

INCORPORATING BONE CONDUCTION WITH VIRTUAL REALITY: CHANGING THE USER EXPERIENCE

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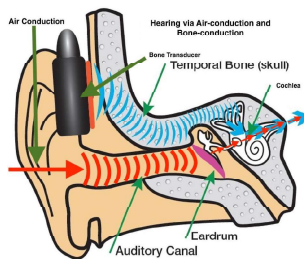


ABSTRACT

This research study investigates the various user experiences for audio stimuli when using a virtual reality headset. Findings on comfortability, immersivity, weight, bone transducer placement, and perceived audio intelligibility were obtained to provide subjective data and conclusions for the investigation.

INTRODUCTION

The human auditory system relies on vibrations in order provide the perception of sounds. Studies have shown that bone conduction is essential in audiometric diagnosis for hearing sensitivity (Margolis H. Robert 2010).



Hearing via Bone-conduction and Air-conduction, Annotated (Traynor, 2016)

There are multiple factors that can affect an individual's hearing preferences. The use of bone conduction is slowly growing in popularity in the commercial market, and being collaborated with other devices to make the auditory pathway experience unique. This method of conduction can provide a non isolated VR environment and allow users to hear their surroundings whilst using the headset.

AIMS

The aims for this project were to incorporate and optimise a pair of bone conduction (BC) transducers into a virtual reality (VR) headset, and investigate whether they could provide an enhanced experience for consumers compared to other commercially used headphones.

Objectives were to discover which placements were preferred for the BC transducers, and provide the best characteristics for the perceptual quality audio.

METHODOLOGY

The method consisted of a pure-tone audiometry examination, a practical listening exercise using three different commercial audio stimuli combined with a VR headset, and a subjective questionnaire to finish. The headsets chosen for the final test procedures were concluded from preliminary data collected from a pilot study. This provided the audio stimulus', BC transducer placement, and content for the final experimentation. The questionnaire was present to evaluate the overall experience that the participants had with the BC/VR device, and how this differed to the VR headset combined with the other commercial headphones used in experimentation.

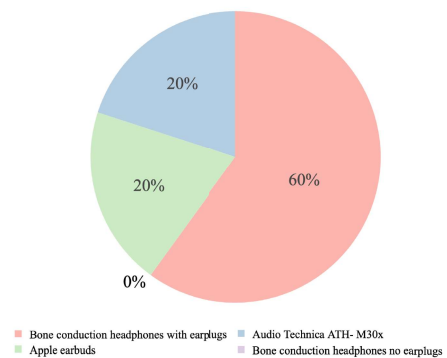
The audio stimuli used were; ATH-M30x Circumaural headphones, Apple earbuds, and Dayton Audio BC headphones (with and without isolation). After conducting an audiometry examination the subjects were exposed to the various combinations of audio stimuli with the VR headset. The content used was three 360 degree videos on YouTube.



RESULTS

The results were concluded from a series of questions that the participants were asked in a subjective questionnaire, after conducting the two experiments mentioned in the methodology.

Preferred audio stimuli to use with a virtual reality headset



The majority, 60% of the participants, chose the bone conduction headphones with earplugs. Interestingly, none of the participants chose the bone conduction without earplugs. This shows how important immersivity is when using virtual reality, and how engaged in the content that the users desire to be.

It was also concluded that the audiometric results for the subjects showed significant correlation with the preferred listening method. The three participants with either CAT 2 or CAT 3 HL audiometry diagnosis chose the BC headphones with isolation (earplugs) as their preferred listening method.

CONCLUSIONS

The correlation between the audiometric results, and chosen audio stimuli provide evidence that individuals with NIHL would gain a better experience through using BC. Also, as BC was chosen by 60% of the participants, half of which fell into CAT1 with normal hearing, this therefore supports the project aims and objectives to provide an enhanced listening experience for all users, whether they have normal or poor hearing. The technology combination provides users with the option of having full immersivity, or still being able to hear their surroundings whilst engrossed within a virtual environment.

ACKNOWLEDGEMENTS AND CITATIONS

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TRAYNOR, R., 2016. Bad to the Bone Headsets [viewed 02/02/20 Available from: <https://hearinghealthmatters.org/hearing-international/2016/bone-conduction-headsets/>