

Relationship Between Perceived Usability of Electric Mobility Devices and Physical/Cognitive Function in Older Adults: An Exploratory Field Demonstration Study

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Following driving cessation, maintaining opportunities for independent mobility has become an important issue for older adults. While electric personal mobility devices can support outing opportunities, required capacities differ among users, and established guidelines are lacking. This study exploratively investigated the relationship between physical/cognitive function and the perceived usability of two electric devices—an electric cart and a motor-assisted four-wheel bicycle—during an exploratory field demonstration in Haga Town, Tochigi, Japan.

Ten community-dwelling older adults (mean age: 77.4 ± 9.6 years, range 60–88; heights: 157.3 ± 8.8 cm; weights: 56.0 ± 9.8 kg; BMI: 22.8 ± 4.6 kg/m²; grip strength: 22.9 ± 5.0 kg; TUG: 10.11 ± 3.45 s, range 6.36–16.85 s; MMSE: 27.5 ± 2.8 , range 22–30; 8 driving license holders, 1 license returnee, 1 non-holder) participated. Ethics approval was obtained from the National Center for Geriatrics and Gerontology Ethics Committee (No. 1928), and written informed consent was obtained. Physical function was assessed using maximum grip strength, the finger-ring test, and the Timed Up and Go (TUG) test. Cognitive function was evaluated via the Mini-Mental State Examination (MMSE). Participants operated both devices—the electric cart and the motor-assisted four-wheel bicycle—in real-world environments. Perceived usability and comfort were evaluated via a questionnaire based on the Technology Acceptance Model (TAM) supplemented by device-specific items, using a 5-point Likert scale. Subgroups were compared using the Mann-Whitney U test, primarily interpreting effect size (r) and directional numerical differences due to the small sample size (total analytical cases = 12).

No statistically significant difference in overall questionnaire scores was observed between the two devices. In exploratory item-level analyses, several perceived usability ratings differed according to functional characteristics; however, subgroup sizes were very small. Based on these premises, some of the key exploratory findings extracted in Table.1 are described below. Participants with faster TUG performance reported higher ratings for speed control of the motor-assisted four-wheel bicycle. For the electric cart, lower grip strength and slower TUG performance were numerically associated with greater intention to use or recommend the device. These findings should be interpreted as hypothesis-generating, and their conceptual relationships are synthesized as a conceptual model in Fig.1.

Older adults' physical capabilities are associated with distinct patterns of perceived usability for different electric mobility devices, emphasizing the need to individualize selection based on functional profiles. Due to the small sample size (n=10), these results serve as hypothesis-generating insights. Future larger-scale research is warranted to validate these relationships and standardize device selection guidelines.

Table.1 Key UX Findings

Assessment (group size)	Mobility	UX item	Higher-rated group (n)	Lower-rated group (n)	r	p
			Median(IQR)	Median(IQR)		
TUG (6vs6)	Overall	Q4. Speed Control	TUG <10 s (n=6) 5(0.0)	TUG ≥10 s (n=6) 4(0.0)	0.797	0.006
TUG (4vs4)	Motor-assisted Four-wheel bicycle	Q4. Speed Control	TUG <10 s (n=4) 5(0.0)	TUG ≥10 s (n=4) 4(0.0)	0.936	0.008
TUG (2vs2)	Electric cart	Q8. Intention to Use	TUG ≥10 s (n=2) 5(0.0)	TUG <10 s (n=2) 4(0.0)	0.866	0.083
Finger-ring Test (8vs4)	Overall	Q2. Improvement of Daily Mobility	Unable to encircle (n=8) 5(1.25)	Just fits/ Gap present (n=4) 2.5(1.25)	0.566	0.050
Finger-ring Test (5vs3)	Motor-assisted Four-wheel bicycle	Q3. Ease of Operation	Unable to encircle (n=5) 5(0.0)	Just fits/ Gap present (n=3) 4(1.0)	0.751	0.034
Grip Strength (10vs2)	Overall	Q9. Intention to Recommend	Low grip strength (n=2) 4(1.0)	Normal grip strength (n=10) 5(0.0)	0.595	0.039
MMSE (8vs4)	Overall	Q13. Ride Comfort	MMSE ≥27 (n=8) 5(1.0)	MMSE <27 (n=4) 4(0.25)	0.627	0.030
MMSE (2vs2)	Electric cart	Q11. Appropriateness of Speed	MMSE <27 (n=2) 5(0.0)	MMSE ≥27 (n=2) 2.5(0.5)	0.817	0.102

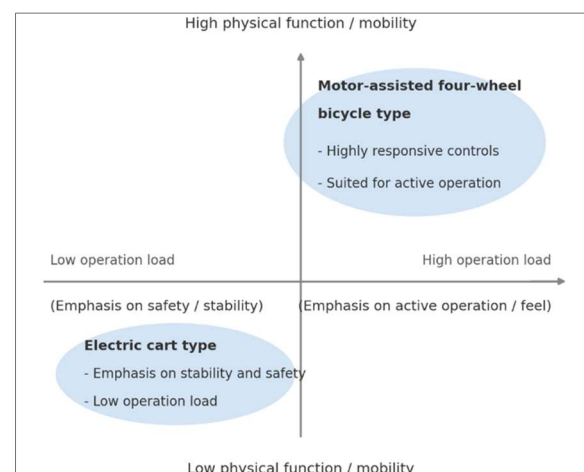


Fig.1 Hypothesis-generating conceptual summary of device suitability