



# DERIVATION OF REFERENCE VALUES FOR PHYSICAL AND COGNITIVE FUNCTIONS RELATED TO DRIVING BY AGE.



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## BACKGROUND

- In 2022, about 12.8% of all drivers (4.3 million) aged 65 years and above, and a recent aging trend has indicated that this measure will increase to 25% by 2050.
- In 2025, South Korea plan to introduce a conditional driving license system, and basic research such as awareness of the system of elderly drivers who can be subject to the system and their driving difficulties are needed.

## OBJECTIVES

- To derive indicators for physical and cognitive functions for drivers.
- To establish reference values for physical and cognitive functions according to age in order to confirm the driving ability of drivers by age.

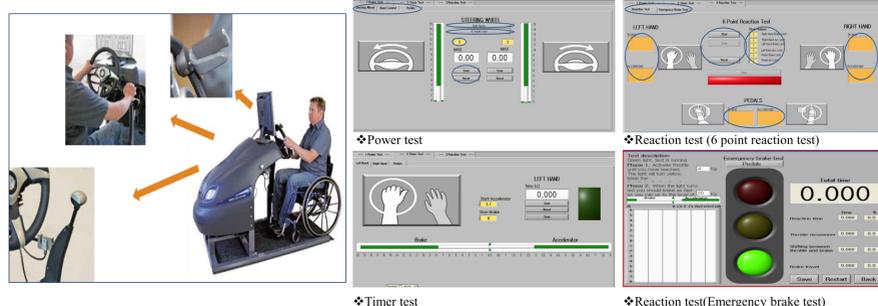
## METHODS & MATERIALS

### 1 Subjects (240 subjects)

- Over the age of 19
- Living in the community who had a driver's license

### 2 Assessment

- Computerized Neurocognitive Test(CNT)
  - ✓ Visual CPT, Digit Span test, Card sorting test, Trail Making Test(A, B)
- Driving Test Station(DTS)



- Actual road driving ability test



### 3 Analysis

- Descriptive statistics and frequency analysis
- Independent t-test and one-way ANOVA analysis
- Pearson correlation analysis
- All statistical significance levels used in this study are designated as  $\alpha=0.05$ .

## RESULTS

- An individual's physical function and actual driving ability were confirmed together by establishing reference values for the driver's physical function and cognitive function.
- Confirming the correlation between actual driving ability and function evaluation in Korea.

Table 1. Reference value of cognitive function related to driving by Age Group

Evaluation	Category	unit	Age value (Mean $\pm$ SD)							p-value
			20s	30s	40s	50s	60s	70s	80s and over	
Trail Making Test	Set A	sec	22.3 $\pm$ 6.6	22.8 $\pm$ 8.2	23.0 $\pm$ 6.2	33.8 $\pm$ 8.9	36.2 $\pm$ 6.6	41.4 $\pm$ 4.0	51.6 $\pm$ 3.8	<.001*
	Set B	sec	34.4 $\pm$ 12.5	37.3 $\pm$ 8.1	42.4 $\pm$ 14.8	55.3 $\pm$ 44.1	70.9 $\pm$ 71.6	97.1 $\pm$ 68.5	175.5 $\pm$ 150.0	<.001*
Digit Span	Forward	T-Score	60.0 $\pm$ 15.6	60.5 $\pm$ 16.3	58.2 $\pm$ 15.9	53.3 $\pm$ 17.3	45.6 $\pm$ 12.4	43.5 $\pm$ 11.6	37.5 $\pm$ 6.2	<.001*
	Backward	T-Score	55.9 $\pm$ 11.8	58.6 $\pm$ 12.4	52.4 $\pm$ 10.9	49.0 $\pm$ 11.7	45.5 $\pm$ 8.8	40.2 $\pm$ 8.3	38.4 $\pm$ 6.1	<.001*
Visual CPT	Number of reactions	T-Score	70.1 $\pm$ 14.1	67.8 $\pm$ 15.2	69.5 $\pm$ 14.3	66.4 $\pm$ 17.0	72.3 $\pm$ 11.1	73.0 $\pm$ 9.8	66.5 $\pm$ 17.1	0.317
	Number of errors	T-Score	70.4 $\pm$ 14.2	68.1 $\pm$ 11.6	59.3 $\pm$ 19.9	57.6 $\pm$ 17.8	50.1 $\pm$ 19.8	45.2 $\pm$ 17.9	44.7 $\pm$ 21.8	<.001*
	Correct time	T-Score	55.6 $\pm$ 10.8	54 $\pm$ 10.3	54.4 $\pm$ 9.5	49.4 $\pm$ 7.5	51.6 $\pm$ 8.9	50.5 $\pm$ 8.5	40.6 $\pm$ 8.7	0.001*
Card Sorting	Categories Completed/ Total Trials	T-Score	59.4 $\pm$ 9.6	59.6 $\pm$ 10.9	61.2 $\pm$ 11.2	51.8 $\pm$ 14.3	45.4 $\pm$ 13.0	40.6 $\pm$ 14.6	33.2 $\pm$ 19.0	<.001*

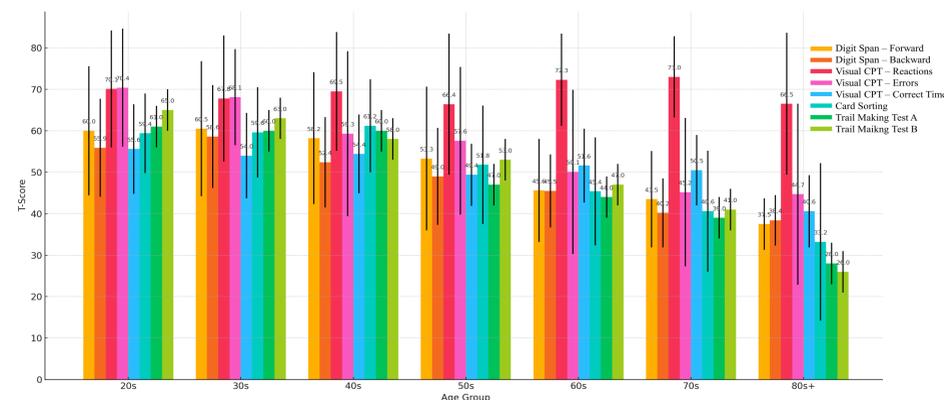


Figure 1. Cognitive Function test results by Age Group

- Visual CPT(Reaction) was found to have little discriminatory power, and TMT-B was the most age - sensitive indicator.

Table 2. Reference value of physical function related to driving by Age Group

Evaluation	Category	unit	Age value (Mean $\pm$ SD)							p-value
			20s	30s	40s	50s	60s	70s	80s and over	
Power test	Accelerator	kg	28.2 $\pm$ 4.2	28.3 $\pm$ 2.2	28.5 $\pm$ 1.9	27.8 $\pm$ 3.3	28.6 $\pm$ 2.9	29.2 $\pm$ 1.6	26.8 $\pm$ 4.4	0.095
	Brake	kg	29.5 $\pm$ 1.7	29.3 $\pm$ 1.9	29.3 $\pm$ 1.9	29.5 $\pm$ 1.5	30.1 $\pm$ 0.8	30.2 $\pm$ 0.2	29.7 $\pm$ 1.4	0.003*
	Left turn	kg	20.4 $\pm$ 1.4	20.7 $\pm$ 2.0	20.4 $\pm$ 2.3	19.2 $\pm$ 3.0	19.4 $\pm$ 1.3	21.1 $\pm$ 11.8	18.6 $\pm$ 2.8	0.008*
	Right turn	kg	20.4 $\pm$ 1.4	20.6 $\pm$ 2.0	20.3 $\pm$ 2.4	19.0 $\pm$ 3.5	19.4 $\pm$ 1.5	19.7 $\pm$ 1.6	18.8 $\pm$ 2.3	0.025*
Timer test	Pedal	sec	0.7 $\pm$ 0.2	0.7 $\pm$ 0.2	0.7 $\pm$ 0.2	0.9 $\pm$ 0.6	0.8 $\pm$ 0.2	0.9 $\pm$ 0.4	1.2 $\pm$ 0.6	0.074
	Accelerator (pedal)	sec	0.9 $\pm$ 0.2	1.0 $\pm$ 0.3	1.0 $\pm$ 0.2	1.2 $\pm$ 0.4	1.3 $\pm$ 0.3	1.5 $\pm$ 0.4	2.1 $\pm$ 0.9	<.001*
	Brake (pedal)	sec	0.7 $\pm$ 0.2	0.8 $\pm$ 0.1	0.9 $\pm$ 0.2	1.1 $\pm$ 0.5	1.0 $\pm$ 0.2	1.1 $\pm$ 0.2	1.3 $\pm$ 0.4	<.001*
	Accelerator (Left hand control)	sec	0.8 $\pm$ 0.1	0.8 $\pm$ 0.1	0.8 $\pm$ 0.2	1.0 $\pm$ 0.3	1.0 $\pm$ 0.2	1.2 $\pm$ 0.5	1.6 $\pm$ 1.0	<.001*
6-point reaction test	Brake (Left hand control)	sec	0.6 $\pm$ 0.1	0.6 $\pm$ 0.1	0.7 $\pm$ 0.2	0.8 $\pm$ 0.3	0.8 $\pm$ 0.2	1.0 $\pm$ 0.5	1.4 $\pm$ 1.2	<.001*
	Accelerator (Right hand control)	sec	0.8 $\pm$ 0.2	0.9 $\pm$ 0.3	0.9 $\pm$ 0.4	1.2 $\pm$ 0.9	1.0 $\pm$ 0.3	1.2 $\pm$ 0.4	1.7 $\pm$ 1.0	<.001*
	Brake (Right hand control)	sec	0.7 $\pm$ 0.1	0.7 $\pm$ 0.1	0.8 $\pm$ 0.2	1.0 $\pm$ 0.8	0.8 $\pm$ 0.1	1.0 $\pm$ 0.5	1.5 $\pm$ 1.1	<.001*
	Reaction time	sec	0.35 $\pm$ 0.09	0.38 $\pm$ 0.06	0.41 $\pm$ 0.05	0.44 $\pm$ 0.14	0.42 $\pm$ 0.06	0.44 $\pm$ 0.11	0.60 $\pm$ 0.28	<.001*
Emergency brake test	Throttle movement	sec	0.03 $\pm$ 0.02	0.03 $\pm$ 0.01	0.03 $\pm$ 0.01	0.03 $\pm$ 0.01	0.04 $\pm$ 0.02	0.04 $\pm$ 0.02	0.05 $\pm$ 0.03	<.001*
	Shifting between throttle and brake	sec	0.09 $\pm$ 0.07	0.11 $\pm$ 0.07	0.11 $\pm$ 0.07	0.11 $\pm$ 0.06	0.10 $\pm$ 0.06	0.09 $\pm$ 0.05	0.07 $\pm$ 0.04	0.240
	Brake control	sec	0.23 $\pm$ 0.14	0.23 $\pm$ 0.16	0.20 $\pm$ 0.14	0.18 $\pm$ 0.09	0.20 $\pm$ 0.14	0.21 $\pm$ 0.14	0.73 $\pm$ 0.75	0.233
	Total time	sec	0.72 $\pm$ 0.75	0.75 $\pm$ 0.19	0.75 $\pm$ 0.17	0.76 $\pm$ 0.20	0.75 $\pm$ 0.17	0.78 $\pm$ 0.18	1.45 $\pm$ 0.92	0.199

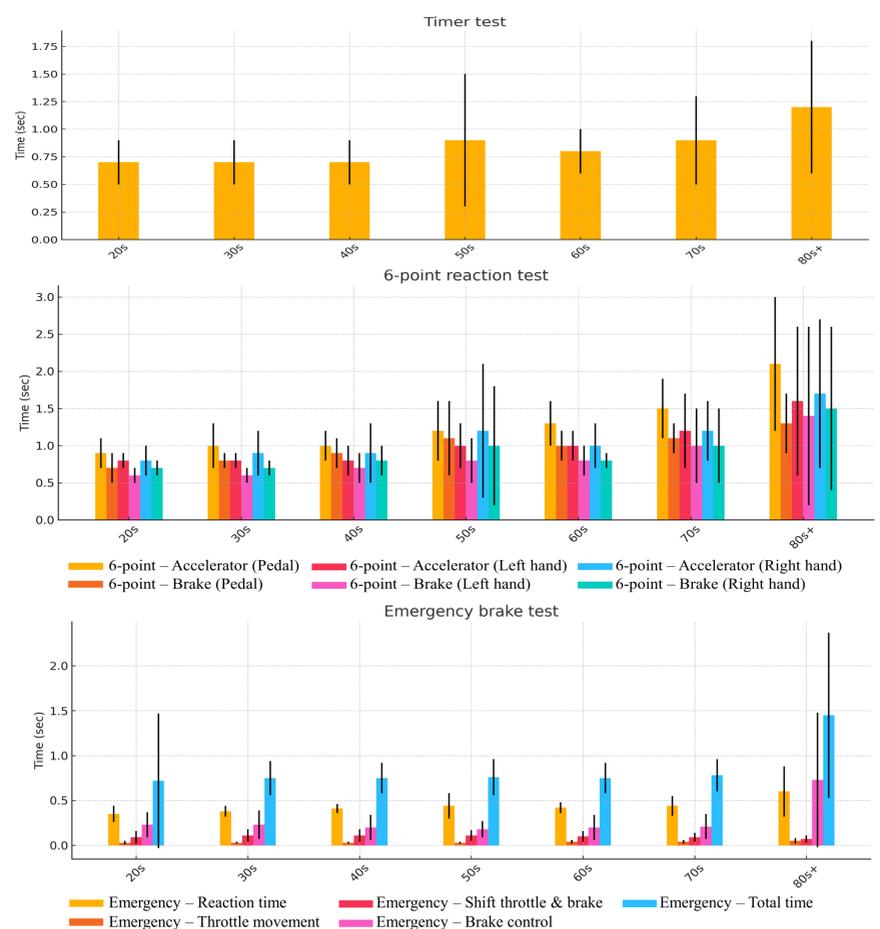


Figure 2. Physical Function test (DTS test) results by Age Group

- Among the subtests of the DTS test, '6-point reaction test' is more sensitive than the others by age.
- Results of DTS test showed significant differences among age groups across all subtest items.

## CONCLUSIONS

- An individual's physical function and actual driving ability were confirmed together by establishing reference values for the driver's physical function and cognitive function.
- Evaluating the driving ability of elderly drivers, it is necessary to implement driving-specific tests, such as reaction time test, in addition to cognitive function evaluations.

### Acknowledgement

This research was supported by a grant from the Ministry of Land, Infrastructure and Transport (MOLIT) Research Fund (NTRH RF-2025001)