PROSTHESIS INCORPORATION: AN OUTCOME METRIC TO ASSESS TOOL INCORPORATION OF A PROSTHETIC LIMB

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ABSTRACT

As new types of feedback systems are realized for prosthetic limbs, it is important to be able to assess the impact of those feedback systems on the amputee's experience. The Prosthesis Incorporation (PIC) outcome measure evaluates an amputee's level of tool incorporation of a prosthesis with feedback. The PIC scoring is performed using a modified crossmodal congruency test [1], while parameters such as training time, feedback agency (trust of feedback), spatial congruency (feedback distance from expected location), and physiological correspondence (naturalness of feedback) are controlled or measured.

The PIC outcome measure can be administered in approximately 20 minutes and immediately provides a quantitative measure of tool incorporation. The test uses feedback pairs to measure the user's reaction time while the pairs of feedback (feedback from the prosthesis feedback system plus visual feedback) are presented in complementary fashion (congruent) vs conflicting fashion (incongruent). The score is calculated as the mean reaction time difference between congruent and incongruent stimuli over four sets of 64 trials. A further assessment can be administered by delaying the user's feedback while measuring the delay in their actions [2]. This additional testing provides a measure of the user's feedback agency.

Our results, on 60 able-bodied subjects using a bypass prosthesis and 6 subjects with an upper limb amputation, show a proportional relationship between training time and PIC score, a proportional relationship between feedback agency and PIC score, a proportional relationship between physiological correspondence and PIC score, and an inversely proportional relationship between PIC score and spatial congruency. Based on this information and the results of the administered tests, engineers and clinicians can adjust and tune the amputee's feedback system to provide a stronger sense of incorporation of their prosthetic limb if necessary.

REFERENCES

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