



National Aeronautics and Space Administration

Acoustical and Intelligibility Test of the Vocera® B3000 Communication Badge

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Introduction

To communicate with each other or ground support, crew members on board the International Space Station (ISS) currently use the Audio Terminal Units (ATU), which are located in each ISS module. However, to use the ATU, crew members must stop their current activity, travel to a panel, and speak into a wall-mounted microphone, or use either a handheld microphone or a Crew Communication Headset that is connected to a panel. These actions unnecessarily may increase task times, lower productivity, create cable management issues, and thus increase crew frustration.

Therefore, the Habitability and Human Factors and Human Interface Branches at the NASA Johnson Space Center (JSC) are currently investigating a commercial-off-the-shelf (COTS) wireless communication system, Vocera®, as a near-term solution for ISS communication. The objectives of the acoustics and intelligibility testing of this system were to answer the following questions:

1. How intelligibly can a human hear the transmitted message from a Vocera® badge in three different noise environments (Baseline = 20 dB, US Lab Module = 58 dB, Russian Module = 70.6 dB)?
2. How accurate is the Vocera® badge at recognizing voice commands in three different noise environments?
3. What body location (chest, upper arm, or shoulder) is optimal for speech intelligibility and voice recognition accuracy of the Vocera® badge on a human in three different noise environments?



Vocera® B3000 badge



MRT Answer Sheet

Methods

Speech Intelligibility Study

Participants

The JSC Human Test Subject Facility provided 7 males and 5 females that were prescreened for normal hearing.

Experimental Design

While utilizing male and female spoken words from the Modified Rhyme Test (MRT), the participants listened and were asked to identify nine words per condition. The conditions included the speakers and listeners in baseline, US, & Russian noise environments, and with the badge at the shoulder, chest, & upper arm locations.

Equipment

Anechoic and space vehicle simulation acoustic chambers at JSC's Acoustics and Noise Control Lab.

Voice Recognition Study

Participants

A total of 10 (Five males and five females) completed the study.

Experimental Design

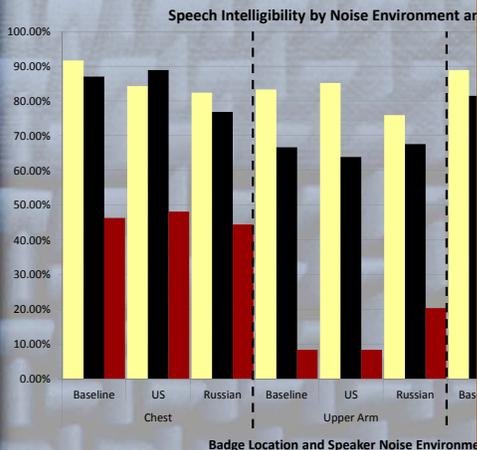
The participants spoke nine commands (e.g., "Call", "Broadcast a message", "Invite", and "Log out") while in the baseline, US, & Russian noise environments, and with the badge at both the shoulder & chest locations.

Equipment

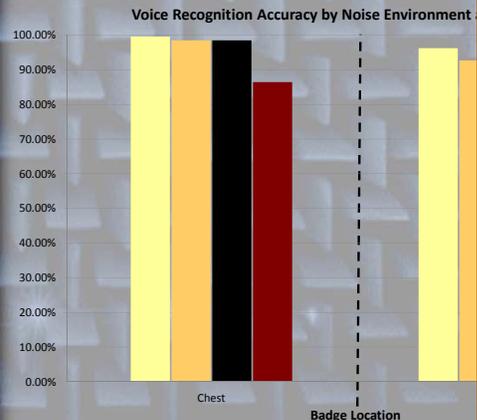
Anechoic and reverberation chambers at JSC's Audio Development Lab.

Results

1. The shoulder and chest locations resulted in higher intelligibility scores. The Russian noise environment had the lowest intelligibility scores.



2. The chest was the optimal location for achieving the highest intelligibility. The US and Baseline noise levels resulted in the highest intelligibility scores while the Russian noise environment experienced a decrease in intelligibility scores (see below).



3. The participants preferred the shoulder location for the badge's speaker and microphone placement. They preferred the chest location in terms of the comfort of the badge.

Conclusions

Based upon the findings of these studies, the human factors team was able to determine the optimal location for the Vocera® B3000 badge of communication for the astronaut using this device while on the ISS. Even though the shoulder provided a slightly preferred location for the user's intelligibility and voice recognition data demonstrated the best overall performance and microphones while at the chest location. Future studies should investigate the use of the badge's speaker and microphone headsets as well as adding an attachment to the badge that would direct the sound upwards while worn on the chest.

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