Using Data from a Sensorized Therapeutic Exercise Platform to Understand Unsupervised Home Rehabilitation Perseverance: Effect of Steadiness of Use on Duration and Volume of Exercise

Veronica, A, Swanson (Department of Mechanical and Aerospace Engineering, University of California at Irvine), Edgar, Ramos D, Muñoz (Department of Mechanical and Aerospace Engineering, University of California at Irvine), George, H, Collier (Virginia C. Crawford Research Institute, Shepherd Center), Daniel, K, Zondervan (Flint Rehabilitation Devices, LLC), Amanda, R, Rabinowitz (Brain Injury Neuropsychology Laboratory, Moss Rehabilitation Research Institute), Raeda, K, Anderson (Shepherd Center; Department of Sociology, Georgia State University), Christopher, Johnson (Biomedical Engineering, University of California at Irvine), David, J, Reinkensmeyer (Departments of Mechanical and Aerospace Engineering, Anatomy and Neurobiology, University of California at Irvine)

In the current rehabilitation service paradigm, clinicians instruct patients to continue practicing movement exercises on their own at home following a period of inpatient and/or outpatient treatment. Though emphasis on home-based continuation of therapeutic exercise has increased, there has not been corresponding innovations to ensure that discharged patients follow-through with home rehabilitation exercise. The commercialization of mRehab (mobile rehabilitation) systems, typically incorporating some form of activity sensing and data archiving via the Internet, provide unique data sets to probe the behavioral factors associated with rehabilitation perseverance. We examined 1,385 anonymous user records acquired from June 20th, 2016 to December 15th, 2019 from the FitMi home rehabilitation system, a medical device marketed to persons who have experienced a stroke to help them perform movement exercise. We analyzed the impact of individual’s steadiness of use on their perseverance with the system as quantified by the number of exercise repetitions performed, minutes spent exercising, and days they used the system. Curvature of normalized cumulative progress lines was used to compare rates across users. Users had a mean curvature value of -1.1, with steadiness curvature predicting the probability of achieving levels of perseverance across the analyzed factors. Users with heavily accelerating or decelerating rates of use exhibited reduced perseverance, however perseverance was more sensitive to accelerating than decelerating use. Using these relationships, the system could introduce notifications warning users if they approach usage rates associated with reduced perseverance. External factors, demographics, or clinical metrics influencing behavior cannot be identified from the data analyzed.