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DRIVING EXPERIENCE, PERSONALITY, AND SKILL AND SAFETY-MOTIVE DIMENSIONS IN DRIVERS' SELF-ASSESSMENTS

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Summary—This study was aimed at measuring skill and safety-motive dimensions in drivers' self-assessments of their driving abilities and at investigating correlations among three driving inventories and six general personality measures. The questionnaires were completed by 113 students with a driver's licence. The orthogonal model with the skill and safety-motive factors explained 35% of the variance in the questionnaire based on the work of Spolander (*Drivers' Assessment of Their Own Driving Ability*, 1983) and Hatakka, Keskinen, Katila and Laapotti (*International Conference on Traffic Safety*, 1991). Multiple regression analysis showed driving experience to be a significant predictor of safety and skill-oriented driving, so that with driving experience drivers assess themselves as more fluent in handling the car, but lower in safety aspects of driving. The safety-motive scale had only weak correlations with driving-specific or personality measures except the Lie-scale of the EPQ, which suggests that 'safe driving' expressed in questionnaires is safety jargon soon forgotten after driving school with driving experience, possibly together with the corresponding safety behavior, rather than a permanent response tendency. The skill scale correlated strongly with scales expressing an emotional attitude to driving and with a sense of coherence. Driving aggression and dislike of driving DBI scales correlated with neuroticism, Type-A behavior, self-esteem, sense of coherence, and locus of control, whereas the MDIE scales correlated only with Type-A behavior and neuroticism.

INTRODUCTION

Safe driving can be seen as composed of two separate components, cognitive skills and motives. The former includes information processing and motor skills whereas the latter includes both transient motivational and more permanent personality factors and attitudes toward traffic and safety. Cognitive and motor skills, i.e. drivers' maximum performance capabilities, do not necessarily predict their accident involvement, but it is essential that the motivational factors determine what they are doing or what they must do with their skills (Näätänen & Summala, 1974, 1976; Summala, 1985; Summala & Näätänen, 1988). This distinction corresponds to that between driver performance and driver behavior (Evans, 1991) and driving skills and driver style (Elander, West & French, 1993).

In the same vein, Spolander (1983) drew a distinction between technical and defensive driving skills, the former consisting of quick and fluent car control and traffic situation management while the latter rather refer to anticipatory accident avoidance skills. Based on 1300 drivers' self-assessments he claimed that with increasing experience drivers assess themselves as higher in skills, however, there are significant gender differences: males overrate their driving skills, and this overrating develops rapidly after licensing being greatest in the first year (Spolander, 1983). This is in line with the proposition that practice and increasing exposure to the diversity of traffic situations predictably result in improved skills but also in increased subjective control of driving, less concern for safety, and habitually driving within narrow safety margins (Näätänen & Summala, 1976; Summala, 1985). This is also reflected in differential development of driver subtasks some of which improve but others drop out, depending on the feedback (Duncan, Williams & Brown, 1991). Those behavioral forms which are immediately and consistently fed back develop fast and persist, but taking heed of highly infrequent coincidences easily become unlearned. Not even specific defensive driving courses which focus on anticipatory, safety-oriented driving habits appear to influence drivers' accident involvement (Lund & Williams, 1985).

The skill–motive distinction of Näätänen & Summala is not fully parallel with Spolander's one distinguishing technical and defensive skills, however. It is evident that some technical and defensive skills are closely intertwined. Unfortunately, Spolander did not verify the two factors in his questionnaire by factor analysis. Therefore this study addressed further clarification of the structure

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of self-assessed skill estimates, and the influence of driving experience on them, mainly based on the Spolander scales. Two factors were assumed to explain drivers' self-assessment; those related to skilled and fluent driving (the skill factor) and the other related to safe and anticipatory driving (the safety-motive factor).

In addition to the general developmental aspect we also addressed the inter-individual effects of the more permanent personality factors on self-assessed skills and safety motives.

Three measures were chosen which have been extensively compared to driving and road safety: locus of control, sensation seeking, and Type-A behavior. The locus of control construct 'externality' has been expected to relate to a lack of caution and failure to take precautionary steps to avoid the occurrence of unfavorable outcomes (Arthur & Doverspike, 1992; Hoyt, 1973; Montag & Comrey, 1987; Phares, 1978; Strickland, 1977, 1978; Williams, 1972). In this study we examined the relation between the Montag Driving Internality and Externality scale (Montag & Comrey, 1987), a traffic-targeted locus of control measure, and Levenson's (1981) general locus of control inventory.

In addition to the inability to control the consequences of one's own driving behavior, the tendency to seek sensation and excitement has been claimed to be related to high-risk driving (Heino, Molen & Wilde, 1992; McKenna, 1982; Näätänen & Summala, 1976; Summala, 1987; Zuckerman & Neeb, 1980). The third personality construct concerned is Type-A behavior and especially driver stress and aggression (e.g. Keltikangas-Järvinen & Räikkönen, 1993). Goldstein and Mosel (1958) have already reported that male drivers' aggression is related to traffic violations and accidents (for a review see Näätänen & Summala, 1976; Sivak, 1983). This study investigated the correlative relations among skill and motive dimensions, driving aggression and Type-A personality.

The studies of individual differences and driving style have usually been based on a correlative design where some personality questionnaires are correlated with driving inventories. This kind of study only based on questionnaires are easily biased by the effects of social desirability caused by self-deception and/or impression management. It is highly apparent that the tendency to respect social desirability—the tendency to embellish answers when asked about bad habits—is generalized to all life areas, and therefore, easily results in significant correlations between personality and driving measures.

Finally, the purpose of this paper is to illuminate the relations between driving-specific questionnaires and more general personality factors.

METHOD

Subjects

The *S*s were 113 student volunteers studying mainly social sciences in the University of Helsinki. The mean age of the sample was 23.9 yr (SD 4.32), 72% of the sample being female. The mean duration of licence possession was 5.2 yr (SD 4.13).

Questionnaires administered

Driving specific and personality measures as well as a form concerning background information were combined into a single questionnaire. *S*s were informed about the purpose of the study (development of verbal measures concerning driving). All *S*s completed personality and the driving specific questionnaires.

Driving specific questionnaires

Montag Driving Internality and Driving Externality Scales (MDIE). The MDIE were translated into Finnish. *S*s answered 15 Internality (DI) and 15 Externality (DE) items by estimating the truthfulness of items on a five-choice scale.

The Driving Behavior Inventory (DBI). The DBI (Glendon, Dorn, Matthews, Gulian, Davies & Debney, 1993; Gulian, Glendon, Matthews, Davies & Debney, 1988; Gulian, Matthews, Glendon, Davies & Debney, 1989) was translated into Finnish and adapted to the Finnish culture, and 33 DBI items were selected. *S*s answered by choosing one of five possible alternatives.

The Driver Skill Inventory (DSI). Spolander (1983) asked drivers to compare their driving abilities with skills of drivers in general by 13 five-choice items concerning different aspects of driving. Due

to a cumulative and well-known finding that the majority of drivers assess themselves as better than average drivers in their skills (Näätänen & Summala, 1976; Svenson, 1981; Svenson, Fischhoff & MacGregor, 1985), drivers tend to answer driving inventories keeping median values in congruence with the driver population. Therefore, Hatakka *et al.* (1991, Hatakka, Keskinen, Laapotti, Katila & Kiiski, 1992) replaced Spolander's external reference (' = average driver') by internal reference: *S*s were asked to assess their own abilities in different aspects of driving skills (Hatakka *et al.*, 1991, 1992). For our study, we adopted 20 items from Hatakka *et al.* (1991, 1992). Furthermore, due to the fact that the two original factors—defensive and other skills—of Spolander (1983) and Hatakka *et al.* (1991, 1992) overlapped somewhat, we added 9 items to measure motivational factors to meet the Näätänen–Summala (1974, 1976) model of skill and motivational determinants of driver behavior (also Hyvén & Summala, unpublished data, 1990). This study aimed at testing an orthogonal solution of that model.

Personality measures

The abridged version of Levenson's Internality, Powerful Others and Chance Scales (IPC). This study was addressed evaluating the validity of the traffic specific locus of control questionnaire (MDIE), i.e. to studying the correlation between MDIE and a non-targeted measure of Locus. The Levenson's Internality, Powerful Others and Chance Scales (Levenson, 1981) were used as a non-specific measure for locus of control. Earlier studies addressed to traffic behavior have mainly measured locus of control by Rotter's scale (Rotter, 1966), but in this study Levenson's scale was used because of its multidimensionality since the correlative relation between Levenson's sub-scales and MDIE scales may show the type of driving internality/externality. In this study 12 items (4 items per scale) were chosen from the Levenson's original questionnaire on a theoretical basis and translated into Finnish. These 12 items were subjected to factor analysis (maximum likelihood method and varimax-rotation), and three scales based on this new solution were calculated. Alpha reliabilities of these new scales were 0.61 (Internality), 0.62 (Powerful Others) and 0.60 (Chance). Although alphas remained low, they exceeded the alphas obtained by the original solution (0.55, 0.46 and 0.53). The new Finnish scoring found in this study was therefore used in further analyses.

Zuckerman's Sensation Seeking Scale (SSS). The tendency to sensation seeking was measured by Zuckerman's Sensation Seeking Scale (Zuckerman, 1979). Haapasalo (1990) studied the validity of the SSS in Finland and also established a scoring key for the Finnish population. All analyses of the SSS in this study have been performed using Haapasalo's three-factor solution and scoring recommendation.

Type-A. Järvikoski and Härkäpää (1987) validated and adjusted the Type-A questionnaire of Matteson and Ivancevich (1982) for the Finnish population. Scoring in this study is based on the scoring solution founded in that study.

The Rosenberg's self-esteem measure. Self-esteem was measured by Rosenberg's questionnaire (Rosenberg, 1962), which is widely mentioned in the Finnish research literature and is, therefore, well tested and validated in Finland.

The abridged Antonovsky inventory of sense of coherence. Antonovsky's questionnaire for sense of coherence measures the *S*'s feeling of comprehension, management and meaning experienced in life (Antonovsky, 1987). Sense of coherence has not been studied earlier in relation to measures specific to driving. The sense of coherence scale of Antonovsky was used in a Finnish 13-item version applied in earlier Finnish studies (Järvikoski & Härkäpää, 1987).

The Eysenck Personality Questionnaire (EPQ). The EPQ (Eysenck & Eysenck, 1975) was used in this study as a control indicator of social desirability bias. The EPQ, also, produced measures of extraversion, psychoticism and neuroticism. Haapasalo (1990) translated and validated the EPQ with a large Finnish sample. In this study Haapasalo's scoring system was used. However, the dichotomous forced-choice alternatives (yes–no) were replaced by the Likert scale in which *S*s were asked to evaluate the items with six choices.

The background variables. The following background variables were recorded: age, sex, line of studies, type and age of driver's licence, number and type (injuries/material damages) and date of self-reported accidents, guilt or innocence of the accidents and driving experience. Both the annual driving total and the total driving experience were requested, but only the annual driving total was used in the analyses, because it was considered to be a more reliable measure than the total driving

Table 1. The Driver Skill Inventory. Factor loadings and communalities (Comm.) of items and eigenvalues of factors in the motive–skill solution

Items	Motive	Skill	Comm.
1. Fluent driving	0.26	0.64	0.48
2. Performance in a critical situation	−0.05	0.73	0.53
3. Perceiving hazards in traffic	0.09	0.61	0.38
4. Driving in a strange city	−0.10	0.54	0.30
5. Paying attention to pedestrians and bicyclists	0.22	0.30	0.14
6. Driving on a slippery road	−0.03	0.46	0.21
7. Conforming to the traffic rules	0.59	0.14	0.36
8. Managing the car through a slide	−0.04	0.57	0.33
9. Preview of traffic situations	0.10	0.62	0.39
10. Driving carefully	0.66	−0.25	0.50
11. Control of the traffic situations	0.04	0.68	0.46
12. Fluent lane-changing in heavy traffic	−0.37	0.67	0.59
13. Fast reactions	−0.10	0.62	0.39
14. Making firm decisions	−0.01	0.60	0.36
15. Paying attention to other road-users	0.61	0.25	0.44
16. Driving fast if necessary	−0.18	0.61	0.40
17. Driving in the dark	−0.08	0.33	0.11
18. Controlling the vehicle	−0.08	0.63	0.40
19. Avoiding the competition in traffic	0.66	−0.19	0.47
20. Keeping sufficient following distance	0.66	−0.10	0.44
21. Adjusting the speed to the conditions	0.57	0.05	0.33
22. Overtaking	−0.12	0.62	0.39
23. Cleaning the car windows on winter morning	0.30	−0.07	0.10
24. Relinquishing one's rights	0.47	−0.00	0.22
25. Conforming to the speed limits	0.62	−0.25	0.45
26. Avoiding unnecessary risks	0.71	0.01	0.50
27. Tolerating other drivers' blunders calmly	0.46	−0.05	0.22
28. Following the traffic lights carefully	0.43	−0.14	0.21
29. Parking in the legal places only	0.33	0.19	0.14
Eigenvalues and sum of squares	4.18	6.04	10.22

The scoring of items in scales is shown by underlining of the corresponding scale. Items 1 through 18 as well as items 25 and 27 were adopted from Spolander (1983) and Hatakka *et al.* (1991, 1993).

amount. Drivers in this study were more capable of estimating their typical annual driving experience (missing values 1%) than their total driving mileage (missing values 9%).

The attitude to driving. The attitude towards driving was measured by the simple question ("What does driving mean to you?") to which the *S*s answered by choosing among four alternatives which were: "I am afraid of driving, and I try to avoid it" (1), "Sometimes I have to drive, but generally, I prefer public transport" (2), "To me driving is, after all, a way to move from one place to another" (3), and "I enjoy driving" (4).

RESULTS

Driver Skill Inventory measures Motive–Skill dimensions

Pearson product-moment intercorrelations were computed for 29 Driver Skill Inventory items, and factors were extracted by the maximum-likelihood method. Only two factors were extracted, because two dimensions or scales—safety motives and skills—were involved. These two scales were considered not to be related, so the factors were rotated orthogonally by the normal varimax method. Oblique rotation (oblimin) was also carried out to see if the factors had a correlative relation, but the orthogonal rotation produced a theoretically better solution.

The yield of factor analysis is shown in Table 1. All items had loadings over 0.30, and 20 items loaded over 0.50, so no items were omitted from the solution. The two-factor solution explained 35.3% of the variance, and both factors seemed to explain variance quite equally; motive factor 14.4% and the skill factor 20.8%. The internal consistency of the questionnaire was measured by coefficient alpha (Cronbach, 1951); both extracted factors seemed internally consistent with alphas of 0.84 (motive factor) and 0.89 (skill factor). This two-factor analysis identified factors that could be clearly interpreted as a safety-motive and a skill factor, as based on the Näätänen-Summala model.

Table 2. Alpha reliabilities for the Driver Behaviour Inventory (DBI) and Montag Driving Externality and Internality Scales (MDIE) obtained in earlier studies and in this study

Scale		Coefficients alpha			
		Gulian *et al.* (1989)		This study	
		Study I	Study II	Orig.*	New**
DBI					
	Aggression	0.799	0.688	0.697	0.832
	Irritation	0.792	0.707	0.854	—
	Alertness	0.595	0.703	0.567	0.605
	Dislike	0.731	0.667	0.738	0.824
	Frustration	0.800	0.661	0.551	—
	Stress	0.858	0.819	0.805	0.816
MDIE					
	Externality	—	—	0.741	0.750
	Internality	—	—	0.782	0.790

*Scales with the original scoring based on Gulian *et al.* (1989) or Montag and Comrey (1987).
**Scales with the scoring based on this study.

Driver Skill Inventory and other driving questionnaires

Driving specific questionnaires (MDIE and DBI) were factor analyzed by the same method as DSI (maximum likelihood method and varimax-rotation). In earlier studies (Glendon *et al.*, 1993; Gulian *et al.*, 1988, 1989) a five-factor solution was used, but it did not prove to be feasible in this study. Therefore, four and three-factor solutions were extracted, the latter being regarded as the most interpretative. Extracted factors could be labelled ' = driving aggression', ' = driving alertness' and ' = dislike of driving'. The scales measuring emotions when overtaken and failing to overtake did not emerge as distinct factors, but the items on these scales were loaded mainly on the factor of driving aggression. Gulian *et al.* (1988, 1989) and Glendon *et al.* (1993) assumed DBI dimensions to be related, so DBI was subjected to an oblique rotation (oblimin) in this study. However, the correlation between factors remained low (from 0.03 to 0.15) and both rotation methods produced almost similar results, so the varimax rotation was used in further analysis. Three DBI scales showed acceptable internal consistency measured by alpha (Table 2).

The Montag Driving Internality and Externality (MDIE) scales were also factor analyzed by the maximum-likelihood method and varimax rotation. The factor analysis reproduced the same solution as originally (Montag & Comrey, 1987), but generally the loadings remained under those reported by Montag and Comrey. The alphas of DI and DE scales are shown in Table 2.

The calculation of the sum scores was based on the factor analyses found in this study. Only items loading over 0.30 were accepted for the solution.

The Pearson product-moment correlations among driving specific questionnaires are shown in Table 3. In addition, partial correlations in which sex and driving experience were controlled were calculated. These partial correlations are presented under the non-partial correlations in Table 3.

Table 3 shows that the motive factor of DSI correlates negatively with DBI driving aggression whereas the skill factor has a weak positive correlation with aggression. This relation was not found in partial correlations in which driving experience and sex were controlled. The skill-scale correlated negatively with the DBI scale measuring dislike of driving, but the motive scale had no relation to the dislike scale. These correlations indicate that drivers underlining skilled and fluent driving actually drive with pleasure, but may get irritated and aggressive in certain traffic situations. Safety motivated drivers, conversely, do not connect any emotional attitudes with driving.

Table 3 also indicates a positive correlation between internality and alertness, and between externality and aggression. Hence internals, i.e. drivers seeing themselves as responsible for traffic safety and capable of influencing it, saw themselves as alert and careful drivers who try to predict possible risks in traffic. Externality, i.e. the tendency to see traffic accidents as matters of chance or as some other drivers' fault, appeared to correlate, although weakly, with self-reported aggressive behavior and risk-taking.

Table 3. Correlation coefficients and partial correlations (sex and driving experience controlled) between driving scales with scoring based on this study

	MDIE		DSI		DBI	
	DE	DI	Motive	Skill	Aggr.	Alert.
Montag Driving Internality and Driving Externality Scales (MDIE)						
Driving Externality (DE)	1.00					
Driving Internality (DI)	−0.19*					
	−0.15					
Driver Skill Inventory (DSI)						
Safety	−0.10	−0.01				
	−0.19*	0.03				
Skill	−0.13	0.12	−0.10			
	−0.02	0.05	0.06			
Driver Behaviour Inventory (DBI)						
Driving aggression	0.27**	0.04	−0.30***	0.25**		
	0.29**	0.06	−0.37***	−0.23*		
Alertness	0.02	0.25**	0.12	−0.18	0.18	
	−0.01	0.28**	0.09	−0.16	0.21*	
Dislike of driving	0.17	0.01	0.09	−0.60***	0.34***	0.13
	0.13	0.06	0.00	−0.53***	0.32***	0.14

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Personality dimensions and motive–skill scale

Table 4 shows correlations among measures tailored to the driving task and questionnaires measuring general personality factors. The partial correlations in which the effect of sex and driving experience are controlled are also shown (below, non-partial correlations) in Table 4. Table 4 shows that the motive scale of DSI had very weak correlative relations with personality measures; the only tenuous correlation was found on the EPQ Lie scale. This relation between the Lie and motive scales was subjected to analysis of variance in addition to the correlation study. The sample was divided into three equally-sized groups on the basis of scores on the Lie scale by the following method: the low-scoring third (33%) of *Ss* was recorded as "honest", the middle third as "average people", and the high-scoring third as "liars". The two-way ANOVA (Sex × Lie scores) indicated that "liars" and "honest subjects" deviated in the motive scale ($t_{72} = -2.87$, $P = 0.005$). Moreover, the interaction between sex and scores on the Lie scale was significant ($F_{2,101} = 3.49$, $P = 0.034$). Females had a tendency to conform to social desirability more than males ($t_{107} = 2.81$, $P = 0.006$). Social desirability seemed not to affect the responses on the skill scale.

The skill scale correlated negatively both with Eysenck's neuroticism scale, the Type-A sub-scale named "Tenseness" and Levenson's scales measuring externality, but positively with sub-scales of Sense of Coherence. One third of *Ss* scoring high on Neuroticism differed on the skill scale from the scoring low third ($t_{64} = 2.55$, $P = 0.013$). "Tense drivers" also deviated from "relaxed" ($t_{67} = 2.58$, $P = 0.012$) and "externals" from "internals" ($t_{64} = 2.16$, $P = 0.035$). In accordance with these findings reflecting a positive relation between sense of mastery over one's life and scores on the skill scale, Antonovsky's Sense of Coherence (SOC) had a positive correlative relation to the skill scale (Table 4). Two-way ANOVA (Sex × Sum scores of SOC) also showed that *Ss* getting high total scores deviated on skill scores from those scoring low on SOC ($t_{67} = -2.72$, $P = 0.004$). No interaction between sex and SOC scores was found.

Driving experience effects on the motive–skill dimension of driving

The multiple regression analyses were administered to see which dimensions of personality and demographic variables may predict high scores on skill and motive factors. The variables involved in analyses were SSS, locus of control, Type-A, Rosenberg's Self-Esteem and SOC scales and sub-scales. Demographic variables like sex and age were taken into account as well as driving experience, number and type of accidents and attitude towards driving. The results of stepwise regression analyses (forward selection, probability of *F*-to-enter: $P < 0.11$) are shown in Table 5. These indicated that driving experience, dislike of driving, attitude towards driving, and the sense of management (SOC sub-scale) predict the scores obtained on the skill scale, but driving experience and driving aggression predict motive scores.

Multiple regression analyses showed that driving experience predicts scores gained on both the skill

Table 4. Correlations between driving specific and general personality measures

Personality measures	Traffic specific measures						
	MDIE				DSI		DBI
	DE	DI	Motive	Skill	Aggr.	Alert.	Dislike
EPQ							
Neuroticism	0.27**	0.02	−0.10	−0.29**	0.48***	0.17	0.35***
	0.23	−0.06	−0.17	−0.33**	0.56***	0.22*	0.34**
Extraversion	0.05	0.10	−0.06	0.18	−0.03	0.08	−0.24**
	0.17	0.02	−0.05	0.11	−0.03	0.02	−0.19
Lie	−0.02	0.12	0.20*	0.09	−0.12	0.01	−0.10
	−0.08	0.16	0.20*	0.11	−0.08	−0.02	−0.11
Psychoticism	0.12	−0.04	−0.18	−0.07	0.06	−0.23*	−0.24*
	0.12	−0.01	−0.21*	−0.05	0.09	−0.27**	0.20*
Type-A behavior	0.29***	−0.08	−0.05	−0.16	0.26**	0.09	0.16
	0.37***	0.01	−0.03	−0.18	0.32**	0.04	0.20*
Competitiveness	−0.05	0.05	0.06	−0.01	0.01	−0.07	0.00
and aspiration	0.03	0.07	0.13	−0.08	−0.03	−0.05	0.05
Tenseness and	0.23**	−0.14	−0.09	−0.23*	0.22*	0.00	0.21*
inability to relax	0.24*	−0.14	−0.05	−0.25*	0.24*	−0.08	0.24*
Impatience,	0.30***	−0.11	−0.15	−0.18	0.33***	0.19*	0.17
irritability and speed	0.40***	−0.05	−0.19	−0.30**	0.47***	0.10	0.20*
Efficiency	0.25**	−0.01	0.05	0.01	0.09	0.10	0.01
	0.25*	0.12	0.04	0.13	0.13	0.12	0.02
Sensation seeking	−0.02	0.11	−0.07	−0.04	−0.01	−0.09	0.05
	0.05	0.08	−0.01	−0.09	−0.07	−0.05	0.03
Disinhibition	0.00	0.02	−0.08	−0.08	0.06	−0.08	0.13
	0.07	0.07	−0.05	−0.12	0.06	−0.05	0.11
Experience	0.08	0.05	−0.05	−0.10	−0.04	−0.06	0.12
seeking	0.06	0.09	−0.09	−0.08	−0.03	−0.08	0.07
Thrill and	−0.03	0.13	−0.09	0.06	−0.07	−0.07	−0.07
adventure seeking	−0.01	0.06	0.08	−0.04	−0.19	−0.01	−0.05
Levenson's IPC-scale							
Internality	−0.09	0.18*	0.02	0.11	−0.27**	0.06	−0.13
	−0.16	0.20*	0.12	0.13	−0.33**	0.09	−0.14
Chance	0.20*	−0.05	−0.06	−0.27**	0.42**	0.09	0.36***
	0.24*	−0.03	−0.25*	−0.19	0.48***	0.02	0.36***
Powerful others	0.03	0.05	0.08	−0.20*	0.22*	0.21*	0.27**
	0.09	0.03	−0.14	−0.13	0.23*	0.10	0.14
Self-esteem	−0.11	−0.04	0.01	0.19*	−0.30***	−0.02	−0.36***
	−0.06	0.02	0.05	0.19*	−0.34***	−0.06	−0.32**
Sense of coherence	−0.13	0.08	0.16	0.34***	−0.46***	−0.05	−0.51***
	−0.06	0.12	0.22*	0.41***	−0.52***	−0.10	−0.51***
Comprehension	−0.13	0.02	0.15	0.32***	−0.43***	−0.03	−0.48***
	−0.01	−0.01	0.24*	0.33**	−0.49***	−0.07	−0.44***
Meaning	−0.07	0.06	0.12	0.28**	−0.36***	0.03	−0.52***
	0.01	0.16	0.17	0.36***	−0.42***	−0.04	−0.53***
Management	−0.12	0.08	0.03	0.37***	−0.39***	−0.27**	−0.44***
	−0.06	0.12	0.15	0.44***	−0.44***	−0.11	−0.45***
Background variables							
Sex	−0.16	0.15	−0.11	0.19*	0.04	−0.16	0.04
(1 = female, 2 = male)							
Age	−0.13	−0.09	−0.04	0.03	−0.16	−0.04	0.01
	−0.18	−0.08	0.07	−0.10	−0.15	−0.07	0.14
Driving experience/year	−0.23*	0.12	−0.31*	0.50***	−0.02	−0.12	−0.22*
Attitude to driving	−0.01	0.16	0.13	0.57***	−0.09	−0.10	−0.64***
(1 = negative, 5 = positive)	0.08	0.19	−0.03	0.56***	−0.13	−0.10	−0.65***
Accidents/exposure	−0.04	0.06	−0.14	0.26**	0.10	0.02	−0.01
	0.20	−0.10	−0.04	0.07	0.17	0.06	0.04

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

and motive scales. *Ss* were consequently divided into two categories by driving experience on the basis of a median split, so that drivers with more than 5000 km/year experience were coded experienced and other drivers inexperienced. Figure 1 shows the average total scores obtained on the motive and skill scale by the different groups concerned, and the corresponding standard errors of the means. Two-way (Sex × Driving experience) analysis of variance indicated that driving experience affected scores both on the motive scale ($F_{1,105} = 5.54$, $P = 0.020$) and the skill scale ($F_{1,105} = 16.12$, $P < 0.001$). Experienced females gained, as expected, higher scores on the skill scale than inexperienced females ($t_{77} = -2.82$, $P = 0.006$), and experienced males got higher scores than inexperienced males ($t_{30} = -2.69$, $P = 0.012$). However, the experienced female drivers got lower scores on the motive scale than inexperienced females ($t_{76} = 2.76$, $P = 0.007$).

Table 5. Summary of stepwise multiple regression with the skill or motive scale as the dependent variable. The driving experience is forced to the model

Step	Independent variables	R^2	ADJ R^2	Change in R^2	F	df	β
Skill as the dependent variable							
1.	Km/year	0.24	0.23	0.24	23.76***	1,77	0.364
2.	DBI-Dislike	0.48	0.47	0.24	35.22***	2,76	−0.208
3.	Positive attitude	0.53	0.51	0.05	28.35***	3,75	0.315
4.	SOC-Management	0.57	0.55	0.04	24.50***	4,74	0.218
Motive as the dependent variable							
1.	Km/year	0.05	0.04	0.05	3.86*	1,77	−0.254
2.	DBI-Aggression	0.19	0.17	0.14	8.78***	2,76	−0.376

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Driving experience did not distinguish males significantly on the motive scale, but the trend of the effect was the same as between female groups. Sex had no effect on scoring on the motive and skill scales, and there was no significant interaction between sex and driving experience. Figures 1 and 2 indicate that driving experience increases drivers' skill orientation, but decreases respect for driving safety and traffic rules. Figure 2 shows that the skill-orientation overtakes motive-orientation when the annual driving experience exceeds the category of 10,000–15,000 km/yr.

The effect of driving experience on the skill and motive scores (scores per item) was also studied within the sex and experience groups. The inexperienced males got higher scores on the motive scale than the skill scale ($t_{13} = 5.18$, $P < 0.001$) as did inexperienced females ($t_{57} = 10.01$, $P < 0.001$). This difference was not found among experienced males and females. These comparisons between different groups suggest that inexperienced drivers emphasize safety-motives more than experienced drivers.

DISCUSSION

The skill and motive dimensions emerged as separate uncorrelated factors in these data, also showing the expected experience-related changes: experienced drivers judged their skills as higher but their safety concern as lower than inexperienced ones. When controlling the practice effects, the inter-individual variance in personality variables had only a modest effect on the skill and motive dimensions. The motive scale especially correlated with only a few personality measures, and in these cases the correlations remained very weak. This lack of relation to personality dimensions may indicate that the safety-orientation expressed in questionnaires is of a general rather than inter-individual nature

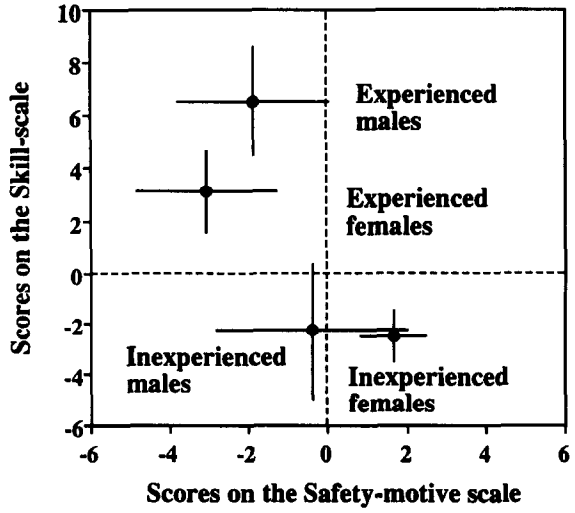

Fig. 1. The average total scores on the motive and the skill scales and the corresponding errors of the means. The mean of the whole sample is marked with zero and with a dashed line.

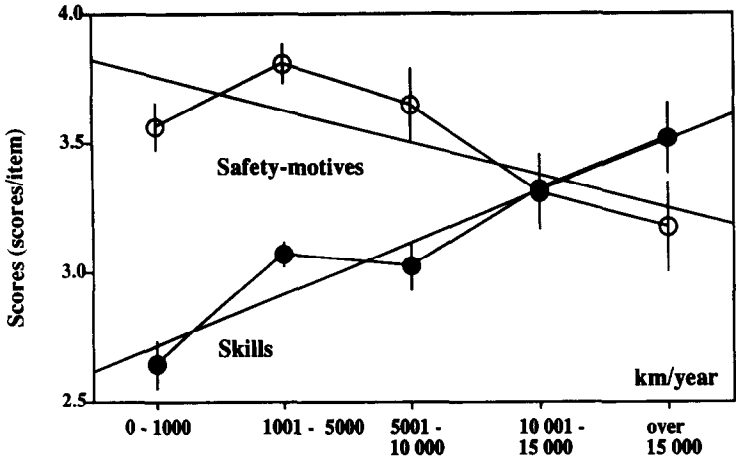

Fig. 2. The safety-motive and skill mean scores and corresponding errors of the means as a function of annual mileage.

and may be traffic safety jargon only, in line with Spolander's (1983) finding that there is a correlation between subjective driving skill and self-reported driving style whereas subjective defensive driving ability had no correlation with driving style.

The skill scale instead had a stronger (negative) correlation with driving scales measuring dislike of driving, and correlated positively with driving aggression and a positive attitude to driving. This result suggests that skill-oriented drivers actually like driving, but they also get aggressive or frustrated more easily if traffic conditions (generally other drivers) do not satisfy their expectations. The skill scale correlated quite strongly with personality scales measuring the sense of mastery over one's life. Hence, the skill scale correlated negatively with locus of control scales measuring lack of control, i.e. externality, and positively with scales indicating a sense of coherence and self-esteem. Obviously *Ss* emphasizing skilled and fluent driving and mastering the vehicle in every situation, also had or wanted to express a sense of having control over their own lives. In this way the need for sense of control is generalized and is manifested in traffic behavior also (Näätänen & Summala, 1976) or, conversely, the achieved feeling of control over the car may even generalize to other aspects of life. In conclusion, the self-assessed skill scale was strongly loaded with motivational factors.

In this study the inexperienced drivers—males and females equally—thought of themselves as more safety-oriented than skill-oriented drivers, and inexperienced drivers also obtained higher motive scores than experienced drivers. This phenomenon occurred even in the sample of students which had less spread of driving experience when compared to the normal population. The development of driving skills along with driving experience, naturally, is manifested in self-assessment of skills, but it also seems to induce the decrease in safety and rule-oriented driving as measured by self-assessment questionnaire. This is the development predicted by the zero-risk model of Näätänen and Summala (1976): increasing driving experience and exposure to traffic increases the sense of subjective control and decreases the sense of subjective risk while decreasing concern for safety aspects.

The unfavorable effect of driving experience is due to selective learning and differential feedback. The safety-oriented responses—either inherent or learnt in driving schools—tend to drop out when drivers learn that they are not needed—why keep one's distance or reduce speed for potential threats which are only assessed at a very low probability (Duncan *et al.*, 1991; Fuller, 1984; Näätänen & Summala, 1976; Summala, 1988; Summala & Pihlman, 1993). Similarly, the 'safety jargon' used by safety educators and in campaigns, and learnt at driving schools, is forgotten quickly with driving experience.

The view that safety orientation in self-assessments is at least partly safety jargon is supported by the finding that there was a correlation between the EPQ Lie scale and the motive scale. Although this correlation was weak, it indicated that *Ss* declaring themselves as careful and safety-oriented drivers tend to score higher on social desirability. This finding suggests that some persons may

embellish their answers concerning their driving behavior. Therefore, the measures based on verbal self-assessments of driving behavior should always include a measure of social desirability.

This study was partly designed to test the Montag Driver Internality and Externality (MDIE) scales and Driver Behavior Inventory (DBI), and to study relations among these questionnaires and personality inventories not targeted to driving. The original factor constructs found in earlier studies (Glendon *et al.*, 1993; Gulian *et al.*, 1988, 1989; Montag & Comrey, 1987) seemed to recur rather well in this study, although the new three-factor solution of Driver Behavior Inventory appeared to be more reliable than the original five-factor one. All MDIE and DBI scales showed acceptable internal consistency, and the new DBI scales (Aggression, Alertness and Dislike) showed even higher reliability than the original DBI scales in earlier studies (Glendon *et al.*, 1993; Gulian *et al.*, 1989). We may therefore conclude that the Finnish versions of DBI and MDIE are reliable enough to be used in further studies.

The validity of MDIE was estimated by correlation between it and Levenson's questionnaire (IPC) measuring three locus of control dimensions (Levenson, 1981). The MDIE was expected to correlate strongly with IPC, because the Internality–Externality dimension is widely assumed to be a personality characteristic having some stability and generalization manifesting itself in various actions (Lefcourt, 1991). Surprisingly, the MDIE had only a weak correlation with Levenson's IPC. Likewise, the MDIE correlated weakly with driving questionnaires, although the most accurate result is generally assumed to be achieved by well-targeted measures (Lefcourt, 1976, 1982; Phares, 1976; Rotter, 1975), in this case by measures specific to traffic (Montag & Comrey, 1987). In general, results concerning the correlative relation between locus of control and driving-specific measures have been conflicting; in some studies locus of control has been reported to correlate with the number of traffic accidents or self-reported traffic behavior (Arthur, Barrett & Alexander, 1991; Montag & Comrey, 1987; Wuebker, 1986), but in other studies it has not been associated with accidents (Arthur & Doverspike, 1992) or traffic behavior in general (Riccio-Howe, 1991). The correlation between MDIE and fatal accidents in the study of Montag & Comrey may be due to the postdictive design which is susceptible to plausible attributional explanations (Arthur & Doverspike, 1992). Far-reaching conclusions, however, should not be drawn about the MDIE and the IPC from this study, because the validity of Levenson's IPC in abridged form has not been studied before in the Finnish population.

In addition to the MDIE, the Driver Behavior Inventory was also studied in relation to general personality questionnaires in this study. In earlier studies it has been found that driver stress is associated with neuroticism (Dorn & Matthews, 1992; Matthews, Dorn & Glendon, 1991). This study confirmed those results, and neuroticism seemed to correlate positively with driver aggression and dislike of driving. Neuroticism has been reported to be associated with Type-A behavior, especially with impatience (May & Kline, 1987; Wong & Reading, 1989). However, only a few studies have investigated the relation between Type-A personality and driving behavior (see Carrère, Evans, Palsane & Rivas, 1991; Stokols, Novaco, Stokols & Campbell, 1978; Synodinos & Papacostas, 1985). In this study driver aggression—as well as the "Externality" scale of MDIE—correlated with the Type-A sub-scale named "Impatience" and "Tenseness". Besides, both Driver Stress and Dislike of Driving had quite a strong negative relation to measures indicating the sense of coherence and self-esteem. Remembering that self-esteem and a sense of coherence are considered to be quite permanent characteristics in personality, these findings suggest that persons with low self-esteem and a sense of coherence also see driving as a repulsive and aggression-provoking task. This may be due to the complexity of the driving task and traffic surroundings—driving requires a certain amount of self-assurance and sense of control.

The Zuckerman Sensation Seeking Scale (SSS) was administered in this study, since we hypothesised that certain dimensions of SSS could be relevant to hazardous driving, especially to aggressive, intolerant and impatient driving leading to risk-taking behavior, although earlier findings in several studies have been mixed (Arnett, 1990; Clement & Jonah, 1984; Donovan, Queisser, Salzberg & Umlauf, 1985; Heino *et al.*, 1992; Mookherjee, 1986). In this study SSS was not related to any driving-specific measure.

This study only used drivers' self-assessments without any data on the corresponding driving behavior. However, this cross sample of students clearly showed that we have to consider skill and safety orientation separately, practice affecting each differently. This study also emphasized the importance of using adequate techniques to control bias caused by social desirability. In this study

the safety concern proved to be learnt safety jargon, possibly related to real behavior, to be dropped with practice rather than reflecting general personality factors.

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