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Toward Standards in AAC-BCI Performance Measurement and a Data Repository

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Introduction: An overarching goal of Brain Computer Interface (BCI) research and development is improving outcomes for human communication and accelerating research discoveries into practice. In order to improve the communication outcomes of individuals with complex communication disorders who rely on augmentative and alternative communication (AAC) and benefit from BCI control, more accurate performance data are needed for measuring and monitoring the effectiveness of treatment. Standard calculations of performance or quantitative dependent variables allow AAC-BCI research and clinical services to measure the effectiveness of manipulating independent variables such as language encoding methods, display types and training protocols. Data logging tools to measure performance provide for analysis of the human-computer interface experience using AAC-BCI systems. The purpose of this paper is to review efforts that have been made at the University of Pittsburgh, Carnegie Mellon University and the AAC Institute in creating standards in AAC-BCI performance measurement and building a data repository of language samples contributed by AAC-BCI speakers for data sharing.

Materials, Methods and Results: The term Language Activity Monitoring (LAM) was coined in 1998 during the feasibility testing of an AAC data logging device [1]. With the focus on language sampling, the reliability of the transcription process and the validity of the reported measures to report performance were established. Language samples based on authentic communication tasks such as interviews, conversations, and narratives have formed an initial library and database repository of LAM data. Focus groups and internet-based surveying along with informed alpha and beta testing were used to identify the types of quantitative measures practitioners believed important for monitoring clinical invention and treatment effectiveness.

Survey respondents who were Speech Language Pathologists delivering AAC services (N=26) identified specific performance measures valued from language sampling analysis. The preferred performance measures associated with monitoring AAC utterance generation were: 1) use of language representation methods (LRMs); 2) type of method of utterance generation (spontaneous generation versus pre-stored messages); 3) frequency of core vocabulary versus extended vocabulary. When questioned about monitoring access and key selections, respondents were interested in 1) average and peak communication rates; 2) selection rate; 3) accuracy.

These data were used in the development and usability and user satisfaction testing of the AAC Performance Report Tool (PeRT) [2], a software analysis tool. Calculation methods have been tested and published for such AAC performance measures as 1) selection rate in bits per second; 2) average and peak communication rates in words per minute; 4) frequency use of LRMs and core vocabulary. Built-in LAM, language transcription, and analysis using PeRT have been used in evaluating AAC-BCI device performance and use in the lab [3] by gathering LAM data during copy spelling and picture description tasks and as a clinical trial [4] by gathering LAM data during daily communication at home and for sending email messages.

Discussion and future directions: BCI research is extending from the laboratory into clinical practice. Standards on data logging formats, collection methods and calculation of performance measures are critical for judicious comparison among results achieved on AAC-BCI systems offering different features. Surveyed stakeholders have been consistent in prioritizing summary measures and positive about proposed operationalized standards. As language sampling is expanded as a testing protocol, more data will be available to share, archive or contribute to a repository. Along with an AAC data logging consortium started in January 2015, further discussion and consensus is needed through a collaboration of researchers, clinicians, and manufacturers to include AAC-BCI language samples in the data repository.

Significance: Standards in AAC-BCI performance measurement and data sharing practices support current and planned innovations to AAC-BCI systems. Diffusion of LAM tools and the growth of the consortium network supports multimedia databases, computational power and internet systems for AAC-BCI research, development, commercialization and use by individuals with severe communication and movement disorders.

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