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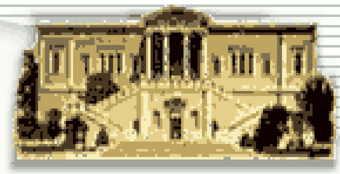

LNEC LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

INTRODUCING SAFETY ON ADVANCED TRAVELLER INFORMATION SYSTEMS AND CONSEQUENT IMPACT ON DRIVERS' ROUTE CHOICES

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Abstract

Advanced traveller information systems providing information on route choice, and drivers receiving such information modify their route characteristics accordingly. So far the information transmitted to drivers is mainly related to traffic conditions such as travel time, delay, queue or incident characteristics. A proposed development that could also improve road safety is to enhance on-board advanced traveller information systems with information on the safety level of the alternative routes. It might be the case, that drivers may change their route to follow a safer one. To assess the significance of such an introduction, its impact on driver choices needs to be explored. Hence, the present research investigates driver route choice in relation to three attributes: route length, travel time and safety level. In order to capture driver choices a questionnaire-based stated preference survey was carried out and discrete choice analysis was performed on the survey results. Analysis results indicated that providing information on route safety influences driver route choice and supporting the development of such a system as a means to improve road safety.

THE CONCEPT

Route Choice may depend on:

- Travel time
- Length
- Familiarity
- Traffic conditions
- Several other parameters, such as road safety

A parameter can only contribute to route choice when its value is known to the driver.

A parameter value can be known by:

- Defined by the user (subjective parameters)
- Previous experience on this route
- Provision of information via radio, internet, navigator, variable message signs etc

Advanced Traveller Information Systems:

- Usually provide information on traffic conditions, incident occurrence, travel times, weather conditions

-Could also provide information on the safety level of the route

ASSUMPTION:

The safety level of a route might be a contributing factor in route choice, if such information were provided to the drivers. A means for this application could be Advanced Traveller Information Systems.

QUESTIONNAIRE SURVEY:

Questionnaire design

The questionnaire consisted of four parts:

PART A. General driver and vehicle characteristics including driver age, gender, driving experience, vehicle type, annual mileage

PART B. The aim of this section is to increase participant awareness on road safety. Hence, this section consisted of road safety related questions including estimation of number of fatalities in Greece during the last year, ranking specific types of serious injuries (with severity order), rating the importance of the parameters travel time, length and safety level when making a route choice.

PART C. This part involved the stated preference experiment. Drivers were asked to choose between two routes (for nine different scenarios) based on their characteristics , which were: travel time, length and safety level.

PART D. This part involved demographic characteristics including marital status, household size, income, profession.

Survey Sample

- The questionnaire survey sample involved drivers making trips in the city of Athens.

-The sampling was random allowing for a representative sample to be included in the survey. Hence, the sampling:

-involved drivers of different age categories and characteristics ,

-took place in various locations (offices, streets, car-washing facilities) and in areas with different characteristics (economical, type of activities etc) ,

-took place in different periods within a day (morning, afternoon and evening), both during weekdays and weekends.

Participant age, driving experience and exposure

	Age	Driving experience	Annual mileage (km)
Average	35.19	14.44	16950.70
Minimum	19.00	1.00	1000.00
Maximum	72.00	51.00	300000.00
St. dev.	11.94	10.91	18952.58

Participant demographic characteristics

Marital Status	No.	Number of children	No.	Household size	No.	Household income	No.	Education	No.
Single	212	0	224	1	46	0-10 000	62	Junior High School	21
Married	148	1	52	2	50	10 001-20 000	119	Senior High School	152
		2	62	3	104	20 001-30 000	88	University	187
		>2	22	4	98	30 001-50 000	56		
				>4	54	>50 001	22		

STATED PREFERENCE DESIGN:

General

- A route choice context was selected considering a typical daily home-work journey.

- A binary choice experiment asking participants to select route A versus route B at a time was designed based on a factorial design of 3 variables and three variation levels.

- The three variables were selected to be: travel time, length and route safety level, .

Choice situation presented to the respondent

Route option A		Route option B	
Travel Time	60	Travel Time	30
Distance	10	Distance	15
Safety Level	20	Safety Level	5

The selection of the variables of travel time and length was made under the basis that they are quite significant both in terms of participant comprehension and driver route choice and also in terms of them being applied in relevant transport-related domains (ATIS and simulation sofware), especially in urban trip scenarios.

Statistical design

-A catalogue plan of fractional factorial designs was used for the statistical design. Variables were coded as [1, 0,-1].

-The design allows for the orthogonal estimation of main effects and denoted interactions, meaning that all estimates of effects are uncorrelated, leading in a full factorial design containing 27 choices.

- A fractional factorial dividing the original design in 3 different blocks of 9 choices was constructed.

-Dominant situations were avoided by swapping variable levels amongst two options.

Variable selection

-The attributes defining each route should be familiar to the drivers.

- The variable levels were defined considering typical values of trips made within the city of Athens.

Variable levels for the SP design

	-1	0	1
Travel time	30	40	60
Distance	10	15	20
Safety Level	5	10	20

RESULTS

Route choice model

Binary logistic analysis was performed to estimate the utility of a route in respect to the three different parameters:

T-dif.: travel time difference (minutes);
L-dif.: length difference (kilometres);
RS-dif.: road safety level difference (number of killed or seriously injured drivers per 10^5 drivers).

Variable coefficients for the route choice model

	Coefficient	t-stat
T-dif	-0.078	26.000
L-dif	0.024	1.714
R-Sdif	-0.147	14.700

The estimated model demonstrated a quite good fit (R^2 = 0.577) and a total prediction percentage of around 80% (coefficients stat. significant at 90%).

Safest route choice model

One other question that arises from the previous results is whether the preference on a safer route also depends on other driver characteristics. Hence, further analysis was conducted using logistic regression modelling and the dependant variable was set to be the utility of choosing the safest route between the two alternative ones:. Utility was set to be:

1 if the examined route (safest route) was selected by the driver
0 if the examined route (safest route) was not selected by the driver

Variable coefficients for the safest route choice model

	Coefficient	t-stat
Travel time	-0.083	-3.952
Safety level	0.207	10.350
Age	0.122	1.649
Driving experience	-0.192	-2.157
Annual mileage	0.085	1.932
Education	-0.163	-2.763

The estimated model demonstrated a fit of R^2 = 0.170 and a total prediction percentage of around 66% (coefficients stat. significant at 90%).

Revealed vs. Stated Preferences

Drivers revealed preferences were tested against drivers stated preferences on the importance of each of the three variables when choosing a route. Results indicated a correlation between revealed and stated preferences. Hence, drivers who would state that the safety level of a route is the most important factor they would choose the safest route rather than the quickest of the shortest ones.

CONCLUSIONS

Results revealed that **the safety level of a route is not only a contributing factor to route choice, but also the prevalent one**, amongst the investigated ones. Drivers' revealed preferences on the significance of the attributing factors on when choosing a route came in accordance with their stated ones, as drivers who choose the safest route rated road safety as the most important parameter. Several demographic characteristics also contribute to drivers choosing the safest route. In particular, drivers tend to choose the safest route more with increasing age and decreasing driving experience. Annual mileage was another contributing factor, as drivers who demonstrated higher exposure would choose more the safe route. Driver education was also found to be a contributing factor, whereas other characteristics such as gender, marital status, household income and profession did not affect drivers' route choice.

The determined significance of road safety reinforces the **need for the introduction of road safety into advanced traveller information systems, with the aim of improving road safety.** It is expected that drivers being provided with information on the safety level of a route might change their route from less safe to safer ones, which may improve road safety. However, this can be a dynamic equilibrium as the safety level of a route is also dependent on traffic volume, and change in traffic volumes might modify the safety level of a route. To assess the effects of drivers' route choice – once safety level is considered as a contributing factor – on road safety**, traffic assignment algorithms that consider route safety level need be developed**. The results of this study and the aforementioned implications emphasise the need for further research on the contribution of the attribute of road safety on route choice.