain plasticity • temporal entrainment

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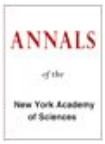

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