MOTIVATIONS, TRAVEL HABITS, ATTITUDES AND BEHAVIOUR OF EUROPEAN PEDESTRIANS

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ABSTRACT

The objective of this study is the analysis of pedestrian motivations, travel habits and attitudes and behaviour, towards road safety in Europe, by using the responses of road users from a large sample including 21 European countries at the SARTRE-4 pan-European survey. The data include pedestrians' responses to the dedicated "Other Road Users - ORU" part of the SARTRE-4 questionnaire, as well as the responses of selected questions of the common part of the questionnaire (addressed to all road users i.e. car drivers, motorcyclists, pedestrians, cyclists etc.). The data was collected by means of personal interviews on a minimum sample of 200 ORU in each country. The analysis consists of two parts, the descriptive analysis and the statistical modelling of pedestrians' travel habits, attitudes and behaviour. More specifically, factor and cluster analyses were carried out. The descriptive analysis of the study (frequencies, percentage and country comparisons, analyses per age, gender, town size and area type) revealed significant trends on pedestrians' road safety attitudes and behaviour. The factor analysis revealed eight factors of pedestrian attitudes, perception and behaviour. The cluster analysis revealed four groups of pedestrians according to their travel habits and three groups of pedestrians regarding attitudes and perception towards road safety. The results are discussed with respect to potential reasons leading to particular attitudes and behaviour, the pedestrians' characteristics, the share of each group in different countries etc.

Keywords: Pedestrians, Safety, Perceptions, Attitudes, Behaviour

INTRODUCTION

Pedestrians are the most vulnerable users of transport networks due to the lack of mass and protection, compared to other road users. Their attitudes and perceptions toward road safety and risk need further investigation since they may reflect their actual behaviour. More specifically, perceptions and opinions about transport, road safety, control measures etc., are very relevant to policy makers for understanding the road users' needs, the limitations of their policies and the potential support for new policies, at national or international level.

The literature review that was carried out, showed that although there are several studies analyzing road users' attitudes and/or behaviour, out of which a number (Assum, 1997; Yannis et al., 2007; Vanlaar and Yannis 2006) are based on the SARTRE 1, 2 & 3 (Social Attitudes to Road Traffic Risk in Europe) research projects, there are not many studies associated with pedestrians' attitudes and behaviour, especially at international level.

In Zhou et al. (2009), 426 pedestrians completed a demographic questionnaire to measure their tendency towards social conformity and another questionnaire based on the theory of planned behaviour in order to measure their intentions, behaviour and perceived risk. It is shown, that pedestrians were more likely to cross the road when other pedestrians were crossing the road too. Sisiopiku and Akin (2003) examined behaviours at and perceptions towards various pedestrian facilities, such as crosswalks and physical barriers. The majority of pedestrians believe that motorists should yield to pedestrians only at designated crosswalks. Pedestrians' responses indicated that '*pedestrians understand the purpose of streets with mixed traffic and are willing to compromise in order to have a fair and safe environment for all users'*.

The National Survey of Bicyclist and Pedestrian Attitudes and Behaviour in the U.S (NHTSA (2008), indicated that the most important reason that pedestrians feel threatened for their personal safety was the presence of other motorists (62%). Kaparias et al., (2012), analyzed perceptions of pedestrians and drivers in shared space and found that pedestrians feel more comfortable in low vehicular traffic, good lighting and pedestrian-only facilities. Mercieca et al., (2011), examined pedestrian perceptions to the redevelopment of Oxford Circus in London suggesting that pedestrians support the increased freedom of movement in space sharing in popular inner city areas.

From the review of the existing literature it is concluded that pedestrian attitudes, perception and behaviour issues have attracted the interest of several researchers. However, the existing studies mostly focus on particular aspects (i.e. only attitudes or only behaviour, specific behaviour e.g. road crossing etc.), the samples examined are small, whereas no results comparing different countries are available. In the SARTRE-4 research project, the attitudes, perceptions and behaviour of a large sample of pedestrians were examined at European level for the first time. The objective of this study is the analysis of pedestrian behaviour, travel habits and attitudes towards road safety in Europe, by using the responses of road users from a large sample including 21 European countries at the SARTRE-4 pan-European survey.

The paper is structured as follows: At first, the data and methods sections are presented, and then followed by the results of the preliminary descriptive statistical analysis on travel habits, attitudes and perceptions and also by the in-depth statistical analysis (factor and cluster analysis). The last sections of the paper are discussion and conclusions sections where the main results are summarized and discussed and also conclusions are drawn.

DATA AND METHODS

The SARTRE-4 Survey Data

The SARTRE-4 project (SARTRE-4, 2011) deals with road users' attitude and perceptions in Europe in relation to road traffic risk. It is based upon a common survey carried out in each participating country and upon a shared analysis of the database. The survey involved a personal interview for the filling of an extensive questionnaire.

In total, 21,280 questionnaires were collected, between November 2010 and February 2011, from 19 European countries, namely Austria, Belgium, Cyprus, Czech Rep., Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Netherlands, Poland, Serbia, Slovenia, Spain and Sweden. In each country, at least 200 pedestrians were interviewed, on the basis of simple random sampling at national level.

The SARTRE-4 database, developed from the coding of the questionnaire responses, involved various common questions that all road users had to fill, followed by a separate section for each category of road user (car drivers, motorcyclists and other road users). The questions that were examined within the present research were those of the common part (CO) of the questionnaire that were considered to be relevant to the aim of the analysis and those of the Other Road Users' (ORU) part of the questionnaire which were associated with pedestrians. For details on the questionnaire design and selection of questions the reader is referred to the final SARTRE-4 report (SARTRE-4, 2012).

The selection of pedestrians among the ORU group was carried out according to the following criterion: pedestrians were identified as those respondents who reported that their most frequent transport mode in the last 12 months was neither passenger car nor motorcycle, and who reported non-zero daily walking distance travelled.

Methods

The analysis consists of two parts:

- Descriptive analysis: frequencies, percentages and country comparisons for pedestrians' travel habits, road safety attitudes and behaviour, and analyses by age, gender, town size and area type.
- In-depth analysis: statistical analysis and modelling of pedestrians' travel habits by means of a cluster analysis.

RESULTS

Descriptive analysis

Travel habits

The majority (71%) of the pedestrians travelled less than once a month by car as a driver last year. Moreover, the majority of pedestrians travel by car as a passenger more frequently; either one to four times a week or one to three times a month. More than 80% of the pedestrians travelled less than once a month by motorcycle as a driver or passenger last year. The percentage of pedestrians that travelled by moped less than once a month last year is greater than 80% in most countries. Pedestrians travelled daily or more than four times a week by walking last year (92%). In the last year, nearly 52% of pedestrians travelled less than once a month by cycling. A notable exception was the Netherlands where the majority (79%) of pedestrians cycled almost every day or one to four times a week. In most countries, the percentage of pedestrians that used public transport at least once a week is greater than 50%.

Nearly all of these pedestrian respondents had not been involved in a road accident as a pedestrian in the last three years. Sweden, Austria, Czech Republic, Spain and Ireland have the largest percentage of pedestrians that have been involved in an accident (more than 5%).

Road safety attitudes and perceptions

Most pedestrians (greater than 70%) are “very” or “fairly” concerned about crime, pollution, health care, as well as unemployment and road accidents. There is a great variation between countries in pedestrians’ concern about congestion. While in some countries (Cyprus, Greece, Serbia, and Poland) pedestrians are “very” or “fairly” concerned about congestion (more than 65%), in some countries (Czech Republic, Germany, Sweden, Hungary and Austria) this figure drops to less than 40%. It is noted that road accidents are the main concern for all road users (car drivers, motorcyclists, other road users) and as expected car drivers and motorcyclists are more concerned about traffic congestion.

The percentage of pedestrians who consider the roads in their country to be “very” or “fairly” safe ranges from 24% (Greece) to 92% (Finland). Pedestrians in Northern and Western European countries are more satisfied with their roads compared to Central and Southern European countries with Greece, Slovenia and Poland having the highest percentages of pedestrians that do not find roads safe at all (Figure 1). On the other hand, the worst perception of road safety is observed in Poland and Hungary, Greece and Slovenia, where interestingly in each country the opinions of the three road user groups (pedestrians, car drivers and motorcyclists) are similar.

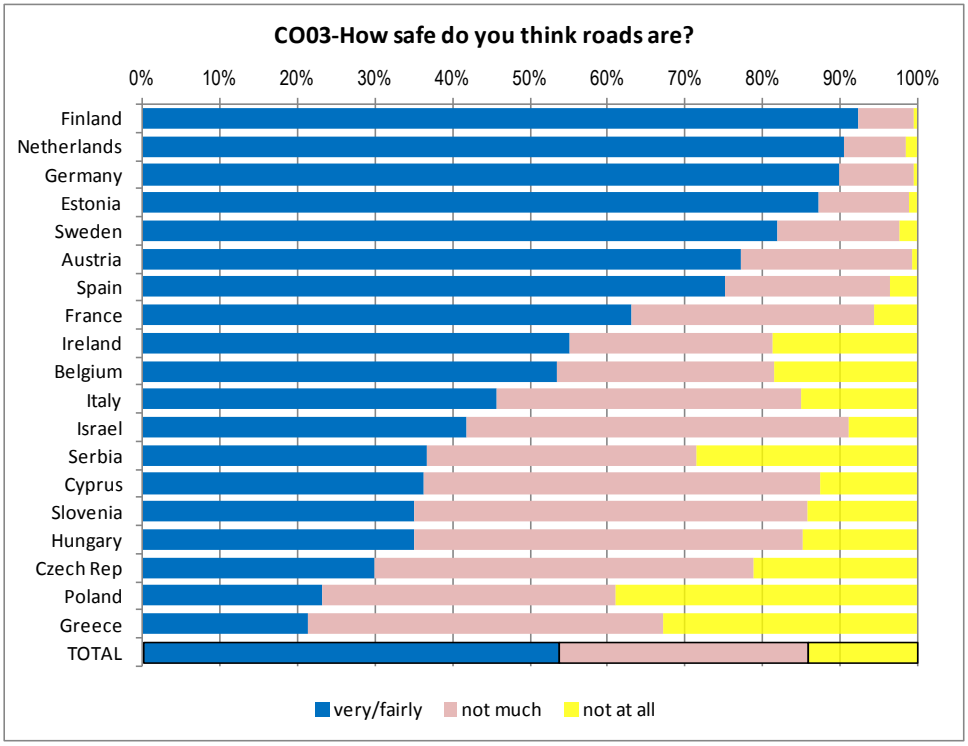

Figure 1. How safe do you think the roads are in our country to travel on?

Attitudes towards safety measures and penalties

The majority of respondents are “very” or “fairly” in favour of using speed limit devices in cars (greater than 70% except for the Netherlands and Sweden where it is just 54% and 57% respectively), black boxes (approximately 80%), fatigue detection devices (around 85%), and alcolocks in cars (greater than 60%). The acceptance of alcolocks for recidivist car drivers is greater than 70% in all countries. Pedestrians seem to support more strongly all in-vehicle devices compared to car drivers and motorcyclists in almost all countries.

The vast majority of pedestrians are “very” or “fairly” in favour of using cameras for red light surveillance (more than 80%), surveillance of speeding at a single point (more than 80%), or between two distant points (more than 70%). In contrast, the percentage of pedestrians who strongly support more ‘30 km/h’ zones is lower compared to the other measures, despite this being a measure explicitly aiming to improve pedestrian safety. On the other hand, most pedestrians (approximately 70%) are “very” or “fairly” in favour of more car and motorcycle free zones.

While most of pedestrians “strongly agree” or “agree” with more severe penalties for speeding offences, there is some variation. For instance, 91% of pedestrians in Hungary support this measure but the corresponding figure for Sweden is just 42%. Nearly all (about 90%) pedestrians, “strongly agree” or “agree” with more severe penalties for drunk-driving offences. There is some variation in the pedestrians’ responses to more severe penalties for not using restraint systems. While some countries “strongly agree” or “agree” with a percentage about 80% (Spain, Cyprus, Ireland, Hungary and Greece) some others have a

lower percentage of about 50% (Sweden, Slovenia and Italy). Most pedestrians (about 80%) "strongly agree" or "agree" with more severe penalties for not wearing helmets on motorcycles with the lowest percentage found in Sweden (58%) and the highest in Greece (90%). Most pedestrians (about 76%) "strongly agree" or "agree" with more severe penalties for using handheld phones while driving and the percentage with the lowest support found in Sweden (65%), Austria (66%) and Slovenia (67%) and the highest in Ireland (89%), Greece (88%) and Hungary (86%). The results are possibly affected by the incidence of risk-taking or distracted driver behaviour in each country.

Pedestrian perceived level of service

Table II summarizes pedestrian perceived level of service. The highest percentage of pedestrians that are "very" or "fairly" satisfied with safety as pedestrians in the area in which they walk can be found in Finland (85%). Most the pedestrians in the majority of countries are satisfied with safety, but notable exceptions are Greece (17%) and Cyprus (20%).

Almost half of all pedestrians are "very" or "fairly" satisfied with pavements, but this varies from low ones such as 27% (Hungary) to very high such as 89% (Sweden). In general, almost half of pedestrians are "very" or "fairly" satisfied with the separation of pedestrians and cyclists (mean value 47%). Most pedestrians are "not much" or "not all" satisfied with speed of traffic. The highest percentage of pedestrians that are "very" or "fairly" satisfied with speed of traffic can be found in Finland (75%). The lowest percentages of pedestrians that are "very" or "fairly" satisfied with speed of traffic can be found in Greece (22%), Poland (31%) and Slovenia (31%). Moreover, it seems that the majority of pedestrians is "not much" or "not at all satisfied" with the volume of traffic. The highest percentage of satisfaction can be observed in Netherlands, Finland and Sweden (71%, 67% and 69% respectively).

The highest percentages of pedestrians that are "very" or "fairly" satisfied with the number of street lights can be found in Austria (77%) and Estonia (77%) with an average of 64%. More than half of the SARTRE-4 sample of pedestrians is "very" or "fairly" satisfied with the number of crossing points. The highest percentage of pedestrians that are "very" or "fairly" satisfied with the number of crossing points can be found in France (77%), Finland (76%) and Netherlands (75%).

Table II: Pedestrian satisfaction responses per country ("very/fairly satisfied")

	Pavements	Separation of pedestrians and cyclists	Safety	Speed of traffic	Volume of traffic	Street lights	Street crossing places
Austria	87%	68%	81%	55%	64%	77%	68%
Belgium	56%	56%	63%	43%	40%	73%	59%
Cyprus	36%	23%	30%	36%	35%	44%	31%
Czech Rep.	56%	41%	56%	36%	26%	64%	50%
Estonia	40%	47%	58%	63%	57%	77%	64%
Finland	87%	56%	85%	75%	67%	73%	76%
France	73%	62%	74%	54%	56%	74%	77%
Germany	80%	41%	78%	48%	48%	70%	63%
Greece	30%	18%	18%	22%	28%	21%	21%
Hungary	27%	31%	43%	34%	32%	57%	37%
Ireland	71%	59%	76%	50%	50%	65%	54%
Israel	74%	48%	66%	54%	52%	60%	64%
Italy	36%	35%	45%	31%	31%	69%	56%
Netherlands	76%	74%	76%	54%	71%	76%	75%
Poland	44%	46%	50%	31%	28%	57%	52%
Serbia	52%	44%	49%	35%	36%	60%	50%
Slovenia	54%	42%	52%	31%	29%	66%	55%
Spain	67%	47%	61%	45%	43%	65%	65%
Sweden	89%	56%	83%	70%	69%	65%	71%
MEAN	60%	47%	60%	46%	45%	64%	57%

Interaction with other road users

The majority of pedestrians (more than 60%) get very annoyed with car drivers at least "sometimes", while almost one in four pedestrians are "often" very annoyed with car drivers, and more than one in ten get "very often" very annoyed with car drivers. Almost one in four pedestrians "often" gets very annoyed with motorcyclists. The highest percentage of pedestrians that get "never" or "rarely" very annoyed with motorcyclists can be found in Sweden (74%). In Greece, Czech Republic, Estonia, Austria, Germany, Poland, Italy, Slovenia and Serbia, more than 25% of pedestrians "often" or "very often" get very annoyed with motorcyclists.

In contrast, most pedestrians are "never" or "rarely" annoyed with bicyclists (more than 55%) apart from Netherlands, Austria, Estonia and Germany (almost 30%).

Pedestrian behaviour

The results on pedestrian behaviours per country are summarized in Table I. It is observed that the highest percentages of pedestrians that tend to commit red light crossings (sometimes/often/very often/always) are in Cyprus (51%), France (41%), Italy (41%) and Netherlands (42%), whilst the lowest respective percentages are in Poland (11%), Slovenia (14%), Czech Rep. (14%) and Hungary (15%): the overall mean is 31%.

As regards crossing outside designated locations, the lowest percentage of pedestrians that cross at places other than pedestrian crossings (sometimes/often/very often/always) can be

found in Estonia (40%) and Israel (40%), and the maximum in Greece and Sweden (both 76%) with an average of 57%. It is notable though, that 7% of pedestrians in Cyprus "always" cross at places other than pedestrian crossings (a percentage that is lower than 4% in all other countries). Due to the small sample size, this result must be considered with some caution.

The lowest percentage of pedestrians that avoid too dangerous streets or intersections can be found in Netherlands (32%) and Sweden (35%). In most countries, the vast majority of pedestrians "never" or "rarely" wear reflective clothing. However, in Northern countries (Sweden, Estonia, Finland, Ireland) pedestrians wear reflective clothing more often. The highest percentages are observed in Estonia and Finland, where more than 75% of pedestrians "sometimes", "often", "very often" or "always" wear reflective clothing.

The highest percentage of pedestrians that have to walk on the street because of obstacles (parked cars or other barriers) can be found in Greece and Italy (94% and 92% respectively) with an average value of 63%.The highest percentage of pedestrians that "never" or "rarely" have to walk on the street because of obstacles can be found in Finland and Germany.

Regarding distractions while walking, there is a great variation in the pedestrians who never make or answer a call with a handheld phone. It ranges from 3% (Estonia) to above 45% (Hungary and Slovenia). Most pedestrians never use MP3/iPod/music devices while walking except for Sweden (59%) and Cyprus (58%), where the highest percentages of music devices use exist.

Table I – Pedestrian behaviour responses per country ("sometimes/often/very often/always")

	Red light crossing	Wrong place crossing	Avoid dangerous streets	Reflective clothing	Parked cars/barriers	Handheld phone calls	Music devices
Austria	37%	63%	38%	10%	51%	66%	42%
Belgium	25%	51%	55%	13%	69%	45%	28%
Cyprus	51%	70%	74%	23%	88%	74%	58%
Czech Rep.	14%	55%	50%	13%	59%	65%	21%
Estonia	25%	40%	72%	77%	81%	79%	31%
Finland	26%	51%	40%	78%	37%	52%	18%
France	41%	54%	49%	6%	67%	44%	26%
Germany	22%	56%	39%	17%	46%	45%	29%
Greece	44%	76%	71%	2%	94%	74%	15%
Hungary	15%	56%	46%	12%	54%	35%	12%
Ireland	36%	70%	61%	54%	69%	67%	31%
Israel	19%	40%	42%	6%	46%	63%	30%
Italy	41%	65%	59%	1%	92%	74%	18%
Netherlands	42%	71%	32%	19%	75%	57%	37%
Poland	11%	43%	38%	10%	61%	42%	13%
Serbia	37%	43%	37%	9%	48%	72%	27%
Slovenia	14%	48%	66%	23%	67%	41%	13%
Spain	35%	53%	51%	4%	58%	62%	36%
Sweden	55%	76%	35%	37%	47%	82%	59%
MEAN	31%	57%	50%	22%	63%	60%	29%

Effects of town size and type of area

As far as the town size is concerned, results show that inhabitants of big and middle size towns cross the road more often when a red light is showing for pedestrians, they use music devices while walking more often, they use their mobile phones more often while walking and they more often cross streets at places other than the pedestrian crossing. On the other hand, residents of big cities wear less reflective clothing and are less likely to avoid dangerous streets and intersections. In most cases, satisfaction with various road safety factors is higher in big cities and gradually decreases with the decrease in town size. This pattern can be seen on issues such as the number of places to cross the street, number of street lights, safety, separation of pedestrians and cyclists and pavements.

Differences between urban, suburban and rural areas are mostly visible in crossing when a red light is shown, mobile phone use and listening to music while walking, which are much less common in rural areas and small towns. Furthermore, crossing at a place other than the designated crossing and having to walk on the street because of parked cars is less frequent in rural areas. On the other hand, wearing reflective clothing and avoiding some streets or intersections is less frequent in urban areas. With the exception of traffic volume, all answers in urban areas showed higher satisfaction with pedestrian infrastructure in these areas, less in suburban areas and small towns and the least in rural areas, although these differences were not always striking (e.g. in traffic speed). Inhabitants of small towns are as satisfied as those of large cities, as regards the number of crossing places and the number of street lights.

Pedestrians' annoyance with motorcyclists increases with the town size, while their annoyance with bicyclists decreases with town size. Annoyance by car drivers does not appear to vary with town size. In marked contrast, a different distribution of results is seen regarding the type of area (urban, suburban, small town, rural). The highest annoyance with car drivers is observed in suburban areas and the highest annoyance with motorcyclists is observed in small towns.

Effects of gender

Making/answering a phone call while walking was done almost equally often by female and male respondents. Men cross streets on a red light or at inappropriate places more often than women, and women avoid dangerous streets or intersections more often than men.

On the country level, statistically significant differences between the genders were found in some countries. More specifically, in Ireland, Italy, Netherlands, Slovenia and Poland female pedestrians cross on red light more rarely than male pedestrians. In Estonia, Italy, Netherlands, Poland and Sweden males cross on the wrong place more often than females. In some of those countries (Estonia, Italy and Poland), male pedestrians do not avoid dangerous streets or intersections as often as female pedestrians.

Male pedestrians in Austria are forced to walk on the streets because of parked cars and other barriers more often than females, in contrast to France. Concerning reflective clothing, in Finland, Hungary and Sweden males wear reflective clothing more often than females. As far as distraction is concerned (phone calls and music devices), male pedestrians are more distracted than females (Estonia, Serbia, Germany, Greece and Netherlands).

In general, male respondents were more satisfied with road safety issues than were females. The difference between male and female respondents was clearest in the satisfaction with pavements (20% of males "very" satisfied vs. 13% of females. The differences between genders were statistically significant, except for 'volume of traffic' and 'number of places to cross the street'.

On the country level, in all statistically significant countries (France, Israel, Serbia), males are more satisfied with pavements. In Austria females are more satisfied with separation of pedestrians and cyclists, in contrast to Estonia and Serbia. Concerning safety, in Cyprus females are more dissatisfied than males, in contrast to Israel and Sweden. Regarding the satisfaction in terms of the speed of the traffic, male pedestrians in Germany, Israel and Netherlands are more satisfied than female ones. In Slovenia females are more satisfied with the number of street-crossing places as well as with the number of street lights.

Female pedestrians report getting very annoyed with other road users more often than male pedestrians. The differences between genders were statistically significant, except for getting annoyed with cyclists.

Effects of age

For all questions on road safety behaviour, statistically significant differences were observed between the age groups with, in general, the older age groups reporting less often dangerous behaviour. This was found especially for the questions about using a mobile phone or music device while walking. The older respondents avoided dangerous streets or intersections more often than other age groups.

Over-representation of younger pedestrians was observed also in most of the countries in 'crossing the street on red light' (Austria, Belgium, Cyprus, Czech Rep, France, Germany, Hungary, Ireland, Italy, Netherlands, Poland, Serbia, Slovenia, Sweden), in 'crossing street on wrong places' (Austria, Belgium, Cyprus, Finland, Germany, Italy, Netherlands, Poland, Serbia, Slovenia, Spain, Sweden) and in 'using hand-held mobile phone' (all except Serbia and Spain). Regarding wearing reflective clothing, older pedestrians do not use it very often in Finland and Sweden. Finally, walking on streets because of barriers shows statistical differences in Cyprus and France, where older pedestrians do that more frequently than younger pedestrians.

In general, the youngest and the oldest age groups responded more often that they are "very" satisfied with the road safety issues mentioned in the question (especially for pavements, separation of pedestrians and cyclists and safety). The older age groups were

less satisfied with speed and volume of traffic than other groups. On the other hand, older age groups seem to be more satisfied with the number of street lights in Sweden. Regarding crossing places, youngest and oldest age groups feel more satisfied in Israel. In Ireland middle-aged groups feel more satisfied.

Older respondents reported that they got less annoyed with car drivers than other age groups. For getting annoyed with cyclists, the differences between the age groups were very small, but for getting annoyed with motorcyclists, the situation was the opposite: young groups reported more often than older groups that they got annoyed with motorcyclists.

In-depth analysis

Grouping pedestrians on the basis of their travel habits

In order to obtain meaningful groups of pedestrians based on their travel behaviour a cluster analysis was performed. The distance travelled per day in the four travel modes: walking, cycling, public transport and as a car passenger, were combined with responses on how often the respondent walked in the past twelve months, in order to produce the dependent variables for the cluster analysis: Total daily travel distance; Percentage of daily travel by four modes. The analysis was performed using two-step cluster analysis, which groups observations into groups based on a nearness criterion (Log-Likelihood in this analysis). The results revealed four types of pedestrians. More specifically:

Type 1: Medium daily travel distance (mean on all means of transport: 22,03km), daily walking but below average distance (mean: 2,83km), higher percentage of usage of public means of transport and higher percentage travelling as car passenger; very low percentage of travelling by bicycle; 44.5% of pedestrians fall into this category. Thus, it can be labelled ‘Average distance traveller, short distance pedestrian and user of public transport’.

Type 2: Very similar to type 1 but it is characterized by a much higher daily travel distance (mean: 79,93km being highest travel distance of all four types) and a much higher walking distance (mean: 8,63km); this is the smallest cluster: 9.9% of all pedestrians fall into this category. Thus, it can be labelled ‘Long distance traveller and pedestrian’.

Type 3: Two thirds (67%) of the daily travel distance is done by walking, another fourth (24%) is done by cycling; low daily total distance (mean 9,5km) as usage of public means of transport and travel as car passenger is very low; 24,1% of cases fall into this category. Alternatively, it can be labelled ‘Short distance traveller - mostly walking and cycling’.

Type 4: Similar to type 1, but with the following differences: higher percentage of daily travel distance by walking (23%) and cycling (14%), minor use of public means of transport (31%) or travelling as car passenger (28%); 21,5% of pedestrians fall into this category. So, a suitable label would be ‘Average distance traveller, short distance pedestrian and frequent cycling’.

Table III: Summary of cluster analysis for pedestrian types with respect to travel habits

	Average distance traveller, short distance pedestrian and use of public transport	Long distance traveller and pedestrian	Short distance traveller mostly walking and cycling	Average distance traveller, short distance pedestrian and frequent cycling
Cluster size	45%	10%	24%	22%
total daily travel distance (km)	22.03	79.93	9.05	21.18
walking frequency nearly daily	100%	93%	100%	64%
walking percentage	17%	19%	67%	23%
walking distance (km)	2.83	8.63	4.45	2.48
public transport percentage	44%	46%	4%	31%
car passenger percentage	31%	27%	5%	28%
cycling percentage	6%	6%	24%	14%

Figure 2 illustrates the distribution of the four different types produced by the cluster analysis across the countries. A few remarks can be mentioned. In Belgium type 1 (Average distance traveller, short distance pedestrian and user of public transport) is found significantly more often and there is a similar pattern in Israel and in Hungary.

In the Netherlands, Ireland and Sweden, type 2 (Long distance traveller and pedestrian) is found less often. In Germany, Austria and Estonia this group is found significantly more often. In Serbia, Sweden, and Israel there is a similar pattern, but in Italy this group is significantly underrepresented.

The proportion of type 3 (Short distance traveller - mostly walking and cycling) differs most notably among the countries. It is found significantly more often than average (24,1%) in Cyprus, Poland and Ireland. In contrast, it is found less often in Austria, Israel, Belgium, France and Serbia.

Type 4 (Average distance traveller, short distance pedestrian and frequent cycling) is seen slightly less often than type 3 (21,5%). It is found significantly more often in Italy and Austria, but there is a trend for it to be found less in Germany, Sweden, Spain and Greece.

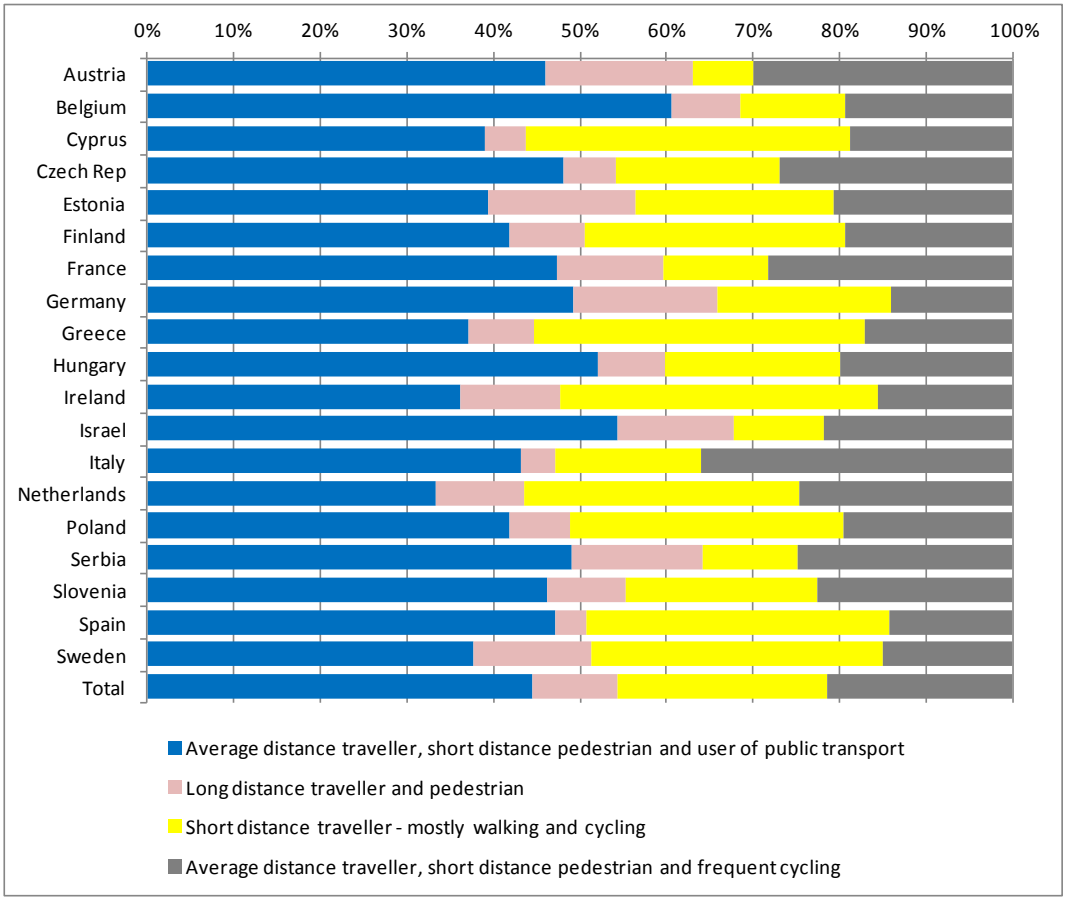

Figure 2. Percentage of pedestrian types per country with respect to travel habits

Identifying factors of attitudes and behaviour

In order to obtain meaningful groups of variables reflecting pedestrians' responses, a factor analysis was performed on thirty three selected variables of the questionnaire. The optimal number of factors - according to the Scree plot and the eigenvalue criteria - was eight. For details of the factor analysis the reader is refered to Papadimitriou et al. (2013). Overall, the factors identified are largely in accordance to the structure of the survey questionnaire, as was expected. Table IV presents the eight factors and their factor loadings (i.e. the correlation coefficient of the linear combination of the variables within each factor), namely:

- Factor 1: Satisfaction with pedestrian environment
- Factor 2: Attitudes towards penalties
- Factor 3: Attitudes towards electronic in-vehicle devices
- Factor 4: Attitudes towards speed limitations and surveillance
- Factor 5: Pedestrian behaviour and distraction
- Factor 6: Attitudes towards pedestrian safety measures
- Factor 7: Annoyance with other road users
- Factor 8: Changing behaviour

Table IV: Summary of factors of pedestrian attitudes and behaviour

Factors	Variables	Loading
Factor 1 'Satisfaction with pedestrian environment'	Dissatisfied with safety	0.761
	Dissatisfied with pavements	0.723
	Dissatisfied with speed of the traffic	0.713
	Dissatisfied with number of crossing places	0.705
	Dissatisfied with volume of traffic	0.673
	Dissatisfied with number of street lights	0.648
	Dissatisfied with separation of pedestrians and cyclists	0.643
Factor 2 'Attitudes towards penalties'	Disagreement with no-wearing helmets penalty	0.807
	Disagreement with severe penalties for not using restraint systems	0.785
	Disagreement with more severe penalties for handheld phone use	0.719
	Disagreement with more severe penalties for drink-driving	0.703
	Disagreement with more severe speeding penalty	0.693
Factor 3 'Attitudes towards electronic in-vehicle devices'	Dissaproval of alcolock	0.823
	Dissaproval of alcolock for recidivist driver	0.809
	Dissaproval of fatigue detection device	0.690
	Dissaproval of black box	0.653
	Dissaproval of speed limiting devices	0.551
Factor 4 'Attitudes towards speed limitations and surveillance'	Dissaproval of speed cameras at a single point	0.811
	Dissaproval of speed zone cameras between two points	0.795
	Dissaproval of red light cameras	0.731
	Dissaproval of 30km/h zones	0.465
Factor 5 'Pedestrian behaviour and distraction'	Frequency of red light crossings	0.718
	Frequency of handheld phone use	0.704
	Frequency of crossings in places other than pedestrian crossings	0.703
	Frequency of music devices use	0.686
Factor 6 'Attitudes towards pedestrian safety measures'	Dissaproval of bicycle lanes	0.790
	Dissaproval of sidewalks	0.788
	Dissaproval of car and motorcycle free zones	0.676
	Dissaproval of 30km/h zones	0.446
Factor 7 'Annoyance with other road users'	Annoyance with motorcyclits	0.812
	Annoyance with car drivers	0.772
	Annoyance with cyclists	0.722
Factor 8 'Lack of accessibility'	Frequency of avoiding too dangerous streets/intersections	0.842
	Frequency of walking on the street because of parked cars/barriers	0.568

Grouping pedestrians on the basis of attitudes and behaviour

A cluster analysis was carried out, aiming to group pedestrians in meaningful groups in terms of attitudes and behaviours. The variables that were selected were the eight factors identified and the grouping was based upon the scores that were calculated from the factor analysis.

The methods of analysis were the two-step cluster analysis and the Log-Likelihood criterion. For details of the cluster analysis the reader is referred to Papadimitriou et al. (2013). The cluster analysis resulted in the identification of three groups of pedestrians, as follows:

Group 1: "Positive attitudes, positive behaviour" (44.4% of pedestrians):
Satisfied with road environment; Agree with safety measures and penalties; Agree with safety devices; Agree with speed limitations and surveillance; Average risk-taking and distraction; Accept pedestrian measures.

Group 2: "Negative attitudes, negative behaviour" (30.7% of pedestrians):
Not satisfied with road environment; Disagree with measures and penalties; Disagree with safety devices; Disagree with speed limitations and surveillance; High risk-taking and distraction; High changing behaviour in terms of adaptation due to lack of accessibility.

Group 3: "Mixed attitudes, positive behaviour" (24.9% of pedestrians):
Average satisfaction with road environment; Agree with penalties; Average agreement with safety devices; Average agreement with speed limitations and surveillance; Low risk-taking and distraction; Disagree with pedestrian measures; Not annoyed by other road users; Not changing behaviour.

Ranking the countries by share of the three groups reveals the inter-country differences (Figure 3). In general, Group 1 is found to include more than 40% of all pedestrians in all countries, apart from Austria, Netherlands, Spain and Germany where pedestrians are equally distributed across the three groups. Group 3 is particularly common in Italy (48.2%), Cyprus (46.5%), Sweden (39.3%) and Greece (38.9%). Group 2 shows the greatest variation, which varies from the lowest, Greece (5.6%), Cyprus (6.9%) and Estonia (8.1%) to the higher values, Hungary (40.5%), Finland (39.2%) and Spain (38.7%).

The distribution of pedestrians of the nineteen countries of the European Union to the three groups reveals some interesting findings. In terms of behaviour, positive behaviour (groups 1 and 3) dominate in most countries. On the other hand, in terms of attitudes, mixed or negative attitudes (expressed by groups 2 and 3) dominate in most countries. Country comparisons overall, show that the neutral pedestrians (mixed attitudes, positive behaviour) have the lowest percentage in the countries having the highest negative attitudes/behaviour.

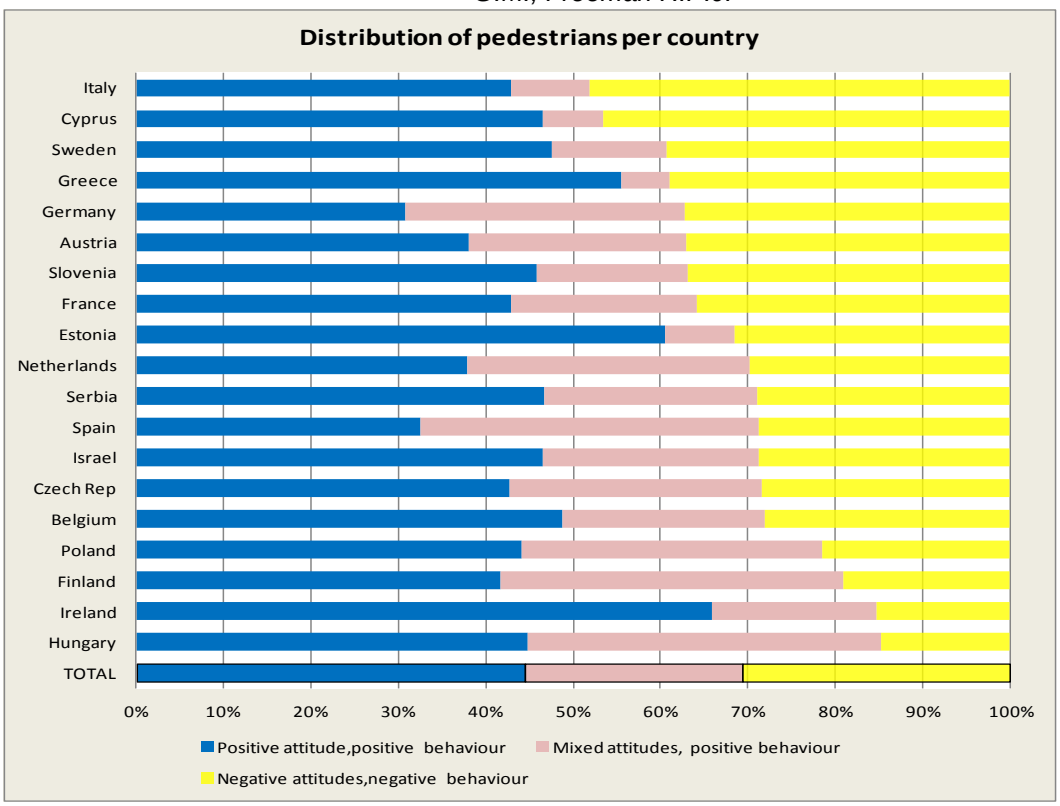

Figure 3: Proportion of pedestrian types as regards attitudes and behaviour per country, in %

DISCUSSION

From the descriptive and in-depth analyses of the pedestrian's responses to the SARTRE-4 questionnaire, a number of interesting remarks can be made. In addition to walking, pedestrians travel frequently as car passengers and as public transport users, but less so as motorcycle passengers. They also seem to be very concerned about several socioeconomic issues such s pollution, unemployment and health care. On the other hand, it is concluded that they are worried about congestion only in a few countries. The responses are clearly affected by the degree to which these issues are relevant in particular countries, and also possibly affected by the overall safety culture of the country.

Pedestrians seem to be quite satisfied with roads, believe that they have become safer and believe that road safety is an important concern of governments in northern and western European countries, but the opposite is the case for southern and central European countries. Results also show that they are very much in favour of all safety measures for speeding, drink-driving and fatigue, especially for recidivist drivers. It is interesting though, that they show less support for the establishment of more '30km/h' zones, even though it is a dedicated pedestrian safety measure.

The lowest satisfaction with the road environment (e.g. sidewalks, lighting, pavements) is consistently found for specific countries, namely Greece, Cyprus, Hungary, Italy, Poland and Estonia. It is somewhat surprising that pedestrians are not satisfied with the speed of traffic,

given that they are not strongly in favour of speed reducing measures. The satisfaction of pedestrians with road infrastructure increases with town size, possibly due to the presence of better pedestrian facilities in larger cities.

Furthermore, pedestrians, and especially females, are quite annoyed with car drivers, less annoyed with motorcyclists and even less annoyed with bicyclists. The results of these questions appear to be affected by the extent of use of each transport mode in each country (e.g. increased pedestrians' annoyance with motorcyclists in Greece, bicyclists in the Netherlands). It is interesting to note that only annoyance with motorcyclists appears to increase with town size, possibly due to increased mobility of motorcycles in big cities.

Although in most countries pedestrians rarely attempt road crossing when a red light is showing, a minority (varying between 10% to 30% in different countries) often does. Men tend to cross streets when a red light is showing or at places other than official pedestrian crossings more often than women; women and the elderly avoid dangerous streets or intersections more often than men and the young. Crossing at non designated locations appears to be a quite widespread behaviour. On the other hand, pedestrians often avoid roads or intersections that appear to be dangerous. Moreover, unsafe or distractive behaviours are more frequent in urban areas, especially in larger sized towns, compared to rural areas, but the use of reflective clothing and the avoidance of certain streets or intersections are more widespread in rural areas. Mobile phone use is quite often while walking, but use of MP3/ipod devices is rare. This may be in part due to lower ownership of these devices in the general population compared to mobile phones, and not necessarily to a lower perceived risk.

The in-depth analysis of pedestrians travel habits reveals four different types of pedestrians covering a wide range of behaviours from short to long distance travellers, public transport users and typical pedestrians. However, the results indicate that the majority of pedestrians do not fit the pedestrian stereotype, i.e. a large proportion of their daily travel is carried out by other means of transport. Moreover, a quite significant variation in these pedestrian types is observed among countries.

The cluster analysis applied on eight factors of attitudes and behaviour revealed three different types of pedestrians in terms of attitudes and behaviours. Type 1 is associated with positive attitudes and positive behaviour, while type 2 is characterized by negative attitudes and negative behaviour and type 3 with mixed attitudes and positive behaviour. Almost 70% of pedestrians have neutral to positive behaviour and attitudes to road safety while 30% express negative attitudes towards measures and interventions as well as towards the existing pedestrian environment and safety. In very few countries one of the three types of pedestrians is dominant; in most countries, a notable proportion of 'negative' pedestrians is observed.

CONCLUSIONS

Pedestrians constitute a very vulnerable type of road users. Although many studies attempted to analyze pedestrian attitudes or behaviour, the lack of large and detailed data, at national and international level and the lack of country comparisons were evident. This study attempts to address those issues by analyzing travel habits, attitudes and behaviour of pedestrians in Europe. The significant variations that were observed among countries raise the need for more specific analyses to correlate attitudes, behaviour and accidents concerning pedestrians. Moreover, important age, gender and area type/size differences regarding attitudes and behaviour show that future analysis could be more focused on specific aspects of pedestrian safety. Similarly, further research is needed in order to obtain more insight about the link of attitudes and behaviour.

Since pedestrian attitudes and perceptions affect their behaviour and also the nature of their interaction with motorized traffic, if pedestrian attitudes and perceptions are well-known and modelled appropriately, policy makers could be assisted in further understanding the pedestrian behaviour issues and safety needs. Finally, planning and implementation of measures to improve pedestrian safety could be more effectively performed, when taking into account the existence of different groups of pedestrians and their particular needs.

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