Patterns of use, perceived benefits and reported effects of access to navigation support systems: an inter-European field operational test

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Abstract: The study presents findings regarding drivers' patterns of use, attitude towards, and reported effects of access to mature nomadic navigation support systems. Three different systems were tested by 582 drivers in four-field operational tests for a period of six months. A majority of the participants used the support system for trips where the route/destination was unfamiliar but there were also other use scenarios. The main benefits entailed convenience and comfort. Reported effects involved increased possibilities to choose the route according to preferences; a decrease in the time it took to reach destinations and in the distance covered to reach the destination. One in four reported a decrease in fuel consumption attributed an increased compliance with speed limits and/or that driving around and searching for the correct route to reach the desired destination could be avoided. A majority reported 'no change' regarding the number of journeys made by car. Reported effects (whether increases or decreases) were however smaller than expected before the trial.

1 Introduction

1.1 Background

High expectations are associated with the use of information and communication technologies (ICTs) in the transport sector. Applications such as traffic information, navigation support systems and other telematics solutions are expected to contribute to a more efficient traffic system and improved use of the existing infrastructure, for instance by providing information on route alternatives, reducing mileage by offering shorter routes and avoiding temporary disruptions [1, 2]. In addition, the systems are expected to reduce the negative impacts of transport on the environment as well as increase traffic safety, for example by providing information on traffic problems, queues and so on, thus decreasing driver frustration [2].

1.2 Earlier research

Even though navigation support systems have been the object of earlier research, empirical findings concerning the actual effects of the systems, in particular the influence on individual travel behaviour, as the basis for the potential effects on the overall system are only available to a very limited degree (compare [1]).

One large stream of early research efforts focused on the use of navigation systems from a safety perspective. As the systems are used in situations where attention is divided, that is, driving being the primary task and use of the navigation support system being secondary, negative effects have been anticipated and some have been identified (see, e.g. [3–5]). Studies on the theme of safety include for instance assessments of the visual attention demand requirements of in-car navigation systems [6–8] and comparisons of visual to auditory to multimodal devices [9, 10]. Along the same path, guidelines have been developed for the design of user interfaces to minimise the visual and cognitive demands of the navigation task (e.g. [11, 12]). At the same time, other researchers have claimed that vehicle navigation systems can reduce the mental workload for drivers by automating elements of the driving task. According to Girardin and Blat [13], navigation support can relieve car drivers of the need to closely observe the environment, to look out for road signs or landmarks, to orient themselves with respect to where they are located and to memorise a chosen route for future reference. Lee and Chang [14] found that drivers performed better when using a navigation system compared with those using a traditional map.

Concern has also been raised that the long-term use of these systems may cause other and unforeseen problems, including suppressing cognitive map development. A second stream of research has therefore investigated the effects of navigation systems on drivers' orientation and spatial knowledge (e.g. [15, 16]).

To the authors' knowledge, only a few earlier studies have tried to reach an understanding of drivers' actual usage of navigation systems. One of them, a survey of a sample of Swedish users, whose cars were equipped with Volvo Road and Traffic Information, concluded that slightly more than 60% of the 54 respondents used the system in unfamiliar environments but that ~35% had the system switched on also in well-known areas [2]. In unfamiliar environments the usage was 'active' (i.e. a destination was configured), whereas in well-known environments the drivers' usage of the system was most often 'passive' (i.e. the system was switched on without an active role). Drivers with high annual mileage were found to value the system more highly than did other users, and more often used their system in a passive manner which implies that the systems were used as a decision support tool for manual routing, backing the users' local knowledge [2]. However, the study provided no evidence regarding how use of the system influenced the drivers' travel behaviour.

According to another survey carried out among a large sample of German users, nearly 20% of the respondents used their navigation system (embedded, personal digital assistant or mobile phone) during every trip and 42% used it often [1]. The systems were used most frequently for long-distance trips and business trips, whereas for everyday and routine trips, the systems were used considerably less often. Nevertheless 42% reported using the systems also in regions they knew well. The users followed the recommendations provided on different routes but the devices were also used as support in scheduling the time to be expended for undertaking the trip. The influence on the choice of means of transport was limited; 8% claimed to use their car more frequently with access to the navigation support.

A slightly different perspective on use was taken by Dingus *et al.* [17] who proposed that with increased experience, drivers become familiar with the system and develop strategies for substantially more efficient and safer use. Moreover, Girardin and Blat [10] noted how users adapted to their in-car navigation systems but also adapted the systems to their needs. However, their target was a particular category of professional users, taxi drivers, whose driving as well as use patterns may differ from that of private drivers.

Thus, little attention appears to have been paid to how drivers actually use the system, if and how they make use of the information provided, and to what extent their access to these systems influences their travel and driving behaviours.

1.3 Aim

The overall objective of the TeleFOT project (e.g. [18]) was to investigate the impacts of different telematics solutions on driver behaviour with large fleets of test drivers in real-life driving conditions over a longer period of time, so-called field operational tests or FOTs. The focus was on the functions provided by aftermarket and nomadic devices. Different support systems were investigated: green driving support, navigation support, traffic information and speed alert/speed information. The aim of this paper is to present findings regarding (i) drivers' acceptance and use of, and (ii) reported effects of access to, navigation support.

2 Methodology

Drivers from five European countries: Greece, Italy, Spain, Sweden and UK participated in testing mature nomadic in-vehicle systems offering navigation support. The FOTs lasted over a period of nine months (with a 'baseline' of three months during which certain data were collected but not reported here). Participants were recruited through advertising in local media. They drove their own cars and were asked to use the devices and services as if they had acquired these themselves.

2.1 Participants

The test involved 582 participants aged from 20 to 78 years. About ~34% were women and 66% were men with some differences between the test sites (Table 1). A majority of the participants considered themselves to be experienced or very experienced drivers and most used a car for transportation 3–5 days per week or more. There were also those who used public transport but then only for occasional trips. About <10% used public transport more than a few times per month.

Table 1 Overview of test site participants and their previous experience of using navigation support

Test site	Participants, *n*	Women, %	Men, %	No earlier use experience	
				Dynamic navigation, %	Static navigation, %
Greece	148	32	68	66	34
Italy	141	22	78	64	37
Spain	120	37	63	78	29
Sweden	94	39	61	80	59
UK	79	45	55	64	29

The distances driven per year varied. The Italian participants were among those that drove the longer distances per year, 15% in the Italian FOT drove more than 30 000 km per year. About 67% of the Greek participants drove <20 000 km per year, the corresponding proportion in the Swedish FOT was 60% and in the UK FOT 72%. Overall, the most common distance driven was between10 001 and 20 000 km/year.

Several of the participants had access to different driver support functions and some had previous experience of the different functions tested in TeleFOT. However, ~43% had no earlier experience of static navigation support and 68% had no experience of dynamic navigation (Table 1).

2.2 Materials

Each of the test sites tested a navigation system (Table 2). The devices differed in physical design as well as in the way the system presented traffic information but all provided static navigation support and the turn-to-turn driving instructions were similar.

2.3 Data collection

To collect information on the participants' attitudes, use and perceived benefits and possible changes over time, paper or online questionnaires were distributed to the participants in their native languages and answered before, during and after the test period.

In the pre-trial questionnaire, background data were collected (age, gender, car ownership, driving experience, participants' previous familiarity with navigation support and their expectations on the effects of the system that they were going to test (Table 3). The questionnaires distributed during and post-trial included questions regarding attitudes towards technology, in general, and support systems specifically, use frequency, benefit assessment and trust. Benefit (perceived usefulness, value) is a common theme across different theories or models of user acceptance and adoption of ICT-solutions (compare [19–23]). Trust has been identified as a critical aspect (compare [20, 23, 24]). Another set of questions concerned experienced effects including comfort, that is, 'a satisfying or enjoyable experience' [25] and efficiency, here defined as the extent to which time or effort is well used for the intended task or purpose.

Table 2 Test sites and navigation support systems used

Country	Test site	System
Greece	Athens	Sygic Nav software for Samsung Omnia II (WinMob 6.1)
Italy	Reggio dell'Emilia	Acer smart phone, model beTouch E 101, Blom Software
Spain	Valladolid	Blom N-Drive Touch XL
Sweden	Gothenburg	Garmin Nüvi 205 WT
UK	Loughborough	Blom N-Drive G800

Table 3 Overview of data collected pre- during, and post-trial

	Pre-trial	During	Post-trial
background data	X		
attitude/impression	X	x	X
use frequency		x	X
benefit	X (anticipated)	X (experienced)	X (experienced)
trust		x	X
effects of access	X (anticipated)	X (experienced)	X (experienced)

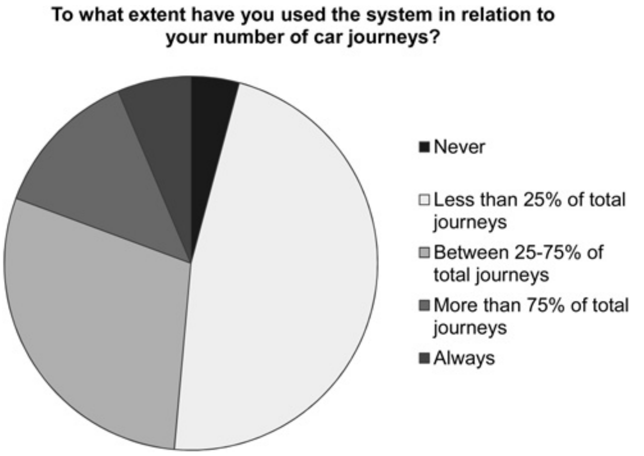

Fig. 1 *Reported use frequency*

All participants. Post-trial questionnaire ($n = 450$)

2.4 Analysis

The responses to the questionnaires were analysed using SPSS Statistics 20 for Macintosh. The data were primarily ordinal in its nature and non-parametric tests were therefore used for significance testing ($\alpha = 0.05$). Correlations with magnitudes <0.2 have been deemed small and thus ignored. Comments and responses to open-ended questions in the questionnaires were (where required) translated into English, and analysed in order to find common themes and more in-depth explanations to assessments and ratings.

3 Findings

3.1 Use

The first research question concerned use and the motives for use and non-use. Use of navigation support is a prerequisite for the system to have an impact on aspects such as the drivers' utilisation of the infrastructure. The participants' level of use was explored by them reporting their use of the navigation support system in relation to the number of car journeys by answering a 5-point Likert scale ranging from 'Never' to 'Always'.

According to the responses collected during the trial, slightly more than 50% of the participants had used the navigation system <25%, whereas 24% had used it for more than 75% of the total number of car journeys made. Post-trial, 45% of the participants answered that they had used the system <25% of the total number of car journeys, ~30% had used it for between 25 and 75% of all journeys and one in four had used it more often (Fig. 1). There was thus a slight decrease in reported usage over time and these changes were statistically significant for the Swedish ($p = 0.012$), the Spanish ($p = 0.005$) and UK ($p = 0.092$) FOTs. No systematic impact of background factors (age, gender and mileage) or previous familiarity with navigation support could be found.

Use frequency differed however between test sites (Fig. 2). In the post-trial questionnaire, the participants from the Greek test site reported to have used the system to a higher extent than participants from the test sites in Italy and the UK. In the latter FOT, 18% had not used the navigation support system at all.

Considering the type of trips for which the navigation support was used, approximately one in four participants reported that they had not used the system for any particular journeys. About 40% had used it for private as well as work-related journeys, whereas 53% had used it for primarily private journeys. About 5% had used it primarily for work-related journeys (Table 4). In addition, a majority of the users had used the support system for trips where the route/destination was unfamiliar. The same pattern was noted across all test sites. However, there were also other use situations for which the systems were used, such as longer journeys and journeys on highways/motorways. These use situations were more common in the Italian and Swedish test sites than in the Greek and UK test sites.

One reason for not using the navigation systems was that they were not as reliable as expected: 'Usage was limited during the trial as I had problems with the software'. (Italian participant) and that the design of the user interface was poor: 'You cannot see names of roads or towns most of the time. This greatly reduces the usefulness of the device when planning journeys'. (UK participant). Another reason was that many of the trips made during the trial were to familiar destinations: 'The routes of my daily routine take place in a familiar environment I tend not to use

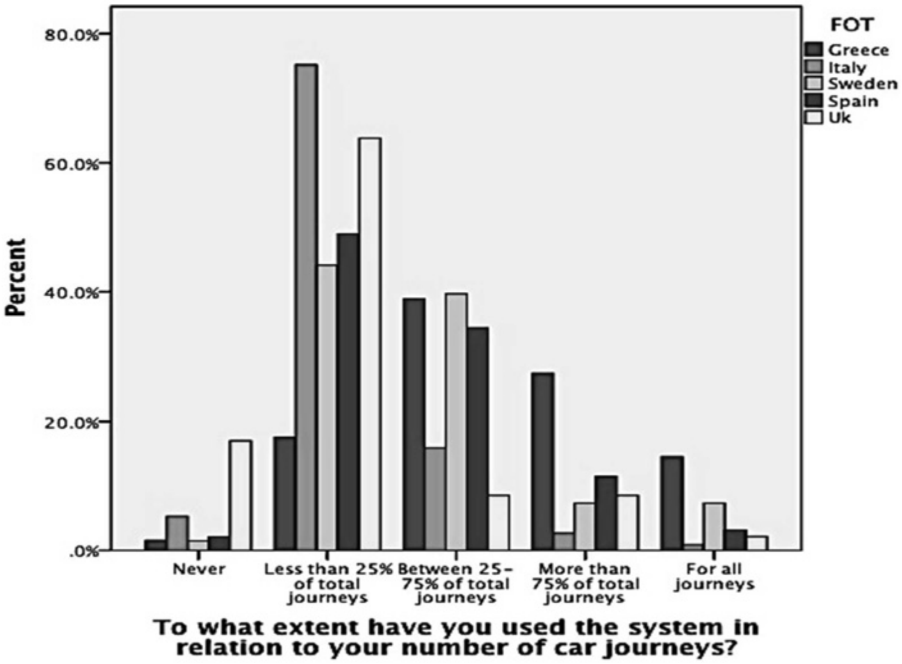

Fig. 2 *Reported system use in relation to the number of car journeys per test site*

Post-trial questionnaire ($n = 450$)

Table 4 Trips and/or situations during which the navigation support system was used

Use situations	Percentage of participants ($n = 395$), %
not for a particular type of journey	24
when the route/destination is unfamiliar	68
for longer journeys	26
when there has been time pressure	7
when (road) congestion has been expected	6
for journeys on rural roads	5
for journeys on highways/motorways	11

Multiple alternatives possible. ($n = 395$).

the system that much. Obviously, if I need to follow a route I do not really know, I will consult the system. There was a time when I needed to plan a route that I would follow and I found it useful since it reduced the time I needed to return home'. (Greek participant).

3.2 Attitude

Attitude has been claimed to influence use of for instance technical devices. Before, during and after the test, the participants were therefore asked to indicate their attitude to navigation support systems on a 5-point Likert scale ranging from 'Very negative' to 'Very positive'.

A substantial proportion of the participants across all FOTs expressed a fairly neutral attitude towards navigation support in the pre-trial questionnaires. Over time the average attitude turned less positive and this less positive attitude continued post-trial ($p_{\text{Freidman}} < 0.0005$; $n = 421$); this was true in particular for the UK test site where 40% became very negative. The exception was the Swedish participants who became slightly more positive over time. Overall although, only a few had a 'Negative' or 'Very negative' attitude possibly because the principle of navigation support was considered a good idea: 'It is a good thing to use when one does not know the way to the destination' (Swedish participant). No systematic impact of background factors or previous familiarity with navigation support could be found.

The systems tested were intended to be mature systems but over time more negative reactions appeared to be influenced by a disappointment in that the system was not as new and different as expected: 'There are so many other devices at your disposal, telephones, iPads etc. which provide the same or even more up-to-date information' (Italian participant). More importantly although, there was disappointment in the content and design of the system, for instance a lack of correct and updated maps and poor design of route-finding directions. One of the Swedish participants commented that: 'Sometimes it did not show the shortest route=irritating. When one knows how to get to the destination one may choose another route'. Similar remarks were made by one of the Greek users: 'The system chooses routes in an entirely flawed way, something that results in increased travel times and distances covered…//… Furthermore, the voice advice is provided at entirely the wrong time, something that results in me turning the car into roads that I should not have driven into'. as well as by one of the Spanish participants: 'The navigation support system has rarely worked well in this device. It did not find the exact location and gave wrong instructions'.

Nevertheless, the participants' comments also show how they adapted to the limitations and still found benefits in the systems: 'Although we could not use it to get from A to B, when we were in a new place it was good to see where we were and the streets around us etc.' (UK participant).

3.3 Trust

Another factor that has been shown to influence users' use of systems and services is trust. In this paper, trust was measured by asking the participants to assess to what degree they perceived that the navigation service had provided them with accurate information. The level of trust was indicated on a 5-point Likert scale ranging from 'Not at all' to 'Completely'.

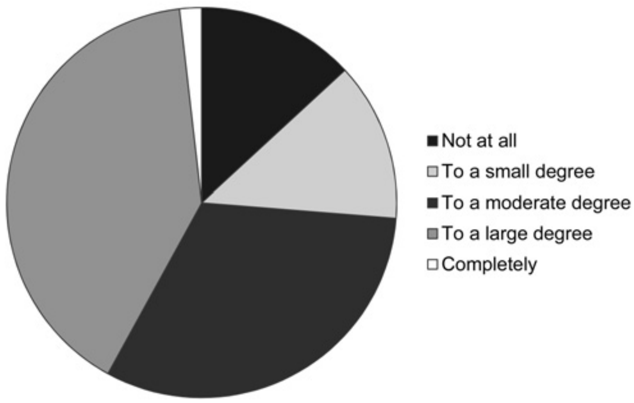

Fig. 3 *Reported trust in the system*

All participants. Post-trial questionnaire ($n = 453$)

According to the responses, very few participants had trusted the information completely, ∼40% had trusted the information to a large degree and 35% to a moderate degree. There were also those who had not trusted the information at all or only to a small degree. As in the case of usage, no systematic impact of background factors (age, gender and mileage) or previous familiarity with navigation support could be found.

The degree of trust varied between the test sites (Figs. 3 and 4) with participants from the Spanish and British test sites, in general, reporting a lower degree of trust and participants from the Greek and the Swedish test sites more often reporting a higher level of trust, even though some of the two test sites' participants noted that: 'The maps were really poor (incorrect) even though upgraded'. (Swedish participant) and 'This particular system, contrary to all the systems that I have used before has unbelievably huge navigation problems, a very bad signal and false route suggestions given to the driver' (Greek participant).

The fact that trust in the information played a significant role is evident in that the participants' attitude towards the navigation system was found to correlate with trust $\rho = 0.62$ ($p_{\text{Spearman}} < 0.0005$, $n = 453$). In addition, the extent to which the participants had used the systems correlated with trust but in this case the correlation was weak, $\rho = 0.323$ ($p_{\text{Spearman}} < 0.0005$, $n = 453$).

3.4 Perceived benefits

Earlier studies have concluded that the perceived benefits that a system/service offer to a large degree determine users' acceptance and use of the same. The participants in TeleFOT were therefore asked before, during and after the test period to rate the possible overall benefit of having access to the navigation support system on a 5-point Likert scale ranging from 'No benefit' to 'Very large benefit'.

In the pre-trial questionnaires, a majority of the participants expected the function to provide a moderate, large or very large overall benefit. During the trial, this assessment changed and even though more than 40% of the participants still regarded the navigation support system as providing large or very large benefits, a statistically significant decrease in perceived benefit was found ($p_{\text{Freidman}} < 0.0005$, $n = 426$) between pre- and post-trials. Nevertheless, post-trial only a major part found the system to provide large or very large benefit (Fig. 5). No systematic impact of background factors (age, gender and mileage) or previous familiarity with navigation support could be found.

As with most assessments, the degree of perceived benefit varied between the test sites (Fig. 6) and the participants from the UK test

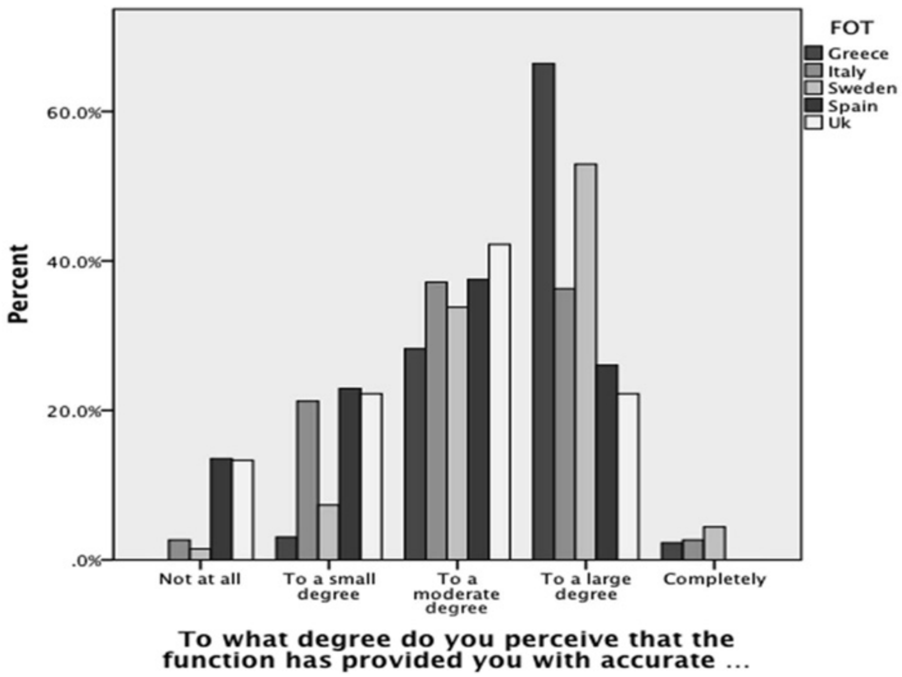

Fig. 4 *Reported trust in the system per test site*

Post-trial questionnaire ($n = 453$)

site reported a lower benefit assessment than the participants from the Spanish and Greek test sites. In the UK FOT, the percentage of participants who thought that the function would provide/ provided no benefits had increased from 2% in the pre-trial to 22% in the post-trial questionnaire. The least notable change was found in the Swedish FOT. The decrease over time was statistically significant for both frequent and less frequent users in all FOTs, except the Swedish one.

The participants were also asked to indicate the character of the perceived benefits. According to the responses, the main benefits were associated with convenience and comfort and less with environmental issues or economic gains (Table 5).

More specifically the perceived benefits included:

- Reduction of uncertainty associated with driving in unfamiliar environments as explained by two of the Greek participants: 'I feel much more relaxed and comfortable. I noted the big difference when we took a vacation to Turkey and I missed this application and its services big-time'. and 'The certainty that the journey will reach its final destination is enhanced, especially in unfamiliar parts of the journey where obtaining information from other sources is impossible'.
- Convenience associated with not having to stop and consult a printed map: 'I obtain information in real time instead of having to stop and look at maps' (Spanish participant).
- *Increased comfort/less stress:* 'The navigator makes the journey more comfortable because the driver, besides the opportunity to plan journey routes, can also follow step-by-step the projected route and view a map of the broader journey area. Observing and controlling the journey as such ensures that the driver (especially in areas that one is not familiar with) is less stressed and has a better chance to 'enjoy' the journey'. (Greek participant) and 'To save time planning before the trip starts. I drive more relaxed because I know that sooner or later I will arrive' (Spanish participant).
- *Increased perceived safety:* 'Less frustration and less stress'. (Greek participant) and 'Safety: I drive more relaxed because I do not have to check constantly how to reach my destination. There is no possibility to get lost' (Spanish participant).

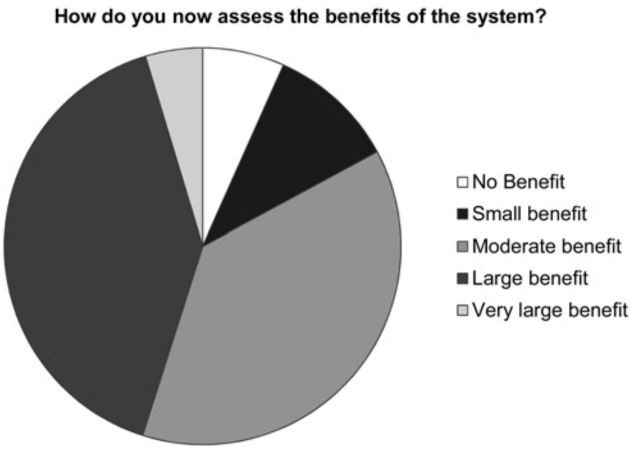

Fig. 5 *Assessments of the overall benefit of access to navigation support per test site*

Post-trial questionnaire ($n = 450$)

Another benefit mentioned by for instance one of the Greek users was the role played by the navigation support system in learning the environment: 'The navigator helped me to memorise the roads I came across and form a 'mental map' that was particularly practical when I had an inquiry about a specific road. I have been doing these morning journeys every day for the past 4 years so I did not need any help really but I learned the road network better' (Greek participant).

However, perceived benefit is a relative factor and there were large differences between individual participants across the test sites. For instance, even though the Greek participants, in general, valued the benefit of access to navigation support higher than several other test site participants, one of them noted, for example, that 'I am very familiar with all the alternative routes and I very rarely need any travel advice'.

3.5 Reported effects

The second main research question concerned the effects of access to navigation support. The participants were asked to indicate their agreement to 15 statements on a 5-point scale ranging from 'Will

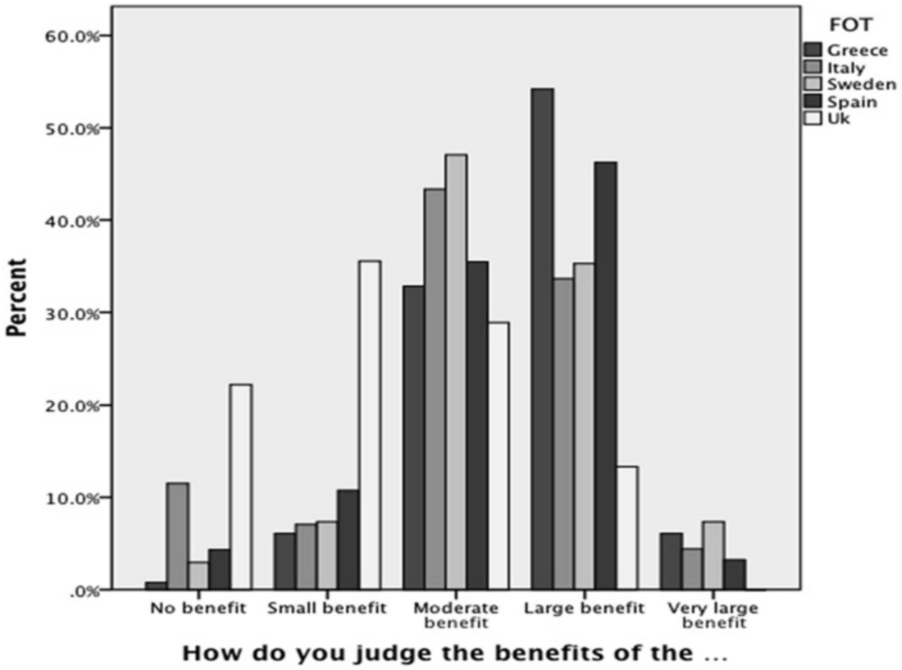

Fig. 6 *Assessments of the overall benefit of access to navigation support per test site*
Post-trial questionnaire ($n = 450$)

radically decrease' to 'Will radically increase'. A similar question was then repeated during and after the test period for the same 15 statements.

One set of statements concerned effects in terms of increased traffic efficiency. According to the post-trial responses, a majority of the participants found that their options for choosing the optimal route according to preferences (e.g. shortest, quickest) had slightly (68%) or radically (10%) increased. About ∼40% found that the information had resulted in a radical or slight decrease in the time it took to reach destinations and a few per cent reported a slight increase in the corresponding time. About 30% noted a slight decrease in the distance covered to reach the destination.

Another set of statements addressed driving behaviour on a tactical level in terms of use of motorways/highways and corresponding use of rural roads. In these cases, only a few per cent of the participants (<10%) reported any changes. On a strategic level, no changes regarding the number of journeys made by car were expected pre-trial. Post-trial more than 90% of the participants reported 'no change' regarding the number of journeys made by car.

One statement addressed environmental/economic impacts in terms of estimated reduction of fuel consumption. In this case, slightly more than 40% of the participants had pre-trial expected a slight decrease in fuel consumption but in the post-trial evaluation only 22% reported that they actually had experienced such a decrease as an effect of having access to navigation support. These gains were attributed to increased compliance with speed limits and/or to the fact that driving around and searching for the route to reach the desired destination could be avoided.

Finally, the participants were to assess the possible safety effects of navigation systems. About ∼30% of the participants reported a slight or radical positive effect on safety but at the same time 10% reported a slight decrease in safety.

Overall although, the most common answer to all statements was 'No change' and the reported changes post-trial (whether increases or decreases) were smaller than expected pre-trial (Table 6).

Table 5 Participants' indication of perceived benefits, percentage of responses per test site

Perceived benefits	Greece ($n = 130$), %	Italy ($n = 100$), %	Spain ($n = 89$), %	Sweden ($n = 66$), %	UK ($n = 33$), %
convenience (easy access to information)	69	44	38	82	52
comfort (being able to plan ahead, being able to avoid undesired road types)	62	50	56	59	39
economic (lower cost due for instance to lower fuel consumption, fewer navigation mistakes etc.)	26	9	9	46	9
environmental (e.g. less fuel because of less detours)	15	10	6	21	6
safety (less irritation, less stress)	29	29	37	41	30

Post-trial questionnaire.

4 Discussion and conclusions

The aim of this paper was to present and discuss findings from an FOT regarding drivers' acceptance, use and reported effects of

Table 6 Statistically significant differences between the expected effects before and stated experienced effects after the trial ($n = 447$)

Expected effects assessed	Change	p_{Asympt} 2-tailed
possibility of choosing the optimal route according to preferences (e.g. shortest, quickest)	smaller increase than expected	<0.0005
the time it takes to reach destinations	smaller decrease than expected	<0.0005
the distance covered to reach destinations	smaller decrease than expected	<0.0005
the number of journeys made by car	smaller increase than expected	0.009
fuel consumption	smaller decrease than expected	<0.0005
safety when driving	smaller increase than expected	<0.0005

access to navigation support. A large part of the participants in the FOT reported that they had used the system for 25% of the trips or less. Earlier studies by Franken [1] and Svahn [2] concluded that drivers report frequent usage of navigation support systems. One explanation for the differences between the investigations could be that the questions regarding use patterns were formulated in slightly different ways, that is, percentage of number of journeys made against often/seldom, and a use frequency of one in every four trips could mean 'often' for some and 'seldom' for other users.

More important although are the motives for use and non-use. One interpretation of the results is that they are the consequence of how drivers understand the content and benefits of these systems. Consistent with earlier findings (and the overall purpose of the function), the most common use situation was for trips when the route/destination was unfamiliar. If a major part of journeys involves regular journeys and familiar routes, and if the benefits of navigation are assumed to relate to unfamiliar environments, usage would not be motivated. The comments made by several participants support such a claim. However, other users also used the systems for other situations and their comments indicate further purposes than merely providing turn-by-turn information. The systems were for instance used to provide a preliminary arrival time for the journey, which resulted in reduced stress and increased comfort. Another and more passive (compare [2]) use was to activate the system to obtain an overview of routes and roads, which resulted for instance in drivers' learning more about the environment, both familiar and unfamiliar. Hence, this and the earlier study by Svahn [2] show that users use and find uses for navigation support systems for other purposes than to obtain turn-by-turn information.

One reason for limited or non-use was, no doubt, that many participants found the respective systems lacking in reliability as well as in usability, even though the systems were (or at least were intended to be) 'mature systems'. However, at the same time as one group of users, across all test sites, consistently commented on these defects another group of users, also across test sites, consistently remarked on the benefits of use. A particularly low level of use was found in the Italian and UK test sites but even though it is feasible that the systems tested in these sites functioned less well than in the other sites, non-use cannot be attributed only to these flaws. Instead, the findings suggest two categories of users; those who create their own use practice with awareness and acceptance of technical flaws and delimitations of the systems and the efforts associated with learning to interact with a less well designed user interface (compare [13]) and those who do not, perhaps because of an (exaggerated) belief in or expectation of technology. Overall, the participants expected certain benefits and effects but the differences between initial, pre-trial statements and assessments made during and after the trial illustrate the emergence of what Girardin and Blat [13] described as an 'expectation gap,' something which can have influenced the outcome of the trials. Improved interface designs and overall accuracy of information provided could have resulted in significantly different results.

The main argument for introducing telematics solutions in transport has been increased efficiency and reduced environmental impacts. Earlier studies [1, 2] have primarily investigated the effects of access to navigation support systems with a focus on efficiency, associated with the desired effects on a societal level. Even though expected effects in terms of more optimal routes and reduction in duration of journeys were reported, the main effects identified in the present paper concerned increased convenience and comfort, less stress and an overall more positive experience of making the trip. The importance of acknowledging these effects too – even though not primary design goals – has also been argued by Girardin and Blat in their study of taxi drivers' use of navigation support systems. Indeed, an important incentive for investing in these systems was to reduce stress rather than improve efficiency. More relaxed driving and less stressed drivers can have considerable positive secondary effects on traffic flow and traffic safety but it must be noted that these effects may at the same time counteract societal goals for less traffic and a reduction in the number of trips by car.

Even though navigation systems are primarily designed to support drivers in strategic (e.g. trip planning, route choice) and tactical (e.g. turn decisions) components of the overall driving task (compare [26]), the rhetoric surrounding transport telematics solutions include arguments that ICT-mediated information services, in general, will lead to changes in people's choice of means of transport. The findings from the study reported here, as well as the study by Franken [1] do not support the notion that navigation support systems have such an impact. One explanation is that the participants in the trials were primarily and frequent car users and earlier research has shown that in most situations people act according to their habitual behaviour (e.g. [27]). Habitual behaviour is performed without much reasoning or deliberation [2] and according to, for instance Kenyon and Lyons [28], modal choice is rarely the result of reasoned action even when a new and/or unknown journey is to be undertaken. If the traveller does not weigh the pros and cons of different modal choices, the information will not be effective, not even if it provides information on alternative modes. Such information will in most cases probably not even be consulted. It is important to emphasise that the navigation services tested were not designed with the intention to, and did not, provide information on alternative modes. However, if questions regarding mode of transport are not asked by travellers and the services do not provide any answers, no impact on mode of transport can be anticipated. There are other services, such as, for example, multimodal travel planners that are designed with the intention to target an even higher level than the tactical and strategic levels described earlier, a level where decisions are taken on whether to undertake the trip in the first place, and if so by what means of transport. There are also ICT-solutions that support a 'lower', operational level, that is, systems that support the driver's control of the vehicle. To understand and develop reasonable expectations for the direct and secondary effects associated with the use of ICT in the transport sector, the use of the term ICT must become more nuanced, and take into consideration these differences between telematics solutions.

Furthermore, the high expectations for ICT to contribute to a more efficient traffic system, increased traffic safety and reduced negative impact on the environment stress, the importance of further FOTs in order to understand what factors that contribute to users' uptake of ICT-solutions but also how use patterns develop over time.

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