It is generally accepted that temporary threshold shift (TTS) leads to permanent threshold shift (PTS) (Baker, 1974). The amount of PTS occurs within the individual or how quickly PTS can lead to TTS, is highly variable and individual. The only way to examine temporary threshold shifts, specifically in musicians, by looking at changes in Distortion Product Otoacoustic Emissions (DPOAE) as well as any shifts in pure-tone, air-conduction audiometry. Previous studies have researched hearing thresholds in musicians by assessing subjects with pure-tone audiometry (Yoshii, et al., 2007). Results of these studies have also been looked at distortion product emission changes in subject’s hearing ability. Changes in auditory function can thus be assessed by changes in DPOAEs or other changes in cochlear function such as changes in the static pressure of the cochlea (Yoshii, et al., 1993), however, these changes can be caused by factors such as changes in the environment, including the level and frequency specificity, which can affect the perception of sound. This push for proper monitoring has led to the development of a new tool that could help musicians monitor their hearing health. The tool is designed to be used during practice to help musicians identify when damage is occurring. The tool is designed to be used during practice to help musicians identify when damage is occurring. The tool is designed to be used during practice to help musicians identify when damage is occurring. The tool is designed to be used during practice to help musicians identify when damage is occurring. The tool is designed to be used during practice to help musicians identify when damage is occurring.

**Methods**

### 1. Pre-Treatment and Post-Testing

During both pre-testing and post-testing, the subject was seated and asked to indicate if any symptoms occurred during testing. Otoscopic examination was performed on both ears. The ear on which DPOAE testing was performed was the same ear each subject was recruited to participate in the study. The subject was seated in a chair at a distance of 2 feet from the testing equipment. Testing equipment was used the 10LE-USB from Otodynamics with a SGD Type OAE probe and a DPOAE probe in each ear of the same subject. The OAE probe was calibrated prior to each subject’s testing. DPOAE tests were recorded in the frequency range of 500-8000 Hz at each frequency. The first test was recorded at 66.5/55 dB and the second test was 55/45 dB and the third test was 45/35 dB. The first test was recorded with the probe tip removed from the subject’s ear and in order to measure the variability of the response at each frequency, the third test was approximately 4 minutes 30 seconds 25 minutes during pre-testing and again during post-testing. Then the subject was seated in a booth for air-conduction audiometry. Air-conduction audiometry was performed using the 3M Avisys Healthcare GSI 61 clinical audiometer with E-A-C insert earphones and Grason-Stadler insert 25 foam pads. Thresholds were tested for frequencies between 250-8000 Hz, including 1000 and 6000 Hz for both left and right ears. This lasted for approximately ten minutes during the pre- and post-testing.

### 2. Sound Exposure

Between pre- and post-testing, each subject was exposed to a 10-min exposure to a continuous 85-dB sound. Sound levels were recorded by a Quantum Technologies 312A sound level meter. The sound level meter was calibrated to a known level every hour. The sound pressure levels of the air was not measured in this study. The sound level meter was calibrated to a known level every hour. The sound pressure levels of the air was not measured in this study. The sound level meter was calibrated to a known level every hour. The sound pressure levels of the air was not measured in this study. The sound level meter was calibrated to a known level every hour. The sound pressure levels of the air was not measured in this study.

A change in DPOAEs was considered “a change” by two methods. The first method was the DP amplitude alone (Tables 3 and 4). If at least two of the DPOAE amplitude data points from the post-exposure results were below at least two DPOAE amplitude data points of pre-exposure results, it was considered a shift (see Figures 1 and 2). For example, for subject T2, shifts occur between 2500 and 5000 Hz in the 65/55 test (Figure 1), however, they also occur at several frequencies between 5000 and 20000 Hz. Similarly, in the 55/45 testing condition, a shift occurs at all frequencies except 100 Hz for subject T2. The second method looked at the signal-to-noise ratio (SNR) of the data points. A criterion of at least 6 dB SNR was used to test whether the emissions were present and if a shift occurred, using the “two out of three” method previously mentioned. The 6 dB SNR criterion is used commonly as a clinical application. For instance, if the pre-exposure data points of a particular frequency, all had SNR above 6 dB, the post-exposure results did not, that was considered a shift because the emission went from present to absent. However, if both the pre- and post-exposure data points had SNR less than 6 dB, those results were excluded from the analysis because the emission signal level was too close to the noise floor. Several subjects showed a shift in certain frequencies when the DP level dropped, however, showed no change when using the 6 dB SNR reliability criteria. However, all subjects still experienced a shift in at least one frequency. Tables 3-6 identify whether a shift occurred in DPOAEs for each subject, at each frequency, for each of the 65/55 and 55/45, respectively. Tables 3 and 4 show the initial analysis looking only at DP amplitude. Tables 5 and 6 show shifts using the 6 dB SNR criteria.

### 3. Conclusions

Results of this study show that even after a relatively short exposure time, a shift occurred at more than one frequency for all subjects. Therefore, it is reasonable to conclude that some amount of hair cell damage has occurred. The data may not be statistically significant, it is hair cell damage nonetheles. Part of the reason for this study was to be a “two out of three” criterion. A “three out of three” method could have been employed, however, it would have been too long and too many criteria. However, all subjects still experienced a shift in at least one frequency. Tables 3-6 identify whether a shift occurred in DPOAEs for each subject, at each frequency, for each of the 65/55 and 55/45, respectively. The particular instruments were played a different instrument. The particular instruments were played a different instrument. The particular instruments were played a different instrument. The particular instruments were played a different instrument. The particular instruments were played a different instrument.

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**References**


