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From Physical to Virtual: Expanding Boccia Accessibility through Patient Partner Engagement

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Introduction: Participation in sports provides significant development, social, and quality of life benefits. Paralympic sports, such as Boccia, provide an avenue for individuals with complex needs to participate in sports. Boccia is a precision Paralympic sport that consists of propelling a ball as close as possible to a target (i.e., a jack ball). Athletes who cannot propel the ball by themselves can use a ramp operated by an assistant. However, those with complex motor needs and limited communication cannot currently play and are deprived of their right to participate. To allow these individuals to play Boccia, we developed a brain computer interface (BCI)-enabled Boccia system that consists of a hardware ramp prototype, and P300-based software to control the rotation of the ramp or the height of the ball [1]. The hardware prototype was functional but lacked ease of transportation and operation. Additionally, the software required multiple P300 selections to reach the desired position. The purpose of this work was to improve the design using a patient partner engagement approach.

Material, Methods, and Results: To improve the ease of use and the user experience we engaged six patient partners. This included three families with BCI experience, two professional Boccia athletes, and one recreational Boccia athlete. Patient partner input for the hardware prototype focused on the importance of ramp stability, rigidity, and ease of transportation (Fig. 1A). We adapted the rolling floor stand from Ideas for Independent Living, Inc (Scarborough, Canada). Patient partner input for the software prototype focused on requiring fewer P300 selections to position the ramp. We developed the new software using the Unity 3D game engine with the BCI-essentials Unity package [2]. The new ramp control interface consists of two fan-shaped selectors that allow more intuitive positioning of the ramp while requiring fewer P300 selections (Fig. 1B). Additionally, patient partners highlighted the importance of being able to use the system at home. Thus, we implemented a software simulation mode. In this mode, the user can control a simulated virtual ramp to practice with the BCI system.

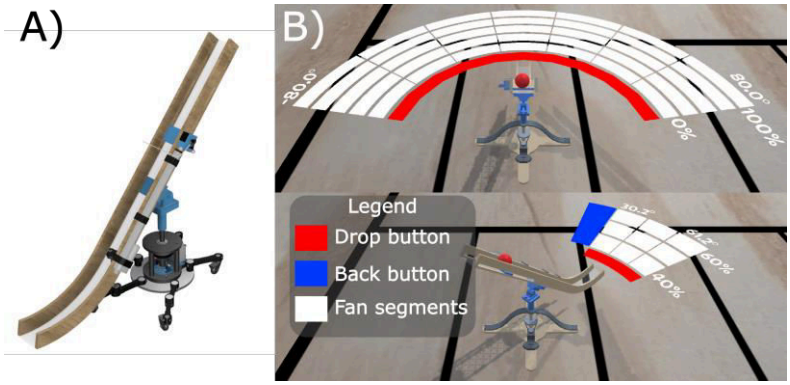

Fig. 1. A). Render of the modified hardware prototype. B) Screenshots of the new software interface. Top: coarse fan for absolute position. Bottom: fine-tunning fan for smaller, relative position adjustments. The player can adjust the number of segments of the fans, and ranges of motion to suit their needs.

Conclusion: Patient partner engagement resulted in improvements of the hardware prototype and software of the BCI-enabled Boccia system. This new design promises to improve user experience thanks to more stable hardware that is easier to operate and transport, and software that is more intuitive to use. Further validation of the system with the target population will focus on measuring ease of use.

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