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In the present study, relationships among sensation seeking, hazard perception skill, and driving attitude were examined in older adulthood. Older drivers ($n = 59$) participated in the Risk Perception Test, Sensation Seeking Scale-Abstract Expression, the screening test for attention by digit cancellation method (D-CAT), and a driving attitude scale. The scores on hazard perception in low-sensation seekers were lower than that in high-sensation seekers. The score on the sensation seeking scale demonstrated positive partial correlation with the hazard perception score after controlling for the effects of both age and the D-CAT scores. No relationships were found between sensation seeking and the driving attitude. These results suggested that low sensation seeking might offer some disadvantage on the hazard perception in older drivers.

Key words: sensation seeking, older driver, hazard perception, driving attitude, Risk Perception Test

Although it is in a decreasing trend, the number of deaths from traffic accidents within 30 days after accident is more than 5,000 annually in 2010s. When the number of deaths in moving vehicles is examined by age, that of older adults (65 years and over) have been higher than adolescents (from 16 to 24 years) every year since 2003 (National Police Agency Traffic Bureau, 2011), highlighting the needs of immediate intervention. In the sense that it presents threats to the driver's health and life, driving is a health risk behavior. In the health psychology, which is aimed to change health harming habits, driving is one of the important research topics.

Sensation seeking (SS) is a representative personality trait that affects driving behavior. SS is a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for its own sake (Zuckerman, 2007). Previously, SS has drawn attention primarily as a trait that promotes reckless driving in adolescents. Many road safety researchers have shown using multiple methods that those who are associated with strong SS (i.e., sensation seeker), when compared to those with weak SS (i.e., sensation avoider), tend to drive at speeds exceeding the

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limits (Burns & Wilde, 1995; Jonah, 1997; Matthews, Tsuda, Xin, & Ozeki, 1999; Whissel & Bigelow, 2003). Additionally, frequent passing has been found to correlate with SS (Watanabe, 1998; Zuckerman, 2007). The many of these studies, which focused on adolescents, have paid attention to sensation seekers as risky drivers.

In contrast, it has been demonstrated that in cases of older drivers, problems caused by weak SS have been highlighted instead. According to a study by Schwebel, Ball, Severson, Barton, Rizzo, and Viamonte (2007), sensation avoiders who were older had greater numbers of traffic accidents than did sensation seekers despite that they had fewer experiences with traffic violation regulation. This result suggests that sensation avoiders have driving problems linked with accidents, but specific nature of the problems were not described. To provide effective safe driving education for older drivers, who will considerably increase in the future, driving problems that sensation avoiders demonstrate need to be understood in detail.

The purpose of the study was to examine the characteristics of sensation seeking in older drivers. As a tool to evaluate characteristics of driving from multiple perspectives, the Risk Perception Test (Fukazawa, 1983) was used. This test is designed to measure both aspects of perceptual skills and driving attitudes of the participants, using illustrations of roads drawn from the viewpoint of the driver's seat. The perceptual skills measured in this test are skill levels to detect sources of dangers that are in traffic situations, in other words, hazards. In traffic situations, there are a number of factors that increase the probability of occurrence of accidents from the viewpoint of a driver, such as other vehicles, pedestrians, intersections, and crosswalks. To accurately evaluate the risk of traffic situations necessitates visually exploring the situation and detecting significant hazards thoroughly. Hazard perception is a task that requires actively directing one's attention to a variety of stimuli that are in traffic situations. It was hypothesized that sensation avoiders had not acquired skills to explore hazards fully because they disliked novel and complex stimuli. The test also measures the attitudes toward judging and decision-making not to drive in hasty while giving consideration for pedestrians and other vehicles. Sensation seekers who are college students rarely moderate speed when driving, and have a tendency to frequently pass other vehicles (Miyazaki & Kanachi, 2011; Watanabe, 1998). If these characteristics were carried over to older adulthood, it was expected that sensation seekers who were older would show responses in this test that lacked carefulness.

Method

Participants

A total of 60 adults aged over 60 years in a city in Ibaraki Prefecture participated in the study who were registered with a human resource center for seniors and drove cars more than once a week.

Measures⁴

Demographic Characteristics. Participants were asked about their age, sex, years of driving, and typical driving frequency.

4. Because the present study was conducted as part of a project regarding personality traits of older adults and driving behavior, other measures were used also, but specifics that do not relate to the present study are omitted in this report.

Risk Perception Test-Brief Form (Fukazawa, 1983). This test is used in evaluating driving aptitude, such as that of a professional driver, whose reliability and validity have been demonstrated. Settings used in the test are traffic situations illustrated from the viewpoint of the driver's seat, and composed of three kinds: driving in the rain in a shopping area, driving straight ahead on a one-way street in a residential area, and driving after a large bus in downtown. Each setting is constituted of two illustrations of spatio-temporally sequential scenes. Participants saw Stimulus 1 for 12 sec and Stimulus 2 for 10, and answered the questions with the stimuli kept out of their sight. There are five to seven questions for each setting, and for all of these, participants were asked to choose one out of five choices. The questions addressed perception of traffic situations, decision making and judgment, and speed rating, and others. Perception of traffic situations is concerned about sources of dangers in each setting, such as pedestrians other vehicles, and traffic signs (e.g., "What was x like?"), and if the setting was accurately understood, the answer was scored correct. Decision making and judgment is concerned about how the participant would drive in the setting (e.g., "How would you drive if you were in this setting?"), and if the participant was able to decide to inhibit hastiness and roughness, while giving consideration for pedestrians and other vehicles, the answer was scored correct. Speed rating is concerned about at what speed (km per hour), and if the participant was able to identify an appropriate speed for the setting, the answer was scored correct. Perception score and attitude score are calculated according to the designated procedures. The perception score is an index of the level of hazard perception skills, and more correct answers to problems in perception of traffic situations will result in a higher score. The attitude score is an index of the level of the driving attitude to restraining from hastiness and roughness. More correct answers to problems in decision making and judgment as well as in speed rating will result in a higher score.

Sensation Seeking Scale-Abstract Expression Using Three-Point Scale. This 3-point scale is a modification of a 5-point scale by Furusawa (1989) for ease of use by older adults, and has been revalidated (Miyazaki & Kanachi, 2011). The original scale consists of three subscales: *Thrill and Adventure Seeking* (TAS), which measures the desire to engage in activities that involve speed and danger, *Experience Seeking* (ES), which measures the desire for novel or unusual experience, and *Disinhibition* (Dis), which measures the desire to avoid social restriction and constraint. Out of these, two subscales of TAS (5 items, e.g., "I like busy jobs even if they are rather dangerous") and ES (5 items, e.g., "If possible I want to have various experiences") were included, with the Dis subscale excluded because it was considered to contain questions that did not reflect lifestyles of older adults (e.g., "I like dancing in an environment that is noisy and fun"). Participants were asked to rate on a 3-point scale, with responses ranging from 1 (*not applicable*) to 3 (*applicable*), to what degree each question was applicable to them.

Safety Driving Scale (Miyazaki & Kanachi, 2011). The scale consists of two scales: *Risk Avoidance scale* to measure the driving tendency to avoid risks (3 items, such as "I try not to speed") and *Hazard Detection scale* to measure the driving tendency to try to explore risks

(2 items, such as “I drive looking around right and left”). Participants were asked to rate on 5-point scale, with responses ranging from 1(*very applicable*) to 5(*not applicable*), then the scores are reversed so that more careful driving tendency will result in a higher score.

Digit Cancellation Test (D-CAT). This is a test to evaluate abilities to concentrate and maintain attention. A total of four trials were administered, with a new trial added to the existing three trials (Hatta, Ito, & Yoshizaki, 2001). The task is to scratch off the designated number out of a randomly arranged series of numbers 0-9 as many as possible in a minute. One number at Trial 1, two numbers at Trial 3, and three numbers at Trial 4 were scratched off. At Trial 2, based on the task of Sohlberg and Mateer (1986), an identical task as in Trial 1 was administered after distracters made of straight lines and curves were written over the series of numbers to complicate detecting numbers. A total performance, which is the total number of the scratched numbers, and omission ratio, which is a product of the number of missed targeted number divided by the number of targeted number to be scratched, are computed, following the designated procedures.

Procedure

Each participant underwent the tests individually in a private room in August or September 2004. D-CAT, Risk Perception Test, Safety Driving Scale, Sensation Seeking Scale were administered in this order by undergraduate or graduate students who majored in psychology or a faculty member, all of who were trained in administering the tests.

Results

Data collected from 59 participants (49 men, 10 women) were rendered for analysis, excluding one participant whose response to the Sensation Seeking Scale was not complete. Mean age of the participants was 70.8 years old ($SD = 5.9$).

For the Risk Perception Test, perception score and attitude score were calculated. For the TAS and ES scales of the Sensation Seeking Scale and the Risk Avoidance and Hazard Detection scales of the Safety Driving Scale, ratings were added to generate scale scores each. Further, the TAS and ES scale scores were added to calculate a total score. For D-CAT, a total performance and omission ratio were computed.

Because the results of Mann-Whitey's U test showed no significant difference due to sex in TAS and ES scales⁵, data from men and women were analyzed together in the following analysis (TAS score: $U = 213.5$, *ns*; ES score: $U = 212.0$, *ns*).

Pearson correlation coefficients between the variables (indices of Risk Perception Test, Sensation Seeking Scale, Safety Driving Scale, D-CAT and age) were calculated (Table 1). Results showed a significant, weak, positive correlation between perception and TAS scores. There was no significant correlation between attitude and Sensation Seeking Scale scores.

Partial correlation coefficient between perception and TAS scores was calculated, controlling for the effect of both age and total performance of D-CAT Trial 1, that were shown

Table 1 Correlations among Risk Perception Test, Safety Driving Scale, Sensation Seeking Scale, and D-CAT

Index (range ¹)	<i>M</i>	(<i>SD</i>)	1	2	3	4
Risk Perception Test						
1 Perception (0-7)	3.78	(1.40)	—			
2 Attitude (0-5)	3.20	(.87)	.29*	—		
Safety Driving Scale						
3 Risk Avoidance (3-15)	10.95	(2.94)	-.12	.13	—	
4 Hazard Detection (2-10)	8.64	(1.69)	.10	.00	.29*	—
Age	70.83	(5.89)	.03	.09	.16	.09
Sensation seeking scale						
TAS (5-15)	8.07	(2.75)	.26*	-.09	-.09	-.03
ES (5-15)	9.86	(3.03)	.08	-.06	-.05	.03
Total(10-30)	17.93	(5.11)	.19	-.08	-.08	.00
D-CAT						
TP in trial 1	247.25	(57.10)	.30*	-.08	-.17	.13
TP in trial 2	243.49	(60.32)	.10	-.11	-.14	.02
TP in trial 3	212.36	(45.34)	.07	-.11	-.10	-.01
TP in trial 4	164.08	(27.91)	-.02	-.28*	.02	-.01
OR in trial 1	3.64	(5.10)	.15	-.12	-.18	.06
OR in trial 2	2.74	(4.47)	-.17	-.09	.12	.12
OR in trial 3	7.66	(6.37)	-.05	-.05	.08	.06
OR in trial 4	12.21	(9.17)	-.04	.05	-.04	-.13

Note.¹ range of values that the variable can take *N* =59

TP=total performance, OR=omission ratio.

***p* <.01 **p* <.05

to have significant correlations with age and perception score. Result showed a significant positive partial correlation coefficient ($r = .287, df = 55, p < .05$).

To understand the details of the relationship between TAS and perception skills, which had been shown to correlate, participants were divided into high and low groups based on the mean TAS score as a criterion. Subsequently, the ratios of those who scored lower than 4 on perception skill in the two groups were compared⁶ (Table 2). Chi-square test revealed that the ratio was significantly higher in the low group than in the high group⁷ ($\chi^2(1) = 4.38, p < .05$). A similar analysis of attitude score did not yield a significant difference between the two groups ($\chi^2(1) = .10, ns$). Subsequently, using the mean ES score as a criterion, participants

5, 7. Because Shapiro-Wilks tests revealed that both TAS score and ES score are not normally distributed variables (TAS score: $W = .900, df = 59, p < .01$; ES score $W = .945, df = 59, p < .05$), non parametric tests were used.

6. According to the norm adopted by National Agency for Automotive Safety and Victims' Aid in Japan (Maruyama, 1983), perception scores lower than 4 are judged to represent considerable deficiency in attitudes to carefully observing traffic situations, and attitude scores lower than 4 are judged to represent a strong tendency to hurry ahead.

Table 2 Cross tabulations of levels of scores on Risk Perception Test separated by levels of TAS and ES

Levels of sensation seeking	Perception score			Attitude score		
	Low (0-3)	High (4-7)	Total	Low (0-3)	High (4-5)	Total
TAS						
Low	<i>n</i> 21 % 58.3	15 41.7	36 100	22 61.1	14 38.9	36 100
High	<i>n</i> 7 % 30.4	16 69.6	23 100	15 65.2	8 34.8	23 100
ES						
Low	<i>n</i> 13 % 50.0	13 50.0	26 100	17 65.4	9 34.6	26 100
High	<i>n</i> 15 % 45.5	18 54.5	33 100	20 60.6	13 39.4	33 100

were divided into high and low groups. Similar analyses yielded no significant difference between the two groups on either score (perception score: $\chi^2(1) = .12, ns$; attitude score: $\chi^2(1) = .14, ns$).

Discussion

Hazard Perception Skills

The ratios of participants who scored lower than 4 on perception skill were 30.4% in TAS high group and 58.3% in TAS low group. Thus, distribution of number of participants showed a clear relationship between TAS and perception skills. This result is consistent with the hypothesis of the present study, indicating that sensation avoiders tend to have lower hazard perception skills.

The resulting partial correlation coefficient supported the correlation between the TAS and perception scores even after controlling for the effect of age and performance in D-CAT. Therefore, the low perception skills cannot be attributed to their old age or inability in concentrating and maintaining attention.

The settings of the Risk Perception Test are novel traffic situations that the participants had never encountered. Generally, it is more difficult for a driver to judge what to direct his or her attention to on an unfamiliar street than on a familiar street. Sensation avoiders have been shown to have vulnerability to stress from novel stimuli. They tend to show physical defense reaction to novel stimuli, and avoid directing visual attention to novel stimuli (Ridgeway & Hare, 1981; Zheng, Xu, Jin, Sheng, Ma, Zhang, & Shen, 2010). It is likely that because they have less experience in driving on unfamiliar streets usually, those who have a tendency to avoid novel stimuli have not sufficiently learned what to direct their attention to in such situations.

Driving Attitude

Tasks of the Risk Perception Test that measures driving attitudes consist of questions such as whether to pass the vehicle before and at what speed to drive in the situation. It was expected that if SS in older adulthood prompted reckless driving attitudes, there would be a negative correlation between Sensation Seeking Scale and attitude score. However, the expected relationship did not result.

The Risk Avoidance scale of the Safety Driving Scale measures the driving attitude to control the speed and avoid high-risk streets. A previous study that used the same questionnaire with college students found that sensation seekers rarely showed careful driving such as these (Miyazaki & Kanachi, 2011). However, the present study did not support a correlation between the Risk Avoidance scale and Sensation Seeking Scale.

To summarize, even when two indices were used in combination, results did not suggest that SS prompted reckless driving attitudes. One possible reason is that participants in this study were in older adulthood. Older drivers tend to show careful driving attitude to compensate for decline in sensory-motor ability caused by aging (Fujikawa, 2002; Matsuura, 2011). It can be considered that SS does not promote reckless driving attitude in older age because of improved driving attitudes in this life stage.

Implications of the Study and Future Directions

It is possible that the personality trait, SS, changes its intensity and function according to the life stage of the driver. SS tends to decrease in old age. According to a cross sectional study, TAS scores peaked in teenage and gradually decreased thereafter (Zuckerman, Eysenck, & Eysenck, 1978). Participants in the present study, who were older, also showed lower mean scores on TAS and ES (see Table 1), when compared with the college age participants in the previous study (TAS score: male, $M=12.2$, $SD=2.0$; female, $M=10.1$, $SD=2.6$; ES score: male, $M=13.1$, $SD=1.9$; female, $M=12.4$, $SD=2.1$; Miyazaki & Kanachi, 2011). Therefore, it can be inferred that in old age, problems due to weak SS, rather than strong SS as has been pointed out previously, manifest themselves.

Previous research has revealed that older sensation avoiders tend to experience more accidents (Schwebel et al., 2007). Based on the findings from the present study, the chief cause of that can be deficiency in hazard perception skills. Hazard perception is a skill that is indispensable for preventing accidents. If the driver does not notice latent hazards in traffic situations, he or she will be involved in dangerous situations unwittingly, thereby delaying reacting to properly avoid the danger. In fact, those who scored low on the Risk Perception Test were shown to have higher accident rates (Fukazawa, 1990). To prevent accidents caused by sensation avoiders, it is necessary in the future to identify specific situations in which problems in hazard perception tend to occur, and discuss countermeasures. Sensation avoiders tend to avoid novel stimuli, strong stimuli, and complex and varied stimuli. Therefore, sensation avoiders can be anticipated to show driving problems in situations that contain strong sensory stimuli and that can change unexpectedly, in addition to unfamiliar traffic situations.

Lastly, I would like to discuss strength of SS in older adulthood and its benefit. To support health promotion of sensation seekers requires not only controlling negative behavior but also guiding sensation seeking to induce positive behavior (Miyazaki, 2005). Driving has a positive role to enhance mobility of older adults and maintain their independent living. It has been known from the previous research on the significance of driving that discontinuation and reduction of driving due to aging increases depression in older adults (Fonda, Wallace, & Herzog, 2001; Ragland, Satariano, & MacLeod, 2005). It is desirable that older adults voluntarily continue to drive as long as they have attitudes to and abilities for safe driving. The present study revealed that those with strong TAS are likely to have some level of perception skills. Hazard perception skills tend to decrease over age, and this is a risk factor for traffic accidents (Ogawa, Renge, Nagayama, 1993). Maintaining some levels of hazard perception skills in the older adulthood, in which cognitive functions tend to decline, can be considered to be strength of sensation seekers. Using such strength, future health psychology will be required to provide support for sensation seekers who have attitudes toward safe driving as long as they wish to continue to drive.

The participants in this study were older adults who were registered with a human resource center for seniors, and actively participating in the society. The findings should be interpreted as characteristics of older adults who maintain some physical and mental health. Additionally, dangerous driving, such as drunk driving and ignoring a traffic light, was not addressed in the present study because the previous research has indicated that there is little incidence of the dangerous driving (Miyazaki & Kanachi, 2011; Watanabe, 1998). To reach a conclusion on the relationship between SS and driving attitudes from a more comprehensive perspective, research with a broader scope with regard to participants and driving attitudes is warranted.

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