Title: Short-term Acoustic Deprivation and Enhancement lead to Central Gain Modulation in the Brainstem and Cortex

Peter J. Hutchison*[#], Hannah Maeda, David A. Eddins, Ann C. Eddins

Auditory and Speech Sciences Laboratory, University of South Florida

ABSTRACT (400 words)

It is well known that a normally functioning auditory system is able to readily adapt to long-term changes in the acoustic environment. Research has shown that unilateral acoustic deprivation via short-term earplug use decreases acoustic reflex thresholds (ARTs) in the plugged ear. Changes in loudness perception following earplug use have also been documented, showing an increase in sensitivity to loud sounds following removal of the earplug. Together, these results suggest the existence a neural gain mechanism that may be reflected at one or more levels of the auditory system. Similarly, research has also shown that acoustic enhancement via prolonged use of ear-level sound generators (i.e., tinnitus therapy devices) may affect auditory central gain by altering loudness perception over time. Furthering our knowledge of such a neural gain mechanism would have broad implications for understanding how the brain adapts to hearing loss (and the associated consequences of hearing loss, such as tinnitus and hyperacusis), and subsequently, how the brain adapts to newly available acoustic information via hearing aids. In the present study, we investigate the effects of prolonged sound attenuation or enhancement on a battery of behavioral and physiological measures of auditory processing. Twenty-two young, normal hearing subjects participated in this study. They were fitted with either a unilateral ear plug (n=12) or with bilateral sound generators (n=10) and were instructed to wear the devices continuously for a prescribed duration of the study. ARTs, categorical loudness judgements, and 64-channel, 40-Hz ASSRs were measured at each visit during the study. Preliminary analyses indicate that ARTs were significantly reduced in the plugged ear during earplug use compared to baseline ARTs in the same ear and a significant increase in ARTs relative to baseline following sound generator usage, consistent with previous literature. Categorical loudness judgments were significantly reduced compared to baseline for the earplug group after 1, but not after 2 weeks of earplug use. In contrast, categorical loudness judgments were not significantly different from baseline judgements during any test visit following sound generator use. Remarkably, the ASSR data also showed a significant increase or decrease in magnitude following earplug or sound generator use, respectively, consistent with a change in central gain at the cortex. Together, these results provide further evidence of central gain modulation with varying acoustic input at both brainstem (ART) and cortical (ASSR) levels of the auditory system but minimal change in loudness perception.

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Presenter's email: phutchison@usf.edu

Presenter's phone number: (215) 932-7736