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Introduction

We aimed to compare whether there are differences in variables related to driving characteristics between real and two-types of simulator driving. Ultimately, we intend to provide evidence on whether simulator driving might serve as a substitute for real-world driving in the context of prescribing PMDs.

Materials and Methods

The 30 patients with disabilities who were unable to walk more than 100 meters outdoors were enrolled. The patients participated three separate driving sessions each using real powered wheelchair, a full-cabin simulator, and a desk simulator (Fig. 1). To assess driving abilities such as starting, stopping, turning left and right, acceleration, and deceleration, we developed a driving scenario flow on the roads of park next to the hospital. For both the full-cabin and desk simulator, the patient drove according to the scenario on a virtual reality road designed to closely resemble the park. To verify the consistency of driving among real driving, the full-cabin simulator, and the desk simulator, driving characteristics data on driving distance, mean speed, and standard deviation of speed were collected.

Results

When comparing the driving distance, mean speed, and standard deviation of speed among real, full-cabin simulator, and desktop simulator driving, statistically significant differences were observed in driving distance and the standard deviation of speed with p-values of 0.000* and 0.001*, respectively. However, for mean speed, there was no statistically significant difference among the three groups (p-value=0.072) (Table 1.) The Intraclass Correlation Coefficient (ICC) analysis was conducted for analyze the correlation of driving distance, mean speed, and standard deviation of speed. The ICC for driving distance was 0.154 (p-value=0.289), which was not statistically significant. However, for mean speed, the ICC was 0.752 (p-value<0.0001*), indicating a strong correlation. The ICC for the standard deviation of speed was 0.562 (p-value=0.004*), indicating a moderate correlation. When conducting correlation analysis between two groups, the results are the same as Figure 2.



Fig. 1 (A) Powered wheelchair, (B) Full-cabin simulator equipment, (C) Desk simulator equipment

Table 1. Comparison of driving distance, mean speed, standard deviation of speed according to types of driving.

	Real driving	Full cabin simulator	Desk simulator	P-value
Driving distance(m)	216.32±50.00	281.74±12.46	284.22±11.15	<0.001*
Mean speed (m/s)	1.14±0.57	1.37±0.36	1.25±0.33	0.072
SD of speed (m/s)	0.45±0.19	0.49±0.12	0.60±0.15	0.001*

Abbreviations: SD; Standard deviation

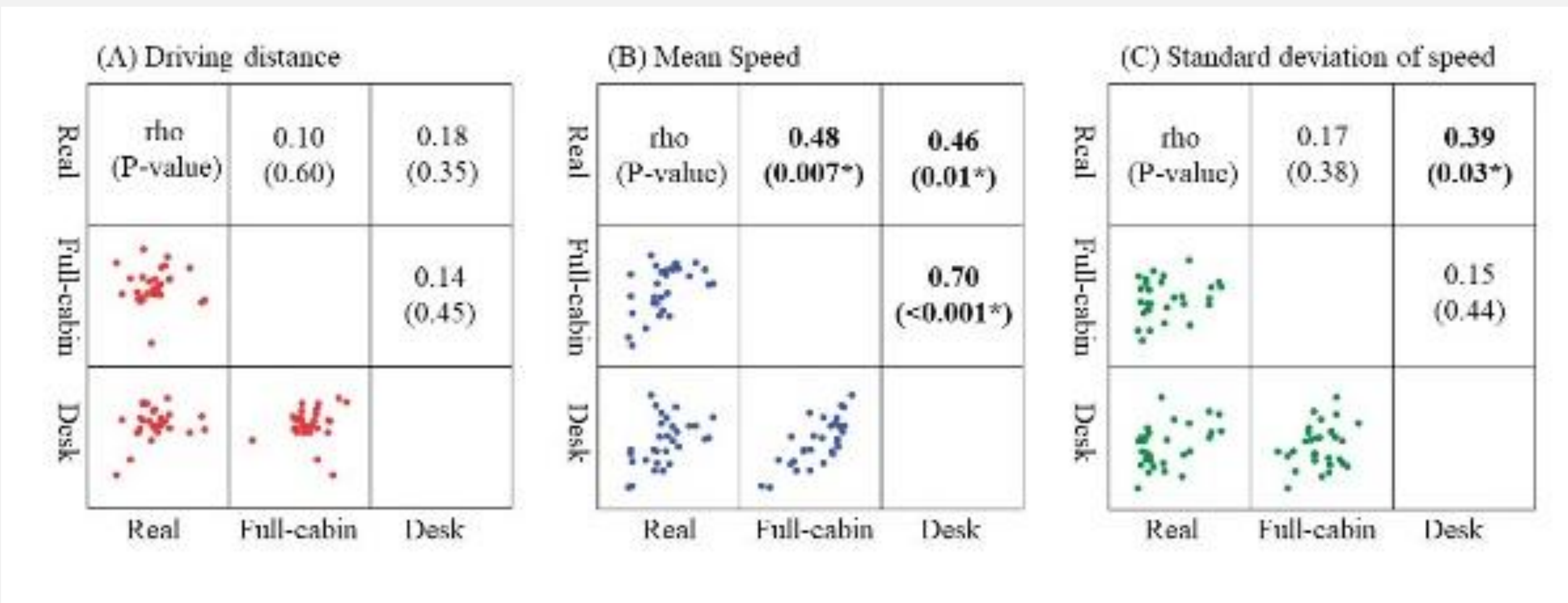


Fig. 2 Spearman’s correlation coefficients between types of driving. ((A)Driving distance, (B) Mean speed, (C) Standard deviation of speed)

Conclusion

In this study, we developed a full-cabin simulator and a desk simulator, and demonstrated that two types of simulators are similar to real-world driving characteristics. Among the driving characteristics, the mean speed showed highest level of similarity, and the standard deviation of speed showed moderate degree of similarity. This results highlights the significant potential of utilizing simulator based driving for training and evaluating the use of PMDs. Furthermore, this study is expected to be used as a valuable reference for considering additional aspects when developing simulators in the future.