Beyond navigation: driver requirements for location-enabled journey support

Beyond Navigation: Driver Requirements for Location-Enabled Journey Support

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1 Introduction

In-vehicle navigation systems for the everyday user are becoming more widely available and many have had great success in the market. This paper considers how the availability of location information can be used to enhance the experience for the user beyond that available in today's systems.

In particular, the issues explored in this paper are the following:

- Current navigation systems focus on the 'A to B' part of the journey, from the point at which the driver moves away to the point at which he stops at his destination. In fact a 'journey' extends beyond those points. There are activities that need to be carried out prior to getting in the car as well as after arrival at the destination. These are usually linked to the purpose of a journey and are not taken account of in current systems. With the advent of location-enabled mobile devices, the pre- and post- journey scenarios are able to be supported.
- Current navigation systems focus on finding the way. The car is not purely a method of moving from one point to another, it can also be considered as a 'space' in its own right. This could be a business space, a family space or an individual space, depending on the user and the context of its use. The availability of location information may be able to support this if the user needs can be understood.
- Current navigation systems do not fully exploit the full potential of knowing location. In these systems, location is only used directly, to guide people from one point to another. Location can also be used indirectly, e.g. to predict the information someone may need because they are at a particular location or to filter information so they only receive that which is relevant to them at that moment.

The two studies reported in this paper sought to identify the needs of drivers over the course of a range of journeys. In addition to needs identification, the studies enabled the assessment of two different methods for requirements capture and the advantages and disadvantages of these are compared.

2 Method

Two separate studies were conducted, using two different methods for data capture. The first study required drivers to capture requirements in real time from the point at which they entered the car to their arrival, on foot, at the final destination. The second study required drivers to recall an unfamiliar journey that had been problematic and covered the entire period from pre- to post-journey.

2.1 Real time logs

The aim of the first study was to investigate the user requirements for a device that is capable of helping the user perform daily tasks in different environments, particularly whilst in the car. The data was captured in 'real time', specifically, recording things as and when they happened, using the methods outlined below. Additionally, the study examined how these requirements change when moving from the car to the outside environment. This study did not investigate use of satellite navigation systems in the vehicle.

The method was developed to assess the user requirements for a new device to aid tasks performed both in and out of the car. It was important to generate both qualitative and quantitative data, which was gathered using Real Time Logs (notebook-based data capture tables shown in Figure 1). Whilst not driving, the logs were completed by hand. Whilst driving, the driver was provided with a one-touch audio recorder and prompts as to the information they needed to record (see Figure 2). Participants were then required to transfer the audio log to the same paper-based Diary log once they had stopped the vehicle.

Each participant completed the Real Time logs for every car journey they completed as a driver over 4 days (2 weekdays, 2 weekend days). Following this, post-log interviews were performed to obtain further information or raise queries with the participants with regards to the logs they filled in over the trial period.

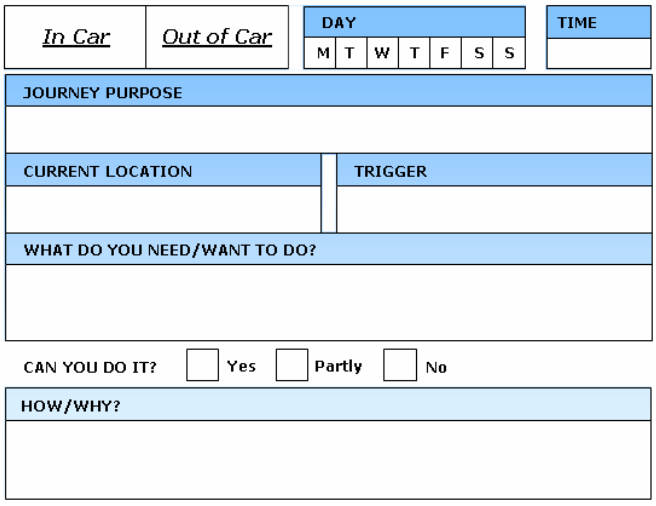

Figure 1 – the content of the Real-Time Log

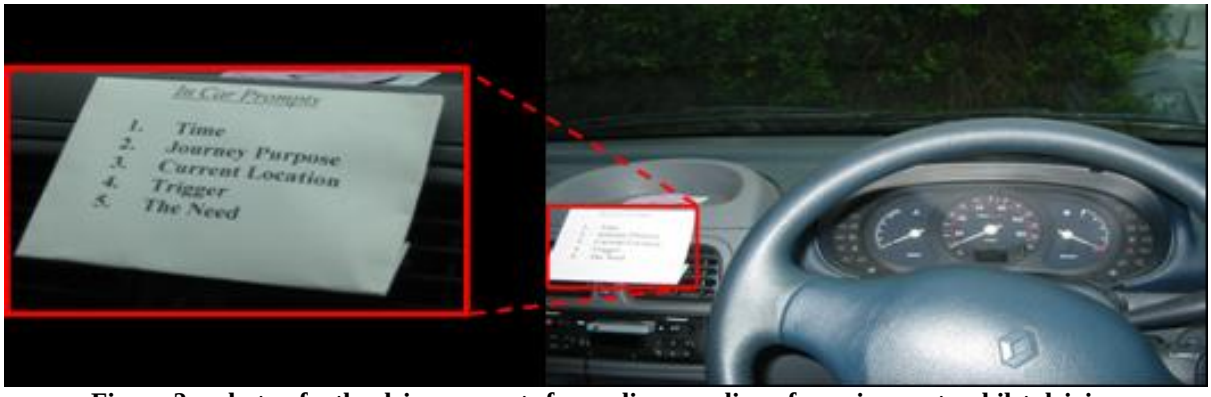

Figure 2 – photo of a the drive prompts for audio recording of requirements whilst driving

2.2 Post hoc recall

The aim of the second study was to generate additional user requirements for unfamiliar journeys aided by satellite navigation systems. The method behind this study differed greatly from the first in that it adopted a post- hoc rationale, gathering qualitative data alone.

The research involved the use of recorded telephone interviews. The interviews were semi-structured which required participants to recall an unfamiliar journey that was particularly problematic using the navigation system, and were subsequently asked detailed questions about the journey and their experience. Therefore the answers given were from a more analytical perspective and consequently differed from those generated in 'real time'.
It was vital to understand the whole experience of the journey in order to establish the range of enhancements that could be made to current navigation systems. With this in mind the journey was separated into five stages (see Figure 3).

	***Pre trip*** – Everything that encompasses the planning of the journey, for example, days, weeks, months before i.e. the use of internet-based mapping, gaining traffic information, phoning a friend for directions etc.
	***Setting off*** – Related to the behaviours undertaken when first entering the car e.g. sitting in the car, typing in the destination, everything that is done before they pull away.
	***On trip*** – All things encompassed 'on route', once pulled away and settled into the journey.
	***Near destination*** – The final driving stage, the last 15 minutes of driving. For example, 'what do you need to know whilst approaching the final destination' e.g. car park information, local services, distance to your location etc.
	***Final destination*** – Unrelated to the journey, everything from parking onwards, once the engine is turned off, having stepped out the car, and heading towards the destination.

Figure 3 – the 5 stages of the journey identified for the post-hoc recall study

Each of the above stages were explained to the participants and then reiterated throughout the interview in order to comprehend all the necessary behaviours undertaken at each stage. Participants were prompted by the interviewer to discuss the following issues to (a) enable a full understanding of the journey context and (b) extract the maximum information possible form each participant:

- Journey purpose and description
- Time of day
- Passengers present

- Familiarity with the journey
- Other sources of information used (in addition to their navigation system), the information sought and the reasoning
- Any extra information or capability they would have liked at each stage

3 Participant Selection

3.1 Real time logs

The real time log study used a sample of nine drivers with the following characteristics:

- Young professionals (and in their first two years of full time employment)
- Regularly drive a car (defined as using a car more than three times a week)
- Age: 22-26 years old
- Gender: 6 males and 3 females
- No dependents (children bring about large lifestyle changes and as young professionals generally do not have children, this potentially confounding variable was eliminated).

3.2 Post Hoc Recall

The post hoc interviews used a sample of ten drivers with the following characteristics:

- Professionals (and in full time employment)
- Regularly drive a car (defined as using a car more than three times a week)
- Navigation ownership (participants were required to have experience of using satellite navigation systems)
- Age – 23-76 years old
- Gender: 9 males and 1 female

3.3 Limitations

It must be stated that due to the differing criteria for the participant selections, the comparisons made between the studies results obviously have limitations.

4 Results

4.1 Real Time Logs

This paper reports only part of the results generated by this study.

The following results show the precise nature of the tasks plus a categorisation of the task into:

- Communication
- Get information
- Make reminder
- Make note

Tasks were only included in this analysis if they met all the following criteria:

- they cannot currently be performed whilst driving
- the consequences for not completing them are high
- the frequency with which the driver needs to complete this task is greater than once a week.

Finally, the tasks were split into 2 sub-categories: those with or without a location element. Those with a location element were identified post-hoc by the experimenter as those where knowledge of location was either essential for the task to be carried out or would enhance the conduct of the task. As this paper focuses on the opportunities offered by location-enabled support, the requirements *with* a location element are presented in full, whereas only illustrative *examples* of those *without* a location element are shown. The requirements without a location element comprised approximately 60% of the total.

4.1.1 Real-time user requirements *with* a location element (full results)

Communication requirements
Tell friends I'm on my way
Call the office to tell them I'm going to be late
Call work to tell them I'm going to be late
Information requirements
Find way to conference centre
Find out traffic and road details on route
Find out best car park to go for shopping area I'm visiting
Find out where café is
Check traffic on M1 to see if I should travel to London tonight
Estimate how long journey will take
Find out how long it will take e from here so I can ring a friend
Look up film times for local cinema
Find recommended restaurants in our price range
Get directions to the restaurants
Find out where friends are and if they are on their way
Find out prices of food etc in the park
Check weather forecast for the day
Reminders
Make reminder to pick some flowers up
Make reminder to watch programme on TV tonight
Make reminder to turn phone off for visit
Make reminder to turn phone on silent before lecture
Make a reminder to fill the car up after shopping
Make reminder to call friend when I'm at work
Make a reminder to stop off at the shops on my way home
Make a reminder to call bank when I'm at work
Make a reminder to pick credit card from house
Make a reminder to fill up car on way back from work
Make a reminder to post letter when I get home
Notes
Make a note of things of things I do when I get home
Note down some questions to ask before lecture
Make a list of things to do in town tomorrow

4.1.2 Real-time user requirements *without* a location element (examples only)

Communication requirements
Ring around friends to arrange a night out
Information requirements
Find the number to call a restaurant
Reminders
Make a reminder to wash the car over the weekend
Notes
Make a shopping list

4.1.3 Comparison of driving vs pedestrian tasks

The Real Time Log also asked participants to identify to what extent (fully, partly or not at all) they were able to carry out the task in each context ('in car' i.e. driving or 'out of car' i.e. on foot). The graph below shows that whilst 'out of car' the majority of tasks could be completed fully or partly. By comparison, whilst 'in car' the majority of tasks could either not be completed at all or only partly.

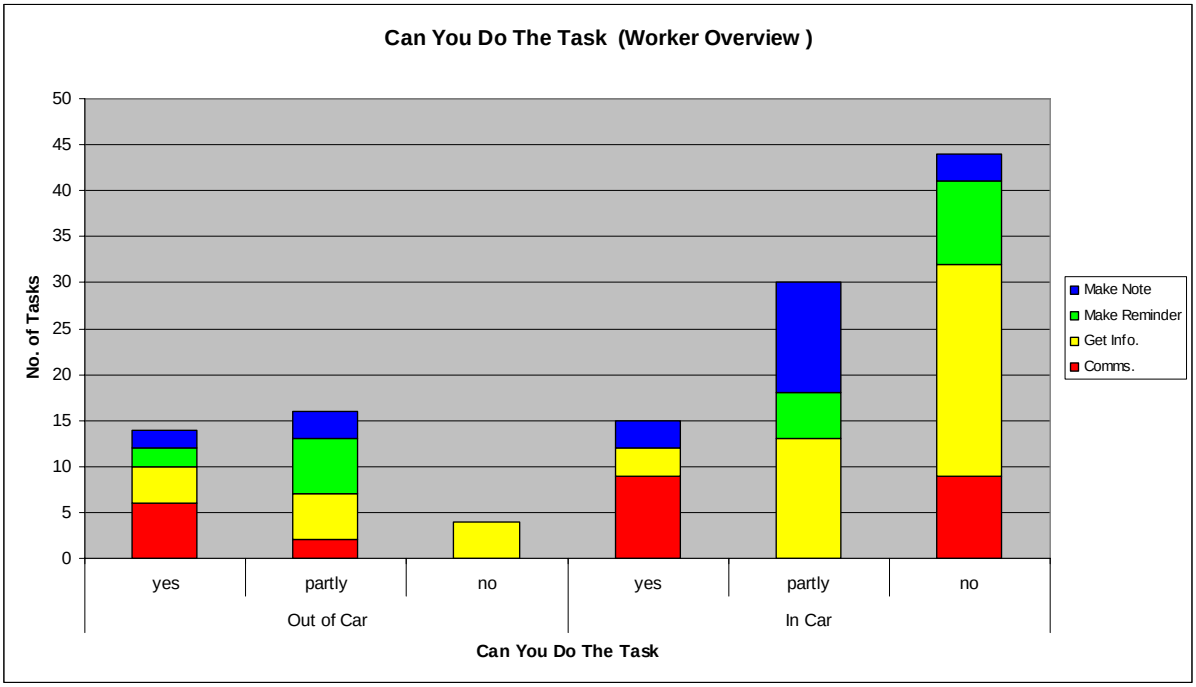

Figure 4 – Comparison of the extent to which tasks can be completed in the two context s ('out of car' vs 'in car')

Figure 4 also shows the following for the 'in car' tasks:

- Getting information appears to be the task participants wished to complete most frequently (but were unable to).
- Some communication tasks could be carried out but an equivalent number couldn't.
- Task that fell into the 'make a note' category were mostly only partly completed.
- None of the 'make a reminder' tasks could be undertaken fully whilst in the car.

4.2 Post Hoc Recall

The following results show the precise nature of the identified requirements plus a categorisation according to journey stage, including an additional 'generic' category (for requirements that were not stated according to a particular journey stage).

As for the first study, the requirements were split into 2 sub-categories: those with or without a location element (as defined previously). Again, as this paper focuses on the opportunities offered by location-enabled support, the requirements *with* a location element are presented in full, whereas only illustrative *examples* of those *without* a location element are shown. The requirements without a location element comprised approximately 30% of the total.

4.2.1 Post hoc user requirements *with* a location element (full results)

Pre Trip
General impression of area around the destination
Determine the length of the journey
Facilities on route e.g. petrol stations, service stations
Traffic jams
Layout of exhibition
Overview of the route
Business contact details
Location of potential customers
Setting Off
Traffic information
Directions via road signs, maps and route planer as a back up to the satellite navigation
Notify when running late
Need for a contact media via voice recognition to receive advice - directory enquires
Out of date database
Unable to recognise specific places
On Trip
Miss turnings if caught in the wrong lane on the motorway
Problems when nearing the city centre and the roadwork's get closer - response from the system is not quick enough
Would not recognise the destination
Laborious method for inputting information
Traffic information
Reminder of schedule/business information
Nearest services
Near Destination
Took the wrong turning as concentrating on driving, I.e. the system did not have verbal instructions
Unclear which exit to take
Parking issues
Need for a guide on car parks:
Where they are located
Price
How many spaces are available
How to find the car again
Level of security
Confirmation/backup of directions via sign posts, marshals and backseat passengers with local knowledge
Directions on parking places in advance
Nearest cash points
Determine where to buy a particular item from
Information on places of interest at the destination
Determine how big the queues were to a concert
Reminder of schedule/business information
Information on local services - a guide on good places to eat
Post trip
Precise directions to the end point
Information about the area being visited (access to local knowledge)
Information about local services, e.g. petrol stations, garages, restaurants etc
Need for an overview of the route
Ability to locate individuals at the end point
Arrange meeting point
Location of potential customers
Need for a more accurate database
Need for advanced warning, and a quicker response rate
Need for traffic information, extreme weather conditions and local roadwork's

Generic
General impression of the area around the destination
Idea of local landmarks
Plan and organise the route order i.e. most efficient way of visiting the clients
Determine the length and mileage of the journey
Overview of the route
Ability to tag information
Ability to control the amount of navigational aid
Provide local knowledge
Traffic, weather and roadwork's information
Location of potential customers

4.2.2 Post hoc user requirements *without* a location element (examples only)

Pre Trip
Calendar/organiser
Setting Off
Wireless internet connection to research aspects of work
On Trip
Memory jogger/reminder of the day's schedule
Near Destination
Ability to synchronise laptop with the satellite navigation system
Post trip
Edit information about work

4.3 Comparison of results from the Real Time Logs and Post Hoc Recall

Looking at the results from both studies it can be seen that the two methods generated some common requirements. However, some requirements were uniquely identified by one of the studies. The following tables provide a summary of both the common and unique requirements.

'Common' requirements identified by Real Time Logs and Post Hoc Recall
Contacting people of destination re arrival
Location of others to meet up with
Directions
Traffic information
Car park information - nearest to destination & available spaces
Local services information
Weather information

'Unique' requirements identified by Real Time Logs
Reminders that are location related;
Turn off phone
Shopping related
When at home / leaving
When at work / leaving
Make notes before and after the event

'Unique' requirements identified by Post Hoc Recall
Reminder of schedule/business related
Overview of the route/destination area
Customer locations / potential customers
Matching to external information
Tagging information
Adding information to already existing data
Car parking - finding car again
Satellite navigation requirements:
Not enough warning (specifically, no information on lane changes, information too late in urban areas with close streets)
Laborious method for inputting information
Partial/unrecognised destinations

5 Discussion

The two methods used in the reported studies differed on two main dimensions: firstly time of data capture (real-time vs post-hoc); secondly navigation system usage (non-use vs use). Despite this, there were several common requirements generated across the two studies, covering a range of journey/task aspects.

Where the results differ, this appears to be mostly due to the timeliness of the data capture method. The real-time logs generated unique requirements that identified transient 'thoughts', mostly the need to remember something when at a particular location (e.g. 'don't forget to put phone onto silent before going into meeting'). The post-hoc recall method was more likely to generate requirements that came from the 'bigger picture' e.g. related to schedules or overviews of the route. In addition, due to the inclusion of navigation system use in this latter study, there were, naturally, requirements pertaining to inefficiencies in the system designs (e.g. laborious input methods or late warnings of manoeuvres).

The main limitation in comparing the results of the two studies was the different samples involved in each study (particularly age and navigation system experience). This was due to the availability of participants at the time of each study. Future studies should eliminate these potentially confounding variables.

6 Conclusions

The main conclusions on the methodological aspects of the studies are:

- The real-time logs were particularly suited to capturing transient 'reminder' tasks.
- The post-hoc recall method was more likely to generate requirements relating to the 'bigger picture'.
- Future studies wishing to identify requirements for location-enabled journey support should use a combination of the two methods, preferable with two matched samples.

The main conclusions related to future location-enabled systems - that build on increase of navigation systems in the market – are:

- Tasks connected to the journey purpose (e.g. schedules, reminders, car parking) are just as important as support of the journey itself (i.e. 'navigation' per se).
- Currently, there is no effective way to support these 'additional' tasks.
- The availability of location knowledge (via the navigation system) offers new opportunities for location-enabled services.
- Most of these new opportunities do not require new technologies or data; they are simply a re-packaging of what is already there in a suitable format to support the task in hand. They therefore have implications across the value chain.

7 Acknowledgements

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