AN INVESTIGATION OF OLDER DRIVER ROAD SAFETY PERCEPTIONS AND DRIVING PERFORMANCE ON FREEWAYS

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ABSTRACT

Research on all aspects of road safety for older drivers is becoming increasingly important as a result of both higher population age and increased crash exposure for older drivers. In this paper we investigate two important, yet largely under-researched issues regarding older drivers; first, we examine perceptions regarding road safety issues and, second, we relate perceptions to driving assessment and self-assessment. Data were collected through a questionnaire that was administered to forty active male drivers between 65 and 74 years old regarding their perceptions of road safety issues; the driving performance of the same drivers was later assessed and self-assessed through an on-road experiment along an urban freeway. Results suggest that drivers may be aware of their reduced driving skills and recognize the need to improve their performance. We note that, as expected, drivers more familiar with the freeway perform better yet experience some discomfort during exiting maneuvers. Our findings may be of particular importance in older driver education, assessment, freeway design and safety inspections.

Keywords: older drivers, road safety, driver behavior, performance assessment

INTRODUCTION

Because of an ageing population and increasing number of licensed older drivers, along with an anticipated rise in their mobility needs (OECD 2001; NHTSA, 2009), the exposure of older drivers to crash risks will increase (GAO, 2007). With greater access to automobiles, older individuals drive increasingly longer distances than they used to, without any indication of a reversal of this trend for most OECD countries (OECD 2001).

The normal ageing process leads to a functional decline in the vision, memory, physical strength

and flexibility needed for safe driving; the degree of such decline varies between older individuals (TRR Special Report 218-1, 1988), while underlying medical conditions or medications used to treat them can result in functional loss. Interestingly, Staplin (TRB-White paper No.5, 2010), notes that neither age nor disease - per se - determine fitness to drive, but rather it is the functional status and not the diagnosed diseases or medication prescribed that relate directly to older driver risk of causing a crash. Functional decline results in a reduction of driving skills and research indicates that moderate functional changes, related to normal ageing, do not necessarily lead to a discernible increase in crash risk. Although a large variability in driving skills among the older population has been recognised, only a small proportion of older drivers is significantly deficient in driving-related activities (Eby et al., 2003; McKnight, 1988; Hakamies-Blomqvist, 2004). The high level of crash involvement per distance driven has been attributed to the physical frailty of older drivers and the association between high crash involvement and low driving distance which may, in turn, be related to urban driving and reduced fitness among the lowest mileage group (Whelan et al., 2006).

In general, the characteristics of accidents involving older drivers differ considerably from other age groups; while a higher proportion of accidents occurs in complex environments and/or where time pressure is involved (a large number of older-driver collisions occur at intersections, for example), the proportion of accidents that could have been avoided through more cautious driving is lower (Hakamies-Blomqvist, 2003). Older drivers have a small share of crashes as non-responsible parties than younger drivers, due to a slow, cautious and more defensive driving (Hakamies-Blomqvist, 2004). These differences reflect, besides some inherent weaknesses of older drivers, the degree to which they self-regulate and some of their general driving habits and behavior such as driving less, avoiding difficult conditions and limiting their driving at peak hours (Whelan et al., 2006). These are compensatory actions that indicate maturity and a conservative decision making process (Hakamies-Blomqvist, 2004).

In the context of driving, current research suggests that the task of driving is conceived as a cognitive process with a hierarchical structure, while compensation is recognised as an integral part of driving. This approach to driving allows for an understanding of the complex relationship between ageing and driving and underlines the importance of different compensatory strategies (Breker et al., 2003; Fuller, 2005; Hakamies-Blomqvist et al., 2004). There are relative positive safety aspects such as personal motives and safety oriented attitudes that include greater use of strategic thinking and less risk-taking (Hakamies-Blomqvist, 2006), and enhanced anticipation and risk perception (Breker et al., 2003). These characteristics allow for older drivers to adapt their driving behavior and for compensating for possibly impaired perceptual motor function by using the compensatory potential still available to them (Holland, 2001).

Research has investigated concerns with respect to the implementation and the effectiveness of compensation strategies in preserving road safety (Fildes, 2006; Smiley, 2004). Although self-regulation and compensation are well recognized, several research findings indicate that not all adaptation contributes to safety (Smiley, 2004). While research findings regarding the association between self-regulation and functional declines are mixed (Charlton et al., 2006; Kostyiuk and Molnar, 2008), several studies have demonstrated that some older drivers do self-regulate. Schlag (1993) notes that although older drivers show confidence in their self-assessment, they often avoid stressful situations and drive less, limiting their exposure to danger.

Older drivers face difficulties with increasingly complex road design and traffic conditions particularly when driving at higher speeds (Holland, 2001), and on freeways (Knoblauch et al., 1997; Staplin et al., 2001; Vardaki, 2008). According to a study on older driver capabilities, drivers with mild to moderate cognitive impairment tend to report difficulties in driving performance and reduced driving exposure. It has been suggested that self-regulation - practiced by those who display such impairment - is insufficient to preserve driver safety and that not all people with impairments self-regulate (Owsley, 2004).

Drivers largely tend to present themselves favorably and assess their driving skills as superior to those of the average driver in a broad range of circumstances (McKenna et al., 1991). Driver judgement regarding the driving ability of other drivers could be considered as a measure of their expectations of other road users and another possible determinant of the risk associated with a situation (Groeger and Brown, 1989). Older drivers think of themselves as more cautious, more courteous and better drivers than younger drivers. It has been found that older drivers have "less illusory self-assessments than younger drivers when comparing themselves with their peers at the same age", and "less self-bias" than younger drivers (Hakamies et al., 2004; Smiley, 2004). Studies reveal that older drivers tend to ignore changes in their own fitness or do not see these changes as affecting their driving behavior (Schlag, 1993); they do not regard themselves as significantly different from middle-aged drivers and, insofar as they recognize age-related changes, generally consider them as having no effect on their own safety. Denying there is a difference between older and middle-aged drivers might indicate a discrepancy between subjectively perceived ability and actual capacities of older individuals (Schlag, 1993); Marottoli and Richardson (1998) stressed that any discrepancy between a driver's self-perceived ability and actual driving performance is crucial from a safety point of view. Further, Groeger and Brown (1989) discussed the need "to distinguish between individual's perception of hazard/danger from self-ratings of their coping ability on the road in an effort to understand perceived risk and accident-provoking behavior" (Groeger and Brown, 1989).

It is interesting to investigate perceived risk, that is the likelihood that a hazard will result in a negative outcome, weighted by the magnitude or cost of that outcome, as adjustments in driver behavior depend on the driver's perception of risk level and self-assessment of skill (Shinar, 2007). Rosenbloom et al (2008) found that perceived risk is greater in older than younger drivers. Similarly, in a recent study, Borowsky et al. (2010) note that experienced older drivers are able to detect more cues and thus to perceive more potentially hazardous situations than novices. Extending work in this line of research, we investigate two important, yet largely unexplored issues regarding older drivers; first, we examine perceptions regarding road safety issues and, second, we relate perceptions to driving assessment and self-assessment.

APPROACH

Data Collection

Forty active male drivers between the ages of 65 and 74 were involved in our investigation. The drivers were all in possession of valid licenses, recently having been cleared by the medical screening required for license renewal, and had not been involved in a recent accident (Christ,

1996). They completed a questionnaire regarding a number of road safety issues including: perceived safe-driving ability, perceptions of 'average' driver safe-driving ability, perceived potentially hazardous situations and discomfort in traffic, driving problems linked to cognitive abilities, driving situations they avoid, perceptions of risky behavior by the 'average' driver, and their own risky driving behavior. Following completion of the questionnaire, their performance was assessed in an on-road experiment along an urban freeway (Vardaki, 2008). The investigation was concluded by a field questionnaire the participants completed following the drive; the questions targeted performance self-assessment.

The Questionnaire

The approach described was developed for jointly investigating actual driver performance along with perceptions regarding road safety issues (Fuller and Santos, Ch.3, 2002). The value of questionnaires in investigating road safety issues has been documented in much related research (Armsby et al., 1989; Fuller and Santos-Ch. 11, 2002; Lerner and Ratté, 1991). The questionnaire, which was completed during face-to-face interviews, included 12 sections, each containing a number of questions covering driving experience, recent driving activity, perceptions of several road safety issues and sociodemographic characteristics.

Situations Drivers Avoid Now and Used to Avoid 15-20 Years Ago

It is widely recognized that avoidance of certain situations might be related to personal preferences and/or lifestyle (Hakamies-Blomqvist, 2004). In this study we establish the adjustments, at the strategic level, that drivers make over time, (Breker et al., 2003; De Raedt and Ponjaert-Kristoffersen, 2000; Lerner and Ratté, 1991; Smiley, 2004); to achieve this, drivers were asked to indicate how often they now avoid fifteen specific situations and conditions and how often they used to avoid them 15-20 years ago. We note that there was also an open-ended section to the questionnaire, where participants could identify any other situations they avoid, or used to avoid, which were not included in the list. A four-point scale was used to rate frequency (always; often; sometimes; never).

Driver Discomfort when Driving on the Freeway

In this section of the questionnaire, drivers were asked to report the extent to which they experience discomfort when driving in situations where research has shown that older drivers face difficulties, particularly on freeways (De Raedt and Ponjaert-Kristoffersen, 2000; Knoblauch et al., 1997; Lerner and Ratté, 1991). The list of questions was also "open" to any other conditions drivers felt were important. A four-point scale was used to rate levels of discomfort (great; some; a little; none).

Driving Practice when Entering and Exiting Freeways

Drivers were asked to indicate how often they adapted speed and position, visually searched, and communicated with other road users (Knoblauch et al., 1997), in an effort to investigate possible (reported) inadequacies and difficulties. A four-point scale was used, to rate frequency (never;

sometimes; often; always).

Driving Problems

Driving problems related to specific functional abilities which are important in safe driving, and they decrease with age (De Raedt and Ponjaert-Kristoffersen, 2000), were included in the questionnaire. These abilities were selected because the related driving problems could be described in a clear and simple way. The functional abilities underlying the driving problems were visuo-perceptual abilities, "useful field of view" (a combination of visuo-spatial and attention functions), reaction time, selective attention, sustained attention, psychomotor performance, knowledge, mental flexibility, executive functions, and planning (Ball et al., 1998; Breker et al., 2003; De Raedt and Ponjaert-Kristoffersen, 2000; Hakamies-Blomqvist, L. 1996; Hakamies et al., 2004; Knoblauch et al., 1997; Lerner and Ratté, 1991). Drivers were asked to report the frequency with which they experienced problems related to cognitive abilities and knowledge of new traffic rules and traffic signs on a four-point scale (always; often; sometimes; never ; see Appendix for a list of problems perceived while driving).

Speed

An example of self-regulatory behavior of older drivers is a change in their driving speed over time (Charlton et al., 2006). Drivers were asked to report any possible change in their speed (in general) over the past 15-20 years (Breker et al., 2003; Smiley, 2004). Drivers used a five-point scale to classify the change in speed (much higher; higher; the same; lower; much lower).

Safe-driving ability

A definition of safe-driving was given to the drivers so that they could respond as accurately and consistently as possible to the questions, having a common understanding of the term. In fact, the definition used in the questionnaire was formulated on the basis of the assessment criteria applied in the driver licensing test and indicated in the European Commission Directive 2005/56/EC. Emphasis was placed on the importance of defensive behavior and anticipatory skills while driving.

Drivers were asked to report both on their ability to drive safely, as well as the ability of the 'average' driver (in general and as well as on freeways). They were also asked to rate their ability and the ability of the 'average' driver to drive safely in various situations and under various conditions. The selection of the situations and conditions was based on the results of a review of the relevant research (Armsby et al., 1989; De Raedt and Ponjaert-Kristoffersen, 2000; Groeger and Brown, 1989; Knoblauch et al., 1997; Lerner and Ratté,1991; Marottoli and Richardson, 1998; McKenna et al., 1991; Watts and Quimby, 1980); They were complex and demanding situations where the driver interacts with other road users, and where older drivers face difficulties because of declines in functional abilities. Drivers were asked to rate safe-driving ability in general and on freeways using a six-point scale: low; quite low; marginal; acceptable; quite high; high. For safe-driving ability ratings in various situations were based on a four-point scale: low; marginal; acceptable; high.

Perception of Potentially Hazardous Situations

A hazard can be considered as anything on the road that has significant potential to lead to a crash unless the driver takes some action such as changing speed and/or driving around the obstacle (Shinar, 2007). Additionally, in their research, Armsby et al. (1989) defined a hazard as any aspect of the road environment or any combination of circumstances on the road environment that an individual perceives as being dangerous. Drivers were asked to rate the degree to which they think certain circumstances and behaviors (such as driving through a work zone on a freeway and entering freeway) are associated with potentially hazardous situations on a four-point scale (high, quite high, not very high, low).

Engaging in Risky Behavior

In hierarchical models of driving behavior, the importance of preconditions (such as risky tendencies and motives) has been widely recognized (Breker at al., 2003). In this sense, deliberately engaging in risky behaviors or violation of traffic rules is important and interesting in the investigation of driver perceptions regarding their own ability to drive safely and their actual performance. Drivers were asked to report on the frequency with which they commit traffic offences or drive dangerously, as well as how often the 'average' driver exhibits risky behaviors on a four-point scale (Breker at al., 2003; Delhomme, 1991; Lerner and Ratté, 1991; Rabbit et al., 2002; Staplin et al., 1999).

RESULTS

Analysing Driver Perceptions

Driver Perceptions Regarding their Own Safe Driving Ability

We used factor analysis on driver perceptions regarding their own and the 'average' driver's safe driving abilities in the situations and the tasks discussed in the questionnaire (Washington et al. 2011). Before proceeding with factor analysis, the suitability of this approach was considered using Bartlett's test of sphericity and the Kaiser-Meyer-Olkin index (*KMO*). Both tests confirmed that factor analysis was likely to give satisfactory results ($p = 0.000 < \alpha = 0.05$ and KMO = 0.749 > 0.5). Factor analysis of driver perceptions regarding their own safe driving abilities in eighteen situations and tasks indicated that four factors could explain 70.5% of total variance, with "ability in maneuvering" explaining 28.3%, "ability in perceiving and reacting correctly in adverse driving conditions" explaining 19.3%, "ability in maintaining correct lateral position" explaining 11.9% and "ability in speed adaptation on the freeway" explaining 11.1% (Table 1). It is noted that to calculate the total amount of variance accounted for e.g. by factor 1, we added the square of the factor loadings in the first column ($0.827^2 + 0.794^2 + \ldots + 0.319^2 = 5.089$). Since all the variables are normalized, the variance of each variable is 1. Thus the total

variance in the data equals the number of variables in the set, i.e. 18. The percentage of total variance accounted for by factor 1 equals 5.089/18 = 28.5%.

Table 1 Rotated four-factor matrix containing 18 situations and driving task components

	Factor			
	1	2	3	4
Urban work zones	**.827**	.317	.139	.096
Rural work zones	**.794**	.277	.029	.139
Urban intersection	**.792**	.101	.368	-.175
Overtaking, freeways	**.788**	.150	.029	.285
Adjusting speed, urban roads	.705	.380	.046	.383
Exiting the freeways	.678	.033	.30	.288
Entering the freeways	.638	.131	.271	.348
Overtaking, rural roads	.596	.193	.449	.068
Driving at night	.056	**.752**	-.110	.003
Wet road	.474	**.674**	-.077	-.014
Unexpected hazard	.249	**.668**	.115	-.100
Heavy traffic, freeways	.190	.663	.455	.248
Searching freeway exit	.288	.658	.209	.475
Searching freeway entrance	.164	.595	.490	.355
Lateral positioning and direction	.184	-.021	**.866**	.012
Heavy traffic, urban roads	.452	.444	.461	.132
Adjusting speed, freeways	.182	.144	-.035	**.841**
Distance, vehicle in front	.319	-.389	.352	.591

Driver Perceptions Regarding 'Average' Driver Safe Driving Ability

Factor analysis was also done on driver perceptions regarding safe driving ability of the 'average' driver. We note that the correlation coefficient between the variables "entering the freeway" and "exiting the freeway" and between the variables "searching for the right exit from the freeway" and "searching for the right entrance to the freeway" equaled to one (1), indicating that the corresponding items coincide. It appears that drivers responded similarly with regard to the ability of the 'average' driver to performing entering and exiting maneuvers and in searching for the right exit and the right entrance to the freeway. Therefore, the items "exiting the freeway" and "searching for the right exit from the freeway" were not included as variables in the factor analysis. Both tests of suitability indicated that factor analysis of driver perceptions regarding the 'average' driver was likely to give satisfactory results ($p = 0.000 < \alpha = 0.05$ and $KMO = 0.777 > 0.5$). The analysis for sixteen situations and tasks indicated that four factors could explain 74% of total variance, with "ability in overtaking maneuver", explaining 21.5%, "ability in driving through work zones", explaining 20.5%, "ability in complex driving tasks requiring attention sharing" explaining 19.3% and "driving ability in adverse environmental conditions" explaining 12.71% (Table 2).

Table 2 Rotated four-factor matrix containing 16 situations and driving task components

	Factor			
	1	2	3	4
Overtaking, rural roads	**.831**	-.028	.294	.010
Overtaking, freeways	**.797**	.160	.073	.294
Adjusting speed, freeways	.674	.180	.426	.167
Unexpected hazard	,664	.309	-.027	.113
Adjusting speed, urban roads	.629	.489	.275	.081
Heavy traffic, freeways	.513	.481	.412	.370
Urban work zones	.096	**.880**	.097	.211
Rural work zones	.152	**.857**	.350	.047
Lateral positioning and direction	.220	.589	.312	-.030
Distance, vehicle in front	.365	.586	.499	-.011
Searching freeway exit	.150	.253	**.822**	.085
Heavy traffic, urban roads	.070	.147	**.761**	.402
Urban intersection	.279	.402	.690	.039
Entering the freeways	.409	.439	.570	.080
Wet road	.261	-.014	.120	**.885**
Driving at night	.089	.150	.139	**.866**

Differences in Perception

We also investigated the differences in perception in three conditions; first, between situations drivers avoid now and those they used to avoid 15-20 years ago; second, between driver perceptions regarding their own and the average driver's safe driving ability; and, third, between driver (reported) frequency regarding their own and the 'average' driver's risky behavior.

The results of the Wilcoxon signed-rank test (Washington et al. 2011), used to statistically investigate differences, indicated statistically significant differences in the frequency of avoidance of certain situations over the period of 15-20 years. Specifically, compared to 15-20 years ago, drivers more often avoid driving under heavy rain, conditions of limited visibility, at night, in heavy traffic, in unfamiliar areas, on trips of more than two hours, in the city, on the freeway at night, on the freeway in heavy traffic, when tired, and in complex environments (e.g. interchanges, complex intersections, and so on). No statistically significant differences were found regarding wet roads, freeways, listening to the radio, or engaging in a conversation in the vehicle while driving.

The same test was also used to investigate the existence of statistically significant differences between driver perception of their own and the average driver's safe driving ability, both in general and specifically on freeways. According to the results of the analysis, there is a statistically significant difference at the 0.01 level between driver perceptions regarding their own ability and the ability of the average driver in general and, also, on freeways. The results regarding the frequency of risky behavior indicated that statistically significant differences exist between driver perceptions regarding their own risky behavior and that of the average driver. In particular, drivers report that the average driver engages in all the risky behaviors included in the questionnaire more often than they do.

Connecting Assessment, Self-Assessment and Perceptions

We present here statistically significant rank correlations (Kendall's tau; Washington et al. 2011), between assessed/self-assessed performance in the on-road trial and perceptions reported in the questionnaire given to participants before the on-road trial.

Situations that drivers avoid now (reported)

Tables 3 and 4 indicate the correlations between the reported frequency of avoidance of driving at night, under heavy rain, and when tired, with various performance variables. More frequently avoiding driving at night and under heavy rain is related to decreased performance, while more frequently avoiding driving when tired is related to better performance and no compensatory behavior. Driver stated feeling of danger due to their own errors in the on-road trial on the freeway is related to more frequently avoiding engaging in conversation while driving (τ=0.304, p=0.043) and more frequently avoiding driving under heavy rain (τ=0.327, p=0.026).

Perceived driver discomfort due to specific situations when driving on freeways

Greater (reported) discomfort with the presence of heavy vehicles on freeways is related with decreased performance in several behavioral variables (Tables 3 – 5) and driver stated feeling of danger due to their own errors in the on-road trial on the freeway (τ=0.361, p=0.014), while greater discomfort with the use of the freeway shoulder by other drivers is related to better performance in some behavioral variables. Also, greater discomfort when exiting freeways is related with higher levels of familiarity with the freeway where the on-road trial took place (τ=0.387, p=0.011).

Table 3 Correlations between various drivers' perception and performance variables

	Performance					
Perception	Freeway driving with exit finding	Following successive directions	Compensation	Visual search, lane change	Driving style, lane change	Use of direction ind., lane change
Avoidance, heavy rain		-0.288*				
		0.049				
Avoidance,		0.323*	-0.360*		0.287*	0.282*
tiredness		0.028	0.014		0.039	0.041
Discomfort, heavy	-0.341*			-0.303*		
vehicles, freeways	0.011			0.025		
Discomfort, other		0.356*				
drivers on fr.shoulder		0.016				
Safe driving ability		-0.311*	0.331*	-0.436**	-0.335*	
		0.045	0.033	0.002	0.023	
Safe driving ability,			0.408**	-0.283*	-0.296*	
freeways			0.008	0.045	0.042	
Problem, stimuli from		-0.316*		-0.318*		
the sides		0.042		0.026		
Safe driving ability,	-0.330*			-0.286*		
heavy traffic, freeways	0.023			0.049		
Safe driving ability,						-0.396**
entering freeways						0.009
Hazard, urban	0.285*	0.455**				
work zones	0.041	0.003				
Hazard, rural/freeway	0.279*	0.372*			0.405**	
work zones	0.043	0.014			0.005	
Hazard, heavy traffic,				-0.297*		
freeways				0.029		
Risky beh./average				0.285*	0.301*	
driver on				0.043	0.038	
freeway shoulder						

Note: ** indicates correlation statistically significant at 0.01 level.
* indicates correlation statistically significant at 0.05 level.

Reported change in speed

The relevant correlation coefficients, as presented in Tables 4 and 5, indicate that drivers who report that they drive more slowly now than 15-20 years ago showed decreased performance in the on-road trial (in terms of lateral position and speed adaptation during the exiting maneuver). In addition, they assessed their performance in freeway driving with exit finding (τ=0.336, p=0.030), and in entering maneuver (τ=0.334, p=0.029) in the on-road trial less favorably.

Perceived safe-driving ability

Compensatory behavior (shown on the freeway in the on-road trial) is related to poor perceived ability in general as well as specifically on freeways. Poor reported safe driving ability are correlated to decreased performance in several behavioral variables (Tables 3, 4 and 5). Poor perceived ability in general is also combined with less favorable assessed performance in freeway driving and exit finding during the on-road trial (τ=0.348, p=0.025). Furthermore, poor perceived ability regarding safe driving on freeways is related to driver stated feeling of danger on the freeway in the on-road trial due to their own errors (τ=0.368, p=0.017).

Table 4 Correlations between various drivers' perception and performance variables

	Performance					
Perception	Visual search, entering fr.	Driving style, entering fr.	Position, exiting fr.	Visual search, exiting fr.	Speed, exiting fr.	Use of dir. indicator, exiting fr.
Avoidance, heavy rain			-0.270* 0.048			
Avoidance, at night	-0.283* 0.047		-0.359* 0.010			
Avoidance, tiredness					0.406** 0.004	
Discomfort, heavy vehicles, freeways	-0.329* 0.018	-0.313* 0.021	-0.358** 0.009	-0.322* 0.018		
Change in driving speed					0.400** 0.008	
Safe driving ability	-0.326* 0.027	-0.293* 0.041		-0.352* 0.014		
Safe driving ability, freeways						-0.302* 0.042

Note: ** indicates correlation statistically significant at 0.01 level
* indicates correlation statistically significant at 0.05 level.

Driving practices when entering freeways (reported)

More frequent stopping at the end of the entrance to the freeway is correlated with less adequate performance in visual behavior during the on-road trial (τ=0.298, p=0.036). Less frequent use of direction indicators when entering freeways is related with driver discomfort with the behavior of the other drivers during the on-road trial on the freeway (τ=0.341, p=0.031). In addition, less frequent reported use of mirrors when entering freeways is combined with a stated discomfort with traffic during the on-road trial (τ=0.356, p=0.025).

Reported driving problems

More frequent driving problems related to cognitive abilities (including knowledge) are correlated to decreased performance in several behavioral variables (Tables 3, 5, 7). In addition, more frequent driving problems related to concentration and sustained attention, flexibility and knowledge, are related to driver stated need for assistance in freeway maneuvers in the on road-trial (Table 6). More frequent driving problems with side stimuli are related to driver discomfort experienced in the on-road trial due to other drivers (τ=0.332, p=0.033); also, more frequent problems related to knowledge are related with less kilometers driven on freeways last year (τ=0.269, p=0.042).

Table 5 Correlations between various drivers' perception and performance variables

	Performance			
Perception	Lateral position	Visual behavior	Use of mirrors	Anticipation
Discomfort, heavy vehicles, freeways	-0.274* 0.044	-0.341* 0.013	-0.316* 0.020	-0.420** 0.002
Discomfort, other drivers on fr. shoulder	0.304* 0.026	0.277* 0.045		0.282* 0.037
Change in driving speed	0.354* 0.014			
Safe driving ability	-0.336* 0.019	-0.321* 0.027	-0.476** 0.001	
Safe driving ability, freeways			-0.311* 0.029	
Problem,stimuli from the sides			-0.320* 0.026	-0.295* 0.038
Problem, knowledge			-0.334* 0.022	
Safe driving ability, heavy traffic, freeways	-0.408** 0.005		-0.358* 0.014	-0.333* 0.021
Hazard, urban work zones	0.305* 0.030	0.282* 0.047		0.299* 0.032
Hazard, rural/ freeway work zones				0.296* 0.032
Hazard, heavy traffic, freeways			-0.348* 0.011	
Risky beh./average driver on freeway shoulder	0.534** 0.000		0.291* 0.041	0.298* 0.033

Note: ** indicates correlation statistically significant at 0.01 level.
* indicates correlation statistically significant at 0.05 level.

Perceived safe-driving ability in various situations

Poor perceived ability in several situations contained in the perceptions questionnaire is correlated to decreased performance in several variables of driving performance during the on-road trial on the freeway (Tables 3, 5, 7). Poor perceived ability regarding driving on the freeway in heavy traffic is related to less favorable assessed performance when exiting (τ=-0.379, p=0.015) and entering (τ=-0.360, p=0.021) the freeway in the on-road trial as well as to a stated feeling of danger due to own errors (τ=0.335, p= 0.034).

Table 6 Correlations between various drivers' perception and performance variables

	Performance		
Perception	Stated need for assistance entering/ roadway conditions	Stated need for assistance exiting/ roadway conditions	Stated need for assistance entering / impr. performance
Problem, concentration	0.355* 0.027		
Problem, delayed reaction		0.314* 0.050	
Problem, flexibility	0.327* 0.041		
Problem, knowledge			0.321* 0.043

Note: ** indicates correlation statistically significant at 0.01 level
* indicates correlation statistically significant at 0.05 level.

Table 7 Correlations between various drivers' perception and performance variables

	Performance					
Perception	Visual search, entering fr.	Driving style, entering fr.	Position, exiting fr.	Visual search, exiting fr.	Speed, exiting fr.	Use of dir. indicator, exiting fr.
Problem, stimuli from the sides	-0.314* 0.034	-0.374** 0.009	-0.341* 0.018	-0.322* 0.026	-0.338* 0.024	-0.297* 0.048
Safe driving ability, heavy traffic, freeways	-0.380* 0.011		-0.329* 0.025			-0.412** 0.007
Safe driving ability, entering freeway						-0.347* 0.025
Hazard, urban work zones				0.300* 0.034		
Hazard, rural/freeway work zones		0.354* 0.011		0.282* 0.044		
Hazard, heavy traffic, freeways	-0.299* 0.033					
Hazard, entering freeway	-0.286* 0.045					

Note: ** indicates correlation statistically significant at 0.01 level
* indicates correlation statistically significant at 0.05 level.

DISCUSSION

Self-assessment and awareness

Correlations between compensatory behavior and less favorable safe driving ability indicate that drivers perceive their difficulties in driving. Similarly, there are correlations between perceived driving problems linked to cognitive abilities with lower performance in the on-road trial. For example, more frequent driving problems with perception of side stimuli is correlated with several behavioral aspects and with performance in task elements of freeway maneuvers (including visual search when changing lanes and when entering and exiting), which were assessed on the basis of delayed reactions and less wide observations. These findings indicate that the study participants may be aware of their reduced driving skills. Results that support these findings further refer to reported driving practices in entering maneuver and in perceived

potentially hazardous situations. In particular, drivers who report more frequent stopping at the end of the acceleration lane on freeways, perform less adequately in visual behavior. In addition, a perceived higher degree of association with a potentially hazardous situation when entering freeways and when driving on freeways in heavy traffic, are combined with decreased performance in visual search during the entering maneuver, while a perceived higher degree of association with a potentially hazardous situation when driving on freeways in heavy traffic is related to less adequate visual search during lane changing.

Drivers' perceptions regarding their own safe driving ability are consistent with self-assessed performance. Drivers' perceptions regarding poor safe driving ability - specifically on freeways - are combined with their feelings of danger during the on-road trial on the freeway due to their own driving performance. Drivers' perceptions of their poor safe driving ability, in general, is related to less favorable self-assessed performance in the on road-trial; drivers who report less frequent use of mirrors when entering freeways state discomfort due to traffic in the on-road trial. The aforementioned correlations support the finding that drivers might be aware of their lower performance in terms of visual driving skills on freeways captured through the visual behavior variable, as well as the variables of visual search during freeway maneuvers assessed in the on-road trial (Vardaki, 2008). Similar to McKenna et al. (1991) who found that driving skill is composed of four factors, the present study identified four factors that underlie drivers' perceptions regarding their own safe driving ability and the safe driving ability of the average driver.

Education and training

Drivers who report less adequate knowledge regarding new traffic rules and traffic signs, more often show decreased performance in terms of lateral position and the use of mirrors; they also express a need to improve their performance (in the entering maneuver) after the on-road trial. A stated need to improve performance in entering and exiting maneuvers was found to be correlated with less favorable self-assessed performance in these maneuvers during the on-road trial.

Some of the inadequacies which were exhibited during the on-road trial might have been the result of lack of knowledge of the appropriate performance, traffic rules and compensatory behavioral adjustments necessary for successful task execution (Vardaki, 2008). Interestingly, as shown by the aforementioned correlations, drivers recognize the need to improve their performance. In addition, drivers with more recent driving activity and who are more familiar with the specific freeway, perform better in several performance variables , while drivers with less recent driving activity report more frequent problems with lack of knowledge of new traffic rules and signs. Training in safe driving practices such as freeway maneuvering (Knoblaugh et al., 1997; McKnight, 1988), visual search techniques, and hazard recognition and avoidance (Borowski et al., 2010; Staplin et al., 1999), could contribute to the improvement of older driver performance, enabling them to gain from their compensatory potential and maintain their level of safe driving.

With respect to other studies in this area, Horswill et al. (2008) note that hazard perception training might benefit older drivers even though they have considerable driving experience;

further, Korner-Bitensky et al. (2009), based on their review of driving retraining interventions, recommend a driving retraining program for elderly drivers that includes physical training and an educational intervention. In addition, they stress the need to explore a multi-faceted intervention that includes education, motor, sensory, cognitive and behavioral aspects. The self-screening instruments to be developed might assist older drivers in developing a critical attitude toward their personal fitness and in strengthening their conscious awareness of the need to adapt (Eby et al., 2003; Smiley, 2004). Indications of performance problems on freeways as well as questions regarding driver perceptions of safety issues which were shown to be statistically significantly correlated with performance were considered in the development of a handbook for safe driving at an older age (Vardaki et al., 2009). Results also indicate that freeway maneuvering, visual search and hazard recognition are related to factors underlying driver perceptions regarding their own safe driving ability. In this sense, drivers might be motivated to improve their performance by using assistance material and participating in on road evaluations which may also provide opportunities for training (Stutts and Wilkins, 2003).

Avoiding complex situations

Results suggest that drivers have changed the frequency of avoiding certain difficult driving situations and conditions over the span of 15-20 years. Drivers who more often avoid driving under heavy rain and at night, perform less adequately in terms of exiting position (assessed on the basis of distance from the start of the exit lane), while drivers who avoid driving more often when they are tired do not show any compensatory behavior and perform better in several behavioral variables (driving style-position and speed- during lane change, speed during the exiting maneuver and following successive directions). The aforementioned relationships indicate that more frequently avoiding complex situations does not characterize driving performance. Interestingly, Baldock et al. (2006) found that older driver on-road driving ability (in terms of an overall weighted score) was not significantly correlated with overall driving avoidance, suggesting that older drivers as a group do not appropriately self-regulate their driving. They concluded that older drivers appear to self-regulate in a manner consistent with driving ability but only for a small number of specific situations. Here we identified relationships between the frequency of avoidance of some situations today and performance in certain aspects of driving

Infrastructure

The correlations between perceptions, assessed and self-assessed performance, reveal interesting issues regarding freeway entrances and exits. Drivers who are more familiar with the specific freeway perform better in some behavior variables, self assess their performance in the on-road trial more favorably, while they report that they experience greater discomfort when exiting freeways. Drivers that more frequently experience problems with the perception of side stimuli show decreased performance in some task elements of freeway entering and all task elements of freeway exiting.

It is also worth mentioning that more frequently reported problems related to certain cognitive functions are correlated with a stated need for assistance in exiting and entering maneuvers through infrastructure improvements. Specifically, more frequent reported problems of delayed

reaction are related to a stated need for assistance in exiting through infrastructure improvements; also, more frequent problems with flexibility, as well as with concentration and sustained attention, are combined with a stated need for assistance in entering through infrastructure improvements. Drivers who perceive a higher association with a potentially hazardous situation when driving through work zones on rural roads and freeways, perform better in several task elements of the freeway maneuvers and in anticipatory behavior. Driver concerns about work zone conditions are also expressed indirectly, since driving through work zones is one of the four factors that underlie driver perceptions regarding the safe driving ability of the 'average' driver.

Finally, information useful for freeway designers and safety inspectors are the concerns of older drivers which are revealed regarding specific situations and environments such as freeway work zones and overtaking maneuvers. Furthermore, results reveal some drivers' perceived need for improvements in freeway exit design. The need to provide a more forgiving environment, i.e. more time and information, also emerged in a few situations and specifically:

- decision sight distance (instead of stopping sight distance) to downstream exits or split points after a curve (horizontal or vertical).
- more advance information and guidance for choosing the appropriate direction, giving them time to prepare and perform the maneuver in a paced way.

The 'average' driver

Our results suggest that drivers perceive the 'average' driver to be less safe than themselves and to engage more often in risky behaviors. It is possible that their perceptions regarding the 'average' driver are indicative of their concerns for the traffic environment and the extent to which they presume it is forgiving. These perceptions might be indicative of the expectations they have from most of the other drivers and may be also revealing of the perceived descriptive norms regarding the behaviors exhibited by the reference group (TRB-White paper No.2, 2010). These findings could contribute to the investigation of the traffic safety culture of the elderly drivers' population. We note that results are consistent with Borowsky et al. (2010) who note that older drivers tended to claim that other road users were responsible for putting them at risk and rarely considered themselves as those responsible for the hazardous events.

CONCLUSIONS

In this paper we investigated two important, yet largely under-researched issues regarding older drivers; first, we examined perceptions regarding road safety issues and, second, we related perceptions to driving assessment and self-assessment. Results from the first step of our analysis suggest that four factors underlie drivers' perceptions regarding their own safe driving ability: ability in maneuvering; ability in perceiving and reacting correctly in adverse driving conditions; ability in maintaining correct lateral position and ability in speed adaptation on freeways. In addition, four factors were found to underlie drivers' perceptions regarding the ability of the average driver: ability in overtaking maneuvers; ability when driving through work zones; ability in complex driving tasks requiring attention sharing; and driving ability in adverse conditions. These factors may indicate driver concerns regarding specific driving situations and environments. Interestingly, while study participants seem to have a general awareness of their

driving performance, they perceive the average driver as less safe than themselves at safe driving, while they think that the average driver engages in risky behaviors more often than they do.

Exiting freeways is combined with greater discomfort for some drivers while others perceive a need for better freeway exit design. Drivers more familiar with the specific freeway, perform better in some aspects of driving behavior, assess their performance in freeway driving (and freeway exiting in particular) more favorably, and experience greater discomfort when exiting freeways. Interestingly, when drivers report more frequent problems with delayed reactions, they state a need for better freeway exit design. The results of the performance assessment and self-assessment of elderly drivers, as well as their perceptions of road safety issues, could be exploited in assessment procedures, self-screening instruments, educational tools, infrastructure improvements and safety inspections.

We note, however, that the results presented should be interpreted with caution since only forty drivers participated. The findings may be applied to a group of older adults with the characteristics of the study participants. Participants belonged in the "young-old" age group, they were active; they were licenced; their families were not concerned with their driving ability regarding their general conditions (health, driving history and activities, safe driving habits); they had not been involved in a recent accident and during the on-road trial they did not perform any serious error such as a dangerous maneuver or errors similar to those referred in on-road tests.

Our work is also based on self-reports regarding driving problems and certain aspects of behavior (change in speed, traffic rule violations). Further research into the association between perceptions and functional abilities, as well as between assessed and self-assessed performance and functional ability, would be of interest. Perceived driving problems, perceived safe driving ability and self-regulation as well as performance in a variety of situations and driving tasks in relation to clinically assessed cognitive functioning warrant investigation. This way, a broader picture of the levels of awareness as well as of actual driving behavior - strategic decisions and actual performance - and their relationship can be explored.

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APPENDIX

Problems perceived in driving

Which of the following are true for you, and with what frequency?
(always, often, sometimes, never)

1. I have difficulty concentrating on more than one action at the same time (e.g. keeping the vehicle centered in the lane and concentrating on the position of other vehicles)
2. I have difficulty judging the distance and speed of other vehicles
3. I am surprised by vehicles and pedestrians appearing from the sides very close to me
4. I have difficulty focusing my attention on traffic signs where there are other signs
5. I have difficulty concentrating and maintaining attention
6. My reactions are delayed when I have to perform an emergency stop
7. I have difficulty moving my hands, feet and neck
8. My knowledge of new traffic rules and new traffic signs is not good enough
9. I have difficulty adapting in sudden changes in traffic control on one of my usual routes
10. Other problem (please complete):

Reviewer 1 -

This paper is well written and easy to follow. However, if the three problems mentioned below can be considered and remedied, the quality of this paper could level up.

1. Problems related with the survey sample: (1) the sample size, only 40, is too small to attest the validity of conclusions. (2) All the respondents are active male drivers aging from 65 to 74.The reason for why not include female drivers in this investigation should be explained, or the data is biased. It is suggested to expand the sample size to more than 200, including both aged female and male drivers.

There were restrictions regarding the sample size due to limited resources. The study involved in-depth interviews and drives on an urban freeway. Each interview lasted approximately 45 min and each drive (34 km) approximately 40-45 minutes. The participants drove their own cars. The size of the sample did not allow heterogeneity in study participants. In relevant research, gender differences in travel behavior have been recognized, i.e. women drive less than men and give up driving earlier than men; the crash-involvement rate per mile for older women is almost twice that for older men; older women report more problems with navigation and when driving at intersections and are characterised by more self-imposed limitations on their driving. Furthermore, as people age, individual differences in functional abilities and driving skills are magnified.

It follows that (as has been added in the Conclusions section), *the findings* (of the present study) *may be applied to a group of older adults with the characteristics of the study participants. Participants belonged in the "young-old" age group, they were active; they were licenced; their families were not concerned with their driving ability regarding their general conditions (health, driving history and activities, safe driving habits); they had not been involved in a recent accident and during the on-road trial they did not perform any serious error such as a dangerous maneuver or errors similar to those referred in on-road tests.*

2. The safely-driving performance is quite different between the aged drivers and the younger ones. If this paper could compare this difference, it is much more helpful for freeway designs and safety inspections.

The study investigates perceptions regarding road safety issues and the correlation between perceptions and driving performance assessment and self-assessment. The study is based on an experiment on actual older driver behavior on a newly designed and constructed urban freeway. The study does not attempt to compare the driving performance of older and younger drivers.

As has been added in the Discussion section, *information useful for freeway designers and safety inspectors are the concerns of older drivers which are revealed regarding specific situations and environments such as freeway work zones and overtaking maneuvers. Furthermore, results reveal some drivers' perceived need for improvements in freeway exit design. The need to*

provide a more forgiving environment, i.e. more time and information, also emerged in a few situations and specifically:

- *decision sight distance (instead of stopping sight distance) to downstream exits or split points after a curve (horizontal or vertical).*
- *more advance information and guidance for choosing the appropriate direction, giving them time to prepare and perform the maneuver in a paced way.*

3. Aiming at improving the safety driving performance of older drivers, several countermeasures are discussed in this paper. The weakness of these countermeasures is that the solutions mentioned are not specific enough for practitioners to follow easily. For example, if the authors could clearly specify how to design an advance guide sign exclusively for older drivers to improve the visibility (and thus relieve the stress while exiting), more values from this paper can be provided for practitioners.

The aforementioned results might be helpful to those who design highways and conduct safety inspections. However, highway-related safety countermeasures, specifically improving safety of older drivers, as well as road design principles taking human factors into account (i.e. drivers' needs and limitations), are included in specific documents which provide useful material for practitioners. Indicatively, the following sources are mentioned:

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Reviewer 2 -

Misspelled title…I believe it should be Perceptions

The issue has been addressed.

Was there a reason for not including females? This is the reason I rated data valid as a 3.

There were restrictions regarding the sample size due to limited resources. The study involved in-depth interviews and drives on an urban freeway. Each interview lasted approximately 45 min and each drive (34 km) approximately 40-45 minutes. The participants drove their own cars. The size of the sample did not allow heterogeneity in study participants. In relevant research, gender differences in travel behavior have been recognized, i.e. women drive less than men and give up driving earlier than men; the crash-involvement rate per mile for older women is almost twice

that for older men; older women report more problems with navigation and when driving at intersections and are characterised by more self-imposed limitations on their driving. Furthermore, as people age, individual differences in functional abilities and driving skills are magnified.

It follows that (as has been added in the Conclusions section), *the findings* (of the present study) *may be applied to a group of older adults with the characteristics of the study participants. Participants belonged in the "young-old" age group, they were active; they were licenced; their families were not concerned with their driving ability regarding their general conditions (health, driving history and activities, safe driving habits); they had not been involved in a recent accident and during the on-road trial they did not perform any serious error such as a dangerous maneuver or errors similar to those referred in on-road tests.*

Could you provide a brief explanation on either Table 1 or Table 2 results? I'm not sure how you are getting "21.5% from ability in overtaking maneuver or any other of the percentages and a brief explanation would be useful to the reader (line 292), etc.

Very well written paper.

To calculate the total amount of variance accounted for e.g. by factor 1, we added the square of the factor loadings in the first column ($0.827^2 + 0.794^2 + ... + 0.319^2 = 5.089$). Since all the variables are normalized, the variance of each variable is 1. Thus the total variance in the data equals the number of variables in the set, i.e. 18. The percentage of total variance accounted for by factor 1 equals 5.089/18 = 28.5%.
This issue has been addressed in the Results section.

Reviewer 3 –

This paper surveyed 40 elderly drivers for their perceptions regarding freeway driving scenarios, their driving abilities, perceived risks, avoidance behavior, and assessment of "average" drivers. The paper presents correlations between driver perceptions and their abilities during an on-road performance assessment.

The topic is said to be "under researched", yet the literature review reported a good number of studies and findings. The literature review was helpful. It was not clear what particular "gap" or "deficiency" the authors feel exist in our current understanding, nor is it clear that this paper really closes that gap. The correlation between self-reported issues and actual issues would be interesting, but the reader is referred to another paper for discussion of the on-road performance assessment. Thus, for example, I have no idea whatsoever how it was assessed that a driver might have difficulty exiting the freeway. So, we know only that someone said there was a degradation in ability, but we have no idea to what degree other than very subjective qualitative terms.
There was no correlation of ages to ability measures. There was a correlation of self-reported perceptions to abilities, but no information was provided to correlate those abilities to crash rates. So, it is a rather vague association at best how perception of danger

correlates (as a surrogate measure would) with a reduction in safety, or an increase in crashes or conflicts.

The study is based on only 40 participants, which is not a lot for a survey, but is for a face-to-face survey (as was done here) and is for on-road performance evaluations. Had the study survey a large number of people, then perhaps we would have learned something about the percentage of people in this population that avoided driving in rain, but 40 drivers was not enough to say anything about the population. We did not learn any specific tangible measures, like a correlation of eye-sight (e.g., 20/40 vision) with reaction times. This was entirely a qualitative set of results, which I honestly find difficult to apply to any value. The results seemed very intuitive. It is at least reassuring that there is a sense that people are aware of their shortcomings, and hedge accordingly. It makes intuitive sense that an elderly driver, who could be expected to be relatively conservative, would assess the "average driver" (who on average is younger) to be less conservative (i.e., more aggressive, risky, or hazardous).
This paper presented a large set of correlations of qualitative information, but did not really put into context any tangible use of the material. It was postulated that this information could have many uses. I didn't feel very convinced that was likely to happen.
My favorite finding regarded how people familiar or not often reported discomfort with freeway exits. I am middle-aged, and I have never liked freeway exits except in small, less populous areas. I have never liked the signage, which seemed inconsistent or gave too late of notice to switch lanes across a several lane freeway in a congested urban area. Signs might say a given junction is a specified distance away, but only when a mile away does one learn whether to be in the left lane or the right lane, when it is often too late to manuever in time. This has nothing to do with my age. This has nothing to do with my health, my vision, or my reaction time. It has to do with poor signage, pure and simple. So, in that light, I would say that reporting of discomfort about an exit tells me little about the root problem or possible solutions. I did not learn much, personally, from this paper.

The study investigates perceptions regarding road safety issues and the correlation between perceptions and driving performance assessment and self-assessment. The study is based on an experiment on actual older driver behavior on a newly designed and constructed urban freeway. The importance of investigating actual performance and perceptions and their relationship is underlined in the relevant research. In particular, observing actual driving performance is recommended through the analysis of observed behavior in an actual road environment combined with driver interviews.

Age does not determine fitness to drive. As people age, individual differences in functional abilities and driving skills are magnified.

There were restrictions regarding the sample size due to limited resources. The study involved in-depth interviews and drives on an urban freeway. Each interview lasted approximately 45 min and each drive (34 km) approximately 40-45 minutes. The participants drove their own cars. The size of the sample did not allow heterogeneity in study participants.

It follows that (as has been added in the Conclusions section), *the findings* (of the present study) *may be applied to a group of older adults with the characteristics of the study participants. Participants belonged in the "young-old" age group, they were active; they were licenced; their families were not concerned with their driving ability regarding their general conditions (health, driving history and activities, safe driving habits); they had not been involved in a recent accident and during the on-road trial they did not perform any serious error such as a dangerous maneuver or errors similar to those referred in on-road tests.*

On-road driving performance assessment is an appropriate way to check whether compensation mechanisms take place and whether a person is able to drive safely. An on-road behind-the-wheel evaluation should always be the 'gold standard' for the final decision about a person's fitness to drive, especially if the results from the previous assessment stages are doubtful. We, however, did not attempt to test fitness to drive.

The investigation of the on-road performance took compensation strategies into consideration in an effort to identify whether these are related to safe driving. Furthermore, drivers' perceptions regarding their own performance and towards various road safety issues were explored.

An evaluation procedure was developed and used and the evaluation form (structured according to the sequence of the driving tasks that drivers were asked to perform following the specific route along the Attiki Odos freeway) was filled in by the rater for each driver during and after the completion of the on-road trial (http://users.ntua.gr/sophiav/). Rating (driving performance assessment) took place after completion of the drive and was based on the observations of the rater. Actual performance assessment was based on task analysis that allows for the assessment to take place while ensuring the investigation of all aspects of driving behavior. Furthermore, compensation-related task elements were identified as choices that influence the difficulty of the driving task, such as driving more slowly or making control movements in a serial manner.

An effort was made to achieve the same traffic conditions (by selection of the day and time of the drive) and also improving the rater's reliability by minimizing the rater's errors (subjectivity) as much as possible through experience and proper training. In addition, a full inventory and systematic checking of task elements (according to road safety criteria) allowed for the consideration of relevant performance in global judgment of each performance variable (e.g. driving behavior main variable, specific maneuver item). Conditions and procedures of the on-road trial are presented in the reference paper (Vardaki, 2008).

The investigation of on-road performance revealed that the freeway environment appeared to be highly demanding for some drivers: although they adjusted their behavior, they occasionally exhibited performance problems such as failure to react early to traffic stimuli and very slow and indecisive freeway maneuvers.

As has been added in the Discussion section, *information useful for freeway designers and safety inspectors are the concerns of older drivers which are revealed regarding specific situations and environments such as freeway work zones and overtaking maneuvers. Furthermore, results reveal some drivers' perceived need for improvements in freeway exit design. The need to*

provide a more forgiving environment, i.e. more time and information, also emerged in a few situations and specifically:

- *decision sight distance (instead of stopping sight distance) to downstream exits or split points after a curve (horizontal or vertical).*
- *more advance information and guidance for choosing the appropriate direction, giving them time to prepare and perform the maneuver in a paced way.*