Background: Hearing in background noise is a significant listening challenge for individuals with hearing loss despite the use of hearing aids. Sound information is sent to the brain through neural responses from the afferent auditory system. These responses are modified by the efferent auditory system, which consists of neural feedback from the brain to the ear. Based on animal research, the medial olivocochlear reflex (MOCR), which forms part of the auditory efferent system, is hypothesized to facilitate listening in noisy backgrounds. Specifically, the MOCR limits the deleterious effect of background noise on auditory nerve responses, thereby, improving the neural signal-to-noise ratio. This improvement may be diminished with age and hearing loss and contribute to age- and hearing-loss related difficulties in understanding speech in noisy backgrounds. Clinical assessment of the MOCR is essential to understand the extent to which a patient’s speech-in-noise difficulties may be explained by MOCR dysfunction. Yet, current assessments of the MOCR, based on otoacoustic emissions (OAEs), require individuals to have good hearing sensitivity. The purpose of this study is to develop an alternative assessment of MOCR function based on a measurement technique – the cochlear microphonic (CM) – that produces reliable responses in individuals with hearing loss. The CM is an indirect measure of cochlear function and is sensitive to the effects of the MOCR on the response from the cochlea. When the MOCR is elicited by contralateral sound, the CM amplitude increases. As a first step toward developing a clinical test of the MOCR, we designed the following study to determine which sound frequencies result in the largest MOCR-induced increase in CM amplitude.

Research Design: The effect of contralateral noise on the CM was measured for frequencies ranging from 100-6000 Hz using an electrode that rests on the tympanic membrane. Contralateral broadband noise (50 dB SPL) was presented to the left ear to elicit the MOCR while an ipsilateral test tone (probe) swept in frequency from 100 – 6000 Hz in the right ear at 90 dB SPL. Six young adults (4F, 2M) completed two sessions in a randomized, counterbalanced order: one with a down-sweeping and another with an up-sweeping probe. All subjects had normal hearing sensitivity, normal middle ear function, and no history of hearing loss or neurological problems.

Results: Preliminary data revealed that CM amplitudes were consistently enhanced by 1 – 2 dB across a wide range of frequencies tested. We observed this enhancement for upward and downward frequency sweeps. Fine structure was observed in CM measurements with and without contralateral noise. The primary effect of the noise was to shift the CM fine structure towards higher frequencies.

Conclusions: The results show that the CM amplitude increased in the presence of contralateral noise, consistent with eliciting the MOCR. This enhancement was greatest for frequencies
between 250 and 2000 Hz suggesting that future clinical tests based on the CM should focus on this frequency region. Similar effects of contralateral noise have previously been reported in OAE assessments of the MOCR. This consistency among CM and OAE results support the CM as an appropriate alternative for measuring MOCR function. Yet, this study’s design shows promise for assessing the MOCR in individuals with hearing loss. The next step in developing such tests is to extend this design to include older adults with normal hearing and hearing loss to test the hypothesis that a CM-based test is sensitive to the putative declines in MOCR function that result from aging and hearing loss.