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# The Effect of Driving Simulator Program on Elderly Drivers

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### *Abstract*

*The purpose of the present study was to present evidence for driving interventions for the elderly by conducting programs that can improve visual perception and cognitive function in a driving simulator for elderly drivers and analyse their effects. Three elderly subjects who were 65 years or older, did not have physical and cognitive impairments, and were able to drive themselves participated in the present study. A total of 12 intervention sessions, of which subjects participated in 10 sessions of nine different visual perception and cognitive function programs available in a driving simulator, were conducted and pre- and post-program assessments were conducted (two assessments in total). The assessments included the evaluation of visual perception, frontal lobe function, concentration, safe driving behaviour, and self-efficacy. The results showed positive effects of the driving simulator program on the visual perception, frontal lobe function, concentration, safe driving behaviour, and self-efficacy of all subjects. Changes in the simulator results showed remarkable improvement in the response evaluation, judgment evaluation, and predictive power evaluation, but showed difficulties in interference tasks and depth perception in common. The results showed positive effects of driving simulator training on the driving ability of the elderly, and consistent provision of such training is expected to improve the quality of life of the elderly by securing the safety of driving and actively supporting social participation.*

***Keywords:*** *Driving simulator, Visual perception, Cognition, Elderly*

## 1. INTRODUCTION

South Korea became an aging society when the population of the elderly (65 years or older) reached 7% of the total population in 2000. South Korea entered the aged society in 2018 with 14.3% elderly population and expected to enter a full-blown super-aged society in 2026 with 20.8% [1]. The number of elderly drivers is increasing due to the recent increase in longevity, and the number of the elderly with a driving license is increasing because community lifestyle has changed to be more active [2]. Accordingly, elderly drivers are expected to become the majority of new automobile consumers in the process of entering the aging society [3].

Driving plays a vital role in assuring healthy aging by making it possible for the elderly to perform daily activities such as to receive medical care and to go shopping and participate in social activities [4]. Driving functions as an important role in societal participation and personal values that affect the quality of life, which was confirmed when the elderly ceased driving [5]. As such, driving plays an important role for the elderly, but unsafe driving often occurs in the elderly who continue to drive. Safe driving is a complex activity that combines physical characteristics, sensory information, and cognitive ability [6]. In the case of elderly drivers,

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decreased driving ability is brought about by age-related dysfunctions such as reductions in motor function, vision, and cognition [7]. Maintaining focus on driving while receiving various stimuli through a narrowed field of vision due to aging is difficult, and the reaction and response to traffic lights and unexpected situations slows down due to memory decline and slower information processing speeds compared to younger drivers [8]. According to Owsley et al. [9], in the case of decreased vision, attention, and cognitive function, the rate of traffic accidents increases three to four times higher than younger drivers.

Therefore, conducting driving intervention programs for elderly drivers who show decreased driving ability is necessary. Current driving intervention programs that are conducted domestically and overseas mainly consist of on-road driving training, cognition, and education programs. The cognition program is composed of interventions for reasoning, judgment, spatial ability, information processing, and memory that all decline through aging [10]. The purpose of these educational programs is to improve the self-regulation abilities and social roles of elderly drivers. 'CarFit,' which provides recognition and advice on vehicle modifications for older adults, is also one of the educational programs [11]. However, in the case of visual perception, attention, and cognitive function training, there is no specifically designated manual, nor were there a sufficient number of studies that showed clear effects of such types of training. In addition, the application of actual on-road driving training is limited due to time and cost issues and the risk of direct training [12]. As an alternative to these challenges, driving simulator training is a viable option. This training can be widely used because it is composed of programs that provide correct vehicle control techniques, risk prediction, and response capability in a controlled situation where safety is secured before participants actually drive [13]. In addition, most of the domains that evaluate and train visual perception and cognitive functions are included. The training also has the advantage of recording the progress of participants throughout the course. Evaluation of various domains is also possible using this program. Recently, training courses using driving simulators is available for the elderly at senior welfare centres and the Road Traffic Authority, and the participation rate of the elderly is also increasing.

As such, driving simulators have the advantage of participation without a burden and its effect can be immediately determined because the trend of change can be identified, but the research is conducted on general elderly subjects the results are insufficient. Accordingly, the present study attempted to present support for driving interventions for the elderly by conducting programs that can improve visual perception and cognitive function in a driving simulator for elderly drivers and analyse their effects.

## 2. METHODS

### 2.1 Participants

The present study was conducted with three elderly subjects who agreed to participate, were 65 years or older, did not have physical or cognitive impairments, and were able to drive themselves with the cooperation of a community welfare centre in November of 2018. To select subjects who had the cognitive ability to complete the program, the Mini-Mental State Examination-Korean (MMSE-K) was used, and all three subjects obtained 27 points or higher, which confirmed that they did not have any problems with cognitive functions. The subjects were one male and two females, and their average age was 69 years (Table 1). Ethical approval was obtained from the Cheongju University Research Ethics Committee.

**Table 1. General information of the subjects**

| Subjects | Gender | Age | MMSE-K score | Driving experience | The biggest reason for the recent difficulty of driving |
|---|---|---|---|---|---|
| Subject 1 | Male | 72 | 28/30 | 20 years | Decreased concentration |
| Subject 2 | Female | 69 | 28/30 | 30 years | Decreased visual acuity, memory decline |
| Subject 3 | Female | 68 | 29/30 | 20 years | Decreased visual acuity, decreased concentration |

## 2.2 Research Design

After the selection of subjects in November 2018, a total of 12 intervention sessions were conducted from December 2018 to January 2019. For 10 of the sessions, the subjects participated in visual perception and cognitive function programs in the driving simulator, and pre- and post-program assessments were conducted. The program was conducted twice a week for 5 weeks, and each session took one hour (Figure 1).

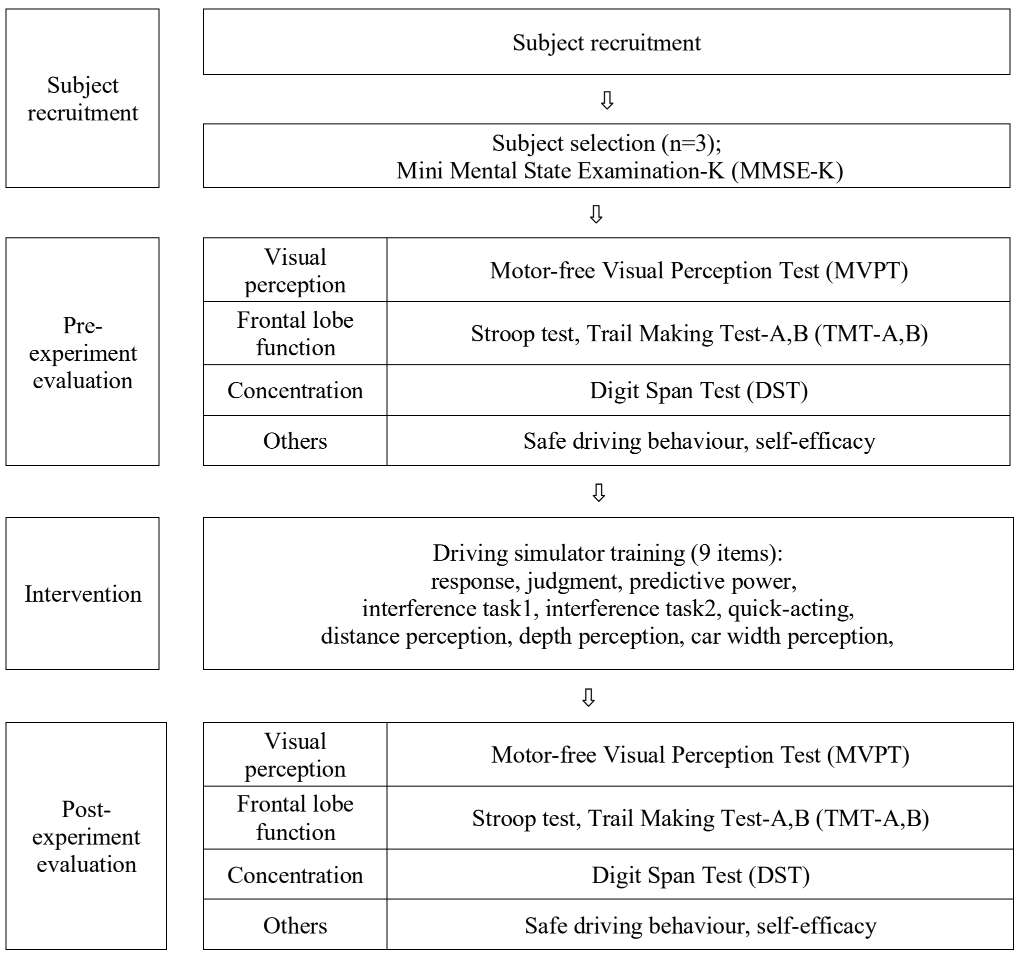


**Figure 1. Flow chart**

## 2.3 Instruments

### 2.3.1. Mini Mental State Examination-K (MMSE-K)

The present study used MMSE-K to select subjects. It was adapted to a Korean version by Park and Kwon [14], and the instrument consists of six sub-items of orientation, memory encoding, attention and calculation, reminiscence, language function, understanding, and judgment. Test scores of 24 points or higher, 18-23 points, and 17 points or lower were defined as normal, suspected dementia, and confirmed dementia, respectively.

### 2.3.2. Motor-Free Visual Perception Test (MVPT)

The MVPT developed by Bouska et al. [15] does not include measures of motor ability, and is designed to be used as a test instrument for discrimination, diagnosis, and research. The instrument consists of 36 items in five domains of figure ground, visual discrimination, visual memory, visual closure, and spatial relation, and it can measure raw scores and visual processing time. The raw score is 36 points.

### 2.3.3. Stroop Test

The Stroop test was developed by Stroop, an American experimental psychologist, to conduct a developmental study of interference phenomena between reading colours and reading the names of the colours. The instrument used in the present study was a subtest of Kim's Frontal-Executive Neuropsychological test, which was modified and standardized for domestic use by Kim [16]. The Stroop test is composed of word reading and colour reading. For word reading, subjects were instructed to say a colour list from a card presented only with colours as fast as possible. For colour reading, subjects were presented with four words for colours (red, blue, black, and yellow) and cards with letters printed in different colours, and instructed to read the colours of the letters as quickly and accurately as possible. Using this instrument, frontal lobe function can be inferenced.

### 2.3.4. Trail Making Test (TMT)

The TMT is a part of the Halstead-Reitan Neuropsychological Test Battery (HRNB), and it can be used as a screening tool or a standalone instrument. The test measures processing speed, sequencing, mental flexibility, and visuomotor skills. The TMT-A is a test that requires subjects to search and draw a continuous line to connect numbers that are written in randomly arranged circles in their numerical sequence as fast as possible. Time is measured at the start of the of the task, and the test is terminated when the subject makes five or more mistakes or five minutes has passed. The TMT-B is an instrument that requires subjects to connect numbers and letters in sequence. The subjects draw lines to connect in the order of '1-A, 2-B, 3-C, …' as quickly as possible [17].

### 2.3.5. Digit Span Test (DST)

DST is a neuropsychological test that measures attention ability and working memory. DST consists of memorizing numbers in the order of presentation and in the reverse order of presentation, and the two tasks are scored separately. The full scores of memorizing numbers in the order of presentation and in reverse order of presentation are nine and seven points, respectively. The version used in the present study was a part of the Seoul Neuropsychological Screening Test (SNSB), which can be used as a screening tool or a standalone instrument [18].

### 2.3.6. Safe Driving Behaviour Measurement tool

The present study used an instrument standardized by Jung [19] to measure safe driving behaviour. Subjects answer questions about their driving behaviour in the past three months, and the instrument consists of 37 items over three domains including people, vehicles, and the environment while driving. It is on a 4-point scale of 'very difficult (1), somewhat difficult (2), slightly difficult (3), and not difficult (4)'.

### 2.3.7. Self-Efficacy Scale

Self-efficacy is a belief regarding whether a specific task can be successfully performed, and self-judgment is how competent one will be in a specific environment or situation. A self-efficacy scale questionnaire that was developed by Sherer et al. [20] and restructured by Son [21] was used in the present study. The questionnaire is composed of a total of 14 items on a 10-point scale from 'not competent at all' to 'fully competent', and higher scores mean higher self-efficacy. The possible score range is a minimum of 14 points up to a maximum of 140 points.

#### 2.3.8. Driving simulator

The driving simulator used in the present study was a STISIM Drive System (M100 Series Simulation Systems). The simulator is composed of three monitors that provide the driver with a 60°-180° visual field, two speakers, a driver's seat, steering wheel, pedals, and a monitor and computer for the experimenter to observe. The simulator has a total of nine visual perception and cognitive function programs including response evaluation, judgment evaluation, predictive power evaluation, interference task 1, interference task 2, quick-acting evaluation, distance perception, depth perception, and car width perception evaluation (Figure 2) (Appendix).

**Figure 2. Driving simulator program**

### 2.4 Analysis Methods

The collected data were analysed using Microsoft Office Excel 2007 and SPSS ver.20.0. Descriptive statistics were used for the general characteristics of the subjects and the results of pre- and post-program assessments. The graphs of the results of driving simulator training were created using Microsoft Office Excel 2007 and edited using GraphPad Prism5.

## 3. RESULTS

### 3.1 The results of subjects' visual perception, frontal lobe function, concentration, and self-efficacy assessments

**Subject 1**

The post-experiment MVPT raw score and processing time of subject 1 were 34 points and 4.9 seconds, respectively, which were small improvements from the pre-experiment scores of 32 points and 5.3 seconds. The performance speed of Stroop test-word was reduced by six seconds, and that of Stroop test-colour was reduced by four seconds. During the assessment, the Stroop test-colour appeared to be especially difficult for the subject. For the TMT, greater improvement was observed for test B for which the subject had to alternately connect words with numbers. For the DST, the pre-experiment forward score was relatively good, and no large change was observed in the backward score. Subject 1's pre-experiment score of safe driving behaviour was high, and the post-experiment score of self-efficacy slightly increased (Table 2).

**Subject 2**

The post-experiment MVPT raw score and processing time of Subject 2 were 33 points and 4.3 seconds, respectively, which showed small improvements from the pre-experiment scores of 30 points and 4.6 seconds. The performance speed of the Stroop test-word became faster by 13 seconds, and that of Stroop test-colour was reduced by 10 seconds. For the TMT, time was reduced by 19 seconds for test B for which the subject had to alternately connect words with numbers. For the DST, both forward and backward scores were slightly increased. The assessment results of Subject 2's safe driving behaviour showed improved scores in many areas after participating in the program. The post-experiment score of self-efficacy was also found to be slightly increased (Table 2).

**Subject 3**

The post-experiment MVPT raw score and processing time of subject 3 were 32 points and 4.2 seconds, respectively, which were small improvements from the pre-experiment scores of 31 points and 4.3 seconds. The performance speed of the Stroop test-colour was reduced by 23 seconds. No significant improvement was observed for the TMT, and the score was similar to that of the pre-assessment. For the DST, the forward and backward scores were either slightly increased or maintained. The assessment results of Subject 3's safe driving behaviour showed improved scores in many areas after participating in the program. The pre-experiment score of self-efficacy was high, and the score was maintained in the post-experiment assessment (Table 2).

**Table 2. The results of subjects' visual perception, frontal lobe function, concentration, and self-efficacy evaluation**

| Test | Scoring criteria | Subject 1 | | Subject 2 | | Subject 3 | |
|---|---|---|---|---|---|---|---|
| | | Pre | Post | Pre | Post | Pre | Post |
| MVPT | score<br>sec | 32<br>5.3 | 34<br>4.9 | 30<br>4.6 | 33<br>4.3 | 31<br>4.3 | 32<br>4.2 |
| Stroop test (word) | sec | 62 | 56 | 60 | 47 | 62 | 56 |
| Stroop test (colour) | sec | 187 | 183 | 138 | 128 | 140 | 117 |
| TMT-A | sec | 17 | 16 | 19 | 16 | 17 | 16 |
| TMT-B | sec | 65 | 46 | 39 | 33 | 28 | 26 |
| DST (forward) | score | 8 | 9 | 5 | 7 | 8 | 9 |
| DST (backward) | score | 4 | 4 | 5 | 6 | 5 | 5 |
| Safe driving behaviour | score | 133 | 133 | 102 | 109 | 124 | 128 |
| Self-efficacy | score | 133 | 135 | 131 | 136 | 138 | 138 |

MVPT: Motor-free Visual Perception Test
TMT: Trial Making Test
DST: Digit Span Test

### 3.2 Trends in the results of the driving simulator

**Subject 1**

The highest score that Subject 1 obtained in the pre-experiment assessment was in judgment. In the activity, the subject moves the steering wheel left and right to avoid getting caught in saw teeth that are inside a rotating disc. Subject 1 was focused and performed the task excellently. The response evaluation and predictive power scores were very low in the beginning. As the experiment progressed, however, subjects' responses to the applicable lights and pressing the button was visibly improved. The quick-acting evaluation scores were maintained at high levels without significant fluctuations. The most difficult tasks for Subject 1 were the interference task and depth perception task. The interference task mimics receiving various stimuli while driving and requires a lot of agility. The scores of the interference tasks 1 and 2 were low in the beginning, and even though the scores slowly increased as the experiment progressed, they did not reach higher scores until the end of the tasks. The evaluation of depth perception measures three-dimensional stereognostic senses while watching the screen; the score was low in the beginning and did not reach a high score even though the score slowly increased. The scores for distance perception evaluation and car width perception evaluation maintained good levels from the beginning to the end (Figure 3).

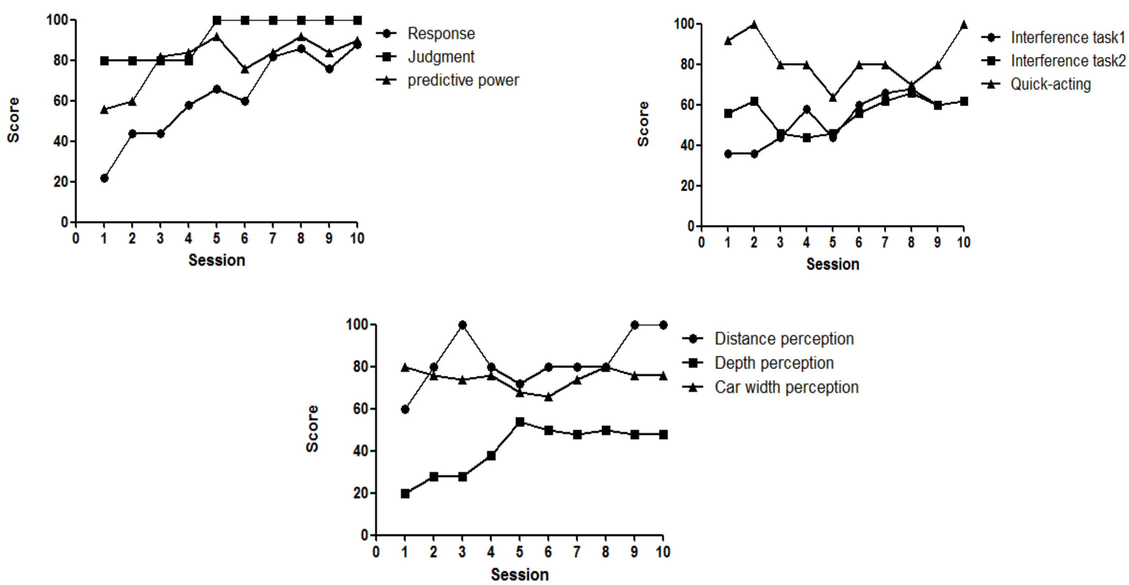


**Figure 3. Changes in the results of the driving simulator of Subject 1**

**Subject 2**

Subject 2 scored low on their response evaluation and judgment evaluation in the beginning, but the score rapidly improved as the experiment progressed. In the response evaluation activity, the subject observes the light shown on the monitor and appropriately presses the accelerator, brake, or horn. Subject 2 was unable to focus, was flustered, and pressed the wrong button in the beginning but began to calmly perform the activity as the experiment progressed. The predictive power evaluation score was favourable from the beginning. Like Subject 1, Subject 2 also showed difficulties in the interference task and depth perception evaluation and did not receive high scores even though the scores gradually improved until the end of the experiment. Subject 2 performed well on quick-acting evaluation without significant fluctuations. The scores for distance perception evaluation and car width perception evaluation were good without large fluctuations except for minor variations depending on the conditions (Figure 4).

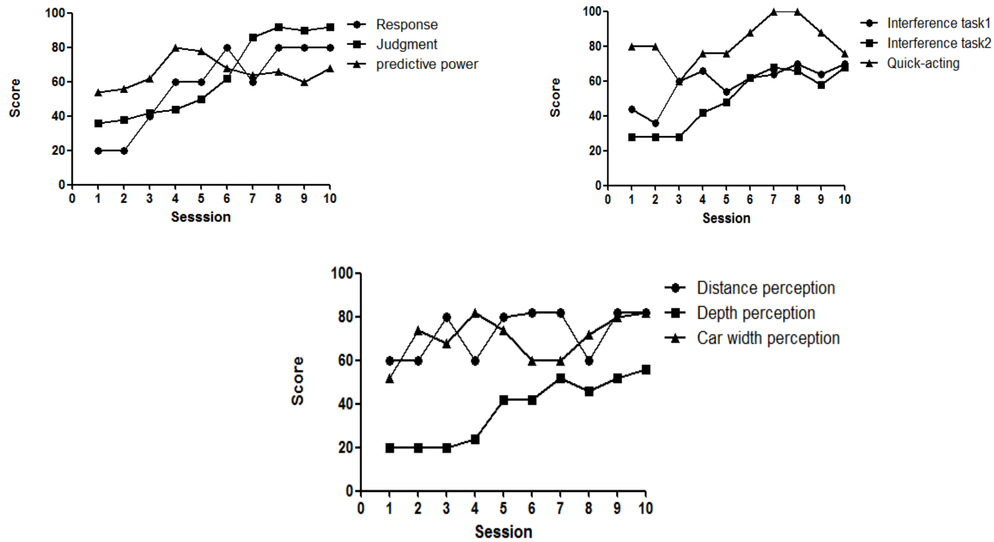


**Figure 4. Changes in the results of the driving simulator of Subject 2**

**Subject 3**

Subject 3 showed consistent improvement in all tasks compared to Subjects 1 and 2. The subject had average scores in response evaluation, judgment evaluation, and predictive power in the beginning, but received high scores as the experiment progressed. Subject 3 showed the same difficulties in the execution of the interference task, which was also seen in Subjects 1 and 2. Even though the subject was supposed to respond to various stimuli while driving, the subject occasionally missed the time window to press the button due to the lack of agility or pressed the wrong button in confusion. The subject started with an above average score of distance perception evaluation, where the distance to the car ahead is maintained, and the subject's performance gradually improved as the experiment progressed. The subject also performed well in car width perception evaluation, in which the subject had to pass between cars without collision, but had difficulties in depth perception, where three-dimensional depth perception was required. The subject reached the average level in the final session through constant practice, but it was the most challenging task for the subject (Figure 5).

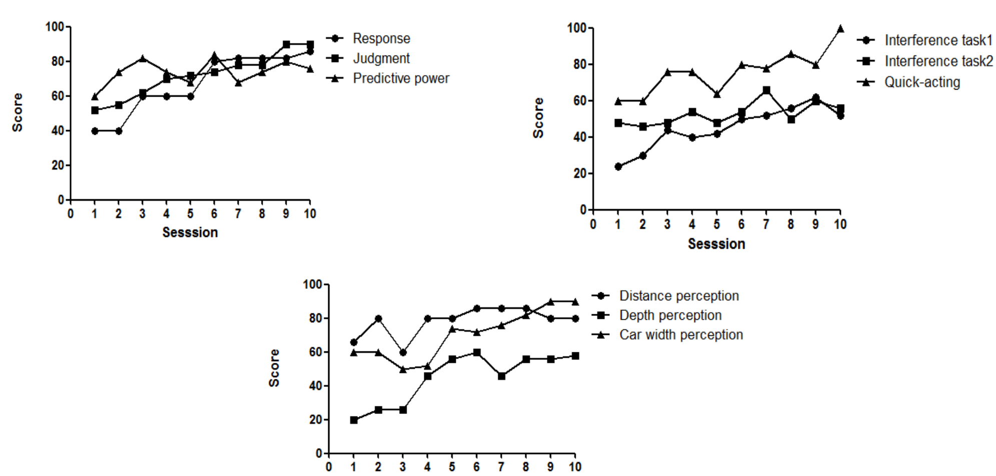


**Figure 5. Changes in the results of the driving simulator of Subject 3**

## 4. DISCUSSION

Recently, research that focuses on the driving of the elderly is drawing attention as other studies are being conducted on the community participation and integration of the elderly. Safe driving requires complex interactions with the surrounding environment including vision, hearing, cognition and perception, and motor skills [22]. In the case of elderly drivers whose abilities have declined through aging, the risk of accidents increases due to the complex nature of driving [23]. Therefore, it is necessary to prevent accident risks by providing consistent training programs for elderly drivers. The present study attempted to present support for driving interventions for the elderly by conducting programs that improve visual perception and cognitive function in a driving simulator for elderly drivers.

Three subjects, one male and two females, who currently drive participated in the present study, and their average age was 73 years. The visual perception, frontal lobe function, concentration, safe driving behaviour, and self-efficacy of the subjects were tested before and after the simulator program, which consisted of 12 sessions. The results showed that all subjects had small increases in the score for visual perception, and their visual processing time was reduced by 0.1 to 0.4 seconds. The changes of visual perception evaluation results were not large, but in light of the small increases in the score and reduction in the processing time, the driving training program is expected to at least maintain the visual perception skills of the elderly. The subjects had difficulties with the Stroop test-colour items, which is a frontal lobe function test, where subjects are presented with cards that have four colours words printed in different colours and are asked to read the colour of the word and ignore the font colour. The processing time of Subjects 2 and 3 was reduced by up to 10 to 23 seconds after the program, which means their processing speed became faster. The reductions for the TMT-A and TMT-B were 1-3 seconds and 6-19 seconds, respectively. The frontal lobe performs high-level brain functions related to insight and judgement [24]. The improved scores on the Stroop test and the TMT signify the positive role of the driving training program in the improvement of frontal lobe function. The DST is an instrument that measures concentration, and the scores of all the subjects were either maintained or slightly increased, which shows the driving training program improvement of concentration. Concentration while driving is important for maintaining driving speed, stop reactions, lane changes, and traffic signal violations [25]. The self-efficacy of all participating subjects was moderately high, and it appears to be due to their continued driving and active social lives as they age. Driving is the starting point for social activities (to form interpersonal relationships and participate in social gatherings) for the socially disadvantaged including the elderly and disabled and makes them feel psychological and social confidence [26]. Choi & Woo [27] stated that higher self-efficacy in old age leads to higher concentration in driving situations where focus is required, and reduces the difficulties that are experienced in confusing driving situations. As such, the relationship between driving ability and self-efficacy is considered to be very close.

Changes in the results from the driving simulator showed that the scores of response evaluation, judgment evaluation, and predictive power evaluation were consistently improved in all three subjects as the experiment progressed. These three areas started with moderately low scores but obtained mostly good scores as the experiment progressed due to the improved concentration of the subjects and their calm responses. All subjects obtained good scores in distance perception evaluation, which is like careful driving while maintaining distance to the car in front. The consistently high scores of this item can be considered an improvement in the concentration of the subjects as the sessions progressed. There has been a report that the elderly are cautious about active activities, and consequently, they tend to be slow and overly cautious when driving [27]. Because of this, older adults maintain a safe distance from the car ahead. In addition, improvements in sustained attention from the participation in the simulator program can also be considered as another factor to maintaining safe driving distances.

The items that all subjects had difficulties were interference task and depth perception. For the interference task, the subjects were required to respond to various stimuli while driving, but they occasionally either missed the time frame to respond due to the lack of agility or they pressed the wrong button in confusion. Divided attention, which allows the simultaneous concentration on two different tasks, decreases as one ages, making it difficult to respond to stimuli that suddenly appear while driving, which can cause accidents [28]. According to the study of Walter et al. [29], the elderly increase the risk of traffic accidents because they have a slower response to dangerous stimuli in a driving environment. A previous study reported that the elderly tend to drive slowly due to cognitive function decline, and vehicle braking reaction time also becomes slower [30]. The results of the present study showed that the subjects had difficulties performing the interference task in the beginning, but scores tended to improve as the sessions progressed. This finding confirmed that simulator training is an effective training method for practicing situations that require rapid reactions. In contrast to subjects' good performance in distance perception and car width perception evaluation from the beginning of the study, some subjects struggled with depth perception evaluation through the end. The difference was that distance perception and car width perception evaluation is examining two-dimensional perception, while depth perception evaluation is measuring three-dimensional perception. The elderly had more difficulties in three-dimensional depth perception tasks. In the case of the elderly, the ability to discriminate depth perception is three times lower than young adults, and due to decreased contrast sensitivity, they have difficulties discriminating pedestrians or other vehicles in night driving or cloudy weather situations [31]. The fact that the scores in these areas did not significantly improve until the termination of the training suggests that these cannot be trained in a short time.

The results of the present study showed that driving simulator training had a positive influence on frontal lobe function, concentration, and self-efficacy that support the visual perception, judgment, and insight of the elderly. In addition, driving simulator training helped reduce the risk factors associated with driving performance by identifying the accident risks of the elderly in advance.

The present study has its limitations, however, in that the generalization of the research findings is limited due to the small number of subjects, and the long-term effects of driving simulator training were not investigated. Despite these limitations, however, the present study appears to provide very useful information before the elderly begin to drive by presenting information about items that the subjects were able to retain and improve in a short period of time, and also identified the items that they had difficulties with from the beginning and could not be improved in a short time. Furthermore, the present study is expected to reduce the rate of traffic accidents of the elderly by providing objective information on the proper evaluation and training methods for the elderly and contribute to the improvement of their quality of life by actively supporting social participation of the elderly.

## 5. CONCLUSION

The present study conducted a driving simulator program for the elderly and analysed its effects. The results showed the positive effects of a driving simulator program on the improvement of the visual perception, frontal lobe function, concentration, safe driving behaviour, and self-efficacy of all subjects. Changes in the simulator results showed remarkable improvement in the response evaluation, judgment evaluation, and predictive power evaluation, and the tasks which the subjects had the same challenges from the beginning were interference tasks and depth perception. These two tasks improved as the sessions progressed, but score improvements were small. The findings of the present study showed the positive effects of driving simulator training on the driving ability of the elderly and provided information on the functions that the elderly retain functions that can be improved in a short time, or functions that cannot be improved in a short time. In the future, the safety of elderly drivers should be secured by consistently providing these types of training and actively supporting their social participation to help them improve their quality of life.

## CONFLICTS OF INTEREST

The author declares no conflicts of interest

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## Appendix. Summary of driving simulator program

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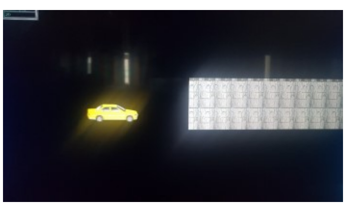
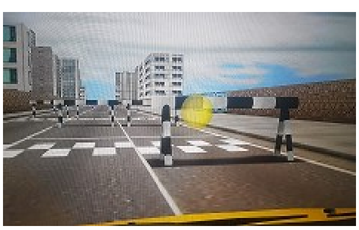
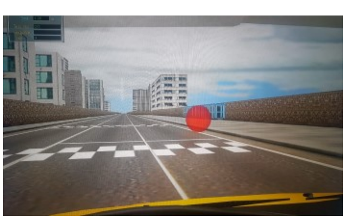
|  | **Response evaluation**<br>- Red, yellow, and green signals appear on the monitor screen, and the subject has to rapidly manipulate the corresponding action in the car. Red, yellow, and green signals appear alternately in the centre of the screen, and the subject has to apply the brakes on red, press the accelerator on green, and honk the horn on yellow. |
|  | **Judgment evaluation**<br>- A rotating circular disk and two dots on the right and left hand side appear on the screen, and the subject has to try not to be caught in the saw teeth inside the rotating disc by moving the two dots using the steering wheel. It is essential to avoid the direction in which there is a possibility for both dots on the right and left side to be caught in the saw teeth, and to hold the steering wheel to the desired direction. |
|  | **Predictive power evaluation**<br>- Predict the speed of the vehicle as it disappears into the tunnel and manipulate the corresponding instrument. Determine vehicle speed while the vehicle is moving from left to the tunnel on the right, and honk the horn when you expect the front bumper of the vehicle will come out of the tunnel after it disappeared into the tunnel. |
|  | **Interference task 1**<br>- Using the steering wheel, the subject has to drive without hitting obstacles that appear in front of the car. At the same time, red, yellow, and green colours appear in the centre of the screen, and the subject has to apply the brakes on red, press the accelerator on green, and honk the horn on yellow. The score will decrease if obstacles are hit or a response is not given within the response time. |
|  | **Interference task 2**<br>- The vehicle is driven on a three-lane road, and the subject has to drive in the correct lane following the voice instruction. At the same time, red, yellow, and green colours appear in the centre of the screen, and the subject has to apply the brakes on red, press the accelerator on green, and honk the horn on yellow. |
|  | **Quick-acting evaluation**<br>- A straight road appears on the screen and the test begins. When the green signal appears in the centre of the screen, press the accelerator to bring the vehicle speed to 100km/h. When the red light appears 3-5 seconds later, apply the brakes as quickly as possible to bring the vehicle to a stop, and a score is given by calculating the response time. |

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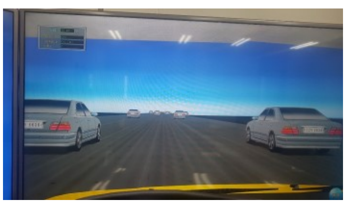
|  | **Distance perception evaluation**<br>- The test starts as soon as the vehicle on standby starts. The test examines how well a constant distance from the vehicle ahead is maintained, and the performance is based off of maintain that distance. |
|  | **Depth perception evaluation**<br>- A location bar is positioned on a straight road with road signs on the right and left. The location bar is slowly moving forward, and the subject has to honk the horn when the location bar is level with the road signs on the right and left. The subject has to properly respond within the response time. |
|  | **Car width perception evaluation**<br>- A straight road appears on the screen, and vehicles are arranged in various intervals on the right and left. The vehicle is operated by pressing the accelerator pedal, and the direction is changed using the steering wheel. The highest score is obtained if the subject passes between vehicles. |