

Determinants of travel mode choice in Europe: Results from a survey on routine mobility

*Alessandro Silvestri**, *Sébastien Foudi** and *Ibon Galarraga***

Abstract

Understanding the differences in travel behaviour across different countries underlined by trip and individual characteristics are paramount to develop effective policies to nudge a shift towards sustainable mobility. In this study we present a descriptive analysis of the results of a mobility household survey, collecting information on citizen travel behaviour, travel mode choices and the factors influencing them. The study involves five European countries: Hungary, Italy, Norway, Poland and Spain. Results describe how travel mode choice fluctuates with users' heterogeneity and that different mobility transition policies receive different support from citizens. Instruments implying a direct financial cost are much less accepted than technology- and infrastructure-based policies. Support to policies such as road expansion is also observed. The transition in mobility should then have to deal with households' beliefs to make them revise their travel behaviours. But the mobility transition is also closely linked to the city development and the distribution of workplace and grocery shopping in the city.

Keywords: Mode choice, urban mobility, travel behaviour, attitudes, commute, survey.

1. INTRODUCTION

Mobility is an essential component of current society. It is highly connected to economic activity and, especially in developed countries, represents a necessity for citizens (Banister *et al.*, 2011). However, the current paradigm ruling mobility, based on conventionally fuelled private vehicle use, is causing several problems.

One of the most important problems is connected to the environment because transport is generating negative externalities significantly contributing to climate

* Basque Centre for Climate Change (BC3).

** Basque Centre for Climate Change (BC3) and Economic for Energy.

change and local air pollution. According to the European Environmental Agency, the transport sector accounts for a third of all energy consumption and more than 20% of total European Union (EU) greenhouse gases emissions (European Environment Agency, 2016). Moreover, it is the only sector that kept increasing its levels of emissions compared to the 1990 baseline, with an increase of more than 25% (European Environment Agency, 2016). Road transport is the main responsible of GHG emissions in the transport sector: its emissions account for about 70% of transport-related GHG emissions. This motivates the necessity to reduce emissions in this sector, which, based on the EU targets, is expected to cut 30% of its emissions by 2030 and 60% by 2050, compared to 1990 GHG emissions levels (European Commission, 2016).

To reach these targets the EU set key actions areas of “increasing the efficiency of the transport system”, “speeding up the deployment of low-emission alternative energy for transport” and “moving towards zero-emissions vehicles”. To allow this, a key role will be played by public administrations, responsible for implementing incentives for low-carbon mobility and encouraging public transport, active travel and bicycle and carsharing/carpooling schemes (European Commission, 2016). Moreover, road transport in cities is a cause of problems connected with quality of life such as congestion and noise. In this line, the high presence of private vehicles is also requiring a high share of urban space dedicated to cars, which could otherwise be used differently. The high presence of vehicles on the streets is also harmful to society by increasing the risk of accidents and causing health problems due to the already mentioned local air pollution. Besides, United Nations (UN) world urbanization prospects estimate that about 74% of European population currently live in urban areas and this percentage will rise to 82% by 2050 (United Nations, 2018). This implies these are going to be key areas where policies should ensure sustainable development of the transport sector. Urban areas are also the place where a higher number of mobility alternatives are available to citizens, hence where there are higher possibilities to shift away from private vehicle use. In these areas, high population concentration, shorter distances as well as congestions and lack of parking space might discourage the use of private vehicles in favour of metro, walking and cycling.

In this context, the aim of this paper is to understand citizen's mobility behaviour, choices and preferences, as well as to identify which are the key drivers and barriers to reducing the carbon intensity of mobility. The study aims at delivering a comparative analysis between 5 countries from both Eastern and Western Europe. The participating countries are Hungary, Italy, Norway, Poland and Spain. To do so we conducted a mobility household survey, which analyses citizen travel behaviour, travel mode choices and the factors influencing them.

With regard to travel behaviour, we want to understand what the routine weekly destinations are and how often are these reached. Moreover, we aim at understanding which travel modes are used in fulfilling weekly travel needs in both urban and rural areas. We do so collecting information on which modes are used and whether trips to different destinations are connected. Besides, we want to understand which are the main factors influencing the mode choice.

Section 2 will review the existing literature on the topic. More details on the methodology used to conduct the survey will be presented in section 3, while the description of the survey results will be presented in section 4. Section 5 will provide discussion of the results and concluding remarks.

2. LITERATURE REVIEW

The determinants of travel mode choices have been widely taken into account in previous research on mobility behaviour. For instance, several papers highlighted that *Land use and built environment* constitute a strong determinant of travel mode choice (Bhat, Sen, S. and Eluru, 2009; Ewing and Cervero, 2010; Limtanakool, Dijst, Schwanen, 2006). People living in urban or rural areas have clearly different needs and travel possibilities. Car use can be expected to be higher outside of cities, as found for example by Dargay and Vythoulkas (1999). In fact, higher population density is associated with higher availability of public transport (Limtanakool, Dijst and Schwanen, 2006). Moreover, it can make driving by car more complicated because of congestion and driving limitations. Nonetheless, in suburban and outer areas larger distances between locations affect active travel (Marquet and Miralles-Guasch, 2014). Aditjandra, Mulley and Nelson (2013) find diverse

travel behaviours between cities and suburban areas also in short length trips, which underlines choice differences that go beyond the infrastructural restrictions. From this, they argue that householders sort themselves in neighbourhoods according to their transport preferences. Hence, people living in a same place might have, to some extent, similar transport preferences and behaviours that can be tackled by specific policies or investments, *e.g.* in public transport infrastructure or car access and parking restrictions.

Another stream of factors which shape consumer mobility decisions are related to *trip characteristics*. The purpose of the trip is generally associated with different mode choices. The trip to work, for instance, is connected with a higher use of public transport given the frequency and regularity of the trip (Ortúzar and Willumsen, 2011). On the contrary, the possibility of storing products in the car can increase its use for grocery shopping while bringing children to school before going to work can be a reason to choose a car (Dieleman, Dijst, Burghouwt, 2002; Salonen *et al.*, 2014). Leisure activities could be done at times at which fewer alternatives are available, such as public transport in late hours (Ortúzar and Willumsen, 2011). Distance by itself influences mode choice: active travel for most people is an alternative only for short distances, while direct connections by public transport are often less available (Limtanakool, Dijst and Schwanen, 2006).

Another important group of factors are related to *individual characteristics*. These have been for a long time considered to be and used as the main discriminant in mode choice (Ortúzar and Willumsen, 2011; Van Acker *et al.*, 2007). However, in other studies their relative importance has been reconsidered and placed on the same level as the external aspects mentioned above (Dieleman, Dijst and Burghouwt, 2002). Individual features can be objective and subjective (Scheiner and Holz-Rau, 2007).

Starting with the objective factors, within the considered literature, four characteristics are found to be influential above others: age, education, gender and income (Lin, Allan and Cui, 2015; Santos *et al.*, 2013). People of different age have different needs and lifestyles which affect their choices and behaviours. Travel demand follows a pattern linked to age by what Dargay and Vythoulkas (1999) describe as 'lifecycle effect': on average, car use increases with age until the age of 50, and then starts decreasing. Young people might not be able to afford a private vehicle, while after a certain age health condition might limit

the possibility of moving by active travel or the ability to drive a car (Santos *et al.*, 2013). Highly educated people tend to have busiest weekly schedules which requires minimising travel time, opting then for using private vehicles (Schwanen, Dijst and Dieleman, 2002). However, they are also found to have a higher propensity towards alternative fuelled vehicles and electric vehicles (Hackbarth and Madlener, 2013; Hidrue *et al.*, 2011) and to take transport problems of congestion, safety and environment, more seriously (Rienstra, Rietveld and Verhoef, 1999). Women are found to be more concerned about transport problems than men (Rienstra, Rietveld and Verhoef, 1999; Vance and Lovanna, 2007) and to have lower car use and ownership and higher bus fare expenditures in general (Nolan, 2003). Interestingly, Golob and Hensher (1998) find that women have a higher environmental commitment and use more public transport, but also find them to be more disposed to perceive cars as a social status symbol. Hence, they argue that women are more likely to choose solo-driving all else being equal. In addition, car use is generally found to be increasing with income (Santos *et al.*, 2013; (Schwanen, Dijst and Dieleman, 2002). This may depend on various factors; on the ability to afford a private vehicle, but also, as in the case of education, on the sensitivity to travel time. However, Lin, Allan and Cui, (2015) argues that higher income households can afford housing locations that reduce distances, hence mitigating these higher private vehicle needs. Also, Golob and Hensher (1998), in Australia, find households with higher income to be more environmentally concerned and Rienstra, Rietveld and Verhoef (1999), in the Netherlands, find them to support more transport restriction policies.

In the last two decades, studies have identified subjective factors. These are associated with individual preferences and attributes of different mobility options (Anable and Gatersleben, 2005). As mentioned before, sensitivity to travel time can increase the propensity to move by private vehicle, while price sensitivity is considered to reduce it (De Borger and Fosgerau, 2008). Moreover, concerns about environmental impacts are found to have a significant effect on the acceptability of car use reduction policies and propensity to actually reduce car use, mainly by influencing personal norms (Eriksson Garvill and Nordlund, 2006; Nordlund and Garvill, 2003). In this context, Schuitema Steg and Rothengatter (2010) argue that convincing people about positive outcomes on congestion and environment is important to increase the acceptability of car use

reduction policies. In addition, Krupnick, Harrington and Alberini (2001) also find that the support of pricing policies depends on political views and perceived effects of car pollution on health. Moreover, safety and security perceptions are found to influence the choice of active travel mode (Singleton and Wang, 2014; Willis, Manaugh and El-Geneidy, 2013), but also public transport for women and higher income groups (Kamargianni *et al.*, 2015).

Cross-country analysis reveal socio-cultural differences. Buehler (2011) finds differences in travel behaviour for active travel modes between Germany and the US, even when controlling for a wide set of land use and individual specific characteristics. Similarly, Schwanen (2002) finds considerable differences both in travel time and distances as well as modal split between European countries. This suggests that in cross-country analysis, other differences, such as cultural or idiosyncratic ones, may emerge to affect travel related choices. These can affect the perception of transport externalities or the propensity to accept certain policies (Cairns *et al.*, 2014; Fujii *et al.*, 2004). For instance, Kim *et al.* (2013) argue that different perception of environmental issues between US and UK students can influence the propensity to accept sustainable transport policies.

3. METHODOLOGY

Our analysis of travel behaviour relies on a mobility household survey conducted in the winter 2017-2018. The survey has been implemented in Hungary, Italy, Norway, and Poland with more than one thousand respondents per country, and 760 interviews in Spain. Interviews have been conducted face to face in all countries except from Norway, which implemented the survey online. In all countries, participants were selected in order to ensure national representativeness.

The survey consists of two sections: a mobility section, which includes questions related to routine travel behaviour and preferences, while the second asks a series of sociodemographic questions (see Appendix A). The whole mobility section can be characterised by three blocks of questions: (i) the description of the routine trips, (ii) preferences towards mode attributes and (iii) a series of attitudinal questions.

- *Routine trip description* is covered by 4 questions (M1-M4) that focus on 5 typical destinations: the workplace (or university for students), children's school, children's activities location, grocery shopping and recurrent leisure activities. Participants are asked not to consider a specific week but rather what they consider to be their most typical weekly mobility behaviour. First, they are asked the weekly *frequency* of travel to these destinations from 1 to 7 days. Second, households are asked to describe in detail for each destination which modes they used to take and for how long. And third, they are asked about the *distance* between the destinations. The way in which these questions are designed also allows describing connected trips, for instance if one uses to go to work directly after bringing children to the school.
- The second block of questions elicits *preferences and attitudes towards mobility alternatives*. Interviewees are asked about the importance of different factors when choosing the travel mode. Factors have been selected according to the literature review presented in the previous section and include cost, travel time, comfort, flexibility, safety, privacy, environmental impact in terms of both air quality and CO₂ emissions, reliability, availability of the mode, and reputation. For each of these, participants assess the importance based on a 5-level Likert scale ranging from 1 = *not at all important*, to 5 = *very important*. In this study, we then group answers to distinguish between *sensitive* (4, 5) and *insensitive* (1, 2, 3) to the attribute. The third block includes attitudinal questions on policies, transport externalities and infrastructure. In the first of these, participants are asked to evaluate the support for a series of policies towards a transition to a sustainable mobility. These include: (a) improving traffic flow; (b) discouraging automobile use; (c) developing walkers and cyclists' friendly neighbourhoods; (d) enforcing emissions standards; (e) giving public transport dedicated traffic lanes; (f) reducing fares, increasing frequency, and expanding route coverage of public transport; (g) promoting mixed commercial and high density development to reduce distances; and (h) encouraging working from home to reduce travel needs. Interviewees are also asked about their perception of transport externalities like (a) congestion, (b) traffic noise, (c) space occupation, (d) air quality impact, (e) accidents, (f) impact on global warming and (g) unsafe communities. Moreover, they are asked about their level of satisfaction with the

following transport facilities: parking space, public transport timetables and coverage, bike and pedestrian lanes, public shared bikes and cars.

- The survey also includes a series of questions on the household's *social and economic characteristics*. In this section, respondents are first asked about their age, level of education, gender and residence city size. Respondents are also asked about their vehicle holdings. Finally, income is assessed by asking for the ability of present income to cover current costs through a 4 level question from “living comfortably” to “finding it very difficult” on present income.

4. RESULTS

4.1. Trip frequency and mode choice

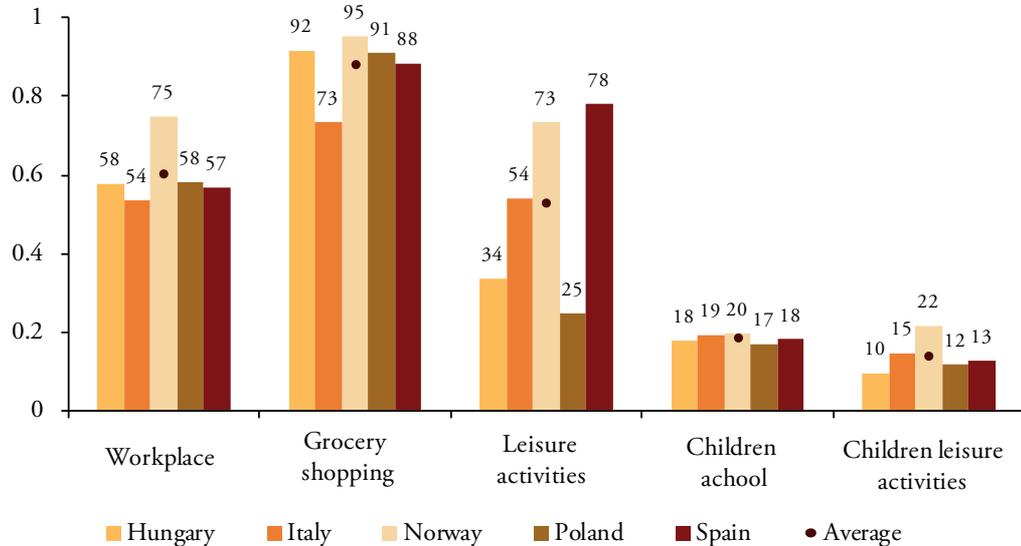
Exhibit 1 below shows the share of population performing the trip in each of the countries analysed and its frequency. Overall, patterns are quite similar across countries with the workplace trip being the most recurrent and the trip for groceries being the one performed by the highest share of population. Leisure activities show substantial differences across countries: in Norway and Spain this is performed by over 70% of the population, while in Hungary and Poland by, respectively, 34% and 25%. Trips related to children needs are performed only by households with minors. This explains the relatively lower shares of population performing the trip.

The workplace trip frequency is close to five days per week, suggesting most of the population tend to work full-time. Bringing children to school is the second most frequent trip in each country. Grocery shopping is done normally around 3 times per week, similar to leisure activities of both adults and children. In most cases, the trips are performed starting from home, although some differences can be found across countries (see Exhibit A1 in Appendix II). For instance, Hungary and Norway show a higher tendency to connect shopping and children's school trips compared to other countries, while Hungary, Italy and Spain have a higher tendency to connect trips related to Children's activities. Average distances and travel time for each trip (Table A1 in the Appendix II) are highest for the workplace trip in all countries. Spain, compared to the others, presents lower

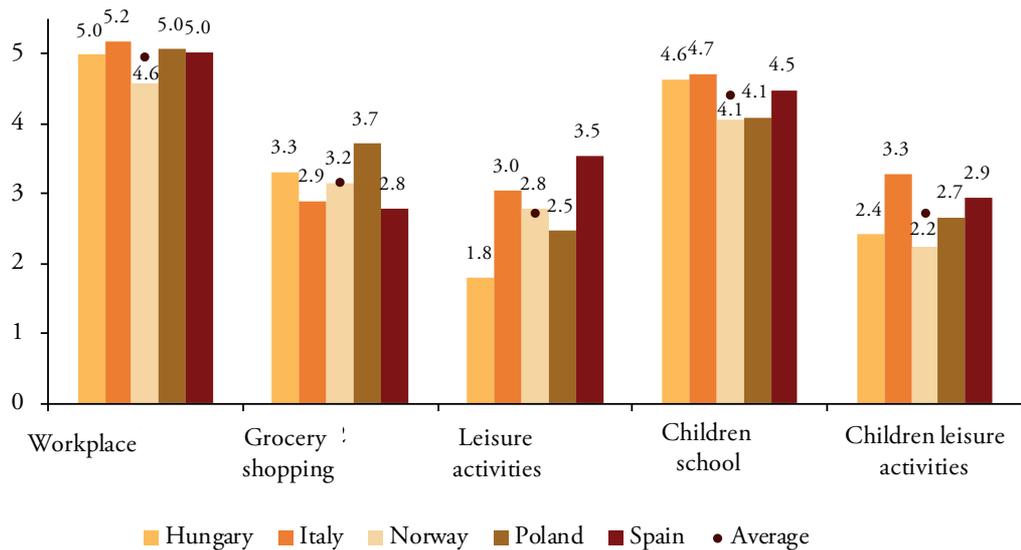
Exhibit 1

Trip frequency

1A. Share of population travelling to the selected destinations at least once in a week (percentage)



1B. Average number of days per week the destination is reached by households who perform the trip



Source: Own elaboration.

levels for each destination in both distance and travel time, while Hungary shows the highest values.

Exhibit 2 shows, for each destination, the shares of population performing the trip by private vehicle, public transport or active modes. Except for Spain where for many destinations active modes present the highest share (over 60%), in the other countries private vehicles seem to dominate in most of the recurrent trips.

Overall, the trip to the workplace shows the highest rate of time spent travelling by public transport, followed by leisure activities and children’s school, while the lowest levels are shown for the grocery shopping and children’s activities destinations. In this case, there seem to be more differences between trip destinations rather than between countries. In most of the cases active modes represent the second higher mode type after the private vehicle, with the exception of the trip to the workplace where these values are lower compared to public transport ones.

Exhibit 2

Shares of mode use in each country by trip destination

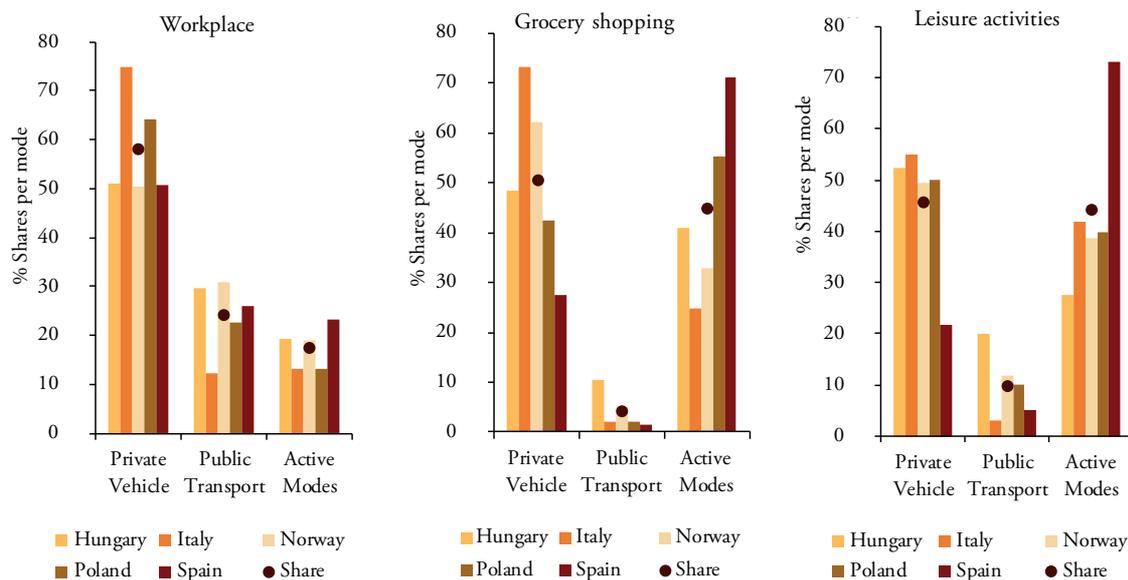
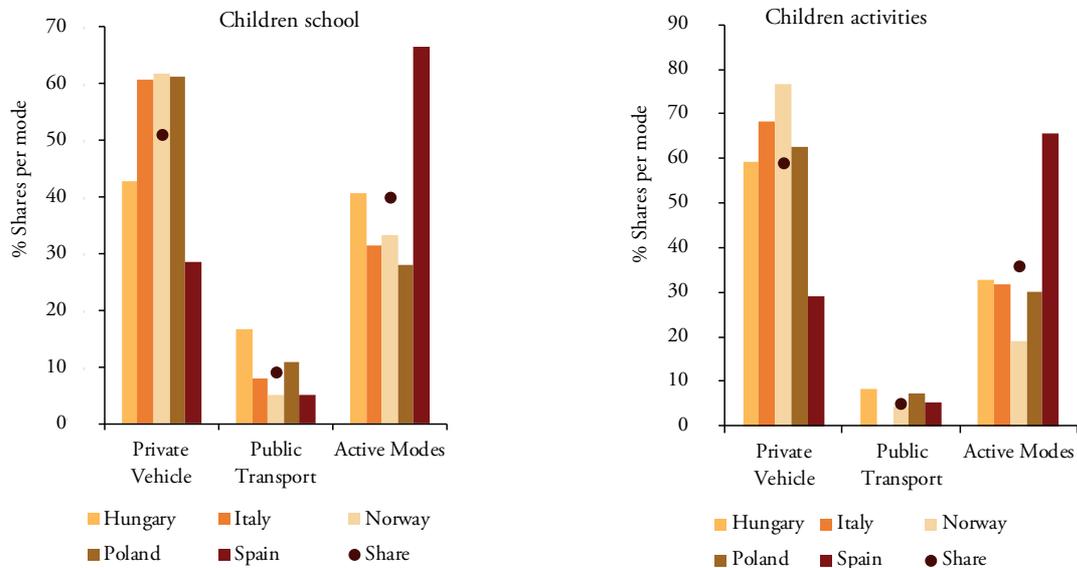


Exhibit 2 (continued)

Shares of mode use in each country by trip destination



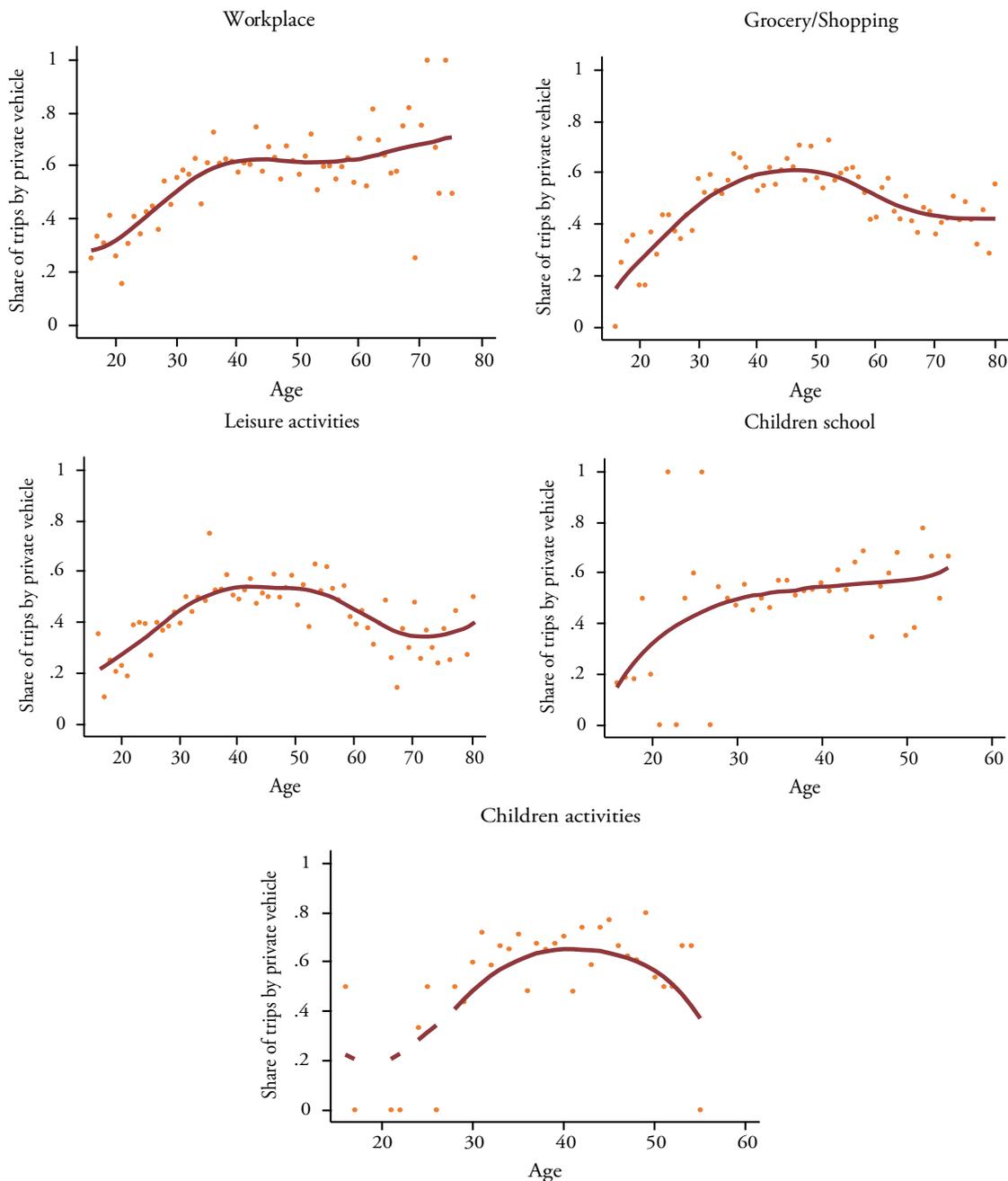
Source: Own elaboration.

4.2. Relationship of mode choice with socio-demographics

Changes in mode choice are then analysed in conjunction with several socio-economic characteristics. Exhibit 3 reports the share of trips with private vehicles by age. The red line represents a local-linear regression and shows the evolution of private vehicle use by age. In all trips, private vehicles' use increases with age up to around 40 years where it becomes steadier. Behaviour changes with older age by trip. In the case of workplace, private vehicle' use starts rising again after 60. In the grocery and leisure trips it lowers. Trips related to children needs have also different trends, where school trips keep increasing with age while activities trips decrease. It must be noted however that in these last two graphs the lower number of observations (respectively 905 and 704 out of the 5028 sample) might affect the estimation of mean values, especially for households with age below 30 and over 50. The same effect might affect the workplace trip after age 65 (the average age of retirement).

Exhibit 3

Average private vehicle use (%) by age



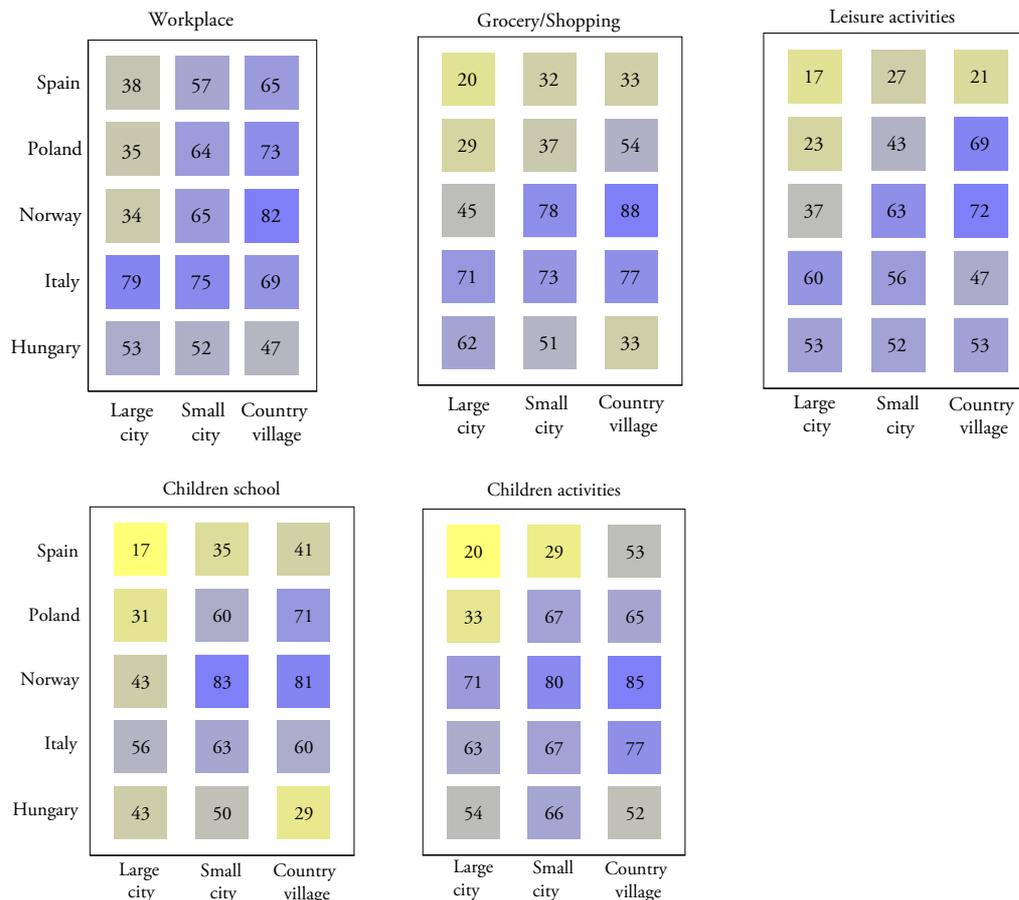
Note: In red, non-parametric local linear regression, kernel = Epanechnikov, bandwidth= 5).

Source: Own elaboration.

Exhibit 4 shows private vehicle use by household location, differentiating by large, small cities and country villages in each country. As shown in the previous section, Italy shows higher levels of private vehicle use than other countries, while Spain features the lowest for non-work related trips. In most cases, private vehicle use seems to be lower in large cities and higher in country villages. This is in line with what one might expect given the limited supply of transport alternatives and the higher distances between locations. However, Italy and Hungary seem to behave differently from other countries with similar use across city sizes, and even a higher use of private vehicles in large cities.

Exhibit 4

Heat maps of average private vehicle use (%) by household location



Note: Colour ranges from yellow (= 0%) and blue (100%).

Source: Own elaboration.

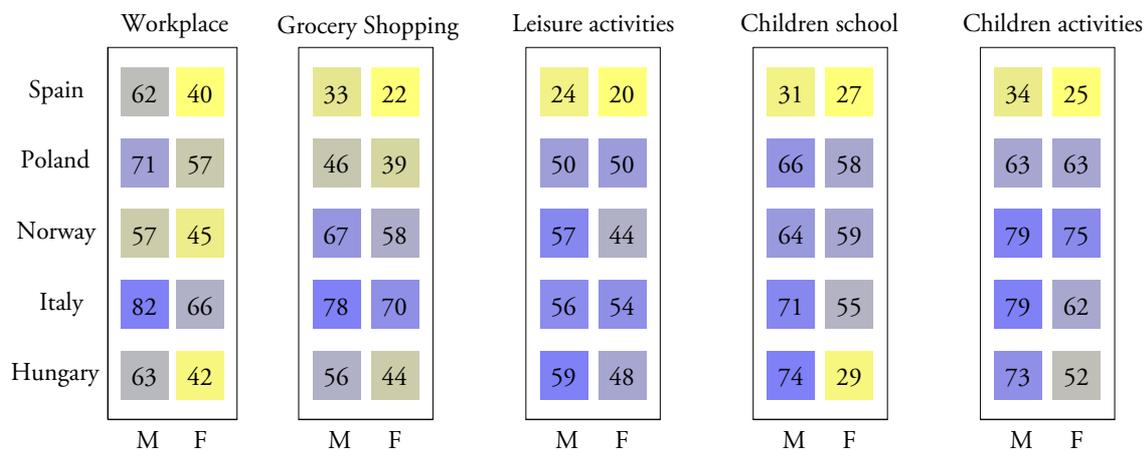
As shown in Exhibit 5, private vehicle use seems to be different between men and women. Men have in most cases a higher private vehicle use than women. The difference seems to be sharper in commuting to work, while for the other destinations, behaviours are rather similar, especially in Poland where the shares for leisure and children activities are equal.

Exhibit 6 shows that changes in private vehicle use with education seem to differ between countries. In Hungary, higher level of education seems to be very much connected with higher private vehicle use. However, in Spain private vehicle use decreases with education in commuting to work but increases for grocery shopping and children related trips. In general, in the grocery shopping trip higher education is related to higher private vehicle use.

With regard to income (Exhibit 7), patterns show that private vehicle use tends to increase with higher income groups.¹ However, in some cases the lowest

Exhibit 5

Heat maps of average private vehicle use (%) by gender



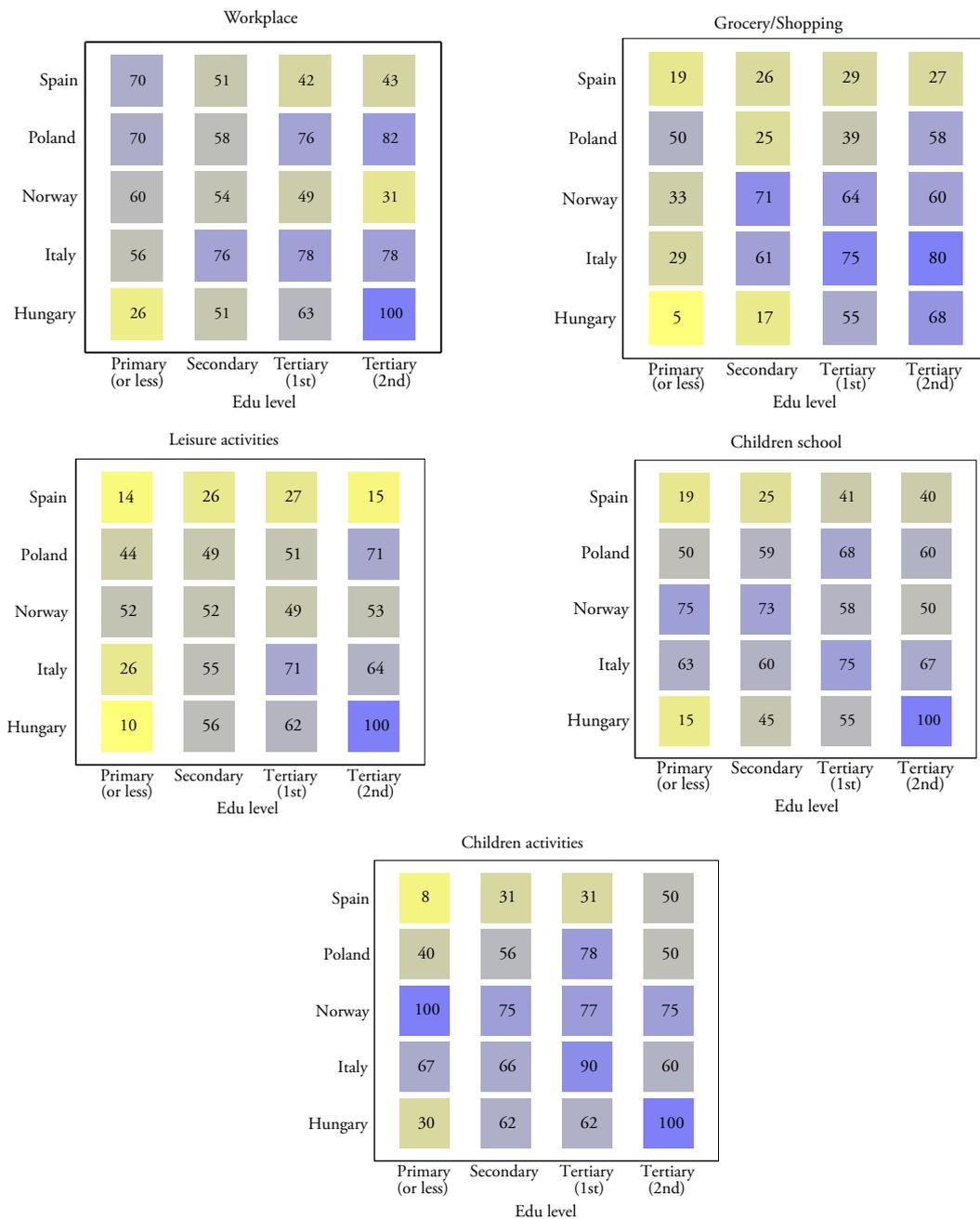
Note: M= Male, F= Female. Colour ranges from yellow (= 0%) and blue (100%).

Source: Own elaboration.

¹ The information used to distinguish income classes refers to a question on how the household perceive the present income allow them to live, ranging from comfortable to very difficultly.

Exhibit 6

Heat maps of average private vehicle use (%) by education level

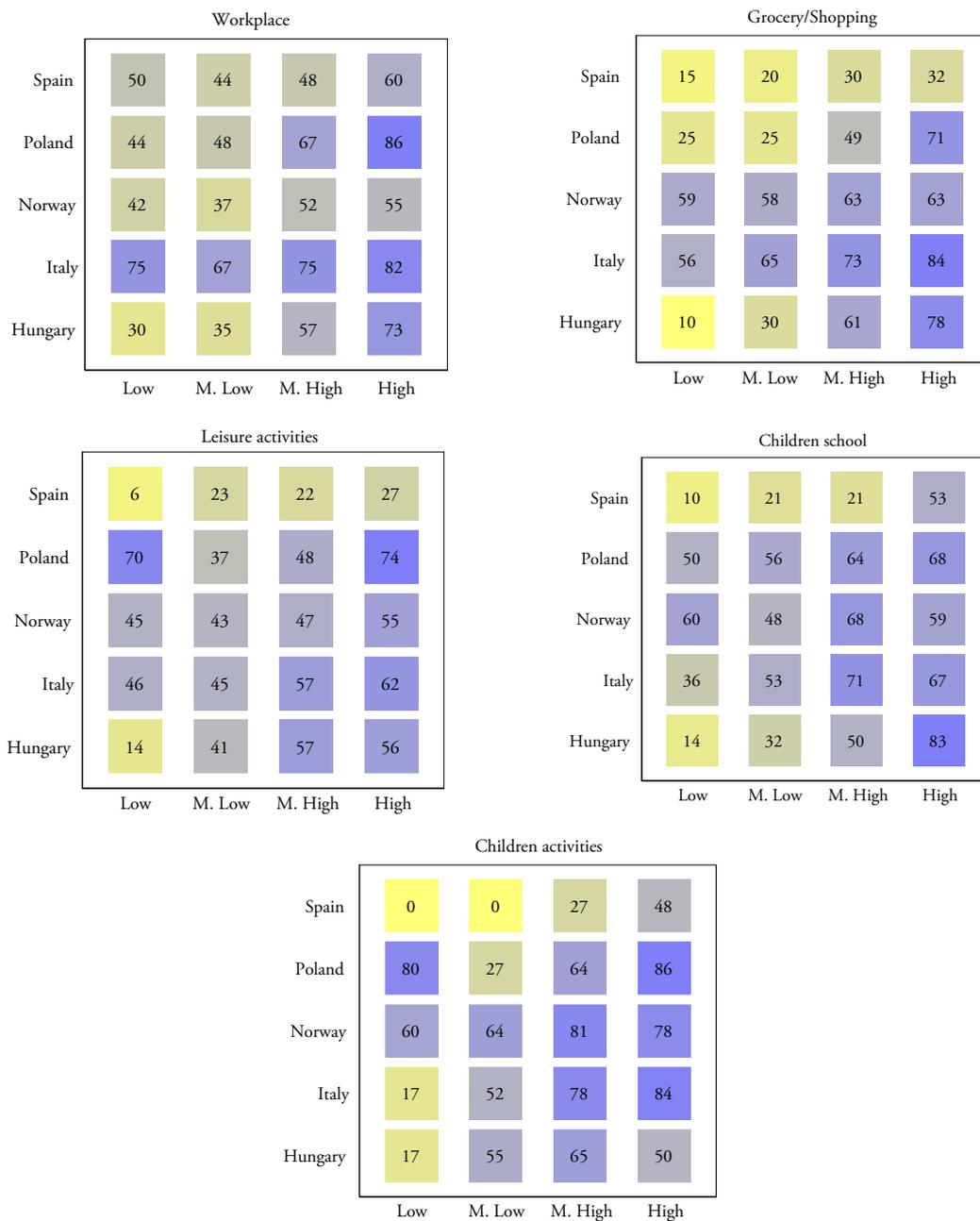


Note: Colour ranges from yellow (= 0%) and blue (100%).

Source: Own elaboration.

Exhibit 7

Heat maps of average private vehicle use (%) by income



Note: Colour ranges from yellow (= 0%) and blue (100%).

Source: Own elaboration.

income group also presents a relatively high private vehicle use. This is the case for commuting to work in Italy or children and leisure activities in Poland. Commuting to work in Spain, Norway and Italy seems to be rather similar across income groups, while it is increasing in Poland and Hungary.

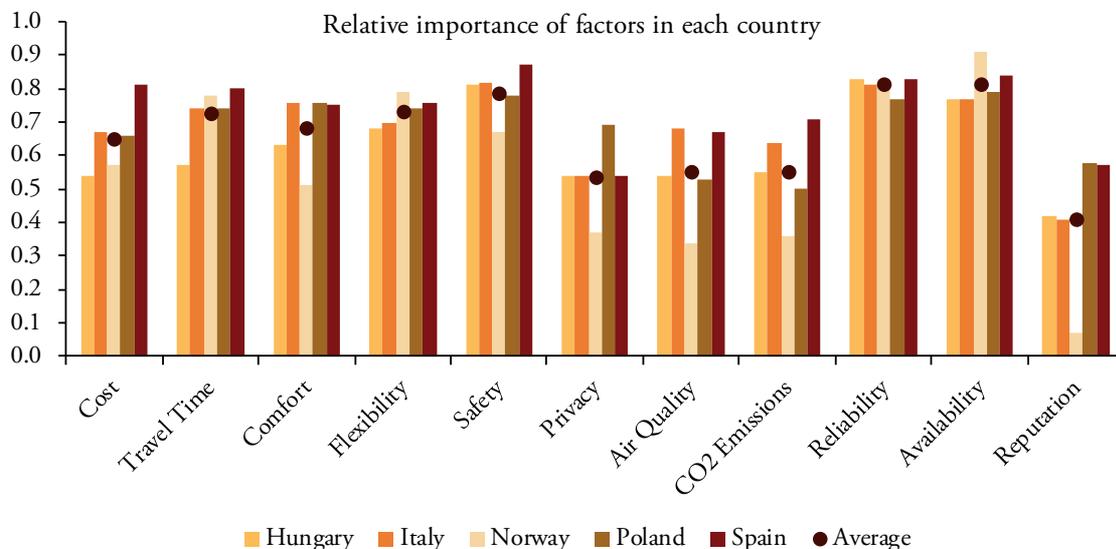
4.3. Households' beliefs and choice attributes

Several attributes influence the choice of travel mode. Exhibit 8 shows the average and country specific evaluation of the importance of a predetermined list of factors. Patterns across countries have some similarities. In almost all countries factors of *safety*, *reliability* and *availability* have been considered a priority, followed by *travel time*, *cost*, *flexibility* and *comfort*. On the other side, factors related to *reputation*, *privacy* and environmental impacts on *local air quality* and *CO₂* emissions are the ones valued less importantly.

Cost factors have been stated to be fairly decisive in all countries, especially in Spain, Poland and Italy, while received less importance in Norway and Hungary. *Travel time* seems in general to be evaluated even more important than cost, with the only exception of Spain where a similar importance is perceived. *Comfort* also ranked high in the household preferences except from Norway, where it scored sensibly lower compared to the others. *Flexibility* received similar votes in each country with around 70 to 80% of the population stating the factor to be 'important' or 'very important'. *Safety* was evaluated as influential by at least 80% of the sample with the only exception of Norway where it scored less (68%). *Privacy* scored fairly low compared to other factors except from Poland, where it was among the two most important factors for 70% of people. *Environmental factors* performed quite low and there seems not to be much difference between local air quality and CO₂ emissions. The lowest levels of concern for these factors have been found in Norway, while southern European countries, Italy and Spain, present a bit higher levels. Reliability and availability scored high and similarly across countries, with around 80% of the population valuing them at least as important. Finally, *reputation* is the least valued factor in almost all countries, hitting the lowest values in Norway, although in Poland it dominates environmental factors.

Exhibit 8

Shares of population valuing the factor as important or very important in each country

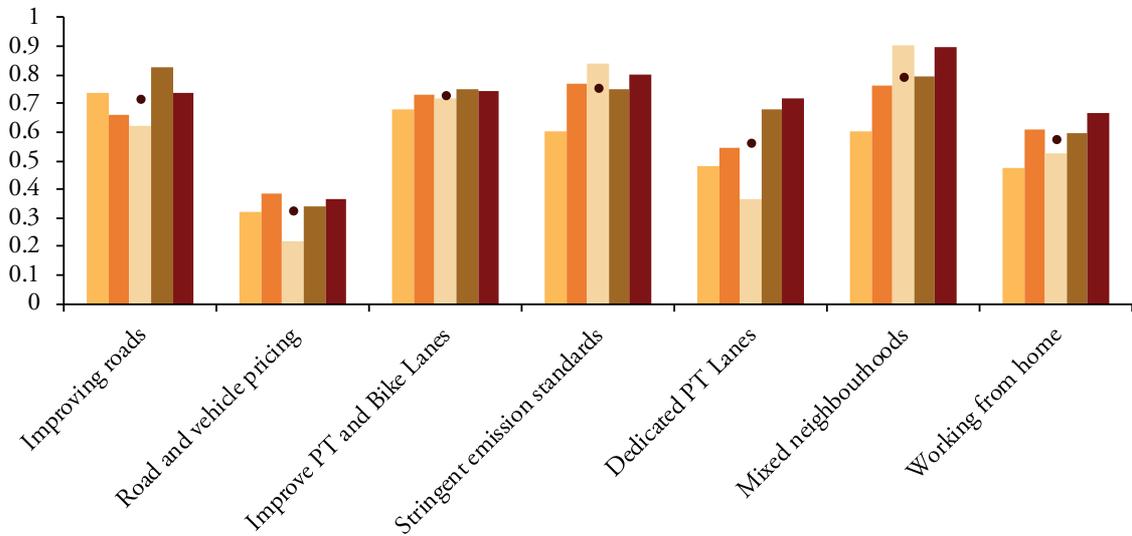


Source: Own elaboration.

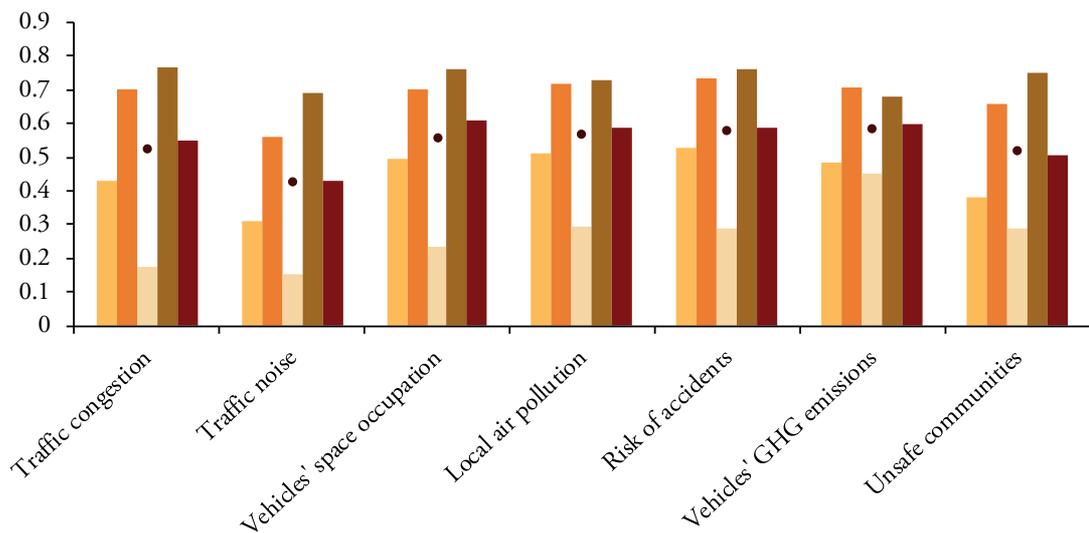
Exhibit 9 shows the preferences towards transition policies, transport externalities and satisfaction with infrastructure. With regard to support to transition policies (Exhibit 9A), the development of more stringent regulation for emission standards and the development of mixed neighbourhoods to reduce transport distances seem to be the most supported policies, especially in Norway and Spain. Nonetheless, high shares of the population seem to favour also improvement of roads as well as public transport and bike lanes. The lowest levels of support in all countries are related to discouraging private vehicle use through road and vehicle pricing. In most cases, answers are similar across countries, with values close to the average. On the contrary, more difference between countries is found in relation to the perception of transport externalities (Exhibit 9B). Norway presents the lowest share of people feeling affected by any of the listed externalities, while these shares are highest for Poland and Italy. The overall average values are quite similar for all externalities, scoring between 50% and 60%, the only exception being *noise* that is the least perceived in each country. Satisfaction

Exhibit 9

9A. Shares of population supporting potential transition policies



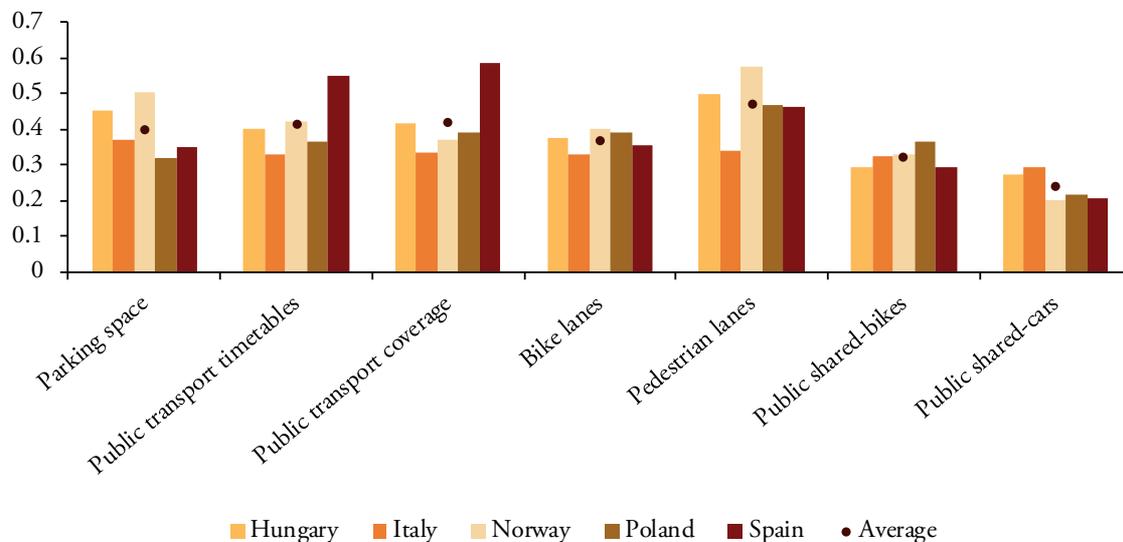
9B. Shares of population sensitive to transport externalities



Source: Own elaboration.

Exhibit 9 (continued)

9C. Shares of population satisfied by local transport infrastructure



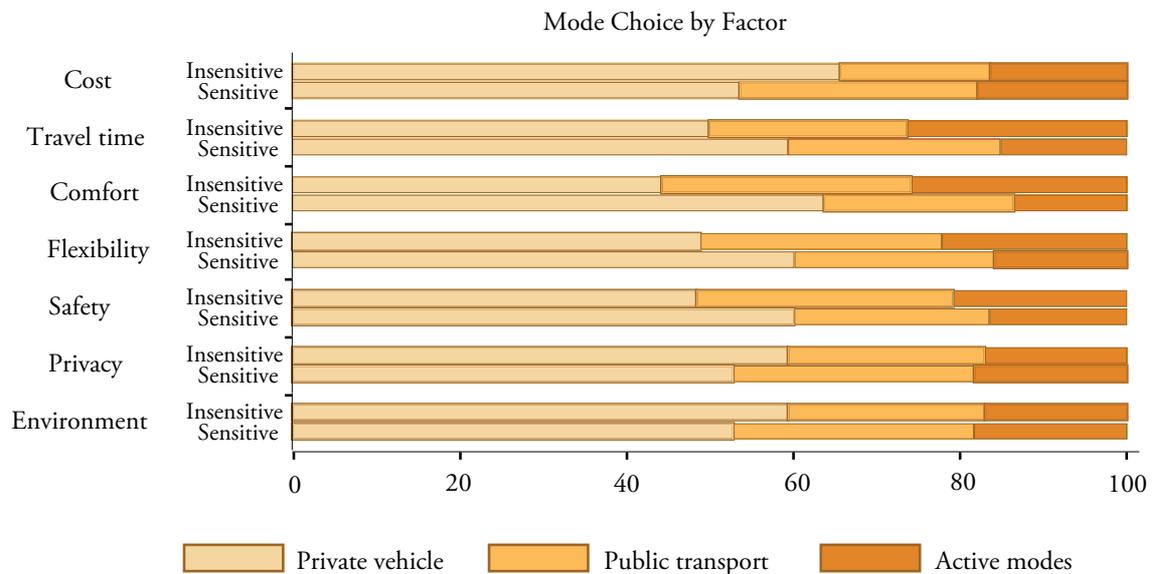
Source: Own elaboration.

with infrastructure (Exhibit 9C) is also, on average similar across the various options, with the exception of public shared bikes and cars which remain at a lower level. Overall, average values are below 50% for each infrastructure. Some differences can be found from country to country, with Spain being mainly satisfied with public transport timetables and coverage, and Norway and Hungary with parking space and pedestrian lanes.

In Exhibit 10, mode choice is analysed in conjunction with some of the choice attributes presented in the previous section. The *sensitive* group includes those households stating the attribute is either important or very important in their choice. Private vehicle use decreases with cost sensitivity and concerns for environmental impact,² while it increases with travel time, comfort, flexibility, safety and privacy. In particular, comfort and privacy are associated with the

² Derived as the mean value between local air pollution and CO₂ emissions sensitiveness.

Exhibit 10

Mode choice by choice attribute, comparison between sensitive and insensitive

Source: Own elaboration.

largest increases. Public transport use increases mainly with cost sensitivity and to a lower extent with travel time and environment. It decreases with the sensitivity to comfort, flexibility, safety and, especially, with privacy attributes. Active modes slightly increase with the sensitivity to cost and environmental impact attributes, while it decreases in all other cases, with travel time, comfort and privacy.

5. DISCUSSION AND CONCLUDING REMARKS

Across the different determinants of travel behaviour analysed in the previous section, the trip purpose seems to substantially affect the frequency of trips and mode choice. However, in the case of frequency of trips, countries seem to behave rather similarly: the work trip is performed on average around 5 days a week, grocery shopping 3 days a week and Children to school between 4 and 5 days a week. Only leisure activities show some country differences, with Hungary and Poland showing a sensibly lower share of people performing these trips. More

differences are found in mode use across the different countries. Italy and Poland seem to have a larger private vehicle use for commuting, while Norway for children related activities. Spain largely dominates in active travel for non-work related trips. In fact, it also shows shorter average distances and lower travel times in all trips. This may be also depending on more favourable weather conditions or on higher urban densities. The main distinction in mode choice is however related to work and non-work related trips. In fact, public transport use is rather low in non-work related activities in all countries, especially in Italy. This, may be due to the fact that public transport use might be limited because of restricted timetables at evenings and being less comfortable when moving with grocery or bags (Dieleman, Dijst and Burghouwt, 2002; Ortúzar and Willumsen, 2011; Salonen *et al.*, 2014).

Results also generally confirm the influence of city size, with lower use of private vehicle in large cities (Dargay and Vythoulkas, 1999). However, Italy and Hungary seem to go against this finding, showing higher private vehicle use. A deeper consideration of contextual factors, such as local transport policies, city structure and road infrastructure, might need to be taken into account. However, this could also underline some differences in cultural attitudes towards car use.

Private vehicle use seems to change with age as also argued by Dargay and Vythoulkas (1999), with an increasing tendency of use up to 40 year-olds. However, while this seems to be reduced for older people in grocery and leisure activities, for commuting it continues to increase. Gender influence seems substantially in line with the literature (Nolan, 2003; Vance and Lovanna, 2007); women having a lower use of private vehicles in all countries and for all trip purposes. Also, the effect of education and income seem to be generally in line with literature, which associates a positive relation of these with private vehicle use. However, highly educated people in Norway and Spain seem to behave differently, using private cars less for commuting to work. The reason behind this would need more investigation. It may be associated with higher environmental concerns, as argued by (Rienstra, Rietveld and Verhoef, 1999), or because the level of education might be higher in larger cities.

When associating the sensitivity of attributes to actual mode choices, interviewees seem to act consistently with their preferences. Comfort seekers and privacy seekers are associated with the largest increase in private vehicle use, while cost sensitivity and environmental concern are associated positively with public transport use and active travel (De Borger and Fosgerau, 2008; Eriksson, Garvill and Nordlund, 2006). The survey also highlights the importance of safety and reliability considerations across all countries (Kamargianni *et al.*, 2015; Singleton and Wang, 2014; Willis Manaugh, K., El-Geneidy, 2013). In fact, not only a high share of population stated to be sensitive to these factors in all countries, but they seem also to have a lower public transport use and active travel. These results highlight that public transport is perceived as a less comfortable, safe and reliable alternative to private transport. Policies should target these limitations in order to facilitate shifting away from private vehicle use.

Countries show in general similar support to mobility transition policies. Road and vehicle pricing are the least supported, followed by dedicated public transport lanes in most countries. Mixed neighbourhoods, more stringent emission standards and controls and improvements of mobility infrastructure seem the most supported. Countries that feature a higher use of private vehicle for workplace trips (Italy and Poland) seem more affected by externalities. This may suggest that the higher private vehicle use makes them perceive externalities more intensely. Conversely, Norway and Hungary, which have the highest public transport use, have a sensibly lower sensitiveness to these externalities. Spain seems to have higher satisfaction with public transport infrastructure. However, it does not seem to use it more than other countries. Similarly, in Norway, the higher parking space and pedestrian lane satisfaction does not seem to be associated with more private vehicle use or active travel. Satisfaction towards shared mobility infrastructure is generally the lowest. This might suggest that the perception of transport externalities might be more connected with different travel behaviour than with the satisfaction with infrastructures.

Causal relations (*e.g.* income and education, distance and mode choice) must be further investigated. This analysis presented the descriptive results of travel behaviour in five European countries and put the attention on aspects to consider when analysing travel behaviour. First, the importance of considering country

specific behaviour when considering factors such as education and city size. Meanwhile, the relative importance of choice attributes and attitudes regarding externalities and transport policies seem to be similar across countries and seem to be associated with consistently different travel behaviour.

The descriptive statistics reveal that transport policies receive different support from citizens. As expected, those policies implying a direct financial cost for users are much less supported than infrastructure or technology-based policies. Citizens are much less supportive of road and vehicle pricing instruments and would rather support mixed neighbourhood development. On this last point, the survey's results show that in some countries active travel is commonly used for grocery shopping. This choice is likely to be motivated by the presence of corner shops in cities. However, citizens are also supportive of policies dedicated to improving road traffic and expansion while it is well known that expanding roads does not solve congestion problems in the long run (Duranton and Turner, 2009). Informational gaps regarding the effectiveness of some instruments to change travel behaviour are thus present. Hence, a successful mobility transition should have to address them so that citizens can accept them and would revise their mobility behaviours.

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APPENDICES

I. ENABLE.EU Mobility Household Survey (partial)

Section M - MOBILITY

Introduction: In the following 4 questions you will be asked about your usual way of moving from a place to another in your everyday routine. You will be presented a list of destination categories, for each of these, please think of the singular most habitual destination that can be referred to this category and answer according to this.

M1. How many days in a week³ do you typically travel (incl. walking) to the following locations?)

ONE answer per row

		Number of days in a week							
		0	1	2	3	4	5	6	7
A	Workplace/university	0	1	2	3	4	5	6	7
B	Children's school	0	1	2	3	4	5	6	7
C	Location of children's activities	0	1	2	3	4	5	6	7
D	Grocery/shopping	0	1	2	3	4	5	6	7
E	Leisure activities (gym, sport, tours,...)	0	1	2	3	4	5	6	7

Source: Own elaboration.

Ask only for M1A-to-E ≠ "0"

Trip to [Destinations A to E]:

M3A. Where do you normally⁴ leave from, when you travel to the [Destinations A to E]?

1. Home
2. Workplace/University
3. Children's school
4. Location of children's activities
5. Grocery/Shopping
6. Leisure activities (gym, sport, tours...)

Source: Own elaboration.

³ Note for the interviewer: Typical day/week are to be referred to the most common day/week in a year, one can think of, according to her/his current situation.

⁴ Please, refer to your most habitual departure location.

M3B. Which of the following travel modes you usually use to perform the trip to the [Destinations A to E] and how much time it takes?

Tick all that apply and mark the respective time, e.g. 5 min walking and 12 minutes bus to reach my [Destinations A to E]

	Time (hh:mm)
1. Traditional car (diesel/ gasoline)	__:__
2. Alternative fueled car (Methane/ LPG)	__:__
3. Electric/ Hybrid car	__:__
4. Motorcycle/ Scooter	__:__
5. Carpooling ⁵	__:__
6. Bus	__:__
7. Train	__:__
8. Metro/Tram	__:__
9. Bicycle	__:__
10. Walking	__:__
11. Other, please specify	__:__
99. Not applicable	

Source: Own elaboration.

M4. How many kilometers does the trip to the following destinations take?

ONE answer per row

	Distance in km	(Don't know / No answer)
A Workplace/university	_____ km	99
B Children's school	_____ km	99
C Location of children's activities	_____ km	99
D Grocery/shopping	_____ km	99
E Leisure activities (gym, sport, tours,...)	_____ km	99

Source: Own elaboration.

⁵ Carpooling defined as moving with a private vehicle but as passenger instead of driver.

M5. What importance do the following factors have in your decision between different methods of travel?

ONE answer per row

		1 Not at all important	2	3	4	5 Very important	Don't Know
A	Cost	1	2	3	4	5	99
B	Travel time	1	2	3	4	5	99
C	Comfort	1	2	3	4	5	99
D	Flexibility	1	2	3	4	5	99
E	Safety	1	2	3	4	5	99
F	Privacy	1	2	3	4	5	99
G	Air quality impact	1	2	3	4	5	99
H	CO ₂ emissions impact	1	2	3	4	5	99
I	Reliability	1	2	3	4	5	99
J	Availability of method	1	2	3	4	5	99
K	Reputation	1	2	3	4	5	99
L	Other, please specify:.....	1	2	3	4	5	99

Source: Own elaboration.

M8. What is your level of support for the following government actions that would influence your transportation system?

ONE answer per row

		1 Strongly opposed	2	3	4	5 Strongly supportive	Don't Know
A	Improving traffic flow by building new roads, and expanding existing roads	1	2	3	4	5	99
B	Discouraging automobile use with road tolls, gas taxes, and vehicle surcharges	1	2	3	4	5	99
C	Making neighbourhoods more attractive to walkers and cyclists using bike lanes, and speed controls	1	2	3	4	5	99
D	Reducing vehicle emissions with regular testing, and manufacturer emissions standards	1	2	3	4	5	99
E	Making public car-sharing and public transport faster by giving them dedicated traffic lanes, and priority at intersections	1	2	3	4	5	99
F	Making public transport more attractive by reducing fares, increasing frequency, and expanding route coverage	1	2	3	4	5	99
G	Reducing transportation distances by promoting mixed commercial and residential, an high density development	1	2	3	4	5	99
H	Reducing transportation needs by encouraging compressed workweeks and working from home	1	2	3	4	5	99

Source: Own elaboration.

M9. Thinking about your daily experiences, how serious do you consider the following problems related to transportation to be?

ONE answer per row

		1 Not at all important	2	3	4	5 Very important	Don't Know
A	Traffic congestion you experience while driving	1	2	3	4	5	99
B	Traffic noise you perceive at home or doing your activities	1	2	3	4	5	99
C	Excessive presence of vehicles occupying urban spaces	1	2	3	4	5	99
D	Vehicle emissions, which impact local air quality	1	2	3	4	5	99
E	Accidents caused by aggressive or absent minded drivers	1	2	3	4	5	99
F	Vehicle emissions, which contribute to global warming	1	2	3	4	5	99
G	Unsafe communities due to speeding traffic	1	2	3	4	5	99

Source: Own elaboration.

M10. How much are you satisfied with the following facilities where you live and conduce your activities?

ONE answer per row

	1 Very low	2	3	4	5 Very high	Not applicable	Don't Know
Parking space	1	2	3	4	5	6	99
Public transport timetables	1	2	3	4	5	6	99
Public transport coverage	1	2	3	4	5	6	99
Bike lanes	1	2	3	4	5	6	99
Pedestrian lanes	1	2	3	4	5	6	99
Public shared-bikes	1	2	3	4	5	6	99
Public shared-cars	1	2	3	4	5	6	99

Source: Own elaboration.

Section S - SOCIAL AND ECONOMIC CHARACTERISTICS

S2. What is the highest level of studies, you have completed?

Only ONE answer

- 1 No formal education or below primary
- 2 Primary education
- 3 Secondary and post-secondary non-tertiary education
- 4 Tertiary education first stage, *i.e.* bachelor or master
- 5 Tertiary education second stage (PhD)
- 9 (Don't know)

Source: Own elaboration.

S4. What year were you born?

1.

99. (Don't know / refuse to answer)

Source: Own elaboration.

S5. What is your gender?

Only ONE answer

- 1 Male
- 2 Female

Source: Own elaboration.

S6. Which phrase describes best the area where you live?

Only ONE answer

- 1 A big city (more than 0,5 mln people)
- 2 The suburbs or outskirts of a big city
- 3 A town or a small city
- 4 A country village
- 5 A farm or home in the countryside
- 6 (Don't know)

Source: Own elaboration.

S8. Which of the descriptions bellow comes closest to how you feel about your household's income nowadays?

Only ONE answer

- 1 Living comfortably on present income
- 2 Coping on present income
- 3 Finding it difficult on present income
- 4 Finding it very difficult on present income
- 99 (Don't know)

Source: Own elaboration.

H4. How many of the following vehicles your household owns?

ONE answer per row

		Don't have	Number of vehicles			(Don't know)
			1	2	3	
A	Petrol car	1	2	3	4	99
B	Diesel car	1	2	3	4	99
C	Alternative fuelled car (methane, LPG)	1	2	3	4	99
D	Electric car	1	2	3	4	99
E	Hybrid car	1	2	3	4	99
F	Motorcycle (or Scooters)	1	2	3	4	99
G	Electric Motorcycle (or Scooter)	1	2	3	4	99
H	Van, truck, caravan	1	2	3	4	99
I	Bicycle	1	2	3	4	99
J	Electric bicycle	1	2	3	4	99

Source: Own elaboration.

II. Trip characteristics and vehicle ownership

Table 1A

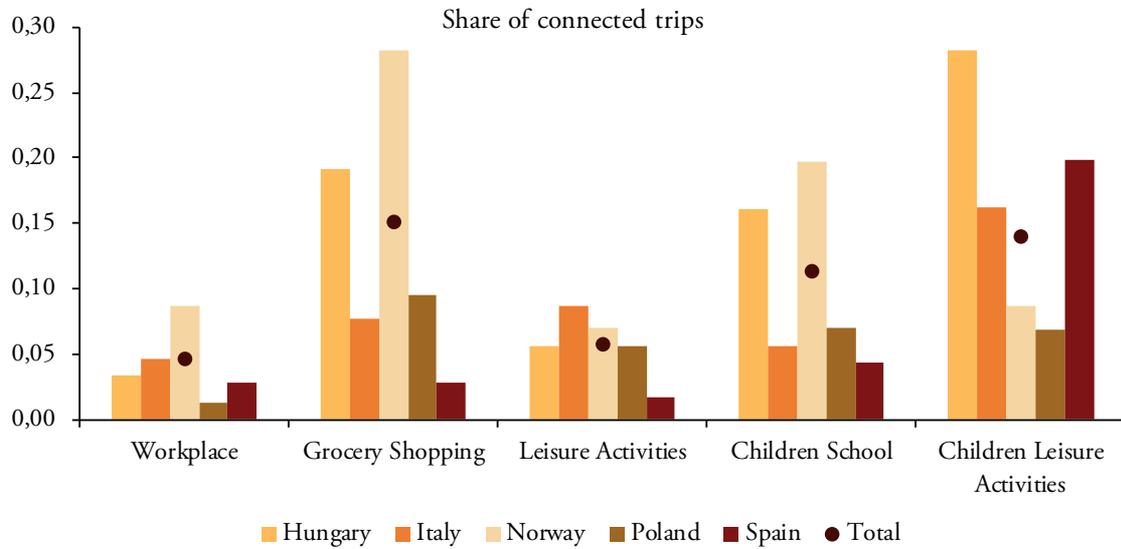
A) Shares of vehicle ownership by vehicle type in each country; B) Average distances of trips by destination; C) Average travel time by destination

	Hungary	Italy	Norway	Poland	Spain	Total
A) Vehicles ownership ()						
No motorized vehicles	35.42	12.29	17.77	27.00	28.95	23.77
Conventional vehicle	64.09	86.24	76.41	64.60	69.34	72.49
Alternative vehicle	1.96	9.37	14.50	13.50	3.68	9.07
Bicycle	58.12	41.85	79.77	66.80	36.18	58.47
B) Average distance (Km)						
Workplace	13.52	12.87	11.27	13.17	7.21	11.29
SE workplace	0.56	0.83	0.48	0.56	0.54	0.26
Grocery shopping	4.66	4.69	2.95	3.16	2.11	3.28
SE Grocery shopping	0.21	0.29	0.15	0.21	0.15	0.19
Leisure activities	12.04	0.54	6.15	6.86	4.41	3.75
SE Leisure activities	0.70	0.05	0.52	0.84	0.60	0.18
Children school	5.47	3.74	3.33	4.98	2.34	3.57
SE Children school	0.54	0.48	0.43	0.64	0.28	0.09
Children activities	7.92	3.90	6.29	6.37	2.03	6.39
SE Children activities	1.22	0.74	0.59	0.94	0.04	0.31
C) Average travel time (mm:ss)						
Workplace	27:55	24:44	25:01	24:58	21:15	24:57
SE workplace	00:39	00:45	00:36	00:33	00:38	00:17
Grocery shopping	17:58	16:53	13:33	13:40	08:39	14:15
SE Grocery shopping	00:24	00:30	00:26	00:19	00:15	00:11
Leisure activities	26:07	21:13	18:09	17:50	11:52	18:09
SE Leisure activities	00:50	00:42	00:33	00:43	00:30	00:18
Children school	19:41	14:11	12:59	15:36	08:48	14:29
SE Children school	00:56	00:50	00:55	00:50	00:30	00:24
Children activities	20:24	15:34	15:35	18:00	10:13	15:56
SE Children activities	01:14	01:07	00:52	01:06	00:48	00:29

Source: Own elaboration.

Exhibit 1A

**Shares of trips connected to a previous destination
(not starting from home)**



Source: Own elaboration.