

# Wearable Integrated Speakerless Sound Protection using Electrostimulative Resonance (WISSPER)

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## Background

- Warfighter exposure to extreme noise conditions is an unavoidable occupational hazard
- As of 2014, over 2.2M veterans were receiving disability compensation for hearing related injuries
- Cost > \$1.2 billion

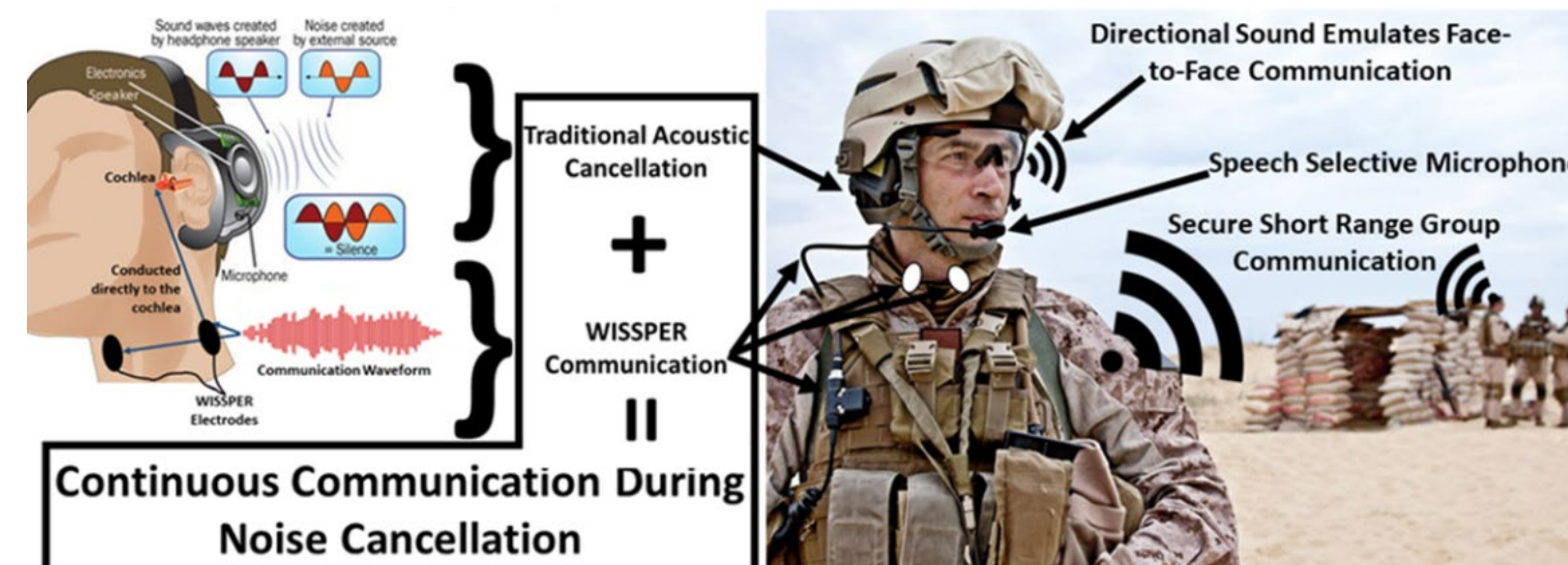
Minimize noise exposure to a level sufficient to protect soldiers

vs.

Inability to communicate while wearing hearing protection

## Approach

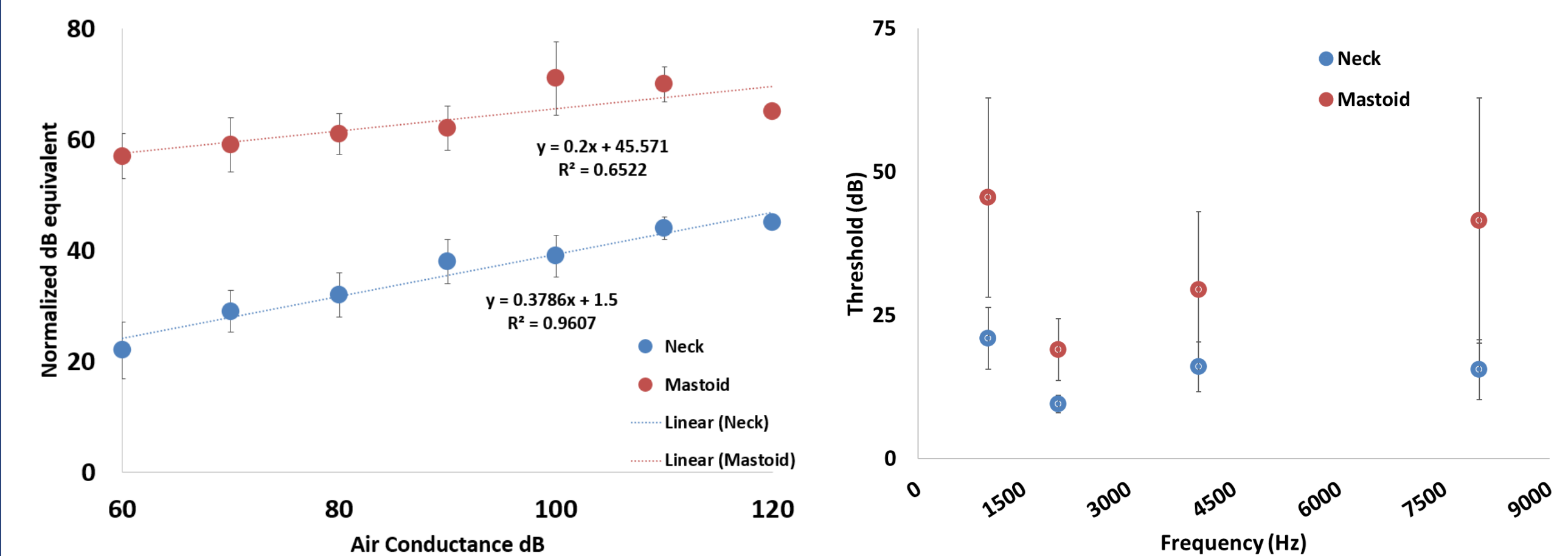
WISSPER (Wearable Integrated Speakerless Sound Protection using Electrostimulative Resonance): allows communications to bypass hearing protections by imparting speech from a talker (via a speech-selective microphone) to a listener through low-level current applied to skin electrodes that directly stimulate the listener's auditory nervous system.



## Characterization of WISSPER

**Lower left:** Normalized dose response curve of current input vs. perceived volume, via electrodes on neck and mastoid.

**Lower right:** Perception threshold at varying frequencies, for neck and mastoid electrodes.



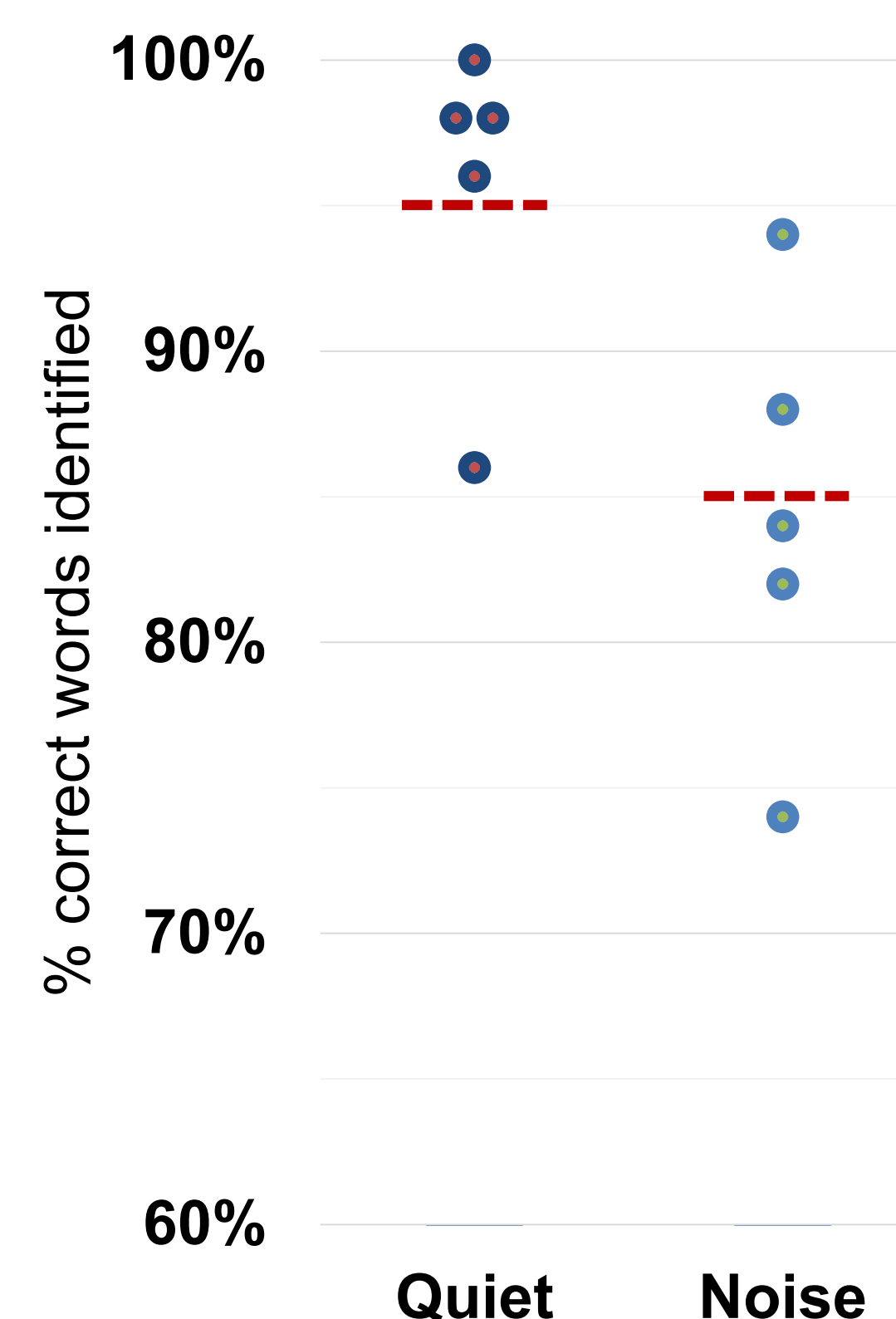
## Evaluation of WISSPER effectiveness

The system was evaluated on five healthy human subject volunteers with no known hearing impairments as follows:

1. Subject fitted with double hearing protection
2. Subject positioned in a controlled auditory chamber to allow for accurate control of background noise exposure
3. Electrodes positioned on the subject's mastoid
4. A Modified Rhyme Test (MRT) is used to assess the subject's speech intelligibility

Each subject was evaluated under "quiet" background noise conditions and with elevated background "noise" at 80dB. The subject was exposed to 50 sets of 6 one-syllable words. The set of words were delivered to the subject through the WISSPER system and the subject marked which word they heard on a multiple choice questionnaire.

**Right:** Each subject's MRT score (% words identified) under both noise conditions. The red dashed lines indicate the target performance of the system under each noise condition.



## Conclusions and future directions

Pathways to deliver robust sound to the auditory nerve:

- Established:
  - Biological auditory
  - Bone conduction

• **Novel: Electro-dermal**

Next steps:

- Optimize audio signal delivery to meet target MRT scores
- Assess use of multiple electrodes to control directionality of sound
- Refine portable, battery powered system for use in military communication devices

## Acknowledgements

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