Characteristics of Anxiety while Driving and Anxious Drivers

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We constructed a driving anxiety scale based on an open question that asked the respondents about traffic situations invoking anxiety while driving. The effects of driver characteristics and driving-related variables on driving anxiety were examined using the driving anxiety scale. A questionnaire including the anxiety scale comprising 26 items was distributed to 726 non-offence drivers and 252 offence drivers who attended a driving license renewal course. A factor analysis based on the scale revealed four factors. The effect of each characteristic on each of the four subtypes of anxiety revealed that females, drivers with shorter driving distances, drivers aged 30 to 39, and non-offence drivers were more anxious than other drivers. CHAID analysis, a multivariate analysis similar to multiple regression, also indicated significant effects of these variables, gender and offence in particular. Characteristics of anxiety while driving and anxious drivers are discussed.

Key words: anxiety while driving, driving anxiety scale, offence drivers

Anxiety is one of the main feelings while driving. Research on driving anxiety has been primarily concerned with the cause and its role in safety rather than experimental measurements of driving anxiety. The causes of anxiety while driving consist of situations that are likely to cause anxiety and the characteristics of drivers who tend to feel anxiety. We first summarize these topics and then discuss the purpose of the study.

Situations evoking anxiety while driving

Anxiety or feeling worried while driving is caused by various traffic situations, road conditions, and environments. Researchers have adopted several items representing these situations for use as a driving anxiety scale, as part of a driving attitude scale, or as part of a questionnaire examining driving stress and emotions. Previous researches indicated that there were around 10 items, or more precisely from 5 to 32.

The content of the items differed to some degree depending on how they were collected and the types of situations (i.e., traffic, road, environmental conditions including weather, manoeuvres, and the actions of other road users) with which the items are concerned. Some studies have collected items based on theoretical models on general anxiety (Banuls et al., 1996; Matthews et al., 1996; Shoham et al., 1976). Many studies seem to have collected items based on the researchers' practical and theoretical knowledge on driving anxiety. No studies seem to have collected items from an open-question posed to drivers about driving anxiety.

A few studies classified driving anxiety into several subtypes using factor analysis. Banuls et al. (1996) obtained four subtypes of driving anxiety: situations that imply evaluation (F1), situations involving criticism and aggression (F2), situations involving external impediments and traffic jams (F3), and situations involving evaluation by the authorities (F4). Hatakka (1998) got three subtypes of driving anxiety from novice drivers: worry about normal driving situations (F1), worry about demanding driving situations (F2), and the risks and troubles connected with unskilled and vul-

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nerable road users (F3). Matsuura (1997, 2005) examined three subtypes of driving anxiety: anxiety about car controls (F1), anxiety toward interaction with other vehicles (F2), and anxiety toward hitting a pedestrian or a cyclist (F3). The factors in each study appear to be different, but in each study the main factor was related to anxiety about the driver's poor driving skill. When drivers, especially those with poor driving skills, confront a difficult or uncertain situation, this would evoke anxiety and this in turn would interfere with effective driving behaviour.

Characteristics of anxious drivers

Most studies on anxiety experienced while driving have examined whether specific driver characteristics have an effect on driving anxiety. One of the characteristics is gender; almost all studies reviewed indicated that women exhibited greater anxiety than men while driving (Forsyth, 1992; Fujimoto & Higashi, 1996; Fujita & Okamura, 1998; Hatakka, 1998; Parry, 1968; Matthews et al., 1996; Matsuura, 1997; Sheppard, 1975; Taubman-Ben-Ari et al., 2004). However, male drivers were found to feel more anxiety than female drivers for F3 anxiety by Hatakka (1998) and to feel anxiety as much as female drivers for F3 anxiety by Matsuura (1997). These types of anxiety were related to vulnerable road users such as pedestrians.

Driving experience also affected anxiety while driving; novice drivers gave higher anxiety scores than experienced drivers (Sheppard, 1975), and the novice driver's anxiety was found to be reduced after years of driving for F1 and F2 types of anxiety by Hattaka and Matsuura (Hatakka, 1998; Matsuura, 1997). Drivers who drive less were found to exhibit higher anxiety for F1 and F 2 by Hatakka (1988), for F1 by Matsuura (2005), and for the anxiety scales by Fujita & Okamura (1998), Sheppard (1975), and Taubman-Ben-Ari et al. (2004). .

Age effects were complicated. However, the age effect for novice drivers was rather clear. Some studies have indicated that older novice-drivers tend to obtain higher anxiety scores than younger novice-drivers for F1 and F2 in Hatakka (1998), for F1 in Matsuura (2005), and for the anxiety scale in Forsyth (1992). The effects of age differences on driving anxiety in a cross-sectional analysis were different among studies. Taubman-Ben-Ari et al. (2004) indicated that age was inversely associated with anxious driving. Parry (1968) indicated that anxiety scores decreased with increasing age for men but tended to increase among older women. Sheppard (1975) reported that those who worried the most were the youngest and oldest drivers. Finally, Matthews et al. (1996) found no age effect.

Role of driving anxiety on safety

Driving anxiety reduces the amount of driving people do (Fujita & Okamura, 1998; Hatakka, 1988; Matsuura, 2005; Sheppard, 1975; Taubman-Ben-Ari et al., 2004).

However, the effect on driving style is not simple. Anxiety has both negative and positive effects on driving. Negative effects include interference with driving tasks, leading to more errors due to attention impairment, miscalculation, or hesitation (Hatakka, 1998; Matthews et al., 1996). The F3 type of anxiety of Hattaka (1998) and Banuls et al. (1997), comprising impatience and irritation, were considered to cause improper driving (Banuls et al., 1997; Hattaka, 1998). Positive effects include greater caution, leading to slower speeds and rule-obedience (Hatakka, 1998; Matthews et al., 1996).

Anxiety while driving had different effects on traffic offences and accidents. Some studies indicated that drivers with higher feeling of anxiety committed fewer traffic offences (Fujimoto et al., 2004; Fujita & Okamura, 1998; Hatakka, 1998, for F2 type of anxiety). Contrary to this, another study indicated that drivers with higher feelings of anxiety were more likely to commit traffic offences (Shoham et al., 1975), while other studies found no relationship between anxiety and traffic offences

(Hatakka, 1998. for F1 and F3 types of anxiety; Taubman-Ben-Ari et al., 2004).

The effects on traffic accidents also varied among studies. Some studies indicated that drivers with higher feelings of anxiety had fewer accidents (Banuls et al., 1997, for F1 type of anxiety; Forsyth, 1992). Another study indicated that drivers with higher feelings of anxiety tended to have accidents (Fujita & Okamura, 1998; Hatakka, 1998, for F3 type of anxiety; Parry, 1968), while still other studies found no relationship between anxiety and accidents (Hatakka, 1998, for F1 and F2 types of anxiety; Matthews et al., 1996; Taubman-Ben-Ari et al., 2004).

Purpose of this study

First we created a driving anxiety scale composed of subtypes of anxious feelings so as to examine the three points that we have mentioned above. The scale is based on an open question to drivers about factors that can cause anxious feelings while driving, such as traffic situations, road conditions, other environments, the driver's own behaviour, and the behaviour of other road users. An open question was used because we want to create an anxiety scale that covers all aspects of driving anxiety.

The second purpose was to examine the characteristics of drivers who are more likely to feel anxiety. Personal characteristics and driving-related variables that affect each type of anxious feeling were examined. Finally, the effect of driving anxiety on traffic offences was examined.

Study 1.　Open question about situations leading to anxiety while driving

We clarified the situations or reasons for anxious feelings while driving so as to create a driving anxiety scale for Study 2.

METHOD

Participants

A questionnaire survey with an open question about anxiety while driving was administered to novice drivers ($N=265$, aged 18 to 26 years) and experienced drivers ($N=127$, aged 21 to 73 years) at a driving license centre. The novice drivers came to the centre to take a theory test for the driving license examination. The experienced drivers came to the centre to participate in a driving license renewal course. Each group of drivers completed the questionnaire after the driving license examination or driving license renewal course.

Procedure

Participants were required to report as many situations in which they would feel anxiety as possible. Their gender and age were also reported. The written answers to the open question were divided into several subtypes of anxiety for male novice drivers, female novice drivers, male experienced drivers, and female experienced drivers.

RESULTS

Classification of driving anxiety items

The answers were classified subjectively into several subtypes of anxiety among which the main subtypes were the following: sudden movement of pedestrians and bicycles (Type 1), unsafe driving of other vehicles (Type 2), a demanding traffic environment (Type 3), and one's own poor driving ability (Type 4).

Table 1 lists the percentage of the answers for each type of anxiety and for each group. We examined whether the frequency of reported anxiety differed among the four groups for each type of anxiety. No significant differences were found in anxiety about Type 1 or Type 3. For Type 2, however, both experience and gender were significant: Experienced drivers were more likely to report anxiety (one-sample chi-square test: $\chi^2(1)=8.39$, $p<.005$) and female drivers were more likely to report anxiety ($\chi^2(1)=4.27, p<.05$). Novice drivers felt anxiety more frequently than did experienced drivers in Type 4 anxiety ($\chi^2(1)=7.43$, $p<.01$).

The reason why novice drivers did not exhibit higher anxiety except for Type 4 was due to their limited experience in vari-

ous traffic situations. They probably cannot imagine the situations vividly enough to feel anxiety.

Constructing a tentative driving anxiety scale

The number of items for each anxiety type is listed in Table 1. Of the 32 items, we chose 24, considering the frequency of answers and ease of reading, as well as the number balance of each type. Two additional items from another driving anxiety scale (Matsuura, 1997) were added to the 24 items. We were thus able to construct a driving anxiety scale with a total of 26 items.

Study 2. A questionnaire study with a driving anxiety scale to examine factors affecting driving anxiety and the role of anxiety in traffic offences

We conducted a factor analysis to classify driver anxiety while driving, using the driving anxiety scale obtained in Study 1. We examined demographic and driving-related variables that affect the subtypes of driving anxiety. The role of anxiety in traffic offences is also clarified.

METHOD

Participants

The participant drivers came from among those who attended driving license renewal courses at two driving license centres, one in Sendai and the other in Kyoto. Drivers in Japan have to renew their licenses every three or five years. The renewal process consisted of two courses when the present research was performed. One course, called the "good driver course," was for drivers who either had no traffic accidents or traffic offences in the last three or five years, depending on their years of licensing, or who had committed only one minor offence in the last three years after having had no accidents or offences before the three-year period. Another course, called the "ordinary driver course," was for those who had either had an accident or committed an offence during the previous three years. We will refer to the "good driver course" drivers as "safe drivers" and the "ordinary driver course" drivers as "offence drivers."

There were 726 safe-driver participants and 252 offence-driver participants. The characteristics of the two groups of drivers and the differences between the groups are presented in Table 2. The two groups differed in gender, age, and years of driving. Males were more dominant among the offence drivers (76.2%) than among the safe drivers (54.7%). Offence drivers were younger and had driven for fewer years than safe drivers. Only total driving distance was the same for the groups.

Table 1   Frequency of answers for four types of anxiety given by four driver groups

Anxiety types			Driver groups			
	Name of anxiety type	No. of items	Male novices (N=143)	Female novices (N=122)	Male experienced (N=81)	Female experienced (N=46)
Type 1	Sudden movement of pedestrians and bicycles	5	64%	70%	72%	74%
Type 2	Unsafe driving of other vehicles	11	32%	45%	51%	74%
Type 3	Demanding traffic environment	9	41%	43%	56%	52%
Type 4	One's own poor driving ability	7	23%	23%	12%	7%

Table 2　Characteristics of the safe drivers and the offence drivers

Characteristics	Participants		Differences between the two groups	
	Safe drivers (N=726), %	Offence drivers (N=252), %	χ^2	p
Gender				
Females	45.3	23.8	36.1	$p<0.01$
Males	54.7	76.2		
Age (years)				
20–24	12.6	37.7	93.5	$p<0.01$
25–29	13.4	19.0		
30–39	22.8	15.5		
40–49	27.6	17.1		
50 and over	23.6	10.7		
Years of driving				
2–3	9.6	25.9	72.6	$p<0.01$
5–6	11.4	20.3		
8–9	12.5	15.1		
11 and over	66.6	38.6		
Driving distance (100 km)				
5 and below	8.6	4.9	7.2	$p=0.41$
5–10	7.6	6.9		
10–30	9.3	13.4		
30–50	9.1	10.2		
50–100	17.4	17.1		
100–200	15.5	17.1		
200–300	10.2	10.2		
300 and over	22.3	20.3		

Questionnaire

Participants completed the tentative driving anxiety scale from Study 1, which is made up of a total of 26 items. They were asked to read each item and to rate the extent to which they feel anxiety during driving in the situation described in the item. They were to choose a suitable alternative from a five-point scale, ranging from "not feeling anxiety at all" (1) to "feeling very much anxiety" (5).

The questionnaire also assessed demographic factors (i.e., age and gender), years of driving after getting an ordinary driving licence, and total driving distance in four-wheeled vehicles.

Data analyses

A factor analysis was performed on the anxiety scale in order to identify subtypes of driving anxiety. The extracted factors were analysed using t tests and ANOVAs to examine the factors affecting the subtypes of driving anxiety.

Another analysis was conducted with a classification tree algorithm, the Exhaustive Chi-squared Automatic Interaction Detector (CHAID) option of SPSS AnswerTree 3.1 J. CHAID analysis can be used when the explanatory variables are nominal (e.g., gender and offense liability) or ordinal (e.g., age and driving distance), and when there is no strong theory concerning the relative importance of explanatory variables in predicting the dependent variable. The analysis starts from the "trunk" of a tree representing the total driver sample. CHAID then creates a first layer of "branches" by displaying val-

Table 3 Factor analysis of a driving anxiety scale: Pattern matrix (Maximum likelihood with promax rotation, $N=894$)

Item	Factor 1 41.9%	Factor 2 4.8%	Factor 3 2.9%	Factor 4 1.9%
Factor 1: Demanding environment ($\alpha=0.90$)				
A vehicle from a side-road is likely to emerge.	0.60			
Driving parallel with a cyclist/motorcyclist.	0.70			
Driving on the opposite side of the road to pass a parked vehicle.	0.55			
Driving in a residential area with a lot of side roads.	0.86			
Driving through a blind corner with traffic safety mirrors.	0.60			
Driving on a busy road.	0.83			
Driving in the rain at night.	0.59			
Driving parallel with a heavy truck.	0.58			
Factor 2: Driver's own driving ability ($\alpha=0.86$)				
Joining an expressway from an acceleration lane.		0.67		
Passing each other at a narrow road.		0.71		
Driving faster than usual.		0.51		
Reversing into a parking space.		0.86		
Driving in poor health.		0.53		
Changing lanes.		0.60		
Driving on an unfamiliar road.		0.54		
Factor 3: Pedestrians' sudden movement ($\alpha=0.80$)				
Passing parked vehicles.			0.70	
Passing pedestrians.			0.80	
A pedestrian is runnning across a street ahead.			0.62	
Factor 4: Other vehicle's risky behaviour ($\alpha=0.69$)				
Someone cuts in right in front of you.				0.68
Someone is following very close to you.				0.83

ues of the strongest predictor (i.e., an explanatory variable) of the dependent variable (e.g., a subtype of driving anxiety or total anxiety). CHAID determines how to group the values of this predictor into two or more homogenous groups, based on either chi-square-test statistics or F-test statistics. Each group is then evaluated independently for the next best predictor. This branching procedure continues until no new groups are created from any of the explanatory variables.

RESULTS

Constructing a driving anxiety scale

A factor analysis consisting of maximum-likelihood extraction was conducted on the 26 items. Four factors were extracted and rotated using an oblique promax rotation method. All factor inter-correlations were high, $r=.40$ to .76. Table 3 presents the pattern matrix for the factor analysis of the driving anxiety scale. Factor 1 explained 41.9% of the variance and consisted of eight items that load high (greater than 0.5) on the factor. Factor 2 explained 4.8% of the variance and consisted of seven items. Factor 3 explained 2.9% of the variance and consisted of three items, and Factor 4 explained 1.9% of the variance and consisted of two items. The internal consistency of the items of each factor, as indicated by Cronbach's alpha in Table 3, was acceptably high. We labelled the four factors as a demanding environment, the driver's own driving ability, pedestrians' sudden movement, and another vehicle's risky behaviour.

We constructed a driving-anxiety scale with four factors (i.e., subtypes) of anxiety (Table 3). Scores for each subtype of anxiety were obtained separately by adding the raw score for each item in the subtype. Table 4 lists the number of items, the average score for the items in each subtype, and the inter-

Table 4 Subtypes of the driving-anxiety scale and their correlations

Subtypes	No. of item	Mean of item	Correlations (r)			
			F1	F2	F3	F4
F1 Demanding environment	8	2.87				
F2 Driver's own driving ability	7	2.58	0.74			
F3 Pedestrians' sudden movement	3	2.85	0.65	0.50		
F4 Other vehicle's risky behaviour	2	2.65	0.48	0.52	0.40	
Total (=F1+F2+F3+F4)	20	2.73	0.93	0.89	0.73	0.64
Total (all items)	26	2.69	0.92	0.89	0.72	0.64

correlations between the subtypes. A repeated measures ANOVA indicated that drivers felt anxiety differently among the four subtypes of anxiety ($F(3, 2724)=5306.2$, $p<.01$). They felt more anxiety in a demanding environment and in response to pedestrians' sudden movement. Correlations between the subtypes were moderately high except for F1 (demanding environment) and F2 (driver's own driving ability), which correlated more strongly ($r=.74$).

Comparing the factors in Table 3 with those in Table 1, F1 corresponded to Type 3, F2 to Type 4, F3 to Type 1, and F4 to Type 2. However, the number of items for each factor did not necessarily correspond perfectly.

Effects of demographic and driving-related variables on driving anxiety

Relationships between the variables

Before examining the effects of the explanatory variables on the anxiety scores, we investigated the relationships between the variables. The chi-square test and Spearman rank-correlation test revealed nine significant relationships between two variables and only one non-significant relationship, between traffic offence liability and driving distance. The relationships included the following.

① Safe drivers consisted of more females than males (females, 84.5%; males, 67.4%).

② Females were younger than males (females, 38.9% aged 20–29; males, 30.5% for aged 20–29).

③ Females had fewer years of driving than males (females, 49.4% drivers with more than 11 years of driving; males, 66.1%).

④ Females had driven a shorter distance after licensing than males (females, 13.9% drivers with driving distance 5000 km or less; males, 3.8%).

⑤ Offence drivers were younger than safe drivers (offence drivers, 37.5% aged 20–24; safe drivers, 12.6%).

⑥ Offence drivers had fewer years of driving than safe drivers (offence drivers, 25.6% drivers with 2 to 3 years of driving; safe drivers, 9.4%).

⑦ Younger drivers had fewer years of driving than older drivers (Spearman rank correlation=0.76).

⑧ Younger drivers had driven a shorter distance after licensing than older drivers (Spearman rank correlation= 0.51).

⑨ Drivers with more years of driving drove a longer distance than those with fewer years of driving (Spearman rank correlation=0.59).

These relationships were consistent with those indicated in previous studies.

Effects of gender, age, driving distance, years of driving and offence liability on driving-anxiety scores

The effects of each demographic and driving-related variable on driving anxiety were examined by t-tests and one-way ANOVAs. The results appear in Table 5. First, they indicate that female drivers felt more anxiety than male drivers except for anxiety about F3, pedestrians' sudden movement.

Table 5 Effects of demographic and driving-related variables on driving anxiety

Anxiety subtypes	Demographic variables		Driving-related variables		
	Gender	Age	Driving distance	Years of driving	Offence liability
F1 Demanding environment	Female*	30–39**	shorter dis.*	n.s	Safe drivers**
F2 Driver's own driving ability	Female**	30–39*	shorter dis.**	n.s	Safe drivers**
F3 Pedestrians' sudden movement	Male+	30–39**	n.s	n.s	n.s
F4 Other vehicle's risky behaviour	Female**	30 & over**	n.s	longer yrs**	Safe drivers**
Total (=F1+F2+F3+F4)	Female**	30–39**	shorter dis.**	n.s	Safe drivers**

Note. $^{+}p<0.1$, $^{*}p<0.05$, $^{**}p<0.01$.
The characteristics of anxious drivers in each variable are shown in the Table.
The number of samples in each cell was slightly different, ranging from 906 to 968.
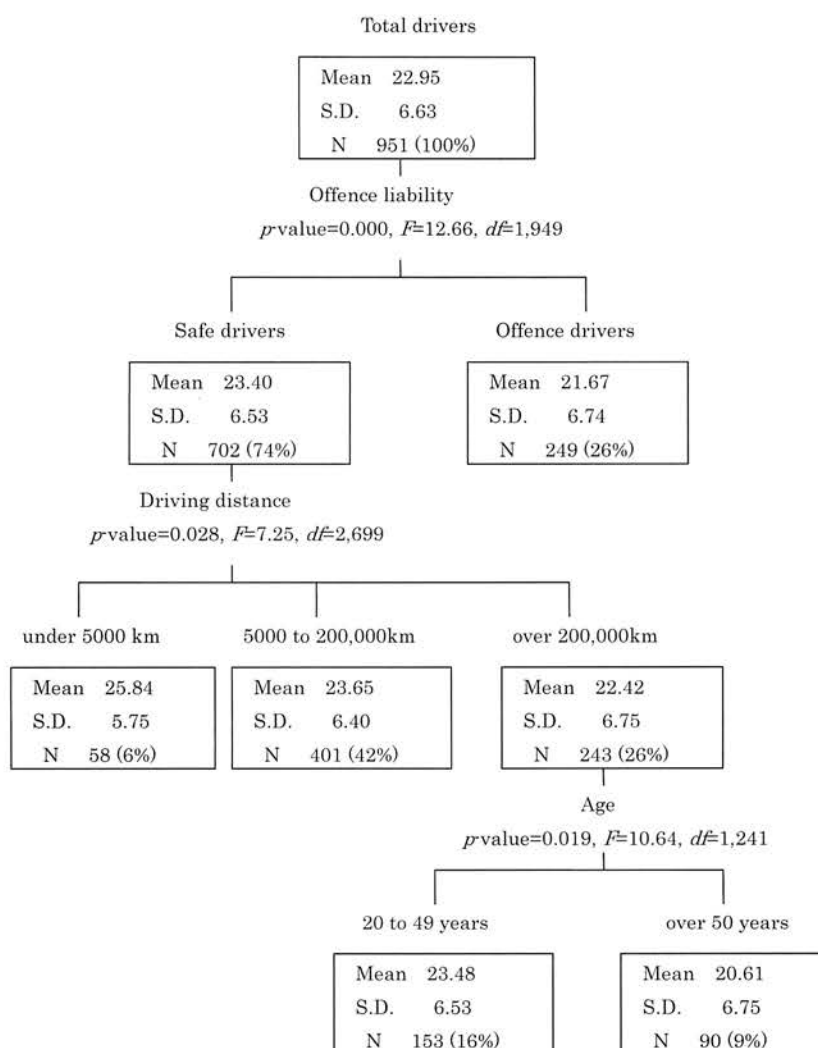
Total drivers

Mean	22.95
S.D.	6.63
N	951 (100%)

Offence liability
$p$value=0.000, F=12.66, df=1,949

Safe drivers

Mean	23.40
S.D.	6.53
N	702 (74%)

Offence drivers

Mean	21.67
S.D.	6.74
N	249 (26%)

Driving distance
$p$value=0.028, F=7.25, df=2,699

under 5000 km

Mean	25.84
S.D.	5.75
N	58 (6%)

5000 to 200,000km

Mean	23.65
S.D.	6.40
N	401 (42%)

over 200,000km

Mean	22.42
S.D.	6.75
N	243 (26%)

Age
$p$value=0.019, F=10.64, df=1,241

20 to 49 years

Mean	23.48
S.D.	6.53
N	153 (16%)

over 50 years

Mean	20.61
S.D.	6.75
N	90 (9%)

Figure 1 Classification tree for driving anxiety about a demanding traffic environment, by exhaustive CHAID analysis.

Drivers aged 30 to 39 were more anxious than younger or older drivers. Drivers who had not driven as much were also more anxious than those who had driven more, for anxiety F1 and F2, as well as for total anxiety. Years of driving did not have a significant effect on anxiety except for anxiety F4. Finally, safe drivers were more anxious than offence drivers, except for anxiety F3.

Predicting anxiety scores by CHAID analysis

The results in Table 5 indicate that gender, age, driving distance, and offence liability had individual influences on the subtypes of driving anxiety. Next we used CHAID analysis to determine the best combination of interacting factors (i.e., the above-mentioned four variables) for effectively predicting each score for the subtypes of driving anxiety.

A classification tree for anxiety about a demanding traffic environment is presented in Fig. 1. It displays three levels of branches. Offence liability was identified by CHAID as the first level of branches. This indicates that the most influential explanatory variable for predicting the degree of anxiety
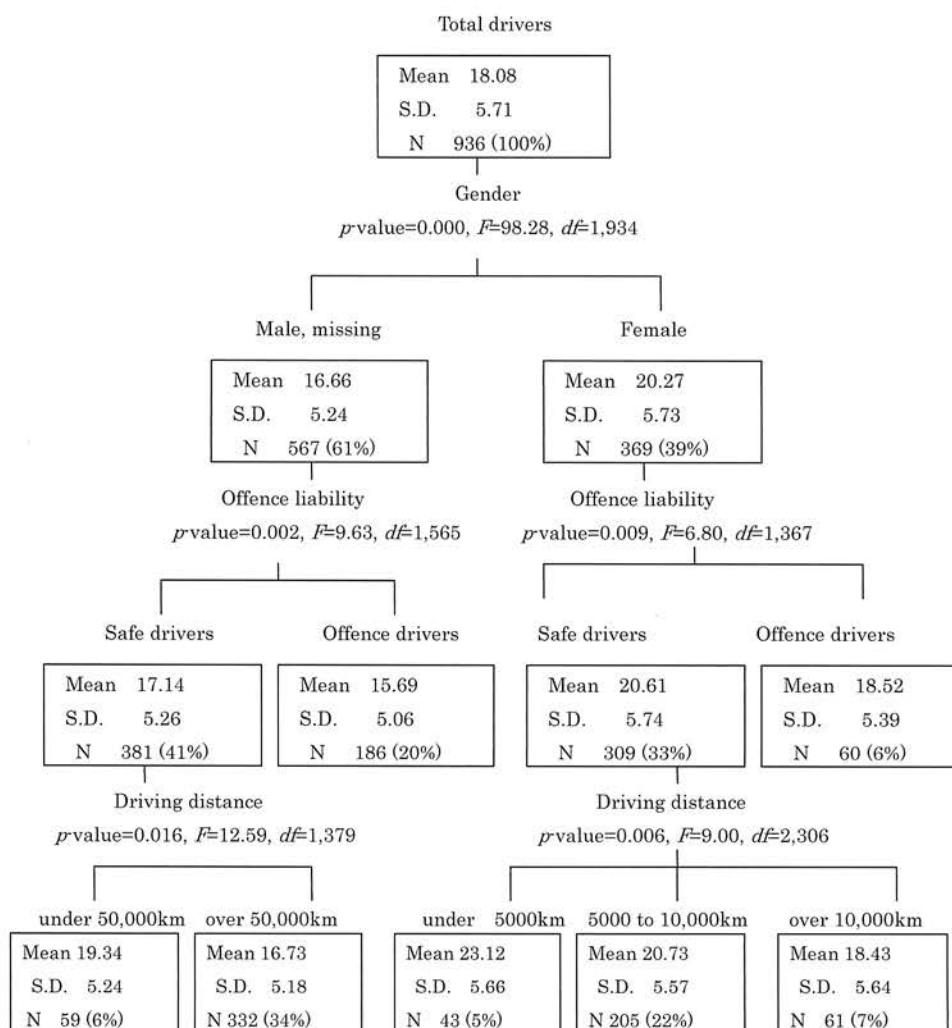

Figure 2　Classification tree for driving anxiety about a driver's own driving ability, by exhaustive CHAID analysis.
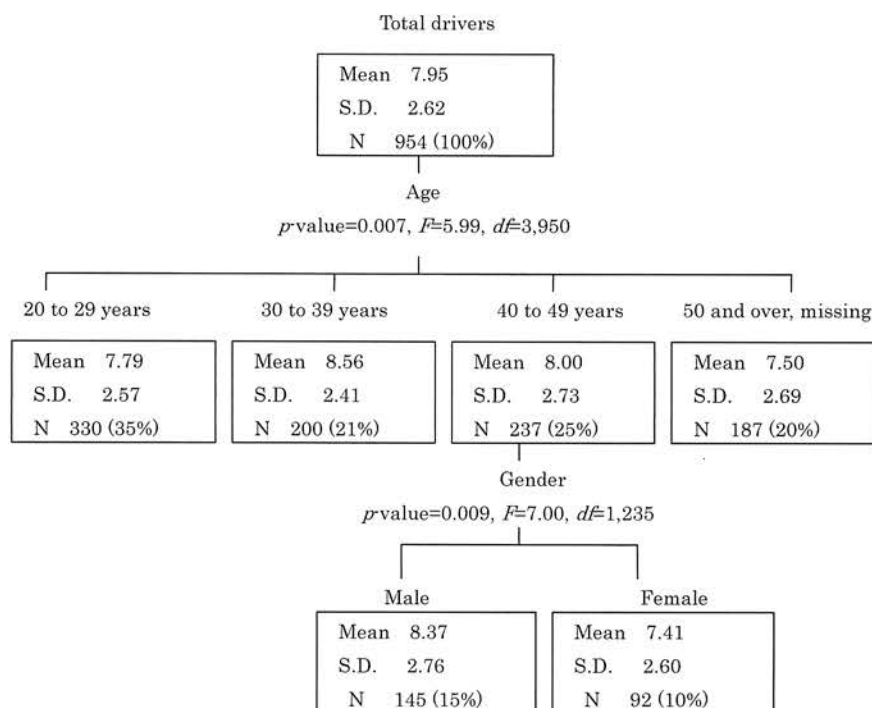
Total drivers

Mean	7.95	
S.D.	2.62	
N	954 (100%)	

Age

p-value=0.007, F=5.99, df=3,950

20 to 29 years	30 to 39 years	40 to 49 years	50 and over, missing
Mean 7.79	Mean 8.56	Mean 8.00	Mean 7.50
S.D. 2.57	S.D. 2.41	S.D. 2.73	S.D. 2.69
N 330 (35%)	N 200 (21%)	N 237 (25%)	N 187 (20%)

Gender

p-value=0.009, F=7.00, df=1,235

Male	Female
Mean 8.37	Mean 7.41
S.D. 2.76	S.D. 2.60
N 145 (15%)	N 92 (10%)

Figure 3 Classification tree for driving anxiety about pedestrians' sudden movement, by exhaustive CHAID analysis.

about a demanding traffic environment was offence liability. Safe drivers were more anxious (mean anxiety score=23.40) than offence drivers (mean anxiety score=21.67). Safe drivers were split as to driving distance. Anxiety about a demanding environment was higher for safe drivers with a shorter driving distance. Safe drivers with more than 200,000 km of driving distance were further split by age. Younger drivers aged 20 to 49 were more anxious than older drivers in this group.

Figure 2 is a classification tree for anxiety about the driver's own driving ability. Gender was identified as the best predictor of this anxiety, followed by offence liability. Females were more anxious (mean anxiety score=20.27) than males (mean anxiety score=16.67), and safe drivers were more anxious than offence drivers in each gender group. Safe drivers were further split by driving distance in both the male and female groups. Both male and female safe drivers with a shorter driving distance felt more

anxiety than those with a longer driving distance.

A classification tree for anxiety about pedestrians' sudden movement is given in Fig. 3. Age was shown to be the best predictor of this driving anxiety. Drivers aged 30 to 39 were most anxious (mean anxiety score= 8.56). Only drivers aged 40 to 49 were further split by gender; males were more anxious than females. Only the offence liability significantly predicted anxiety about other drivers' risky behaviour; safe drivers were more anxious (mean anxiety score=5.92) than offence drivers (mean anxiety score= 5.04). A classification tree for total anxiety indicated two levels of branches, the same as those in Fig. 2. Gender was identified as the best predictor, followed by offence liability.

Discussion

Driving anxiety scale

We have identified four subtypes of anxiety experienced while driving, using a factor analysis applied to 26 anxiety items col-

lected from open questions. The factors were a demanding environment (F1), the driver's own driving ability (F2), pedestrians' sudden movement (F3), and other vehicles' risky behaviour (F4). F1 and F2 represent driving anxiety experienced when confronting various traffic and road situations and would coincide with many one-dimensional anxiety scales. F1 is a situation that was more demanding and hazardous than F2.

When comparing our scale with that of Hatakka (1998), our F1 and F2 are in agreement with his F2, worrying about demanding driving situations. For example, 'Driving on a busy road' in our F1 is almost equal to 'Driving in city traffic' in his F2, and 'Reversing into a parking space' in our F2 is almost the same as 'Parking, reversing etc.' in his F2. Our F1 and F2 do not correspond with his F1, worrying about normal driving situations. Our F3 matches his F3 in describing risks connected with pedestrians. Our F4 has no matching factor in Hatakka's scale. If we compare our anxiety scale with that of Banuls et al. (1997), which is based on theoretical models of anxiety, our F1, F2, and F3 correspond to her F1. Our scales do not match her F2, F3, and F4 because her F2 and F4 represent the emotion and evaluation of other road users including policemen, and her F3 is related to irritation and aggression, which is almost in agreement with the aggression scale used in the Driver Stress Inventory (DSI) by Matthews et al. (1996).

Characteristics of anxious drivers

The characteristics of drivers who are more likely to feel anxiety were examined by statistical analysis with one explanatory variable, i.e., by t-test and F-test, and by statistical analysis with multiple explanatory variables, i.e., CHAID analysis. The effects of gender indicate that female drivers are more anxious than male drivers; this result confirms those of previous studies.

There are two kinds of effects of driving experience on anxiety. First, the finding that novice drivers have higher anxiety than experienced drivers (Hatakka, 1998; Matsuura, 1997; Sheppard, 1975) was not supported in the study. This may be due to the fact that that the novice drivers in our study, with two to three years of driving experience, were not typical novices. Second, we examined whether drivers who drove fewer kilometers exhibit higher anxiety. This result was confirmed for the F1 and F2 types of anxiety.

A literature review had indicated that age effects were complicated and that there were no generally accepted facts. Our study examining the effects of the age variable suggested that drivers aged 30 to 39 were more anxious than other age groups, but a multivariate analysis by CHAID indicated that the age effect, when considering other variables, was only seen in the F3 type of anxiety.

Driving anxiety as a feeling deterring driving itself and traffic offences

Anxiety while driving has been shown to have different results in its effects on traffic offences. Some studies demonstrated that drivers with a higher feeling of anxiety were unlikely to commit traffic offences (Fujimoto et al., 2004; Fujita & Okamura, 1998; Hatakka [1998] for F2 type of anxiety). The results of the present study replicated this finding for the F1, F2, and F3 types of anxiety. There are two common points in these studies. One is that traffic offences were investigated by official record. If drivers with higher anxiety had been asked for the frequency of traffic offences by questionnaire they might have responded with a larger number of traffic offences than drivers with lower anxiety due to the negative self-appraisal of anxious drivers. The second common point is that the studies were conducted in Japan, except for the study of Hatakka (1998). As pointed out by Fujimoto et al. (2004), Japanese drivers may obey traffic rules based on anxiety or fear of accidents as well as such variables like attitude, normative belief, and controllability, which are described in the theory of planned behaviour.

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