Impulse Noise Paradigm Developed for Otoprotection Trials

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SUMMARY

Multiple agents reduce noise-induced hearing loss (NIHL) in animal models at 117 dB peak SPL. Despite > 5 dB TTS, it has not been possible to identify an exposure condition that reliably induces a TTS. In addition, there have not been significant reductions in DP otoacoustic emissions amplitudes following any exposure level. Additional parametric investigation is needed; future trials may include frequency-shifted stimuli, multi impulse stimulus batteries, and impulse stimuli embedded in constant noise background. If this model is successfully developed, it would have significant real-world relevance with respect to TTS induced by transient impulse noise exposure which is common in both military and industry conditions.

RESULTS

Table 1: Procedure of Selecting Exposure Level and Number of Shots Fired

![Image 1: Wii Shooting Game](https://example.com/image1.png)

Figure 1. Average temporary threshold shift (TTS) was small.

![Figure 2: Temporary threshold shift (TTS) varied across participants](https://example.com/image2.png)

![Figure 3: DP Gram](https://example.com/image3.png)

METHODS

EQUIPMENT

A Nintendo Wii™ game console was connected to a Tucker-Davis Technologies (TDT) RX6 multiprocessor function. During game play (Paintball), the game audio was stripped and used as a trigger for a digital sound simulation of a shotgun. Sound levels were measured and real-time as the participant shot targets in the video game (Figure 1). Shots were delivered through a Headphone and attached microphone, with amplitude controlled using a A-Wear KV-8550 headphone. Headphone output was measured using a B&K 4190 Headphone Stimulator and analyzed using the software. Sounds ranged from 88-117 dB peak SPL, and the number of presentations ranged from 50 to 3200.

TESTING

After providing written informed consent, participants were screened to confirm normal hearing, with thresholds ≤ 25 dB HL from 250 Hz to 8 kHz, right/left asymmetry ≤ 15 dB, and air-bone gaps ≤ 10 dB. Ear training was performed to ensure that the participant heard the sounds correctly. The testing paradigm was as follows:

1. **Baseline Testing:**
   - **ABR Data:**
     - Conventional (0.25-8 kHz) and high frequency (10-16 kHz) tones, and distortion product otoacoustic emission (DPOAE) testing were performed. A-BR data were recorded at baseline with F2 ranging from 2-12 kHz. Testing was repeated 2-min and 15-min after game play. If the participant had a shift ≥ 15 dB, the paradigm was repeated at hourly intervals until full recovery was observed. The initial exposure condition was 50 rounds at 88 dB peak SPL and sound levels were systematically increased as shown in Table 1. The paradigm in which level increases and increases in the number of stimuli were alternated was modeled after Price (2007).

2. **Testing Post-Game:**
   - **ABR Data:**
     - ABR data were collected at frequencies where threshold deficits were smaller, i.e., ~20 dB TTS measured 24-hours post-noise, do not appear to have decreased amplitudes, and there has been no obvious synaptic change in the corresponding region of the inner ear.

3. **Testing Post-Game:**
   - **ABR Data:**
     - ABR data were collected at frequencies where threshold deficits were smaller, i.e., ~20 dB TTS measured 24-hours post-noise, do not appear to have decreased amplitudes, and there has been no obvious synaptic change in the corresponding region of the inner ear.

4. **Testing Post-Game:**
   - **ABR Data:**
     - ABR data were collected at frequencies where threshold deficits were smaller, i.e., ~20 dB TTS measured 24-hours post-noise, do not appear to have decreased amplitudes, and there has been no obvious synaptic change in the corresponding region of the inner ear.

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References:


**Figure 4: Testing Post-Game:**

- **ABR Data:**
  - ABR data were collected at frequencies where threshold deficits were smaller, i.e., ~20 dB TTS measured 24-hours post-noise, do not appear to have decreased amplitudes, and there has been no obvious synaptic change in the corresponding region of the inner ear.

**SUMMARY**

- Although there have been a small number of participants that have had > 5 dB TTS, it has not been possible to identify an exposure condition that reliably induces a TTS.
- In addition, there have not been significant reductions in DP otoacoustic emissions amplitudes following any exposure level.
- The paradigm in which level increases and increases in the number of stimuli were alternated was modeled after Price (2007).