

Physical Therapist Feedback Regarding Wearable Technology



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INTRODUCTION

Wearable technology has the potential to augment current subject evaluation with objective measurements of gait in inpatient rehabilitation settings. An ongoing study at St. Luke's Rehabilitation Institute has been investigating such wearable sensor-derived measurements by having patients perform a standardized gait task called the ambulatory circuit (AC). The tasks required of the AC resemble every day activities such as rising from a chair, walking, and vehicle transfer (see Figure 1).

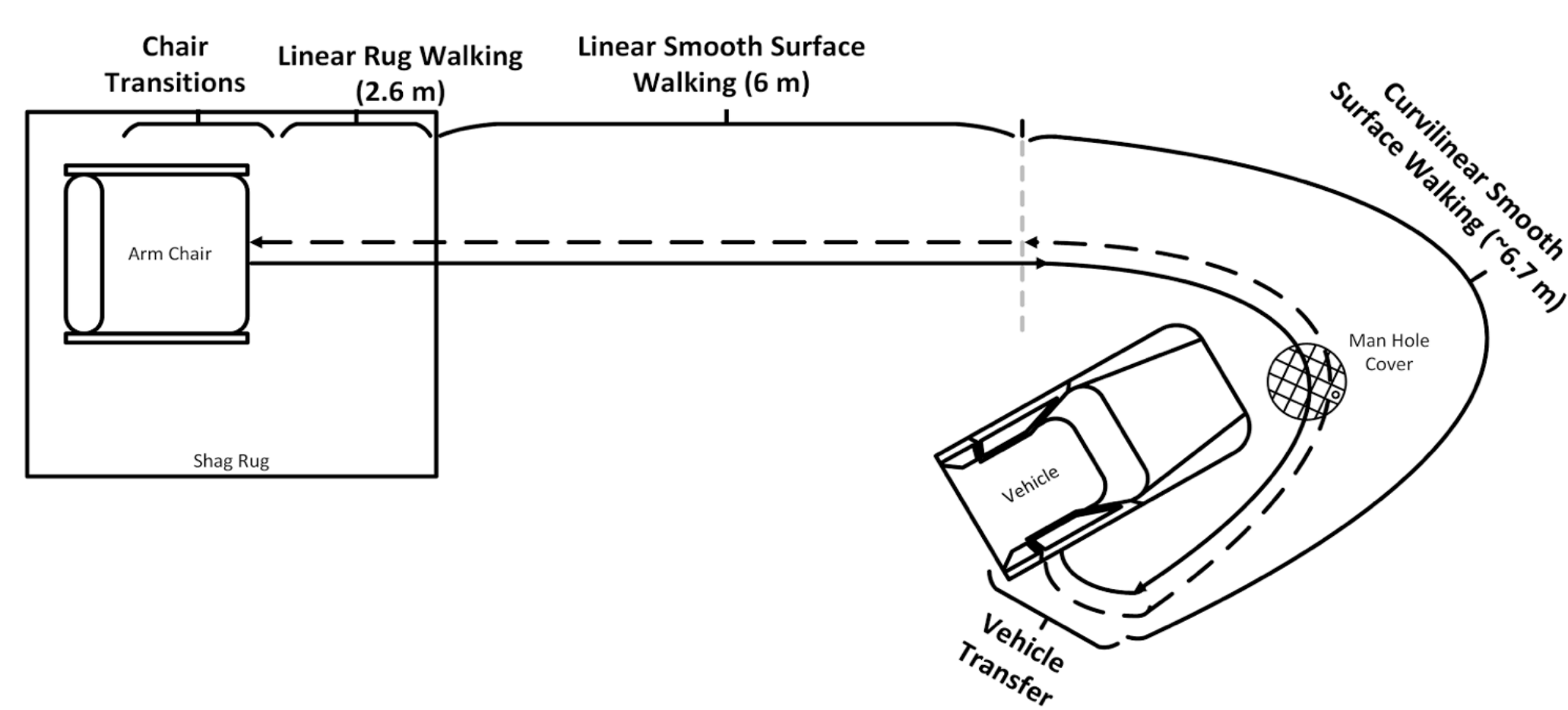


Figure 1: The Ambulatory Circuit.

Gait characteristics such as total ambulatory circuit duration, smoothness index, and double support percent are computed from the collected acceleration and angular velocity data from three wearable inertial sensors worn on the center of mass, left shank and right shank (see Figure 2 for sensor placement).

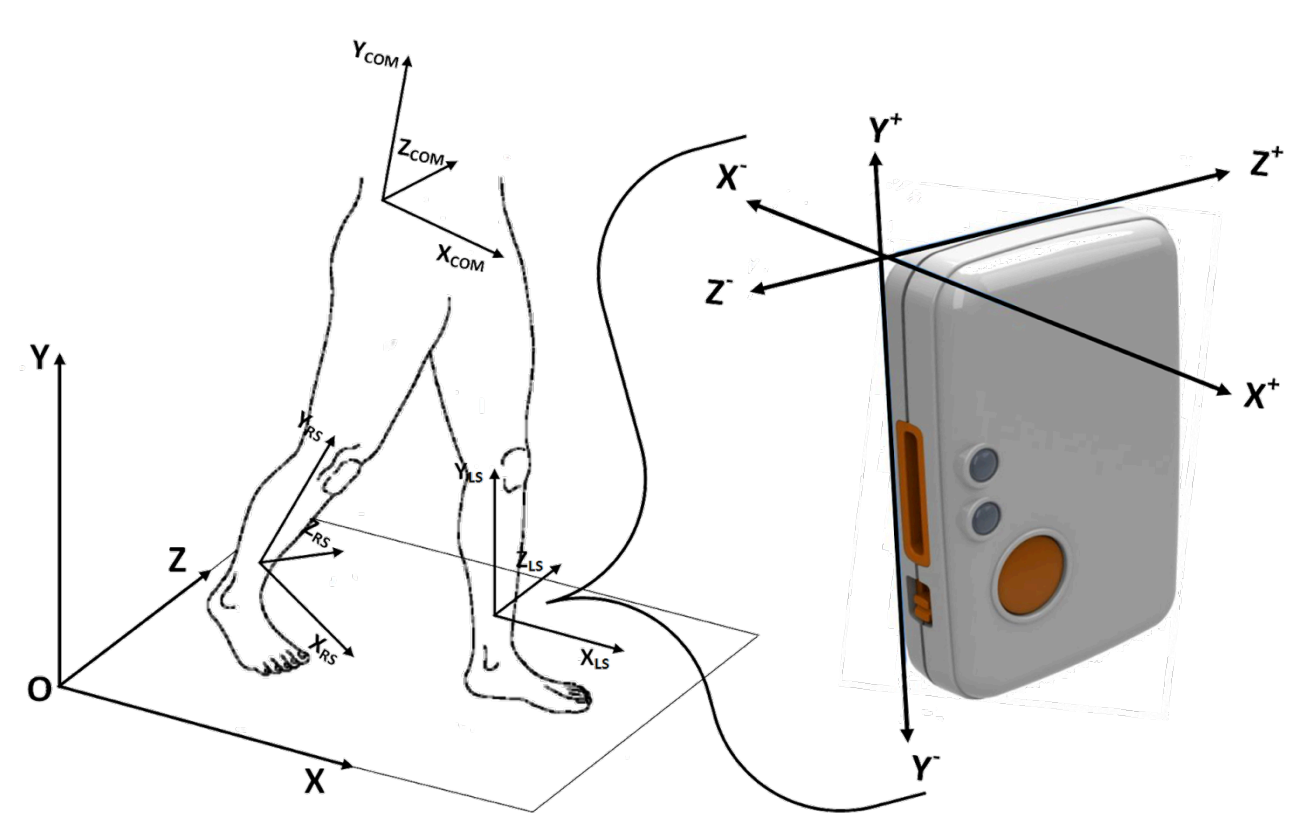


Figure 2: Sensor Placement.

Sensor units were mounted on the center of mass (COM), left shank (LS), and right shank (RS).

From this data researchers are able to quantitatively describe ambulation performance and present the information with visualizations such as plots and graphs. The results of this research are relevant to the engineering community; however, the usefulness of this data for the clinical community has not been verified. To investigate the clinical utility of the wearable sensor system for gait analysis, Physical Therapists (PT) from St. Luke's were recruited to undergo an interview process to gather their feedback.

METHODS

Physical therapists were presented with three different visualizations of wearable sensor-derived metrics. They were then asked to answer a series of questions related to the data and their perceived usefulness of it. The interviews took approximately 30-45 minutes and consisted of multiple-choice, likert scales, and free response questions. An example visual display and question is shown below in Figures 3 and 4.

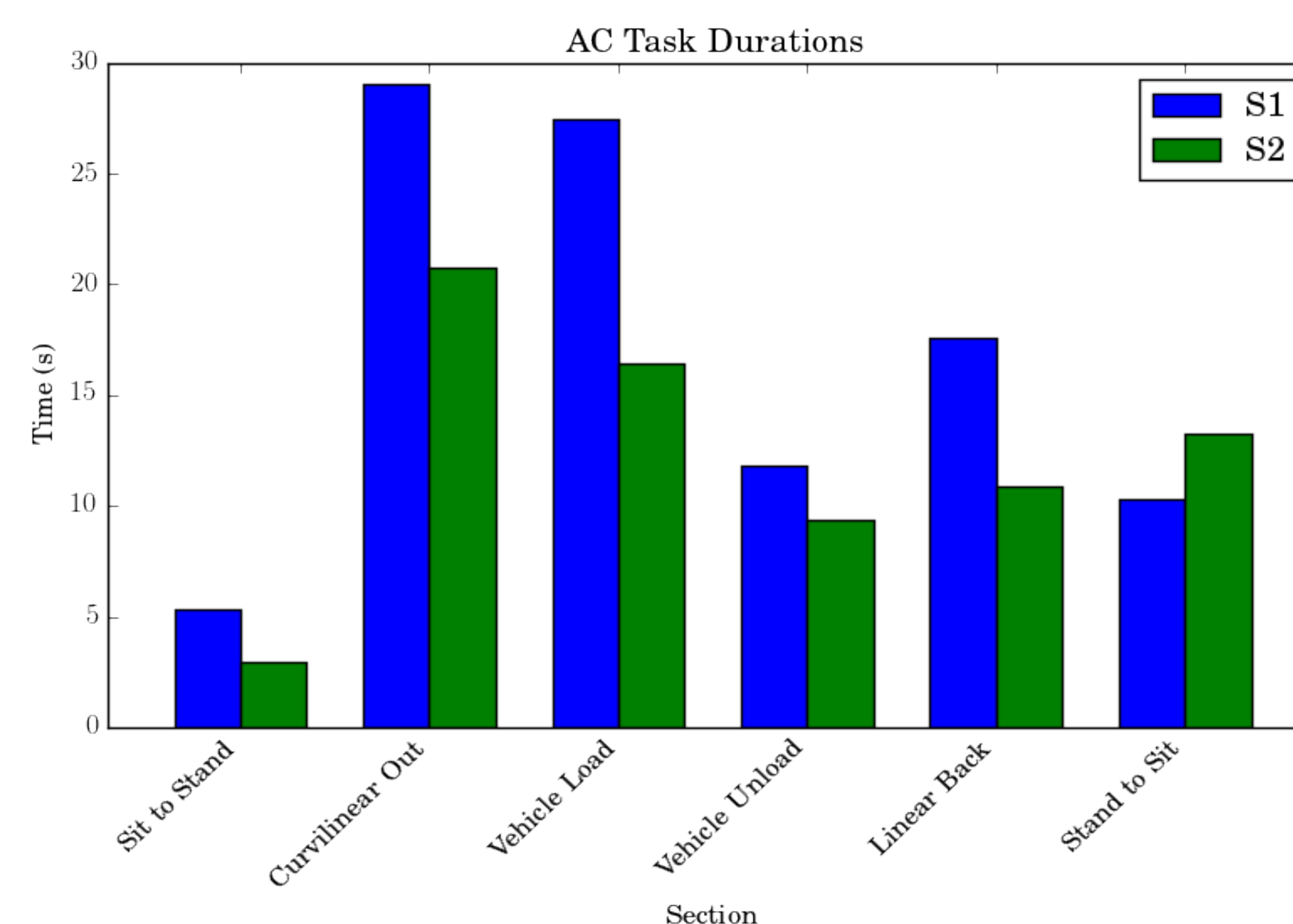


Figure 3: Task Duration Plot. A plot shown to PTs in the interview that shows AC task durations for sessions exactly 1 week apart.

Q 6.4 Please rate the following statements regarding your thoughts on the task Duration Plot.

	Strongly disagree(1)	Disagree (2)	Neither disagree nor agree (3)	Agree (4)	Strongly agree(5)
I think that I would use this plot frequently	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 4: Rating Scale. Likert question corresponding to Task Duration Plot in Figure 3.

FUTURE WORK

Several participants use assistive devices, such as canes and walkers, while performing the AC. An inertial sensor is also mounted on the assistive device and this data has not been processed yet. Future work could include computing metrics based on inertial data from the assistive devices and measuring the clinical utility of such information.

RESULTS & DISCUSSION

There were five PTs interviewed, four were female with one male. Their average age was 40.6 years old. The group on average rated their level of comfort with technology a 4.8 out of 5 with a standard deviation of 0.84, which was encouraging to know they were open to technology. Currently though, the PTs only use technology to show videos on the computer to patients. While there was no significant difference in answers between physical therapists and physical therapist assistants, there was quite a difference in response to metrics usefulness between PTs that had prior experience (PE) with wearable technology vs PTs with no prior experience (NPE).

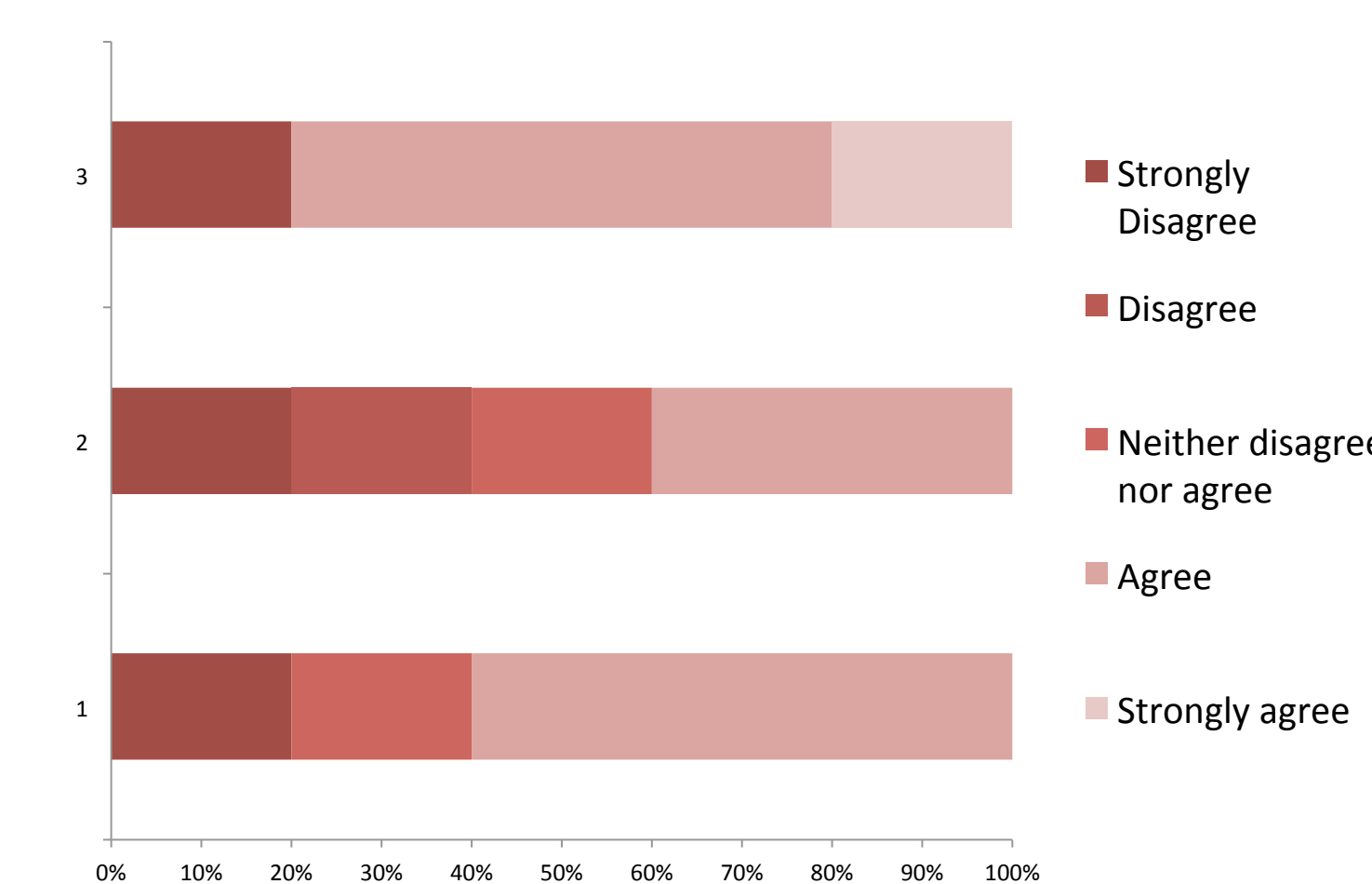


Figure 5: Likert scale. Stacked bar graph of group responses to whole body movement metrics usefulness.

Figure 5 shows the groups response to the whole body movement metrics, however when categorized into PE vs NPE, PTs with PE rated the metrics usefulness on average 3.92 while PTs with NPE rated it only 2.33 out of 5. This shows that on average the PTs with PE find metrics derived from wearable technology more useful than PTs with NPE. The metrics that all PTs found the most useful for each metric type (task duration, whole body movement, and gait cycle) were walking speed, smoothness index, and cadence. The PTs thought these metrics would be useful in giving patient feedback combined with their observations. A few PTs stated completing the circuit at a faster rate doesn't necessarily equal improvement, some tasks may take longer because the patient is using the proper safety precautions. Overall though, PTs thought wearable technology would be useful in adding objective measures to patient ambulatory ability evaluation.

ACKNOWLEDGEMENTS

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