OLDER DRIVERS' PERCEPTION AND ACCEPTANCE OF IN-VEHICLE DEVICES FOR ROAD SAFETY AND TRAFFIC EFFICIENCY

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Abstract

A multitude of new technologies (ranging from guidance systems to speed-limit exceeding systems and to fatigue detection systems) are emerging, many of which are either explicitly targeted to older drivers or expected to benefit them the most. However, these same older drivers are more likely to find adapting to the use of such technologies challenging. Therefore, understanding older drivers' perception of such devices will allow experts to take the necessary steps to ensure their smoother acceptance and complete success of their deployment. Using Greek drivers' data collected within the scope of an extensive recent survey in 23 European countries (the SARTRE-3 dataset), a statistical analysis of the perception of usefulness and acceptance of new technologies by older drivers is presented, indicating that -in this dataset- older drivers are more willing to accept these new technologies. The results of the developed ordered logit models provide insight into the human-factors' aspect of the introduction of advanced technologies with respect to the more sensitive segments of the driver population.

Methodology

Using data collected from Greek drivers within the scope of an extensive recent survey in 23 European countries (the SARTRE-3 dataset), a statistical analysis of the perception and acceptance of new technologies by older drivers is presented. In this research, the emphasis is in the self-reported perception of in-vehicle devices for road safety. Data from the Greek drivers has been used. The distribution of age and sex in the data set is shown in Figure 1

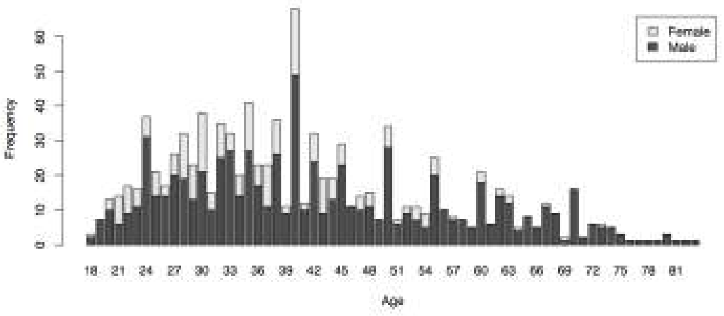
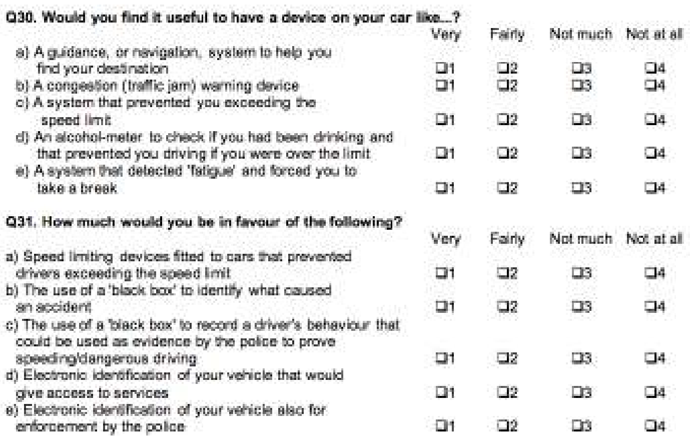


Figure 1. Age and sex distribution in the data set

Figure 2 presents the part of the questionnaire that asked the drivers about their attitude toward technological devices that could improve safety conditions.



Q30. Would you find it useful to have a device on your car like...?

	Very	Fairly	Not much	Not at all
a) A guidance, or navigation, system to help you find your destination	☐1	☐2	☐3	☐4
b) A congestion (traffic jam) warning device	☐1	☐2	☐3	☐4
c) A system that prevented you exceeding the speed limit	☐1	☐2	☐3	☐4
d) An alcohol-meter to check if you had been drinking and that prevented you driving if you were over the limit	☐1	☐2	☐3	☐4
e) A system that detected 'fatigue' and forced you to take a break	☐1	☐2	☐3	☐4

Q31. How much would you be in favour of the following?

	Very	Fairly	Not much	Not at all
a) Speed limiting devices fitted to cars that prevented drivers exceeding the speed limit	☐1	☐2	☐3	☐4
b) The use of a 'black box' to identify what caused an accident	☐1	☐2	☐3	☐4
c) The use of a 'black box' to record a driver's behaviour that could be used as evidence by the police to prove speeding/dangerous driving	☐1	☐2	☐3	☐4
d) Electronic identification of your vehicle that would give access to services	☐1	☐2	☐3	☐4
e) Electronic identification of your vehicle also for enforcement by the police	☐1	☐2	☐3	☐4

Figure 2. Relevant part of the SARTRE 3 questionnaire

Model formulation

Respondents in surveys are often asked to express their preferences in a rating scale. Such scales are often called Likert scales (Likert, 1932, Richardson, 2002). A multinomial logit model could be specified with each potential response coded as an alternative. However, the ordering of the alternatives violates the independence of the errors for each alternative, and therefore the Independence for Irrelevant Alternatives (IIA) assumption of the logit model. Nested or cross-nested models are one approach to overcoming this issue. Ordered logit models provide another approach that estimates parameter coefficients for the independent variables, as well as intercepts (or threshold values) between the choices.

Figure 3 shows the distribution of the choice probability P as a function of the utility U. Assuming a ranking scale with four levels (like the one used in Figure 2), there are three thresholds or critical values (k1, k2, and k3) that separate the choices (1 through 4). For example, respondents choose the alternative "very useful" if the utility is below k_1, alternative "fairly useful" if the utility is between k_1 and k_2, and so on.

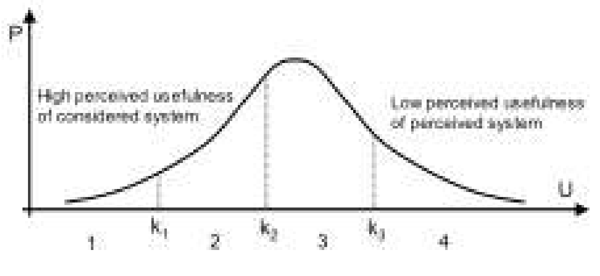


Figure 3. Distribution of the respondents' preference (adapted from Train, 2002)

Model estimation results

Socioeconomic characteristics have been used as the explanatory variables. Table 2 provides an example of model estimation results.

Table 2. Model estimation results for a system preventing exceeding of speed limit

	Prevent Exceeding Speed Limit	
Intercept	**Est. coef.**	***t-value***
k_1	-1.3611	*-9.562*
k_2	0.3122	*2.307*
k_3	1.5082	*10.072*
Variable	**Est. coef.**	***t-value***
Age <30	—	—
30<=Age<40	**-0.4006**	***-2.425***
40<=Age<50	**-0.8629**	***-4.922***
50<=Age<60	**-0.8607**	***-4.078***
Age >= 60	**-1.3805**	***-6.540***
Sex: Male	—	—
Sex: Female	**-0.485**	***-3.511***
Number of observations	987	
Residual deviance	2441.126	
Akaike Information Criterion (AIC)	2457.126	

Marginal effects and elasticities are very useful elements in the interpretation of model results. The use of binary (0/1) dummy variables for the age groups in the above models makes the estimated coefficients directly comparable across models, providing thus a measure similar in concept to elasticities for factor variables. An interesting aspect of this property is that these coefficients can be directly used to develop a ranking of the various systems in terms of how useful they are perceived by each age group. Figures 4 and 5 provide concise visual representations of the relative perception of age groups against the various systems.

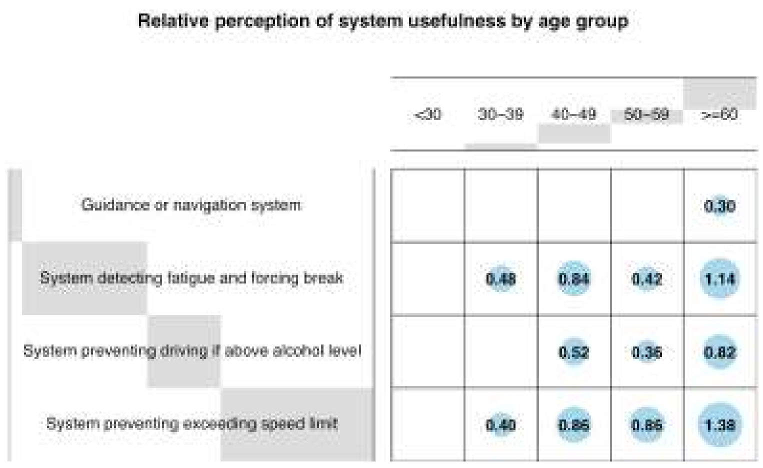


Figure 4. Relative perception of system usefulness by age group

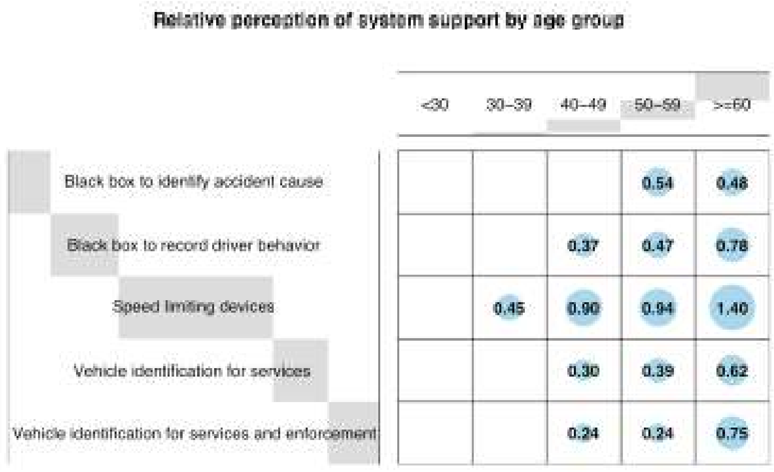


Figure 5. Relative perception of being in favor of each system by age group

Discussion

- **Ordered logit** models have been used to analyze the **perception of older drivers** (compared to other age groups of the population) regarding the **acceptance of in-vehicle devices for road safety.**
- The results indicate that older drivers are much more open to such devices, which could be explained when one considers the more **risk-averse behavior** of older drivers.
- Furthermore, this **willingness to accept new technologies** could be a manifestation of the fact that older drivers actually comprehend and recognize their limitations due to aging, such as slower response time and impaired vision.
- However, it should be noted that it cannot be assumed that the willingness to test and potentially adopt new in-vehicle devices offsets such age-related implications.