Poster

Gait Variability and Assessment of Cognitive Impairment

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Abstract

Background: Walking has long been considered to be an autonomic process involving little or no higher cognitive input. In healthy adults, stride-to-stride fluctuation of many gait parameters (eg, gait speed, stride time) is on the order of just a few percent, testimony to the accuracy and reliability of the fine-tuned systems that regulate locomotion. When the systems regulating walking are disturbed as a result of neurological disease or abnormal aging, movement control may be impaired leading to increased variability of several gait parameters. Gait assessment while the patient performs a cognitively challenging secondary task ("dual-tasking") has been widely used to assess interaction between cognition, gait, and the risk of falling. Dual-task testing is clinically relevant, as most activities of daily living require the simultaneous performance of two or more cognitive and motor tasks. Traditionally, gait variability has been difficult to quantify and has been carried out in specialized laboratory settings. Current motion analysis systems are expensive, require trained personnel to operate, and limit evaluation to a few strides. Advances in consumer electronics allow for the development of a system that is cheap, unobtrusive, and easy-to-use in unconstrained ambulation. In addition, the use of a portable electronic device facilitates the development of a gamified Go/NoGo response inhibition task, which enables an automated approach to measuring relative trade-off in dual-task conditions.

Objective: Our primary objectives were as follows: (1) to develop a simple mobile-based tool to enable collection, aggregation, and visualization of gait variability data through a co-design process with clinicians; (2) to examine the feasibility of integrating a gamified dual-task assessment; and (3) to answer the question "If we build it, will they come?" Our secondary objective was to explore the factors that influence rehabilitation therapists' willingness to use mobile/wearable technology in clinical practice.

Methods: We took an iterative design approach to incorporate user feedback during the development of the mobile application. To validate the gait assessment data, we utilized a convenience sample of 12 healthy adults and evaluated 30 seconds of walking data using the mobile application against a Vicon Motion Capture System. In parallel, we developed a questionnaire to gain insight into the barriers and motivating factors that affect use of consumer technology in clinical practice by physiotherapists. The questionnaire was pilot tested for content validity and internal consistency at a rehabilitation center and was distributed online.

Results: Preliminary validation demonstrates good agreement between the mobile application and the Vicon system for mean stride time (r=0.89, P<.001) and stride time variability (r=0.79, P<.01), n=12. However, further testing is required among cognitively impaired older adults.

Conclusions: Assessment of gait in single and dual-task conditions is suitable using a mobile device and allows for simple development of a game to assess cognitive challenge during ambulation. Barriers to clinical use exist, but physical therapy is a promising area to assess ideas and implementation strategies in mHealth. Consequently, more research is needed to understand the attitudes of physical therapists toward emerging consumer-grade technology in practice.

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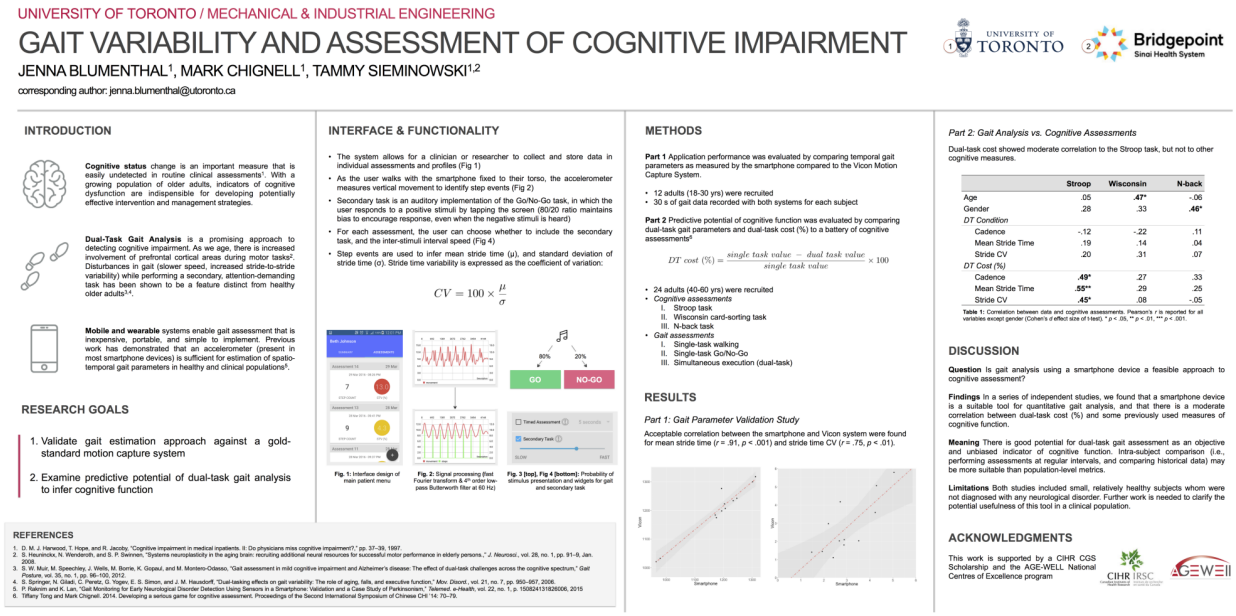
KEYWORDS

gait; cognitive impairments; falls; neurorehabilitation; mHealth; Technology Acceptance Model (TAM); user-centred design

This poster was presented at the Connected Health Symposium 2016, October 20-21, Boston, MA, United States. The poster is displayed as an image in Figure 1 and as a PDF in Multimedia Appendix 1.

Figure 1. Poster.



Multimedia Appendix 1

Poster.

[PDF File (Adobe PDF File), 1MB-Multimedia Appendix 1]

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