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Electromyographic Biofeedback

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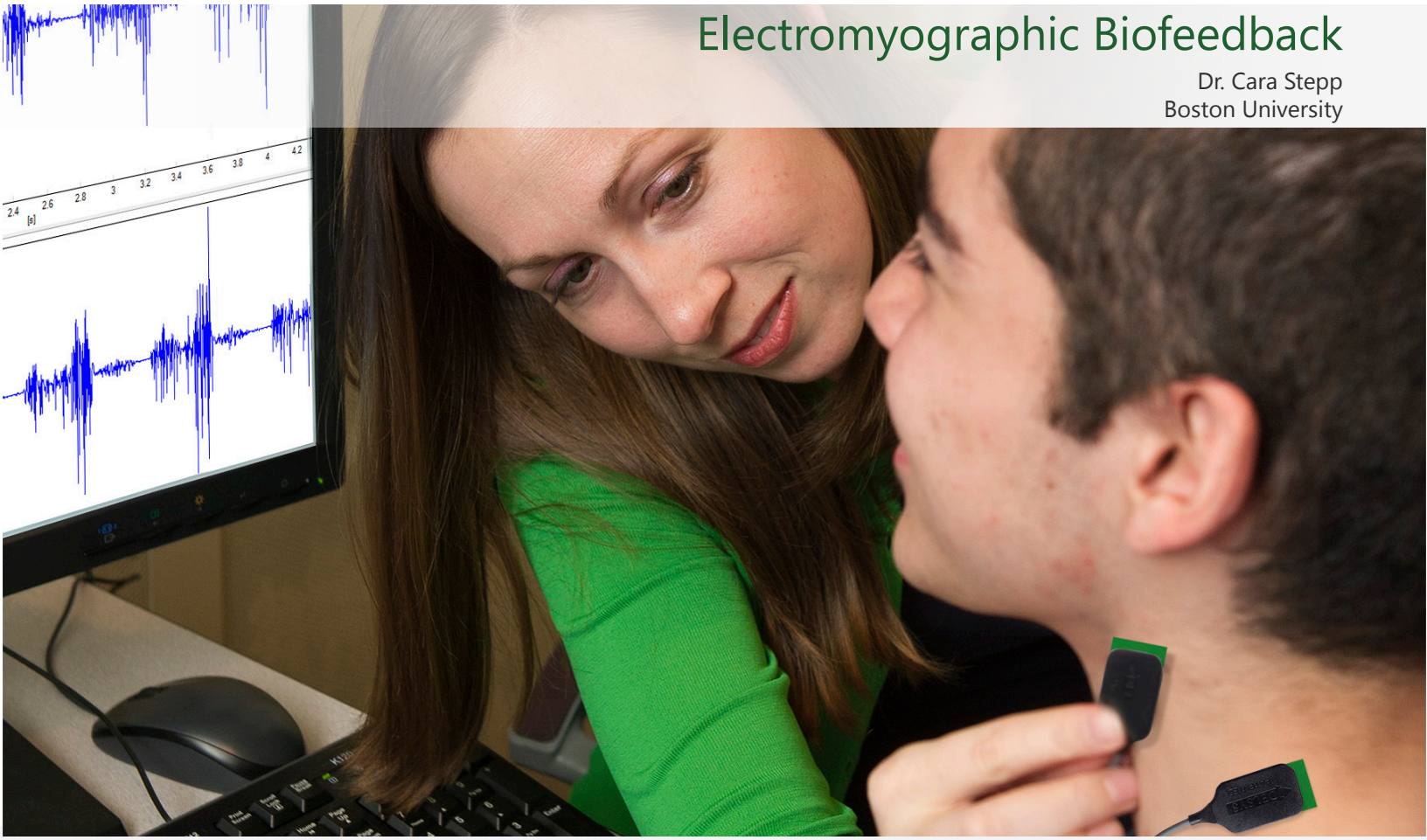

BACKGROUND

Human-machine interfaces (HMIs) can utilize ones biosignals in order to perform tasks, typically those involving communication or mobility. For those who have lost normal user functions, HMIs can provide a means to restoring them. Many HMIs require **visual feedback** from the user causing their normal vision to become distracted. To resolve this problem, **auditory feedback** and facial expressions are being tested as ways to control HMI output.

A common biosignal used in HMIs is surface **electromyography** (sEMG) which is used by the HMI to convert muscle activity into interface commands. A study[1] at the University of Technology Malaysia tested eleven facial gestures to determine which are most effective in controlling HMIs. Surface EMG signals were recorded from cranial muscles during a combination of gestures. A differentiation accuracy of 90% was found, proving that sEMG signals can be reliably used to operate HMIs

keywords: human-machine interfaces, electromyography, visual feedback, auditory feedback

DR. CARA STEPP

Dr. Cara Stepp has worked extensively with HMIs and other rehabilitative devices used to restore ones daily functions. She has utilized EMG signals from the face and neck as a way to control an electrolarynx[2]. Furthermore, she has analyzed the effect of visual feedback training on auditory-motor performance where facial sEMG signals were used to control the HMI[3]. She continues to research the use of auditory feedback for HMI control.

Dr. Stepp and her colleagues performed a study[4] to determine the extent to which categorical speech perception can be used to improve HMIs using auditory feedback via vowel synthesis. Users were separated into one of three test groups.

The first two controlled an HMI using auditory and text cues for specific American English vowels and a third used auditory cues that were vowel-like sounds, but not part of American English. Surface EMG signals were collected from the left and right **orbicularis oris muscles** using a **Delsys Bagnoli™ EMG System**. The sensors provided a **high signal-to-noise ratio (SNR)** input which could be utilized in visual and auditory feedback training. The sEMG signals provided real-time visual feedback during training allowing the subjects to identify the accuracy of their movements. Over time the visual cues were removed in order to identify the performance with the auditory feedback alone. The results showed that auditory feedback can be effective in HMI control when paired with established targets, although including both auditory and visual feedback can further improve HMI operation performance.

CONCLUSION

The ability to use auditory feedback in HMIs can provide users with control even without full visual function. Dr. Stepp concludes that HMIs can be effectively controlled through the use of auditory feedback if paired with established targets. However, auditory feedback alone still remains slightly less effective than the combination of auditory and visual feedback.

REFERENCES

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[5] www.delsys.com

DELSYS EMG SYSTEMS

Delsys EMG Systems feature wired and wireless surface EMG sensors designed to produce a consistent EMG signal with low muscle crosstalk and reduced motion artifact.

The **EMGworks®** software acquires and analyzes EMG signals. EMGScript can determine maximum voluntary contraction percentage (%MVC) of each orbicularis oris muscle to map power activity to vowel targets for use in controlling HMIs.

The Study Parameters:
HMIs were controlled using:
- Auditory and text cues of American English vowels
- Auditory cues of American English vowels only
- Auditory cues for Vowel-like sounds

The Study Focus:
- EMG providing high SNR input
- EMG used as real-time biofeedback

Delsys Instruments Used in the Study:
- 2 channel Bagnoli™ EMG System