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Public acceptance of *SocialCar*, a new mobility platform integrating public transport and car-pooling services: insights from a survey in five European cities

Steve Wright[a], Francesca Cellina[b]*, Maria Bulgheroni[c] Fabio Cartolano[d], Luca Lucietti[d], Patrick van Egmond[e], Luc van Wijngaarden[f]

[a] Centre for Transport Research, School of Engineering, University of Aberdeen, Aberdeen, AB24 3UE, UK
[b] *University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Campus Trevano Canobbio 6952, Switzerland*
[c] *Ab.Acus srl, Milano 20100, Italy*
[d] *FIT Consulting srl, via Lavinio 15, Rome 00183, Italy*
[e] *Luxmobility, 70, Boulevard de la Fraternité, L-1541 Luxembourg, Luxembourg*
[f] *Zight B.V., Breestraat 5, 2311 CJ Leide, The Netherlands*

Abstract

In this paper we present results of a technology acceptance and stated intention survey delivered in five European sites to assess citizens' attitudes and perceptions towards a new multi-modal mobility service named *SocialCar*, developed under a EU H2020 research project and aimed at reducing individual car use. Such a service facilitates a fruitful integration between public transport and car-pooling services, by means of a smartphone application and advanced artificial intelligence algorithms. Citizens' willingness to actively use the new App and to alter their behavior as a result is therefore crucial for the success of the *SocialCar* concept and the creation of new collective mobility practices. The survey provides insights on intention to use *SocialCar* and the related expected changes in travel behavior for different groups in society. It also reveales differences between each site and highlights context-specific open challenges to address in order to favour future large-scale diffusion of the *SocialCar* mobility service. A real life test, to be conducted in Autumn 2017 and presented at the conference, will give us additional insight.

Keywords: multi-modal mobility; sharing mobility; carpooling; stated intention survey; public acceptance.

* Corresponding author. Tel.: +41-(0)58-666-6261
E-mail address: francesca.cellina@supsi.ch

1. Introduction

Current mobility patterns are dominated by individual car use. How can we stimulate people to change their mobility behaviour and opt for other means of transport? One of the elements most citizens mention as a critical barrier to change, is the lack of adequate public transport (PT) options, both in terms of access to stops, frequency of the routes and flexibility and easiness of the interchanges (see for example Cellina et al., 2016). Seeking for alternatives to individual car use by relying on PT alone, in fact, often imposes lengthy walks to/from PT stops, followed by convoluted and time-consuming multi-leg journeys, which are not convincing as viable alternatives to door-to-door car routes. Alternatives such as (dynamic) car-pooling or ridesharing are instead gaining popularity, though they are not always available, since matches between demanded and offered trips are not easy to be found, if a critical mass of user is not reached (see for example Handke and Jonuschat, 2013).

In such a framework, *SocialCar* overcomes the traditional competition between private and public modes of transport, envisioning instead a fruitful collaboration among them: it develops the integration between PT and car-pooling services, exploiting real time traffic data and automatically processing them by artificial intelligence algorithms. *SocialCar* envisions a sort of a "Public-Private-People Partnership" for urban transport, as defined by Majamaa et al. (2008), where PT companies, car-pooling companies and citizens collaborate to the co-production of a new mobility service, which offers multi-modal, time-effective and flexible on-demand mobility options. Such services are offered by means of a smartphone App, which allows planning, booking and (wherever possible) payment for multi-modal trips, combining rides offered by other citizens with regular PT. While technology enabled carpooling/ridesharing is an emerging and rapidly growing travel option, its use is still not commonplace. Combining carpooling with PT is a relatively untried concept, which opens up the potential for many more travelers to find a combined mode match between their origin and destination, where single mode journeys options using only PT or only carpooling do not exist. However, public attitudes to new services and combined multi-modal travel are not always positive, due to resistance to change over established habits, lack of familiarity with untried services and additional perceived risks associated with interchanging from one mode/service to another. Therefore, analyzing the level of public acceptance of the *SocialCar* system before offering it on the market is essential. To gain understanding on such a public acceptance, we developed a stated intention survey, based on the Technology Acceptance Model (TAM) framework, and delivered it in five different European cities: the cities of Brussels (Belgium), Edinburgh (Scotland), Zagreb (Croatia), Torino (Italy) and the Canton Ticino region (Switzerland). Results of the survey will be backed-up and confirmed by data arising from a real-life testing of the whole *SocialCar* system, which at the time of writing (Autumn 2017) is ongoing. Final results including elements from both the survey and the field test will be presented at the TRA 2018 conference.

After an introduction to the *SocialCar* technology (Section 2), in this paper we focus on the stated intention survey we developed for *SocialCar* (Section 3), illustrate how it was distributed to the population and present the results obtained. In particular, we provide specific insights on intention to use *SocialCar* and expected changes in mobility behaviour for each site, also highlighting similarities and differences between sites (Section 4). We also discuss if and how the results obtained can be related to factors such as previous experience using carpooling services and with use of smart phones/App technology. We conclude by commenting on the limitations of such an approach and by identifying open challenges to be addressed in order to favour future large-scale diffusion of the *SocialCar* mobility service (Section 5).

2. The *SocialCar* technology

In the context of the sharing economy, web and App-based travel assistance services quickly spread, frequently triggering changes to the operational models of conventional transport providers, such as PT providers and taxi companies, by promoting greater cooperation and flexibility. From initial *trip or journey planners* (Internet and mobile Applications assisting users in searching for the best route from an origin to a destination at a given moment and with a specific mode of transport, based on travelling time, cost or environmental impact), such services evolved in *mobility aggregators* (multi-modal journey planners, exploiting dynamic map-matching models and real-time location based services). They are expected to further evolve in *Mobility as a Service (MaaS) schemes* (Kamargianni et al, 2016; Mulley, 2017), that are able to satisfy users' major transportation needs, by offering mobility packages including access to PT, ridesharing, bike and car-sharing and taxis: with the convenience of a single payment point, *MaaS* schemes create viable alternatives to car ownership. The *SocialCar* system lies in this framework, in between an *aggregator* and a *MaaS* provider. Table 1provides an overview of the characteristics of the most used travel assistance services/Apps we identified in 2017 in a desk-based research at the international level, compared to *SocialCar*.

In more detail, *SocialCar* allows users to offer and seek for a ride, by means of a smartphone App, available for Android and iOS operating systems. The App has recently been rebranded as *RideMyRoute*, though for the sake of simplicity here we will refer to it as the *SocialCar* app. After logging in and shortly specifying their profile preferences, both as "drivers" and as "passengers", *SocialCar* allows user to either offer a ride or to ask for a ride from point A to point B. When users seek for a journey, a multi-modal route planning engine is activated, which takes into account walking possibilities, PT time-tables, car rides offered by other users and any disruption in the related time schedules, by exploiting real time traffic information, even provided by other users by means of social networks. Real time route planning and ride matching algorithms used by the system are presented in Jamal et al. (2016). As a result, they provide the user with a number of full-length trip proposals, that usually include both carpooling and PT legs. This allows to combine the flexibility of carpooling services with the advantages offered by existing PT services; e.g. a network of low cost services which provide connection to the main trip attractors. Fig. 1 shows some App screenshots.

To simplify the user mobility experience and to reduce the risk of missing connections due to traffic or any other reason for delay, carpooling legs are only offered either at the beginning or at the end of the whole trip. In between, PT and walking legs are offered. If more options are found, users are allowed to order them by overall travel time or cost (estimated by the system). While travelling, real-time updates are provided on the status of each leg of the journey, providing advance warning if delays or incidents are likely to disrupt their journey. In such situations the App can suggest alternative options to avoid or minimize the disruption, thus reassuring travelers that connections will be met. Finally, to overcome resistance to carpooling due to the fear of sharing rides with strangers, a user feedback and rating system is included, directly connected with social networks: after every ride, users are requested to rate their travel companion and can share the assessment on Facebook.

Table 1. Functionalities offered by the most used travel assistance services/Apps identified in a market review in 2017.

Travel assistance service/ App	Intermodal journeys	Integrated booking and payment	Real-time journey planning	Real-time travel updates	Travel cost estimate	Travel time
City Mapper	x		x	x	x	x
Google Maps	x			x		x
Uber	x	x			x	
Waze	x		x	x		x
Moovit	x		x	x		x
Moovel	x	x	x	x	x	x
GoMore		x			x	
SocialCar	x		x	x	x	x

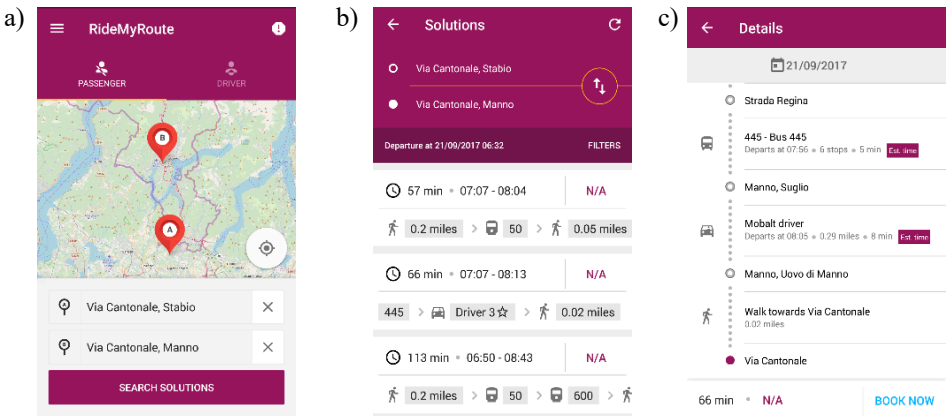

Fig. 1 Screenshots of the *SocialCar* App: a) passenger asks for a ride; b) available options found; c) trip legs of a selected option.

3. The Survey Design

3.1 Structure and contents of the survey

The objective of this survey was threefold:

1. To understand the most important *SocialCar* App features in influencing citizens intention to use the App.
2. To get an indication of the proportion of travellers who state an intention to use the *SocialCar* App and to understand the extent to which its use is likely to change their mobility behaviour.

3. To identify if there are any differences in factors influencing traveller's intention to use *SocialCar* (and the subsequent changes in mobility behaviour) by demographic variables, current mobility habits and familiarity with smartphone technology.

To meet the first objective, a set of questions were included based on the Technology Acceptance Model (TAM), developed by Davis et al. (1989) and cited in most of the research that deals with user acceptance of technology (Chutter, 2009). TAM describes a well-established and accepted methodology to understand the relative extent to which different factors influence intention to use new technologies. According to TAM, "Perceived Ease of Use" (PEOU) and "Perceived Usefulness" (PU) are the most important determinants of actual system use, since they directly influence "Intention to Use". Davis defines perceived usefulness as the prospective user's subjective probability that using a specific Application system will enhance his or her job or life performance. Perceived Ease of Use can be defined as the degree to which the prospective user expects the target system to be free of effort. TAM was originally developed to understand the factors which influence intention to use new technologies introduced in the workplace and was first developed when PC word processors were replacing typewriters in offices. Over time it has evolved and extended to be used in other environments where new technologies are being introduced and where other factors influence intention to use the technology. Although recent literature applied TAM to mobile technologies, most of the early work in this field is related to intention to use a smartphone. While this has some relevance for *SocialCar*, we are probably past this stage, as smartphone penetration across Europe has reached an average of 60% of all adults (and over 80% of under 35's) (Poushter, 2016). Kaasinen et al (2011) present a modified technology acceptance model customized for mobile services (TAMM), which is relevant for *SocialCar* and was therefore (partly) adopted in our survey. In particular, TAMM also identifies that "Trust" and "Experience" play an important role for user acceptance. In the *SocialCar* context, experience can refer to journey planning services/Apps, use of smartphones or carpooling.

To meet the second objective, we included a set of stated intention questions aimed at eliciting respondents attitudes on their likelihood of using the *SocialCar* App and the related "Impact of use", in terms of their likelihood of using PT more, carpooling more and driving less.

To meet the third objective, questions relating to social-demographic variables (gender, age, income) and the level of comfort using smartphone App technology (possible answers ranging from "poor" to "excellent") were included as well. Finally, respondents were also asked to provide travel details for their most frequent journey (mode of travel, travel duration, time of day of travel, origin/destination, congestion levels on trip, purpose of trip) and to identify what would motivate them most to change their travel behaviour (possible answers being "lower cost", "less travel time", "more convenience", "more reliability", "improved journey information", "environmental concerns", "health related considerations").
Fig. 2 shows the TAM-based model we referred to in our survey and the questions we offered in the questionnaire. In order to complete it, respondents needed to have a feel of what the *SocialCar* App could offer them and how it would look. As the App was not yet available at the time of the survey (end March 2017), we opted for showing a short video which highlighted its main features and functionalities, introducing them through mock-ups. The video was developed in order that the most important features of the App could be shown without any positive or negative bias, and was at first developed in English (https://www.youtube.com/watch?v=AYTHAWSlWFA). While the English version was used in Edinburgh and Brussels, translation in the local language were made for Canton Ticino and Torino (Italian) and for Zagreb (Croatian).

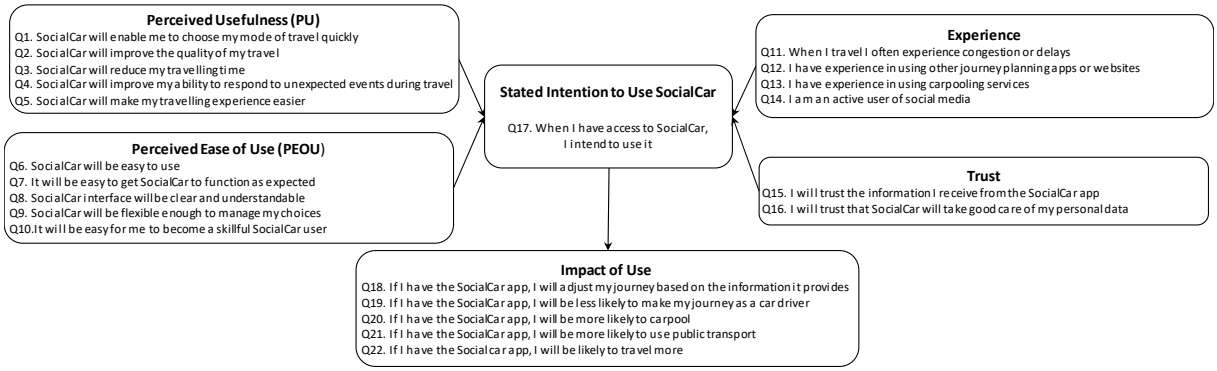

Fig. 2 The TAM-based questions we used to assess stated Intention to use the *SocialCar* App and the related Impact of use.

3.2 Delivery of the survey

In each site, delivery of the *SocialCar* questionnaires was organized with the twofold aim of (i) maximizing

response rates and (ii) getting responses from a representative sample of users. In particular, target respondents had to be representative of the average population, both regarding their socio-economic features (age, gender, income) and their mobility patterns (purposes of trips, preferred modes of travel, car ownership): a mix of respondent's profiles was sought, to give a fair reflection of the need for, and usefulness of, the *SocialCar* service for differing trips. A target of at least two hundred responses was set for each site, with an absolute minimum of one hundred completed responses required from each site.

To this purpose, we adopted a three-pronged approach: (i) direct email contacts by the project partners (universities, cities and companies) to their employees, (ii) communications in newsletters of carpooling and PT services, and partner NGOs, as well as posts in their social networks, and (iii) organization of raffles for tangible prizes (random draws among all the respondents, offering 10 prizes per site, of the value of around 50 euros each). Differentiating contacts allowed us to differentiate respondents. For example, sending the questionnaire only to university students would have resulted in a disproportionate number of responses from similar types of citizens (young, tech savvy, non-car owners). Moreover, we were also looking for respondents with a mix of travel destinations, since issues associated with travelling to a city centre location may differ respect to travelling to an out of town location. By involving local PT and carpooling companies, we expected major opportunities to capture a mix of users and situations. Prizes were introduced with the aim of engaging "car-dependent" citizens, namely those social groups being the exact target of *SocialCar* services, who were not expected to be spontaneously attracted by the invitation to join a survey regarding how to reduce solo car use.

The survey was delivered as an on-line questionnaire, which included the short video illustrating the *SocialCar* service and App, for respondents to watch before answering the questions. The video was approximately four minutes long and answering the questions took around five minutes, for a total of around ten minutes. The survey went live in March 2017, when the first e-mails, newsletter and social media posts were sent out. It remained available for four weeks, during which weekly email reminders were sent to the target population, and further promotion through website news and social media posts was performed.

4. Results

4.1 Number and characteristics of the respondents

Overall, 1'072 persons answered the survey (see Table 2). An overview of their socio-economic characteristics, their familiarity with the smartphone technology and elements they declared on their mobility patterns (car ownership and main mode of transport used), in shown in Fig. 3.

Table 2. Number of responses to the *SocialCar* survey, per site.

	Edinburgh	Ticino	Brussels	Torino	Zagreb	Total
Number of responses	227	386	152	176	131	1'072

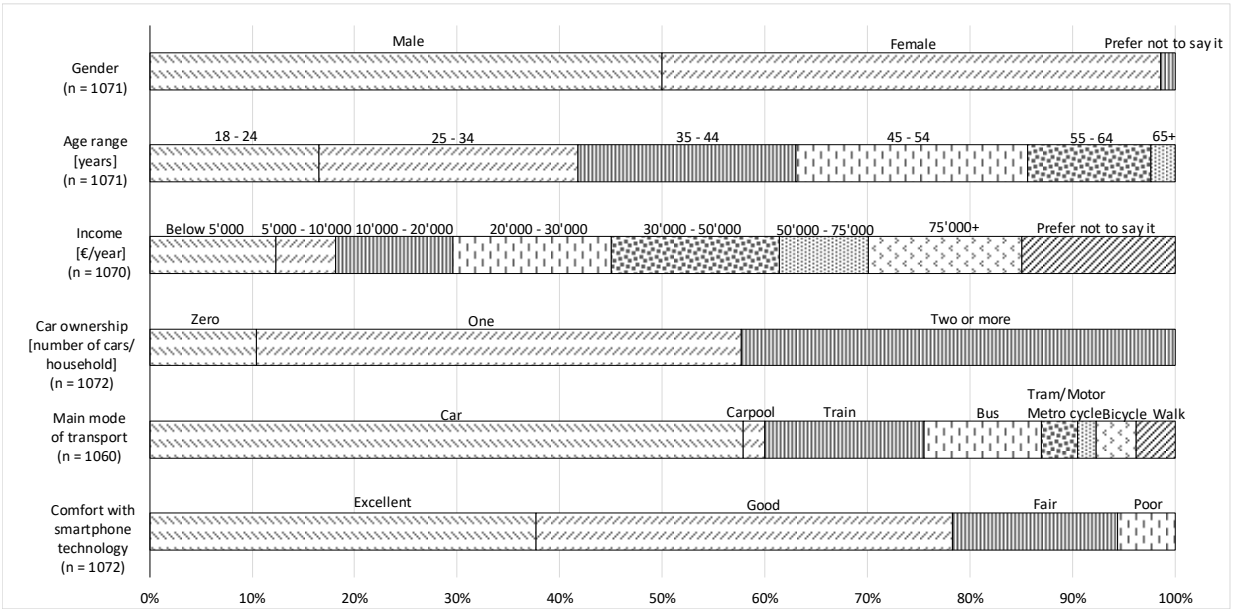

Fig. 3 Characteristics of the respondents, across the five sites.

4.2 Factors influencing Intention to use the SocialCar App

The questions in the TAM-based section of the survey required respondents to give answers on a 7 point Likert scale, from 1 (strongly disagree) to 7 (strongly agree). The data returned from the survey has been analysed to establish the relationships between each of the individual questions (and groups of questions related to the same variable) and the stated Intention to Use the *SocialCar* App, using regression analysis. Regression analysis provides a means of estimating the relationships among variables, enabling us to understand how Intention to Use *SocialCar* (dependent variable) changes, when any one of the independent variables is varied, while the other independent variables are held fixed. This allows us to understand the relative importance of each factor on influencing Intention to Use *SocialCar*.

Initially, reliability checks were performed to ensure that the questions in each grouping were appropriate. They showed strong internal consistency between the groups of questions relating to PU (Cronbach alpha score of 0.93), PEOU (Cronbach alpha score of 0.90) and Trust (Cronbach alpha score of 0.81). Any score above 0.8 is deemed to offer good internal consistency. However, weak consistency was calculated for the group of questions related to Experience (Cronbach alpha score of 0.45). As a result, Experience questions are treated as separate variables in subsequent regression analysis.

Regression analysis revealed that Perceived Usefulness (PU) is more important than Perceived Ease of Use (PEOU), which is in turn more important than Trust, in influencing intention to use *SocialCar*. In particular, the individual factors which showed most influence in intention to use *SocialCar* were:

- Q2. *SocialCar* will improve the quality of my travel (related to PU),
- Q4. *SocialCar* will improve my ability to respond to unexpected events during travel (related to PU),
- Q5. *SocialCar* will make my travelling experience easier (related to PU),
- Q10. It will be easy for me to become a skillful *SocialCar* user (related to PEOU),
- Q15. I will trust the information I receive from the *SocialCar* App (related to Trust).

Overall, including PU, PEOU and Trust, the model explained 53% of the variation in Intention to Use *SocialCar*. This is a reasonable score and suggests a rational model.

When examining the influence of the Experience variable on Intention to Use *SocialCar*, it was found that experience of regular congestion and delays outweighs experience of using carpooling or of using other journey planners or social media, in Intention to Use *SocialCar*. This suggests that having familiarity with the technology or the act of carpooling (both of which would likely lead to better PEOU scores) is less important than encountering regular congestion (which would likely lead to higher PU scores) in influencing Intention to Use *SocialCar*. This is consistent with the findings of the regression analysis above.

4.3 Differences across sites in Intention to use the SocialCar App

Results presented in the above section Apply to the combined findings from all five sites (1'072 responses). Variations in scores between sites for each of the independent variables in the regression model are illustrated in Fig. 4. In these figures an average score of 4 reflects a neutral stance. The higher the score above 4, the more the respondent is in agreement that the *SocialCar* App will be useful/easy to use/can be trusted.

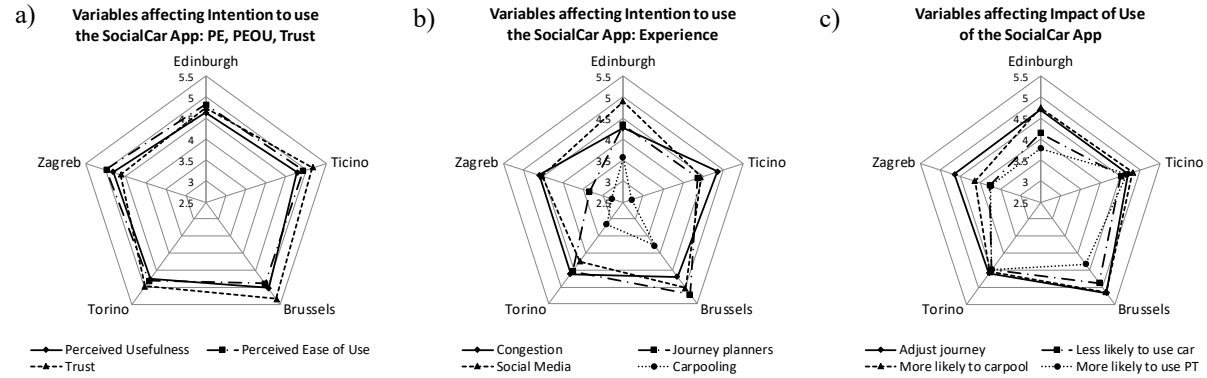

Fig. 4 Average Likert scale scores of the independent variables affecting Intention to Use the *SocialCar* App and the related Impact of Use.

From Fig. 4 a) we can see that on average all sites display a positive response (i.e. values greater than 4) to each variable. All sites except for Brussels agreed more strongly that the *SocialCar* App would be easier to use than it

would be useful. This is perhaps because Brussels experiences the worst travel delays for car drivers of the five test sites (INRIX, 2016) and has an extensive network of PT services which are segregated from the road congestion (Poelman and Dijkstra, 2015), providing the conditions in which *SocialCar* could be perceived as useful. The level of trust is relatively high in Brussels but lowest in Zagreb, reflecting the greater familiarity and acceptance of journey planners in Brussels (Fig. 4 b).

Fig. 4 b) also shows that previous experience with carpooling is low across all sites, although relatively higher at the Brussels and Edinburgh sites, where long established carpool services exist, supplied by nationwide operators (Liftshare in Edinburgh and Taxistop in Brussels). The most active social media users are the respondents from the Brussels and Edinburgh sites. Congestion is experienced at all sites, although this appears to be slightly less of a problem (in terms of perception) at the Edinburgh site.

Likert scores for respondents Intention to Use the *SocialCar* App are presented in Table 3. They suggest all sites display a positive agreement on Intention to Use the *SocialCar* App (average Likert scores always above 4), with Brussels displaying highest overall Intention, and Edinburgh lowest Intention, consistent with the PU ratings at these sites, which was identified as the variable most influencing Intention to use.

Table 3. Overall Intention to use the *SocialCar App*, expressed on a 7-point Likert scale.

Intention to use *SocialCar*	Edinburgh	Ticino	Brussels	Torino	Zagreb	Average
Average Likert scale score	4.38	4.64	5.03	4.59	4.49	4.63

To derive the likelihood of using the *SocialCar* App, we apply a set of conversion factors to the individual Likert scale responses, as shown in Table 4. If a Likert value of 1 to 3 is returned, then there is 'somewhat' to 'strong' disagreement that the respondent intends to use the *SocialCar* App. In such cases, we assume there is no likelihood that this respondent will actually use the *SocialCar* App. A value of 4 suggests there is neither disagreement nor agreement that the respondent intends to use the *SocialCar* App. As a result, we assume there is a slight likelihood (20%) that she will use the *SocialCar* App. The likelihood of use then increases linearly with increasing level of agreement, up to a value of 7 (strong agreement that the respondent intends to use the *SocialCar* App). A likelihood value of 80% is applied in this case since there may be ease of adoption barriers which limit 100% conversion from Intention to Use. Applying these conversion factors to the individual respondent data at each site, results in the % Intention to Use *SocialCar* presented in Table 5. This gives an average stated intention to use *SocialCar* of 35.8% of the respondents, with variations at site level from 32.3% in Edinburgh to 42.8% in Brussels.

Table 4. Factors Applied to Likert scale responses for Intention to use *SocialCar*, to derive the likelihood of using *SocialCar*.

When I have access to *SocialCar*, I intend to use it (Strongly Disagree =1 to Strongly agree = 7)							
Response	1	2	3	4	5	6	7
Likelihood of using *SocialCar*	0%	0%	0%	20%	40%	60%	80%

Table 5. Intention to use *SocialCar* App derived for each site.

Site	Edinburgh	Ticino	Brussels	Torino	Zagreb	Average
% Intention to use *SocialCar*	32.3%	35.3%	42.8%	35.6%	35.4%	35.8%

4.4 Impact of Use and effects on mobility behaviour

The average scores for the stated likely impacts of using the *SocialCar* App are shown in Fig. 4 c). All sites show a positive agreement (average Likert scores above 4) that they will be likely to adjust their journey based on the information *SocialCar* provides them, with Brussels respondents providing the strongest agreement on this. All sites also indicate some agreement that respondents will be more likely to carpool as a result of using the *SocialCar* App. This is again strongest in the Brussels site but weakest at the Zagreb site, possibly reflecting the current level of experience with carpooling at these two sites. Other than the Zagreb site, there is agreement that use of the *SocialCar* App has the potential to result in less use of the car. There is some positive agreement that use of the App will result in more use of PT at three sites: Ticino, Torino and Brussels.

We now analyse these statements in more detail, focusing in particular on increased likelihood to carpool and use PT, as a consequence of use of the *SocialCar* App. As an example, let us consider carpooling. In order to derive the actual likelihood of increasing carpooling through use of the *SocialCar* App, we apply a set of conversion factors to the 7-point Likert scale responses to the question "If I have access to SocialCar, I will be more likely to

carpool" (see Table 6). If a value of 1 to 3 is returned, then there is 'somewhat' to 'strong' disagreement that the respondent intends to increase carpooling activity through use of the *SocialCar* App. In such cases, we assume there is no likelihood that these respondents will carpool. A value of 4 suggests there is neither disagreement nor agreement that the respondent intends to increase carpooling activity through use of the *SocialCar* App. As it requires significant motivation and effort to actually change mobility behavior, a response of 4 is thought to be unlikely to result in any change in behavior and so a conversion factor of zero is again applied. For a response of 5 there is 'somewhat' agreement that the respondent is likely to increase carpooling through use of the *SocialCar* App and so a conversion factor of 25% is applied. The likelihood of carpooling increases linearly with increasing scores, up to a value of 7 (strong agreement). A likelihood value of 75% is applied in this case as other factors such as availability of suitable carpool matches affect ability to carpool. So, while respondents may strongly agree that they are more likely to carpool, physical availability of suitable services may be a barrier to actual use.

Table 6. Factors Applied to Likert scale responses to Impacts of Use of *SocialCar*, to derive actual increased likelihood of carpooling/PT use.

If I have access to *SocialCar*, I will be more likely to carpool/use public transport (Strongly Disagree =1 to Strongly agree = 7)							
Response	1	2	3	4	5	6	7
Increased likelihood of carpooling/using public transport	0%	0%	0%	0%	25%	50%	75%

By combining the responses to question on Intention to Use *SocialCar* and question 20 on likelihood of increased carpooling through use of *SocialCar*, and applying the appropriate conversion factors, we get an indication of the increased likelihood that a user will carpool. Following the same procedure to increased likelihood that a respondent will use PT, we obtain the results presented in Table 7: likelihood to use PT increases between 9% (Edinburgh) and 13% (Canton Ticino) of the respondents, and likelihood to carpool increases between 13% (Torino) and 18% (Brussels) of the respondents.

Table 7. Increased likelihood to carpool and use PT, due to use of *SocialCar*, for each site.

Site	Edinburgh	Ticino	Brussels	Torino	Zagreb	Average
% Increased likelihood of carpooling	14.1%	13.9%	17.6%	13.4%	14.5%	14.7%
% Increased likelihood of using public transport	8.7%	12.8%	12.2%	11.8%	10.4%	11.2%

4.5 Variation in Intention to Use SocialCar by user type

While the results presented in the above tables give some indications on the overall opinion at each site on the *SocialCar* App, its attractiveness and potential impacts, the aggregate nature of the data presented is of limited use in identifying likely levels of use of the *SocialCar* App and subsequent changes in travel behaviour as a result of using the App for different sections of society. For instance, although Zagreb displays the second lowest overall intention to use *SocialCar*, it also has the highest proportion of responses which were in strong agreement that they intended to use *SocialCar*. This highlights that this kind of aggregate presentation of results can miss important differences between types of user.

Examining variations by user and characteristics of their most frequent journeys, we get insights into which types of user and for which types of journey *SocialCar* is likely to provide the greatest attraction. The following Table 8 and Table 9 show variations with respect to average % Intention to Use given in Table 5, considering all the sites.

Table 8. Variation in % Intention to use *SocialCar* App, per socio-economic characteristics of the respondents and considering all sites.

Variation respect to the average % Intention to use *SocialCar*											
Gender		Age [years]				Income [€/year]		Comfort with smartphone technology			
Male	Female	18-24	25-34	35-54	55+	Below 50'000	Above 50'000	Excellent	Good	Fair	Poor
+1.0%	-1.0%	+5.3%	+0.8%	-1.7%	-2.7%	+3.7%	-2.2%	+5.3%	+1.8%	-9.1%	-21.8%

Answers to the survey show there is little difference between male and female respondents, with males showing a 2% greater intention to use *SocialCar* (36.8% compared to 34.8%). Intention to Use *SocialCar* decreases with increasing age, with 18-24 year olds displaying a 41.1% Intention to Use, while those aged over 55 display a 33.1% Intention to Use. This might be related with both higher comfort with smartphone technology and with lower individual car ownership, by younger people. Those on lowest incomes also state a higher Intention to Use *SocialCar* (39.5%) than higher income respondents (33.6%). This might be related to the reduced need of owning a car, for *SocialCar* used, and the resulting money saving. Comfort with using smart phone App technology is the

most significant user characteristic affecting Intention to Use *SocialCar*. While those who describe themselves as having excellent comfort with smart phone App technology have a stated Intention to Use *SocialCar* of 41.1%, those with poor comfort in smart phone App technology have a stated Intention to Use *SocialCar* of only 14%. This is directly related to the fact that the whole *SocialCar* system depends on interactions via an App.

Table 9. Variation in % Intention to use *SocialCar* App, per stated mobility pattern of the respondents and considering all sites.

Variation respect to the average % Intention to use *SocialCar*										
Car ownership per household			Most frequent Mode of travel				Travel time of the most frequent journey			
No car	One car	Two or more cars	Car	Train	Bus	Bicycle and Walk	0-20 mins	20-45 mins	45-60 mins	60+ mins
+5.6%	+0.6%	-2.0%	-2.4%	+3.1%	+8.9%	-0.2%	-3.5%	-0.5%	+2.6%	+5.3%

Regarding car ownership, respondents living in no car households state a 41.4% Intention to Use *SocialCar*, while respondents from households with two or more cars have a 33.8% stated Intention to Use *SocialCar*. While this difference is substantial, it also shows that *SocialCar* is not only attractive to households without car access. Those respondents who currently travel by bus for their most frequent journey show the highest Intention to Use *SocialCar* (44.7%), while car users still state a 33.4% Intention to Use *SocialCar*. High Intention to Use by bus users might be related to the low average speed of buses and expected reduction in travelling times, while low Intention to Use by car drivers is symptomatic of the difficulty in changing individual mobility patterns and reducing individual car use: respondents using car as their most frequent mode of travel would get the greatest benefits from *SocialCar*, though they are the most reluctant to use it. Finally, survey respondents show that, as travel time of their most frequent journey increases, so does stated Intention to Use *SocialCar*: when journeys are short, there is less need to look for alternatives and multi-mode trips incur connection times which are relatively high, as a proportion of the overall journey time; instead, when travelling times are longer, connection times are a relatively smaller component of overall journey time, and multi-mode alternatives may result in shorter overall travel time if *SocialCar* can direct drivers to connect onto fast PT services for a significant part of the journey.

5. Discussion and conclusions

Lee et al. (2003) and Chuttur (2009) identify a set of limitations that are inherent to the TAM approach itself, and can be attributed to the *SocialCar* survey as well. They range from the short exposure to the technology before testing, to the lack of a longitudinal comparison over time (user's perceptions and intentions change over time, thus they should be measured over different periods of time), and to the self-selection bias of the respondents and lack of representativeness of the sample. We believe the most critical shortcoming is, however, that system use is estimated based on self-reported usage and stated intentions, instead of using actual use real data. In TAM-like approaches, the hypothesis is made that self-reported data reflect actual usage. However, self-reported use data is a subjective measure, thus often unrealiable in measuring actual use of a system. It is in fact a well-known phenomenon that respondents overstate their intentions in stated response surveys (due to hypothetical bias and non-commitment bias). Based on a review of the relevant literature, it is apparent that this overstating of intentions can range widely from 25% to 300% in extreme cases. A meta-analysis by Murphy et al (2005) selected 28 studies that yield a total of 83 observations for which the distribution of calibration factor (the ratio between hypothetical/stated preference and actual/revealed preference values) is skewed with a mean value of 2.60 (160% overstatement of intention) and a median value of 1.35 (35% overstatement of intention).

In such a context, it is very likely the case that a downward adjustment to the figures presented in this paper should be made when considering actual use of the *SocialCar* App and resultant changes in mobility behaviour. Within the *SocialCar* project, in Autumn 2017 real life testing is conducted in four cities (Edinburgh, Ticino, Brussels and Ljubljana), by inviting common citizens to download and use the *SocialCar* app for at least one month. Testers complete the same survey at the start of the test, before using the App (based on viewing the video described in this paper), and again at the end of the test, after they have experienced the real *SocialCar* App for an extended period for travel in their city. This field test will give us a clearer indication of the degree of downward adjustment to apply.

Keeping the above limitations in mind, we can however comment on the insights on social acceptance of *SocialCar* we gained so far. Willingness to use *SocialCar* and the likelihood of increasing carpooling trips combined with PT is highest amongst younger people (who tend to have the greatest comfort with smart phone technologies) without cars travelling longer distances. The cities which reveal the greatest opportunity are those with recurrent significant road congestion combined with good PT alternatives separated from the road network (e.g. Brussels). An existing well established carpool service or previous experience with carpooling is an advantage but not an

overriding requirement.

In many ways these survey results are not surprising. For example, people without cars represent a "captive market" for PT and carpooling. What is particularly interesting is that, even for households with two or more cars, around a third of respondents (33.8%) remain interested in using *SocialCar*. The potential for using marketing channels focussed on car owners, such newsletters and magazines of insurance providers, automobile associations and breakdown services, is therefore a possibility that could be pursued. Over 40% of people with journey times over 45 minutes for their most frequent journey expressed an intention to use the *SocialCar* App, suggesting that people in peri-urban areas could find the service of most interest (depending on the size of the city). This result aligns with general experience that people are more likely to accept changes of transport mode or service connections for longer journeys, as the time for the change then becomes relatively less significant. This point could help to inform the geographical area that becomes the focus for marketing the App.

An obvious conclusion is that marketing could therefore be focussed purely on younger people, who are most likely to download and use the mobile App. From a marketing perspective this raises the question, should the objective of *SocialCar* be to become a trendy product that is used by the young generation and that helps people to get around more effectively (the more receptive audience for the product); or should *SocialCar* try to convince a 50-year-old to change old habits. From a pragmatic point of view, car ownership is typically higher amongst older age groups and therefore the chances of attracting "drivers" offering lifts may therefore improve if they are targeted with promotional activities and incentives. It is of interest there are slightly more people in the 45-64 year age group willing to carpool than in the 35-44 year age group, and it is possible that a good proportion of these are car owners willing to offer lifts – it would therefore be important that the marketing does not neglect this segment. On the other side, younger citizens could be targeted with promotional messages aimed at stimulating their use of the *SocialCar* system as "passengers", thus requesting lifts. Therefore, the survey results suggest that, in initial marketing phases, it may be best to target different social groups, with different promotional messages (35-64 years old citizens as drivers and younger than 25 years old citizens as passengers), in order to get higher chances of success in establishing the *SocialCar* mobility service in the marketplace.

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