The Use and Appropriation

of In-car Satellite Navigation Systems

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Abstract

Technologies are used and appropriated by the user, who adopts and adapts them to better address their needs. How does this process develop over time? How do different users appropriate the technology in different situations? What are the factors affecting their appropriations?

This study investigates such issues by looking at in-car satellite navigation systems. Particularly, it focuses on the development of the relationship between the driver and the technology, the driver's adoption and adaptation of the technology to their practices, and the factors determining their appropriations (or disappropriations) throughout time. This study takes a qualitative approach, consisting of observations in the car and interviews with a broad spectrum of participants and in a variety of use scenarios. As a result, three main themes are found: factors for appropriation, cost benefit analysis and social dimensions of use. The first describes how appropriation manifests itself over time, with a difference between novice and expert drivers, and novice and expert users; the second describes a particular strategy of use adopted by expert users; the third describes unpredicted uses of the technology. Additionally to this, three appropriation patterns are identified and implications for the design of satellite navigation systems are drawn from the main findings, with the aim to help designers predicting the possible user's paths of interaction with the technology.

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1. Introduction

A relationship of co-dependence, co-influence and co-production exists between the technology and the user. The technology shapes the user's activities and practices, and the user shapes the technology itself. The process by which the user adopts and adapts the technology, inventing often new strategies, workarounds and opportunities of use not intended by the designer, is called *appropriation* (Dourish, 2001).

Appropriation has gained the interest of different research fields over the last years. Social sciences have looked at the topic with the aim to understand the process by which a technology is integrated into the user's life (e.g. Silverstone, Hirsch & Morley, 1992). Computer-supported cooperative work (CSCW) has focused on understanding the user's needs and practices, and how these are supported and influenced by the technology use (e.g. DeSanctis & Poole, 1994). Human-Computer Interaction (HCI) studies have looked at appropriation from different perspectives: some have developed design principles and guidelines (e.g. Dourish, 2003), others have focused on the cognitive processes involved with the perception of new opportunities of use of the technology (e.g. Salovaara, 2008). The investigation of how and why technologies are taken up and appropriated is critical in HCI, where the aim is to design with the user in mind. Such knowledge can help designers understanding the match between the technology and the actual user's needs and practices, the unpredicted use scenarios, the possible patterns of use, and the reason for the *disappropriation* of the technology (Salovaara, 2006).

This thesis contributes to the knowledge of appropriation by investigating several

issues not previously explored. How does appropriation unfold over time and what does it consist of? How do different users appropriate the technology in different contexts and scenarios? What are the factors influencing their appropriations (or disappropriations)?

In order to answer these questions, a qualitative study was conducted on the use and appropriation of in-car satellite navigation (satnav) systems. This location-aware technology is globally wide spreading and has been already adopted by millions of drivers. Mounted on, or embedded in the car dashboard, it is designed to help drivers navigate and find their route by making use of the global positioning system (GPS).

By carrying out observations in the car and interviews with a broad spectrum of participants and in different contexts and scenarios, this study aimed to understand how the appropriation process happens over time, how it differs for different people, and what are the main factors determining the appropriation (or disappropriation) of the technology. For instance, it is likely that different kinds of users will reach different degrees of use and appropriation of the device. A novice driver will use the device in a different way than an expert driver by being more keen to rely on it. A user who buys the device merely for way finding will appropriate it differently from another who like gadgets to play with. A user driving in an area characterised by chaotic driving behaviour will use the device in a different way from another driving in a well-regulated traffic area.

There are two main motivations for choosing satnav systems to investigate these issues of use and appropriation. The first motivation concerns the fact that the satnav has a main straightforward purpose (i.e. route finding), but is used in a mobile activity, where settings and user's needs often change. This unbalanced mapping

between the functionality of the technology and characteristics of the user's practices might create situations in which appropriation visibly manifests itself (Salovaara, 2008), in different ways and at different degrees. The second reason concerns the fact that previous user-centred studies on satnav systems have mainly focused on relevant ergonomics (e.g. Jonsson, Harris & Nass, 2008) and usability (e.g. Papatzanis, Curzon & Blandford, 2007) issues, but have not explored the user's process of adoption and adaptation of the artifact. Few studies have looked at some aspects of these latter (e.g. Girardin & Blat, 2008; Leshed, Velden, Rieger, Kot & Senger, 2008), but neglected others. Investigating the appropriation aspect of the interaction between the user and the technology in-depth is fundamental, as it contributes to designing satnav systems which guarantee both a satisfying experience with the technology, and an undisrupted, safe and pleasurable journey in the car.

1.1. Layout of this thesis

This thesis is structured in six chapters.

After this introduction, Chapter 2 provides a literature review on appropriation and user-centred location-aware technology studies.

Chapter 3 presents the methodology used to investigate the research questions and draws a series of considerations on this.

Chapter 4, firstly, describes the participants and the observation settings. Secondly, it presents the findings from both observations and interviews through three main emergent themes: factors for appropriation, cost benefit analysis and social dimensions of use.

Chapter 5 provides a discussion of the findings, linking them back to the literature

reviewed in Chapter 2. Furthermore, it describes three appropriation patterns identified from the findings and draws implications for the design of satnav systems. Chapter 6 presents final considerations, research limitations and ideas for further research.

2. Literature review

In this chapter, an account of the previous research on the topic of appropriation and user-centred location-aware technology is given.

2.1. Appropriation

In order to introduce appropriation, it is fundamental to make a distinction between two approaches to the study of technology: the *technological determinism* and the *social determinism*. The first approach describes technology as following its own developmental path outside the human influence, and being the force which shapes society (McLuhan, 1994). The second approach argues that society shapes technology. Particularly, the social constructionist theory (Bijker & Law, 1992) describes technology as constructed by users in different phases. In the beginning, the artifact does not have a defined shaped due to *interpretative flexibility* (i.e. different interpretations of the technology coexist for different social groups). Throughout time, a number of *relevant social groups*, whose members assign the same meaning to the artifact, emerge. Finally, the social groups agree on the technology shape and this reaches a *closure*. Appropriation can only be explained if it is acknowledged that also the society shapes technology.

To give a unique definition of appropriation is not simple. What seems to be a thorough description of the concept is given by Dourish (2001; 2003), who affirms that the technology use is not predetermined by the designer, but emerges from the situated activities in which people employ the artifact. People adopt and adapt the

technology to better address their needs, reconfiguring it, discovering new opportunities and inventing new uses not envisaged by designers (Dourish, 2003). This definition includes both social elements and technical features.

To understand appropriation can help bridging the gap between the designers' intentions and the user's actual practices of use, critical for HCI, where the attention is on designing with the user in mind.

2.2. Perspectives on appropriation

Research on technology appropriation has been mainly characterised by studies investigating how users adopt and adapt the technology into their practices and how these latter are shaped by it. Some of these studies have taken a theoretical perspective, trying to define appropriation; others have taken a practical perspective, trying to explain appropriation and generate design principles and guidelines from their findings. Such studies mainly involve the social science and CSCW research stream. Only lately, the cognitive research stream has began to gain interest in appropriation. Attention is drawn to all these, as they are complementary in the understanding of such phenomenon.

2.2.1. Theoretical perspective

From a theoretical perspective, one way to look at appropriation comes from the sociological research on *domestication*, an approach focused on understanding the use and integration of media technologies in the household and everyday practices.

Attention is given to the negotiations and interactions happening between the user and the technology, and the socio-cultural context in which the technology is used (Silverstone *et al.,* 1992). In their *technology adoption cycle*, Silverstone *et al.* (1992) describe four steps: appropriation, objectification, incorporation and conversion. Appropriation is the stage in which people own the technology and, due to interpretative flexibility, assign particular value and meaning to it, in accordance to their practices and needs. This entails that the process of appropriation always happens and is different for every user or groups of users.

Other studies have looked at the adoption and integration of CSCW technologies in working practices, with the aim to understand the social and organisational issues obstructing or facilitating them. One example is the work of DeSanctis and Poole (1994), who believe that technology and social context mutually influence. They affirm that understanding the reasons for different adoptions and adaptations of technologies entails observing the physical context, the social processes and the emergent patterns of technology use. Using their *Adaptive Structuration Theory*, they conducted an ethnographic study to evaluate the use of a group decision support system in an office environment. They found that the technology, originally designed for assisting groups in their decision process, was appropriated to redefine budget priorities. This, in turn, led to redefine the social structure of the organisation itself. DeSanctis and Poole (1994) described this situation as characterised by a gap between the *spirit* of the technology (i.e. the use as intended by the designer), and the *appropriation* (i.e. the actual use by people). Only those appropriations faithful to the spirit of the technology were to be considered positively. An opposite perspective is the one of Dix (2007), who describes appropriation as a positive phenomenon which

demonstrates the user's ownership of the technology.

2.2.2. Design perspective

A different line of research, related to design and more practical, has become relevant in the last years.

Taking a sociotechnical perspective, Dourish (2001) considers appropriation as the *co-evolution* between the practices in which the technology is employed and the technology itself. Therefore, he aims to investigate both the user's work practices and the technological features facilitating appropriation. For instance, in one of his works, Dourish (2003) developed a set of design principles from the study of *Placeless*, a document management system used by a group of people. These principles were aimed to help designers developing open and flexible technologies, which supported the social meanings created around them and lent themselves to be appropriated by different users.

Along the same lines, Dix (2007) describes *designing for appropriation* as a fundamental practice, in order to let the user "finalise" the design according to their needs. In his paper, he also suggests a set of general principles for designing for appropriation, which include concepts such as configurability, interpretation, visibility and sharing of discovery.

Through their studies on mobile phone use, Carroll, Howard, Vetere, Peck and Murphy (2001; 2002) and J. Carroll (2004) proposed a *Model of Technology Appropriation*, in which the role of the user is highlighted. They mark a distinction

between *technology-as-designed* (i.e. the technology as envisaged by the designer) and *technology-in-use* (i.e. the technology as used and shaped by the user). It is suggested that there are three possible outcomes defining the technology-in-use: when people do not show any interest in the technology or in some of its features, *non-appropriation* occurs; when the user adopts and adapts the technology to their necessities, *appropriation* occurs; when the user rejects the technology after having interacted with it, *disappropriation* occurs. The authors distinguish between *attractors* and *repellents*, which are attributes of the technology encouraging people to appropriate or non-appropriate it. They also distinguish between *appropriation* and *disappropriation criteria*, which encourage users to appropriate or disappropriate the technology. Finally, they describe the presence of *reinforcers,* as high-level drives motivating to use the technology throughout time. J. Carroll (2004) affirms that understanding this process of appropriation can enable designers to create future versions of the same technology or new technologies.

For instance, in their research on mobile phone appropriation by youths, Carroll *et al.* (2002) found that attributes such as cheap, fashionable, usable and familiar constituted attractors for the young generations. On the other side, attributes such as expensive, frivolous, unusable were repellents, leading to non-appropriate the device. Appropriation criteria were, for instance, the fact that mobile phones facilitate social relationships, give a sense of security and become life-style organisers. On the other side, disappropriation criteria were the fact that mobile phones have hidden costs and reception problems. Finally, reinforcers were the fact that mobile phones construct the identity of young people.

Insights on appropriation can be indirectly seen in the work on *tailorability*, an

approach aimed to empower users to re-design technology while using it. One example is the work of MacLean, Carter, Lövstrand and Moran (1990), who developed a software system, *Buttons*, which could be tailored by the user to match their work practices. In their paper, they emphasise the importance of constructing a *tailoring culture*, so that the user feels free to adapt the technology to their needs. Another example comes from Trigg and Bødker (1994), who explain how system developers can learn from the user's tailoring work and better support it. These studies attempt to encourage the user to adapt the technology to their needs. Nevertheless, they focus on single tools at a time, whereas the user carries out their activities by employing a number of tools, which are all connected and interdependent (Dourish, 2003).

2.2.3. Cognitive perspective

A rather novel way to look at appropriation comes from Salovaara (2006; 2008; 2009), who has presented several papers arguing that previous research has failed to recognise the importance of the cognitive processes happening at the level of the individual. According to Salovaara (2006; 2008), appropriation happens because the user interprets and perceives the purposes of use of the technology differently in different situations. When the user perceives a new opportunity of use (which can happen through insight, exploration or in the attempt to master it), they will create a new *usage schema*. Such schema adds on existing schemas, enriching the use of the device. Understanding the processes of interpretation and perception, the drives to appropriation and the pace of such phenomena means to study appropriation (Salovaara, 2006). Differently from others (e.g. DeSanctis & Poole, 1994), this

perspective on appropriation does not imply the existence of proper uses envisaged by the designer; rather, it makes of the user a designer as well (Salovaara, 2006).

One of his main works regards the appropriation of *Comeks*, an MMS-based comic creator, by young students (Salovaara, 2007). Herein, appropriation is seen as the development of resources for action, thanks to which every different participant uses the comic creator to arrange meetings, maintain relationships and send greetings in their own style of expression.

Finally, the novelty of Salovaara's approach also lies in the methodology challenges raised and the research strategies suggested, which move towards a more empirical approach to study appropriation. Salovaara (2008) suggests to conduct field studies, but also employ more controlled experiments (e.g. by looking at the consequences of manipulating the interface design). Finally, given that the focus is on cognitive processes, he suggests to look at perception, mental models, learning and creativity.

2.3. Location-aware technologies and appropriation

Research on appropriation encompasses the study of a variety of technologies in the context of information and communication technologies, computer-mediated communication, collaborative work and learning. In the interest of this thesis, issues and findings from the literature on user-centred location-aware technologies are presented.

Many of the studies on location-aware technologies have often taken a technology-driven perspective, focusing on issues such as service coverage, battery life, connectivity and portability (Girardin & Blat, 2008). Other studies have taken the

traditional approach to interactive system design and evaluation, employing techniques such as task analysis and cognitive evaluation, with the aim to understand the possible user's interaction patterns (Dourish, 2001).

Cognitive studies have been carried out trying to understand the issues around human orientation in unfamiliar environments. For instance, Kitchin (1994) studied how people use cognitive maps for processing and using spatial information.

Ergonomics studies have focused on the safety and efficiency of location-aware technologies, and the impact of these on the driver. For instance, Jonsson *et al.* (2008) found that the accuracy of information strongly affects the driver's performance and trust towards the device.

Usability studies have focused on reducing the possibility of error in multimodal technologies such as in-car GPS. For instance, Papatzanis *et al.* (2007) used several analytical and empirical usability evaluation methods to evaluate the usability of satnav systems, for the purpose of setting up a route. In particular, they found that each of these approaches uncovered a number of issues, while neglecting others.

However, all these studies do not take much into account the way people use and integrate the technology in their practices.

Lately, research on how people use location-aware technologies has began to emerge. One interesting example is the work of Perry, O'hara, Sellen, Brown and Harper (2001), who studied the use of mobile technologies by UK mobile workers. They found a gap between the technology possibilities and the users' needs. They also identified several strategies through which the users overcome the technology limitations: for instance, users are ready to employ more versatile artifacts (e.g. paper) when the technology is not flexible enough. On the basis of their findings,

Perry et al. (2001) suggested guidelines for mobile technologies able to support the unpredictability and uncertainty of mobile workers' practices.

The flexibility of location-aware technologies in interpreting and responding to the user's mobile needs is a critical issue for the design of these systems. Brodersen and Kristensen (2004) elaborated the *interaction through negotiation* paradigm, which describes how the interaction between users and ubiquitous technologies is negotiated in mobile activities. This paradigm argues that designers should not limit the design space by creating defined rules on the *normative use* of the technology, expecting that the user will follow them. Rather, they should take into account the possibility of unanticipated uses and design for them. This can enable the user to interact with the technology in a richer way and in accordance with their contingencies. Particularly, the authors suggest three concepts which should inform the design process: *availability* (how the technology manifests itself and is perceived by the user), *interpretability* (how the user understands the technology in different situations) and *connectivity* (how the technology is connected to other devices).

Other studies have looked at how people use in-car navigation technologies.

Leshed *et al.* (2008) have carried out an ethnographic study on how people engage and disengage with the environment when using the satnav. They found that drivers often disengage with the environment as they merely follow the GPS guidance. However, they also discover new opportunities for engagement as they feel more secure to explore and discover new places. Looking at their findings, the authors suggest implications for the design of GPS technologies. These include the possibility to: navigate using landmarks; make visible the ambiguity of GPS data;

augment the context-aware capabilities of the GPS; support the social interactions happening in the car.

Another ethnographic study has been conducted by Girarding and Blat (2008) on the appropriation of satnav systems by Barcellona taxi drivers, early adopters of this technology. Interested in the integration of the device and its influence on these particular drivers' practices, they found that: it is used in complementarity with other tool; it gives a sense of tranquillity to reach the destination; it tends to be less used with experience; it is a learning tool which does not impoverish the taxi drivers' orientation and driving skills.

2.4. Aggregating evidence for appropriation

This literature review showed different perspectives and studies on appropriation. Theoretical studies have attempted to define appropriation and build frameworks to represent it. Social science and CSCW studies have looked at the social and organisational issues which come into play when the adoption and adaption of technological systems is negotiated by users. These studies have considered the user's contribution and role in the shaping of technology and in the creation of new opportunities of use. Nevertheless, they have not looked at ways for the technology to facilitate appropriation.

Design studies have attempted to explain appropriation and the factors affecting it, with the aim to draw implications for the design of interactive systems. Nevertheless, they have focused much more on the technological features promoting appropriation than on the social aspects of it.

Cognitive research has only lately gained interest in the phenomenon of

appropriation and there are not many substantial studies on it yet.

In regards with the research on location-aware technologies, much has been done from a technology-driven perspective. Only lately, field studies and ethnographical studies have been conducted with interesting findings on the way people use and adapt such technologies to their daily life. Nevertheless, they have often considered only particular populations of users.

Overall, many studies have looked at how groups of users appropriate cooperative technologies, but only a few have looked at technologies for individual use. Moreover, none of the previous studies has focused on how people appropriate technology at different stages of experience with it.

This study will attempt to bridge the gap between these different perspectives and research on appropriation, by focusing on both the social issues around the integration of technologies into working practices and the features of the technology encouraging an appropriation behaviour. Moreover, differently from previous research, a broader spectrum of users of satnav systems in different contexts and scenarios will be chosen. Finally, this study will highlight the factors driving appropriation throughout time with the aim to understand how this phenomenon develops over time.

In the following Chapter 3, a description of the methodology used to address the research questions is provided.

3. Method

This chapter describes the methods and techniques used to gather and analyse data for the study. The study was conducted between June and July 2009 in Italy and England. It used a qualitative approach, consisting of two data-gathering sources: observation and interview.

3.1. Ethical clearance

Before the research started, ethical clearance was granted from the UCL Research Ethics Committee. All participants were informed and consented to take part in the study, knowing that they could withdraw at any time.

A risk assessment was conducted in order to ensure that both participants and researcher did not run any particular risk. Given that the observation was conducted in the car, the researcher decided not to talk nor ask any question to avoid interruptions or distractions. Nevertheless, to obtain such unobtrusiveness was sometimes challenging, as some of the participants had a close relationship with the researcher and tended naturally to speak to them.

3.2. Recruitment of participants

Ten participants were recruited through word-of-mouth via e-mail, and were selected on the basis of their driving experience and use of the satnav. Most of them were familiar to the researcher. Of all participants, six were recruited in the area of Naples in Italy; four in the area of London in England. This choice to gather data from

participants in two different countries did not intend to shed light on the cultural differences among these. It arose from the researcher's interest in understanding the factors coming into play in the relationship between the driver and the satnav, and in the process of appropriation of the device. Two diverse driving environments, such as the ones in Italy and England, would have enabled to obtain a broader spectrum of participants and scenarios illuminative for this study.

3.3. Observation

Participant observations were conducted in the car, while the participant was driving and using the satnav for their own purposes. Their length varied from 35 minutes to one hour. When possible, the research had the benefit to more easily observe the participant's actions and the context of their actions by sitting on the front seat.

For safety reasons and to ensure unobtrusiveness, field notes were taken alone. As suggested in Marshall and Rossman (2006), an holistic description of what was seen and heard was fruitful to define the areas of interest. This became particularly critical, given that appropriation is not easily observable and becomes evident only throughout time (Salovaara, 2008). Nevertheless, a checklist was created to ensure that all observations gathered the same type of data: contextual factors (e.g. type of journey, time, weather conditions, types of road, familiarity with the environment, social presence in the car, others drivers' behaviour), set up of the device, incidents along the journey, recalculations of the route, approach to the destination, arrival.

Whenever the researcher felt that deeper investigation was needed in regards to anything particular, or whenever the participants said something about the satnav during the observation, a note was taken and appropriate questions were raised

during the interview session afterwards.

At the end of the observation, photos of the car inside view were taken with the participants' permission. Such photos were aimed to remind the researcher of two things: the configuration and personalisation of the satnav and its place in the ecology of objects in the car.

3.4. Interview

The interviews were conducted after the observation and consisted of 45 minutes sessions which took place every time in a coffee bar. Interviews were semi-structured, in order to enable the researcher to follow up new interesting topics, whenever they came up (Preece, Rogers & Sharp, 2002).

In addition, the critical incident technique (Edvardsson, 2000; Flanagan, 1954) was employed for some of the themes explored, by asking participants to tell memorable stories about their use of the satnav. This technique is used in formative evaluations (Scriven, 1967), but also in investigations on how people use interactive technologies, as it enables to obtain retrospective data on actual positive and negative experiences (e.g. Mack, Lewis & Carroll, 1983). This characteristic of the technique was beneficial to the present study as well. Although the participants' answers might have been affected by memory and recall effects, their stories of successful way finding or breakdowns enabled to gain a deeper understanding of the process of appropriation (and disappropriation).

To make sure to gather the same kind of data, the same set of topics together with an outline of the questions was used for all the interview sessions (See: *Appendix A*).

The interviews investigated the findings of the observation, and elicited information about the user's practices of use of the device, their attitudes towards it, their relationship with it, and the processes of adoption, adaptation, configuration, personalisation and appropriation of the device.

All interview sessions were audio-recorded and transcripts were produced for analysis. When quotes from the participants' answers will be used in the text, any corrections made to clarify ambiguous expressions will appear in square brackets.

The interviews conducted with Italian participants were translated in English by the researcher. Issues of transcription and translation are raised in the literature (e.g. Marshall & Rossman, 2006) in regards to the process in which the researcher constructs and attributes meaning in the act of translation. As suggested in Marshall and Rossman (2006), whenever the translation does not directly represent the intended meaning, quotes from participants will also include phrases or words from the Italian language.

Finally, memos were written during and after the interview as well as the observation sessions. These annotations facilitated the researcher's analysis work and personal reflexivity. Potential biases and actual limitations of the approach were clearly highlighted and reflected upon during the stages of data gathering, analysis and interpretation.

3.5. Analysis

The analysis of the qualitative data gathered by observations and interviews was

conducted with an inductive approach. The open coding technique, one of the coding stages of the Grounded Theory methodology developed by Strauss and Corbin (1998), was employed. Open coding enables to extrapolate categories since the early data gathering sessions, but such categories are subject to change when more data are collected. In this study, the initial coding considered as categories the main themes investigated. Firstly, the raw data from field notes and interview transcripts were "cleaned" and formatted in a common standard. Secondly, by looking at the data, a number of concepts were identified and assigned to the categories (represented by the main themes investigated). Afterwards, such categories were modified to represent emergent themes and patterns, and clustered together when overlapping or redundant.

The analysis was conducted with the aid of post-it notes on the wall. Each note represented a concept and each cluster of notes represented a category. This enabled to see themes as they emerged, and to quickly rearrange concept and categories whenever needed. Moreover, throughout this process, memos were written to reflect both on the data and the process of data analysis.

3.6. Validation

In order to validate the findings from the observations and interviews, a short electronic questionnaire was sent to all participants (See: *Appendix B*). Herein, two initial questions were asked in order to identify the respondents' years of experience with driving and using the satnav (Q1.1; Q1.2). Following this, the main themes emerged from the analysis of the data were presented in form of statements. The participants were asked to rate their agreement with these using a five-points Likert

scale. In order to avoid acquiescence bias, not only positive but also negative statements were presented. Moreover, in order to avoid social desirability bias, a careful attention was given to wording the questions appropriately.

All but one participant responded to the questionnaire. Five respondents were expert users, four were novice users. Overall, the results corroborated the findings, but minor changes were to be made. *Table 3.1* shows the mean and standard deviation (σ) for each of the questions asked in the questionnaire.

	Q 2.1	Q 2.2	Q 2.3	Q 2.4	Q 2.5	Q3.1	Q4.1	Q4.2	Q4.3
Mean	4.33	4.67	4	2	4.17	4.17	2.5	2.33	4.33
σ	0.52	0.52	0.63	1.55	0.75	1.17	0.84	1.37	0.82

Table 3.1. Mean and standard deviation (σ) of results for validation questions (Q)

The first theme describes appropriation as a phenomenon changing over time and affected by several factors. Firstly, all respondents agreed with the finding that the experience in driving affects the degree of reliance on the satnav (Q2.1; Q2.2). Secondly, most of the respondents' answers supported the finding that, during the initial phase of use, people feel free to explore and discover the technology (Q2.3). Thirdly, the finding that there is a difference between novice and expert drivers in employing other navigation tools or way finding strategies was confirmed. In fact, the results suggested the existence of two different groups (Q2.4). However, one expert driver, who was a novice user of the satnav, responded differently from other expert drivers. This contributed to confirm the idea that not only the driving experience, but also the experience with the technology affect its use and

appropriation. Moreover, it also encouraged the researcher to mark a clearer distinction between these two factors in the presentation of the findings. Finally, the finding of new developed opportunities of use was strengthen by the respondents' answers, with only a few disagreements (of novice users) (2.5).

The second theme describes a cost benefit analysis which determines the adoption or rejection of the device in particular circumstances. Firstly, the finding that expert drivers adopt such strategy more than novice drivers was confirmed by the existence of two groups in the data (Q3.1). Secondly, the main factors previously identified as determinant for the decision on whether to appropriate the device were all mentioned but one (Q3.2). *Table 3.2* shows the frequency of selection of the multiple answers of Question 3.2.

Q 3.2 multiple answers	Frequency of selection
Familiarity with the environment	8
Awareness that the satellite navigation system might be wrong	6
Awareness that the satellite navigation system might suggest something which does not fit the driver travel needs	5
The presence of passengers in the car	5
The mood of the driver	0
None of the above	0
Others. Please, specify	0

Table 3.2. Frequency of selection of multiple answers in Question 3.2

Only one factor (i.e. mood of the driver) was never mentioned and, therefore, excluded. Interestingly, while expert users selected a wide range of factors, novice drivers limited to select one (e.g. familiarity with the environment) or none. This confirmed the idea that such strategy is typical of expert users and that, overall,

appropriation happens over time and at different degrees.

The third theme describes unintended social uses of the device. Firstly, respondents' answers showed that they tend to follow the passengers' guidance over the satnav (Q4.1). This confirmed the idea that the way finding practices are collaboratively negotiated, and that the driver often prefers the passengers' opinion as these are more able to take contextual factors into account. Secondly, the finding that the satnav is often used collaboratively was confirmed by most of the respondents (Q4.2). However, one outlier was found; already in the interview, in fact, one of the participants expressively affirmed to have developed strategies to prevent collaborative uses of the device. For completeness, such strategies will be reported in the findings as well. Finally, the finding that the satnav is often a motive of discussion was confirmed overall (Q4.3).

3.7. Considerations

Overall, the techniques chosen enabled to gather a rich set of qualitative data. This triangulation was intended to test the findings from each technique and counterbalance the weaknesses of these; moreover, it was also aimed to obtain complementary insights by looking at the phenomena under analysis from different angles (Cairns & Cox, 2008).

While interviews enabled to gather self-reported data, observations enabled to directly observe the participants' behaviour and the scenarios of use of the technology. The researcher's experience and skills in observing, making field notes

and interviewing might have affected the study. Nevertheless, the choice of looking at emergent themes in the actual data and the validation questionnaire contributed to ensure validity for this study.

In the following Chapter 4, the findings from the observations and interviews will be systematised in emergent themes of use and appropriation of in-car satnav systems.

4. Findings

In this chapter, the findings from this study will be presented. Firstly, the participants and the variety of settings in which the observations took place will be described in detail. Secondly, the main themes of use and appropriation of the satnav, derived from the analysis of the data of both observations and interviews, will be presented.

4.1. Introducing the participants

Of all ten participants, six were recruited in the area of Naples in Italy; four in the area of London in England. They were all male, except one English participant. They will all be addressed with "he" to ensure total anonymity.

Overall, four participants were novice drivers, (P1, P6, P7, P10), four were expert drivers (P3, P4, P5, P8) and two were elderly drivers (P2, P9). Of these, two novice drivers, three experienced drivers and one elderly driver were Italian; two novice drivers, one experienced drivers and one elderly driver were English.

They all used their satnav for daily and/or occasional travel, except one Italian expert driver who used it also for work. Of the ten participants, four were novel users (P6, P8, P9, P10) and six were expert users (P1, P2, P3, P4, P5, P7).

For more information, see *Table 4.1*. For an accurate summary of each of the participants, see *Appendix C*. In the text, whenever appropriate, there will be references to this appendix in the format "Number of participant (Table section, Page)", in order to enable the reader to see the derivation of the findings.

Participant Code	Age	Location	Years of Driving	Years of Satnav Use	Current Type of Satnav	Main Purposes for Satnav Use
P1	23	Naples, Italy	5	2	Old model, not embedded, touchscreen	Occasional travel in unfamiliar places, frequent use in highway and city canoeing*
P2	66	Naples, Italy	48	3	Latest model, not embedded touchscreen	Everyday routine, occasional travel in unfamiliar places
P3	36	Naples, Italy	18	3	2 satnav devices: - Not embedded, touchscreen	Frequent travel in unfamiliar places, city canoeing*
P4	33	Naples, Italy	15	2	Not embedded, touchscreen	Occasional travel in unfamiliar places, city canoeing*, highway
P5	34	Naples, Italy	16	4	On smart phone, touchscreen	Everyday work, occasional travel in unfamiliar places, highway
P6	22	Naples, Italy	4	2	Old model, not embedded, keys interaction	Occasional travel in unfamiliar places, frequent use in familiar places, highway
P7	22	Bath, England	4	3 years + 10 months	2 devices: - On smartphone, touchscreen (using it since 10 months) - Not embedded, touchscreen (only occasionally)	Occasional travel in unfamiliar places, more frequent use in the past
P8	36	London, England	16	1 year + 6 months	Not embedded, touchscreen	Everyday routine, occasional travel in unfamiliar places
P9	60	London, England	36	1	Not embedded, touchscreen, traffic information	Frequent travel in unfamiliar places, occasional city canoeing*
P10	26	London, England	3	2 years + 9 months	Not embedded, touchscreen	Occasional travel in unfamiliar places, occasional use in familiar places

*City canoeing: the act of manoeuvring in city streets, between narrow and large streets, low- and high-traffic scenarios.

Table 4.1. Participants demographics and data

4.2. Introducing the observation settings

Ten observations enabled to collect a rich set of situated data on the users' work settings and broad practices of use of the technology. The observations happened in disparate contexts: with different satnav models; in different areas (familiar and unfamiliar); in different types of journeys (for the purpose of routine activities, going out with friends, work, short trips); at different times of the day (morning, afternoon, evening); in different types of roads (small city, city, outside city, highway, low- and high-traffic); with or without social presence in the car (in five of the ten sessions there were other passengers in the car).

For more information on the observation settings, see *Table 4.2*.

Participant Code	Time of the Day	Duration	Type of Journey	Locations and traffic conditions	Social Presence
P1	Afternoon	50 min	Visit to a friend's house	Begin: unfamiliar, small city, low traffic; Mid: unfamiliar, highway, low traffic; Arrival: familiar, city, high traffic	Driver, Researcher
P2	Morning	45 min	Pick something up	Begin: familiar, city, high traffic; Mid: familiar, highway, low traffic; Arrival: unfamiliar, small city, high traffic	Driver, Researcher
P3	Afternoon	1 h	Go to an art exhibition	Begin: unfamiliar, small city, medium-high traffic; Mid: unfamiliar, highway, low traffic/ familiar, city, very high-traffic; Arrival: familiar, city, very-high traffic	Driver, 2 Passengers, Researcher
P4	Evening	45 min	Go out for dinner with friends	Begin: familiar, city, low traffic; Mid: unfamiliar, highway, low traffic; Arrival: unfamiliar, small city, low traffic	Driver, 3 Passengers, Researcher
P5	Morning	1 h	Visit clients for work	Begin: familiar, small city, high traffic; Mid: unfamiliar, highway, high traffic; Arrival: familiar, small city, high traffic	Driver, Researcher
P6	Morning	45 min	Visit to a friend's house	Begin: familiar, small city, high traffic; Mid: unfamiliar, highway, medium traffic; Arrival: unfamiliar, city, high traffic	Driver, Researcher
P7	Afternoon	45 min	Trip to touristic place	Begin: familiar, small city, low traffic; Mid: familiar and unfamiliar, small cities, medium traffic; Arrival: unfamiliar, small city, low traffic	Driver, 1 Passenger, Researcher
P8	Morning	35 min	Go out for coffee with a friend	Begin: familiar, small city, low traffic; Mid: familiar/unfamiliar, small city, medium traffic; Arrival: unfamiliar, small city, low traffic	Driver, 1 Passenger, Researcher
P9	Evening	35 min	Trip to touristic place	Begin: familiar, city, low traffic; Mid: unfamiliar, highway, low traffic; Arrival: unfamiliar, village, low traffic	Driver, 1 Passenger, Researcher
P10	Afternoon	40 min	Pick something up	Begin: unfamiliar, city, low traffic; Mid: unfamiliar, city, low traffic; Arrival: familiar, city, low traffic	Driver, Researcher

Table 4.2. Observation settings

4.3. Main themes

Three themes were identified during analysis: **factors for appropriation**, **cost benefit analysis** and **social dimensions of use**.

The theme of factors for appropriation is about the factors influencing the development of a relationship between the driver and the satnav, and how these reflect on the appropriation of the technology over time.

The theme of cost benefit analysis is about the decision-making process in which the driver analyses the possibilities of use of the technology, and how these relate to their needs, task-goals and willingness to invest effort for achieving them.

The theme of social dimensions of use is about the adoption and adaptation of the satnav to the social practices happening in the car, and its unpredicted social utility for some of the participants.

4.4. Theme 1: Factors for appropriation

The main finding from this study was that appropriation is a phenomenon which happens and develops over time, and that it is influenced by several factors. The main ones are the experience in both driving and using the device, which have an impact on the way people integrate the technology into their life, adapt it and develop new opportunities of use. Other factors, mainly contextual, were also identified. These affect the appropriation or disappropriation of the device (or of some of its functions) during single episodes of use of the satnav.

Firstly, by looking closely at the observation and interview data, it is possible to draw a timeline of the relationship between the driver and the satnav as it unfolds over time (See: *Figure 4.1*). The participants' experience with the satnav is also shown on this timeline. Their approximate position was established taking into account the time and frequency of use of the device, and their mastery of it.

Novelty ————————————————→ **Expertise**

P10 P6 P8 P9   P1 P4 P7 P2 P3 P5

Breakdown(s)
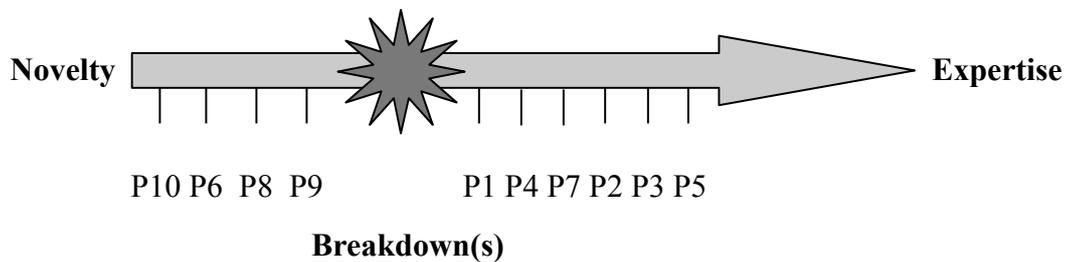
Figure 4.1. Timeline of relationship driver-satnav with participants' position

At the extremes of the timeline there are *novelty* and *expertise,* which regard the driver's general attitude towards, and use of the satnav. P9, P8, P10 and P6 were novel users, whereas P1, P4, P7, P2, P3 and P5 were more expert users. As seen in all expert users' interviews, at a certain point along this timeline, a *breakdown* occurs. This leads to changes in the attitude towards, and use of the satnav. Overall, it was found that different degrees of appropriation manifest themselves at each point of this timeline. The next paragraphs (4.4.1; 4.4.2; 4.4.3) will describe this in detail.

Secondly, by looking at the observation data, it was found that the appropriation of the satnav is not only dependent on the experience of driving and using the device, but also on a number of contextual factors which manifest themselves during a single ride in the car. Therefore, the driver adopts or rejects the satnav guidance on the basis

of what is happening in and outside the car. An axis can be drawn to represent such phenomenon, whose two extremes are *reliance* and *non-reliance,* two opposite attitudes towards the device. These diverse attitudes are a result of the influence of several *factors* (See: *Figure 4.2*).

Reliance ⬅️➡️ **Non-Reliance**

Main Factors
Experience with driving
Experience with the device

Contextual Factors
Trust in the device
Familiarity with the environment
Situation awareness
Travel needs
Availability of other tools
Social presence in the car
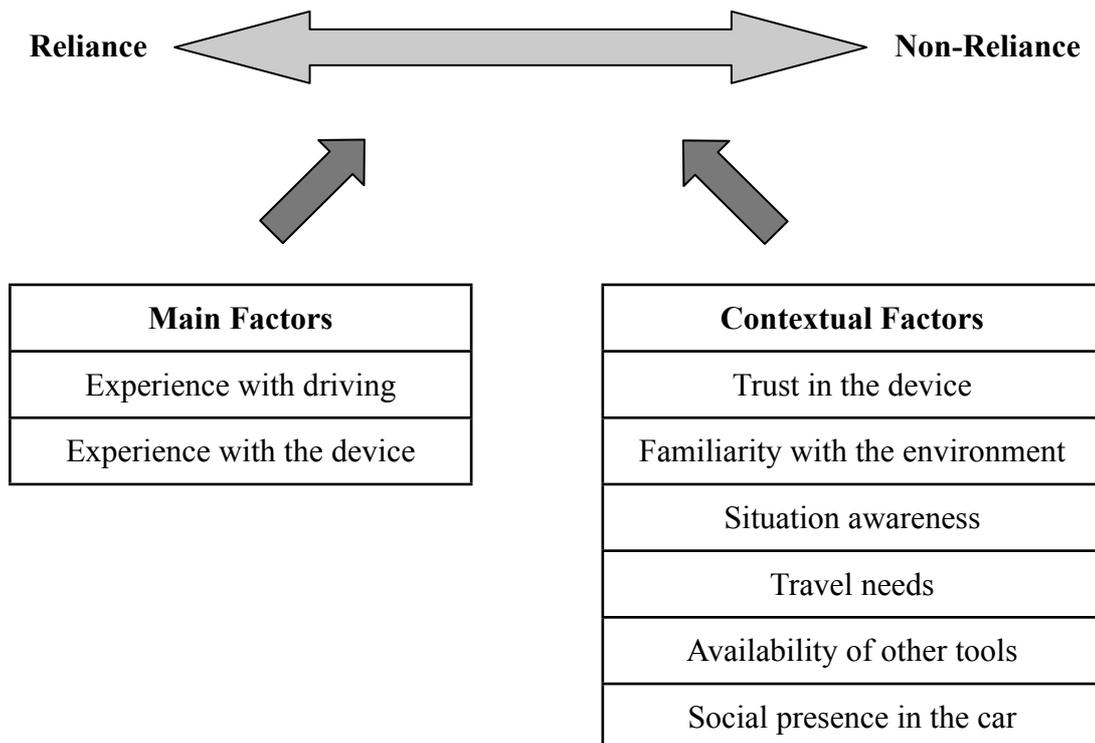
Figure 4.2. Axis of reliance on satnav for single journey and factors influencing oscillation of driver's attitude

During their journey in the car, every driver begins to drive positioned at a certain point of the axis, relying more or less on the device. Then, they dynamically move along the axis, depending on: their expertise with driving and the device, their familiarity with the environment in which they are driving, their trust in the device, their situation awareness, their travel needs, the availability of other navigation and way finding tools, and the presence of passengers in the car.

Participants with low driving experience tend to rely more on the device than

experienced drivers. Participants with novice experience have an open attitude towards the technology and rely more on it. Participants driving in unfamiliar environments rely on their satnav more than in familiar places. When they do not have enough information on the contextual elements which might impact their task, they rely more on the satnav. When their travel needs are to arrive as soon as possible, they tend to consider the satnav as their unique source in order to avoid confusion and loss of time, unless the technology is making visible mistakes. When they are willing to explore they rely on the satnav but employ also other sources. When other passengers are in the car, reliance on the satnav oscillates in accordance with the opinions of these in regards with the way finding practice.

The next paragraphs (4.4.1; 4.4.2; 4.4.3) will present all this in detail. The significant differentiation between novice and expert drivers and users will constitute the main structure through which to explain this theme of appropriation. The description of how and at what degree contextual factors affect the appropriation of the device will be explained for each of these types of users.

4.4.1. Novelty

Novelty refers to the initial period of use of the device, when the driver explores and uses the device functionalities, putting them in connection with their needs and goals.

Planning

Overall, the interview data showed that all participants changed the way they plan

their travels right after acquired the satnav. Before owning a satnav, their planning was careful and employed the consultation of one or more sources (e.g. maps, websites). Travel was perceived as a serious experience for which it was necessary to be well-prepared in advance. Once acquired the satnav, the participants tend to plan their travel in the car, leaving more space for situatedness: such change is caused by the perception of the flexibility of the satnav in responding to changing conditions and scenarios.

"Because it has all the maps and does things like automatic recalculation of the route, I don't need to do anything before I step in the car.", P8.

For some of the novice users, planning happens "on the way", even while already driving. Very often they do not feel the need to carry with them additional tools for way finding. Such attitude towards technology shows a feeling of security, confirmed during the interviews:

"*Whatever happens I just push bring me home and I know I will get there."*, P10.

Exploration

Novel users like to "play around" with the device for curiosity, and for configuring and personalising it in accordance to their travel needs and driving practices (e.g. by choosing the fastest route for getting to destination as soon as possible, if this is what they need to do). Interestingly, during this initial phase, some participants (e.g. P2 (18, 87), P8 (5, 105)) anthropomorphise the device and choose a name for it. During

the observations, they spoke directly to the device more than once, complaining or congratulating with it for its guidance.

This initial phase of exploration lays the foundations for appropriation: by discovering the possibilities of use of the device, its functioning and pitfalls, the participants invent new opportunities of use. The interviews showed that, while P2 acquired the satnav with the main purpose of detecting speed cameras, other participants (e.g. P3 (4, 88), P4 (6, 92), P9, P10) casually discovered the speed camera warning function and began to appreciate it. Interestingly, they also reported that to visualise their driving speed and the road speed limit on the screen encourages them to drive responsibly. In the first days of use, other participants (e.g. P1 (7, 82), P3) remembered to have tried their satnav in familiar environments with the aim to test it; they ended up discovering new friendly routes, which convinced them to use the technology almost routinely. On these same lines, others (e.g. P6 (5, 99), P4 (6, 92) P1, P10) reported to have organised small trips with family and friends for trying out the device. This led to a re-conceptualisation of distance: while before owning a satnav they were not easily ready to embark in long journeys, they feel now more free to do it. Therefore, the satnav becomes trigger for further exploration of familiar environments as well as for travel occasions in unfamiliar environments.

Trust and attitudes

Acquired the satnav, a feeling of security is coupled with trust and reliance. This is typical of novice users, who have an open attitude towards the technology. Nevertheless, there are differences between participants: some were of the opinion

that *"trust must be gained"* (P5)*,* others preferred not to question the satnav suggestions (e.g. P10 (5, 109)). Such diverse attitudes can be attributed to different experiences of driving among novice users.

Expert drivers approach the satnav with their own established habits of driving. Thus, they are more reluctant to integrate it in their practices and are inclined to question its suggestions:

"I have never seen anything transcendental in my GPS... it is an object I use as I used maps before... just a better one... but I never really listened to him unconditionally.", P4.

They soon feel the need to adapt the device to their well-defined needs. One example is P9, who frequently does trips with his partner in the countryside, where he likes to "get lost" and discover "hidden gems" along his journey. During the interview, he affirms that the satnav is satisfying in bringing him to destination, but is not good enough for suggesting scenic routes. Moreover, it is not able to support and enhance the situatedness of his plans and actions, which is a distinctive characteristic of his driving practices:

"With the satnav you can go past places of interest and you wouldn't know about.", P9.

After a few journeys, P9 acknowledged the mismatch between the information asked by the device and his actual knowledge of such information. Therefore, he affirms to

now plan his journey with other tools, in order to find out what is to see on the road. Then, he sets the device accordingly.

Opposite to this, novice drivers approach the satnav more openly and rely on it much more. This happens because the technology frees them of the burden of way finding and helps them concentrating on the road:

"I always follow my GPS because it always gives me enough time to prepare my next movement and be in the correct lane.", P10.

Such drivers tend to embed the satnav use in their budding habits, thus learning to rely on it as a normal part of their driving experience. As a result of this, they maintain only a limited *situation awareness,* which is critical for rapid decision-making occurring while the driver is in the car. For instance, whenever the device repeatedly suggests to drive an inaccessible road, P10 attempts to *"lead him off track"* (P10) by driving far away from the area, until the device recalculates the route differently. Rather than disappropriating the device, P10 adapts to it. Given that his priority is to have at his disposal the time and resources to concentrate on the act of driving, he prefers to rely on the device, rather than question its suggestions in exchange for uncertainty and potentially risky situations. On these same lines, P8, who acquired the device when moving to a new city, feels bounded to it and trusts it almost always. When asked about their attitude towards the satnav, particularly in the case of breakdowns, both participants blamed themselves. Therefore, using the device while learning to drive, they adapt to the technology, rather than appropriate it in particular ways. Nevertheless, if any appropriation is to be identified, it is in

regards to the way such novice drivers fit the technology in their driving practices: appropriation is the natural act of embracing the technology and making it an irreplaceable tool for navigation and way finding, as it helps them in quickly receiving information on the environment and maintaining concentration on the driving activity.

4.4.2. Breakdowns

From the interview data, it was found that a new relationship with the device is defined when one or more breakdowns occur with the satnav. When limitations of the technology are unveiled, the driver develops interesting appropriations and disappropriations to address their needs.

Overall, it was found that the satnav inability to be traffic-aware and constantly updated on the road conditions and directions are the main breaking points. The participants begin to establish a new way to use the device: they take alternative routes independently from the satnav suggestions and, in extreme cases, switch off the device and use other tools and strategies (e.g. physical maps, road indications, asking people).

In some cases, technical problems lead participants to develop a strongly negative attitude, as found in the interview with one participant:

"I was used to follow my GPS... Then I was in this place I had never been before and the satnav stopped working. I needed to get something small enough to fit in the

small hole of the GPS but I couldn't find anything, a needle or something like that... I was so mad, I had to drive very far before finding a sign post which helped me understanding where I was.", P7.

After this episode, P7 decided to radically change his relationship with the device: from a device he listens to turn-by-turn, to a tool he consults only in the beginning to plan the main landmarks and, occasionally, along the route to confirm the correctness of his direction and of the road indications.

4.4.3. Expertise

Expertise is gained after exploration and repeated use of the satnav, when the driver develops a more mature relationship with the device and understands its strength and limitations. During the observations and interviews, all expert users demonstrated a very critical position towards the device, showing that gain of mastery with the satnav is a powerful drive for the appropriation of the device.

Planning

Planning changes after having realised the limitations of the technology: often experienced users prefer to have a back-up plan, constituted by physical maps or documents printed off websites:

"After some bad experiences I never embark in long trips without having also a map with me.", P4.

Attitudes

With the growing experience, the exploration phase is over, mainly because of people's boredom, lack of time and, ultimately, their task-oriented behaviour with the device. One participant affirms during the interview:

"If I had it around the house, I would probably switch it on sometimes to try different voices or map views just for the fun of it... you know, like I do with my mobile when I'm bored... but when I'm in the car I really need to get from A to B. The rest doesn't really count.", P1.

The satnav is soon perceived as a task-oriented tool (*"It's like a calculator!"*, P2) which does not leave a lot of space for a "playing-around" behaviour, which is common in other portable devices such as mobile phones. Certainly, the context of use and the restricted number of functions available in the participants' satnav devices affected such findings (except in the case of P9, whose device could also function as a music player).

Nevertheless, the participants shape the use of the device and find new opportunities of use. One example was P2, who did not have the correct destination address during the observation. He typed in the city centre as arrival point and, once there, he used the points of interest (POIs) displayed in the satnav as landmarks to orient himself. Other participants affirmed to do the same (e.g. P1 (9, 83), P3). In this case, an appropriation of POIs, originally designed for being used as destination points, was developed to overcome the lack of thorough information on the journey.

Trust

Trust diminishes with time, after breakdowns occur. Rather than substituting the driver's role of decision-maker, the satnav becomes a support in their decision-making process.

As found during the observations, some participants (e.g. P3, P5, P7) use the device, but have a critical attitude towards the satnav suggestions and maintain an elevate situation awareness. A particular case is P5, a sales representative who drives from place to place with his satnav. During the observation, his use of the device oscillated from low to high reliance. In familiar areas, the participant tended to keep the device on but not to listen to it intensively because, as he explained in the interview:

"Naples is not a city where you can use a navigator. He tells you to go here and there... but you cannot go everywhere he tells you to go. Some streets are narrow, there are many cars and people walk everywhere... if you listen to the satnav you just get "imbottigliato" (stuck in a bottle)!", P5.

In unfamiliar areas, P5 raised his attention towards the satnav and began to rely on it, as *"this is the only thing* [he] *can really do when* [he doesn't] *know where to go!"* (P5). Trust and reliance are, therefore, a function of the familiarity with the environment.

Other participants (e.g. P2 (14, 86), P1, P4) affirm that they often decide to switch it off and use other tools or strategies (e.g. physical maps, road indications, asking pedestrians for indications). They disappropriate the device due to its incapability to

pick up contextual factors (e.g. traffic conditions, type of road, type of travel):

"If I begin to see that it just slows me down or keeps sending me off weird routes, I just turn it off and do it my way.", P4.

This mainly happens in familiar areas, where the driver can better situate their actions in accordance to the contingencies at hand by only benefiting of their local knowledge. Nevertheless, this does not easily happen when they are in unfamiliar areas and depend exclusively on the satnav.

A particular story of appropriation in terms of workarounds was found in the interview with P7. He currently uses a satnav on a smartphone which does not indicate the driver's direction. When he is approaching a junction and is uncertain of his position on the screen map, he slowly drives a few meters along the road which he reckons to be the right on; then, he glances over the screen to confirm whether he his driving in the correct direction. Thus, P7 provides for his satnav limitations by employing a *trial-and-error* approach.

4.5. Theme 2: Cost benefit analysis

As described in the previous paragraphs, expert drivers appropriate the satnav, adopting and adapting it to their practices and needs. This is due to changes in their perception of trust in the device, their experience in both driving and using the device, their travel needs, their situation awareness, the contextual factors and the presence of passengers in the car.

An interesting story of appropriation was found in many of the observations and the participants' interviews. While driving, the participants often perform a *cost benefit analysis,* which helps them deciding whether it is convenient to follow the satnav guidance. During this analysis, they question the device suggestions and evaluate the desirability of alternative choices available to them.

During the observation, P1 was driving along a straight road and the device suggested a route requiring a number of turns:

"Hold on, what does he wanna me to do?! ... (he zooms in the map) *I just keep driving straight"*, P1.

When asked during the interview about such incident, P1 affirms:

"[I didn't follow him because] *it was just easier to drive straight... There was no traffic... Instead he wanted me to turn right, check if other cars are coming, then drive along, then again on the right and again check if other cars are coming* [...] *"Manco pe' fa tutto sto burdell'" (It is simply not worth the effort)"*, P1.

Other participants (e.g. P2 (13, 86), P4 (13, 93), P5 (13, 97), P9, P3) do the same kind of consideration in their interviews. P3 affirms:

"Even if I say I want the fastest route, for him velocity is the sum of certain parameters... main street = X, highway = Y, minor street = Z. He doesn't take in consideration that I might not like doing stressful routes only to save few minutes of

my time.", P3.

And again:

"Arriving five minutes earlier won't change my life, but driving frantically will.", P3.

In a very short amount of time, the participants evaluate the satnav suggestion to see whether the benefits of following it outweigh its costs. Moreover, they also compare such possibility with the alternatives available to them. In familiar environments, such reasoning is quickly carried out, as the driver can estimate costs and benefits accurately and easily. In unfamiliar environments, such reasoning is carried out less frequently and mainly when the driver has the time, willingness and possibility to leave space for uncertainty.

The accuracy of such cost benefit analysis mainly depends on the driver's *situation awareness*, that is their perception and understanding of the state of the environment (inside and outside the car), and their ability to project how future states will affect their driving experience and goals. Nevertheless, such awareness is limited. The driver will never be able to figure out all the alternatives nor evaluate their outcomes:

"I thought it could get complicated... what if the street were narrow or there was a lot of traffic? And you wouldn't know until you get there, would you?", P1.

Therefore, the driver is guided by a *satisficing principle*, according to which they do not aim to the optimal choice, but only to what is good enough for them. For

instance, in the case of P1, to keep driving along a visibly traffic-free street was good enough. Such decision-making strategy drives the appropriation of the satnav, determining the conditions in which it is employed and relied upon.

Furthermore, another example of cost benefit analysis was found in the way the participants configure the satnav route. The majority of them often uses the same configuration that was set the first time, despite being aware that this does not always match their needs. When this is the case, they prefer to intentionally deviate from the suggested route and let the device recalculate the journey. A particular example is P7, who complains about the satnav inability to suggest scenic routes. Although he could use the mid-point function to overcome this limitation, he does not do it:

"It costs too much time and anyway often I don't really know what it is to see in the area I'm gonna drive... At this point I prefer to do a deviation when I find an interesting spot on the way", P7.

Alike P7, many of the participants intentionally choose to disappropriate some of the device functions, being guided by a *least effort principle*. Adopting a more opportunistic and reactionary behaviour, they prefer to leave space for situated actions, rather than make the effort to change the settings or plan in advance the places to see.

Finally, appropriation guided by a cost benefit analysis was found in one interesting story of personalisation behaviour. P7 intentionally did not save his exact home address in the device, being afraid of disclosing important information to eventual

thieves of the satnav. Rather, he saved his home town as home address. By doing this, he could still use the "Bring me home" function, but avoid potential risks. This reflection on the costs and benefits of different degrees of personalisation of the satnav led him to appropriate such function in a different way.

4.6. Theme 3: Social dimensions of use

While the satnav is designed for navigation and way finding, it was very interesting to see that new "social" uses became evident in both observations and interviews.

Firstly, several participants (P1 (11, 83), P3, P6, P10) appropriated the function displaying the arrival time as a way to avoid unpleasant social situations:

"I'm always late and this is embarrassing sometimes... everybody is waiting for me! With the satnav I always know in advance if I'm gonna be late... I ring up my friends to let them know about it and they can begin doing things without me.", P10.

Secondly, a different social scenario which has implications on the use and appropriation of the satnav is the one where other passengers are in the car. During the interviews, some participants (e.g. P2 (15, 86), P5) affirmed to not perceive the device differently. Others (e.g. P3 (15, 90), P4 (15, 94), P8) recognised that the social interactions interfered with their understanding of the satnav instructions, but this did not have a negative impact on the overall driving experience. What is relevant is the fact that, in many of the observations where other passengers were present (e.g. P3, P4, P8, P9), a negotiation on the way finding practices took place between the driver,

the passengers and the device. While the satnav seems designed for the driver alone, the reality is that the way finding practices are often carried out collectively with other passengers:

"I always listen to what the others say because they are human beings... differently from my satnav, they can see if there is traffic or the road is closed... often they even know the place better.", P8.

Inevitably, the satnav suggestions are evaluated on the basis of the passengers' opinions on the route. As a result of this, in some cases the satnav is disappropriated. For instance, during the ride with P4, a night out with friends where the destination was to be decided on the way, the passengers replaced the satnav role more than once. This occurred because the situatedness of their plans did not find the right support from the technology.

In other cases, the passenger takes control of the device to help the driver orientating in unfamiliar environments. For instance, during a short trip with P9, the passenger had a very active role: he operated the device throughout the whole time, gave instructions to the driver and discovered places to stop on the way by employing several orientation tools. From the interviews, it was found that this is a common practice when travelling with other people, as it augments discovery and engagement with the environment.

An opposite but worth to mention attitude is the one of P7, who affirms to intentionally place the device at his driving side, in order to disable the passenger from "having their say" in the way finding practice. In this case, he perceives the

social adoption of the satnav as a potential hazard to his control of the situation.

Finally, another interesting finding was that all of the observations conducted with other passengers in the car presented a common element: a considerable amount of time spent talking about the device. The satnav becomes a "communication facilitator" for the people in the car. People begin by discussing way finding and end up talking about the device and its functionalities, and telling stories about personal or other people's experience. For instance, during the observation, P3 was in the car with two other passengers with which he had a very formal relationship. In the interview, he affirmed that talking about the satnav and its questionable guidance was useful to "break the ice" and begin a discussion, which eventually made him feel more comfortable. This social function of the satnav is an interesting case of appropriation, as it was not intended by designers, but yet was present in all of the scenarios observed.

4.7. Summary

To sum up, the experience in both driving and using the device affects the appropriation of satnav systems. Moreover, other factors influence appropriation, such as the driver's familiarity with the environment, their situation awareness, their travel needs, the availability of other navigation tools and the social presence in the car.

Novice drivers tend to rely on the satnav more than expert ones: they embed the technology in their driving practices and are more prone to adapt to the device, leaving few space for appropriation. On the other side, expert drivers soon feel the

need to adapt the technology to their well-established needs and develop interesting appropriations and disappropriations.

Novice users tend to have an open attitude towards the device, which enables them to discover its possibilities and create new opportunities of use. On the other side, after breakdowns, expert users become aware of the technology limitations and employ other tools or strategies to overcome them.

One of the strategies adopted is a cost benefit analysis performed during the decision-making process, when the costs of using the device are outweighed with its benefits.

Finally, the appropriation of the device involves also its fit in the social practices happening in the car, and new unpredicted social uses of the device.

In the following Chapter 5, these findings will be discussed in relation with the literature reviewed in Chapter 3.

5. Discussion

This chapter, firstly, discusses the results of this research, linking them back to the literature reviewed in Chapter 3. Secondly, it draws a series of implications for the design of satnav systems.

While many of the studies on location-aware technologies have taken a technology-driven perspective, this study aimed to look at the user-centred aspects of the use of satnav systems. Moreover, while ergonomics and usability studies have mainly focused on issues of efficiency, effectiveness and satisfaction with these technologies, this study aimed to look at the active role that users have in integrating, adopting and adapting the technology to their practices.

In detail, this study aimed to understand how appropriation develops over time, how it differs for different people in different contexts, and what are the factors determining it. The results showed that appropriation manifests itself at different degrees for novice and expert users, and for novice and expert drivers (See: *4.4*). Moreover, a number of contextual factors affect the uptake or rejection of the technology during every single ride (See: *4.4; 4.5*). Furthermore, a series of appropriations, disappropriations and strategies to overcome the technology limitations are developed, mainly in the case of expert drivers and users (See: *4.4; 4.5*). Finally, a number of "social" uses (not envisaged by designers) characterise the drivers' adoption of the satnav (See: *4.6*).

These findings will be systematised in three appropriation patterns and linked to previous work on appropriation. Implications for the design of satnav systems will

also be drawn from this.

5.1. Appropriation patterns

Before going in the detailed presentation of the appropriation patterns identified, it is worth to explain the choice of patterns.

Patterns are an approach to abstract reusable knowledge about a particular system and what is conceptually possible in it (Kotzé, Renaud, Koukouletsos, Khazaei & Dearden, 2006). They always present a recurrent problem and suggest solutions (Borchers, 2001). The choice to identify and describe appropriation patterns comes from the realisation that well-defined paths of interaction between the user and the satnav existed. Moreover, the choice of patterns is preferred to other knowledge transfer mechanisms (e.g. guidelines or anti-patterns) as patterns always include their rationale and present diverse levels of abstraction (e.g. descriptions, illustrative examples). These can help to better understand the phenomenon at hand (Kotzé *et al.*, 2006).

Following, three appropriation patterns will be presented together with their implications for the design of satnav systems.

5.2. Appropriation timeline

This pattern regards the fact that the use and appropriation of the technology develop throughout time in different ways and at different degrees. Dourish (2001) sociotechnical approach to the study of interactive systems seems to fit well here: the

appropriation of the satnav depends on both the user's attitude, capabilities, needs and practices, and the features of the technology at hand (See: *4.4*).

As found in this study, overall, every user interpreted the purposes of the satnav in their own way. They gave a particular value and meaning to it, in accordance to their driving practices and travel needs. Such finding is in line with the concept of *interpretative flexibility* (Bijker & Law, 1992; Silverstone *et al.*, 1992). For instance, many users interpreted the satnav as a device which will always "bring them home". This sense of tranquillity is also found in the taxi drivers' interpretations of the technology in the study of Girarding and Blat (2008).

Moreover, mostly in the first period, users discovered new opportunities while exploring the satnav, testing it, attempting to master it. For instance, many drivers found the speed camera warning function while "playing around" with the menu, and ended up using the device to avoid bills for speed excess. This finding is in line with the theory of appropriation of Salovaara (2008), according to which users perceive new purposes of use while exploring the technology, and remember them for later use.

Nevertheless, what is new is the finding of a significant difference between the interpretations given by novice and expert drivers, which in turn led to different types of adoptions and adaptations.

On one hand, novice drivers acquire the device for the purpose of way finding, but soon adopt it as unique driving aid and embed it in their budding practices. Their appropriations in terms of unintended uses are low, as they tend to adapt to the technology rather than the opposite. For instance, they rarely reject the technology,

even when this is visibly providing inefficient guidance. This attitude towards the technology might lead to deskilling in orientation and driving in the long-term.

On the other hand, expert drivers acquire the device for the purpose of way finding or detecting speed camera warning, but soon question the information it provides and adapt it to their well-established practices. They are not affected by deskilling in orientation nor driving, as they employ the device in a critical way. This finding is in line with the results of the study of the adoption of satnav systems by taxi drivers (Girardin & Blat, 2008). Expert drivers' appropriations in terms of unintended uses, strategies and workarounds are at a higher degree than novice drivers, and their disappropriations more frequent. Although DeSanctis and Poole (1994) would consider these appropriations a dysfunctional phenomenon in contrast with the *spirit* of the technology, this research found that they were fundamental for the user to address their needs.

Throughout time and with the experience growing, users change their relationship with the device. This mainly happens because the device is unable to take into account contextual factors (e.g. travel conditions, travel needs, driver's familiarity with the environment, social presence in the car). Therefore, users begin to adopt strategies and workarounds to overcome the technology limitations: for instance, they plan their travel in advance, by consulting several other sources and preparing redundant way finding information resources. Doing so, they learn not to depend on the technology. This type of strategy was also found for UK mobile workers (Perry *et al.,* 2001), who overcome their mobile technology inflexibility by carrying with them any document they might need or any versatile tools they might prefer.

Therefore, expert users develop different appropriations and, eventually,

disappropriations. This finding was in line with the Model of Technology Appropriation proposed by Carroll *et al.* (2001; 2002). Once appropriated the device because of its perceived fit into the user's practices, the user considers a number of *appropriation criteria*, such as convenience, reliability, ability to pick up contextual information, ability to support the social interactions in the car. Such criteria are contextually examined every time the satnav is in place, determining its adoption or rejection. Overall, also high-level *reinforcers* of appropriation were identified: for novice drivers, a sense of tranquillity; for expert drivers, the necessity of an orientation tool more flexible than a physical map.

Implications for the design

Implications for the design of satnav systems can be drawn from this pattern. They are intended to help designers foreseeing possible interaction paths of different users and their interpretations of the technology.

The study shows that different users adopt and integrate the satnav in their working practices in different ways. Therefore, *malleability* and *openness to interpretation* should be distinctive characters of satnav systems. These principles are in line with those suggested by Dix (2007) and Dourish (2003). This latter, for instance, attributes the positive appropriation of *Placeless*, a document management system, to its flexibility and ability to support multiple interpretations.

Moreover, given that the driver's needs and plans are often changing due to the mobile nature of their practices, it is very important that the satnav is able to support

such flexibility appropriately (Perry *et al.*, 2001). This means that the user should not be required to know all the information in advance. Rather, the user should be able to give *ambiguous information* to the device and adjust it "on the way", whenever needed or possible. As also J. Carroll (2004) and Dix (2007) propose, the user should be the one who "finalises" the design.

This suggestion is also in line with the interaction through negotiation paradigm of Brodersen and Kristensen (2004). In fact, designers should expect that the driver will not always follow normative rules of use (e.g. if the satnav suggests "Turn on the right", the driver will turn on the right). Rather, they should *take into account the situated aspect of human actions*.

Given that there is a significant difference between novice and expert drivers' appropriations, the design of the interface could change with the increment of the driving experience and the technology expertise. This suggestion is similar to the *training-wheel approach* of J.M. Carroll (1990). It could enable different drivers to discover the device possibilities and limitations at the right time, and prevent them from becoming too much or too less reliant on the device.

For instance, novice drivers perceive convenient to rely on the device (even when it errs). In order to prevent them from developing a relationship of dependance on the technology, the possibility that satnav is incorrect should be *made salient* to them. This suggestion is also found in Leshed *et al.* (2008), who propose to highlight the ambiguity of information to reduce the user's over-reliance on the satnav. Moreover, to give novice drivers the possibility to *choose among alternative routes* might encourage them to be more aware of the situation and play the role of active decision-makers. At the same time, this suggestion could be well-received also by

expert drivers. These, in fact, are used to compare the convenience of following the satnav with a number of alternatives: if the device itself presents these alternatives, it might support and fasten such decision-making process; as a result, the drivers might not disappropriate the device.

Finally, as expert drivers adapt the device to their established need and often reject it, the satnav could *learn from the driver's history of compliance* with its guidance, in order to provide future suggestions which better fit their practices.

5.3. Appropriation costs and benefits

This pattern regards the fact that expert drivers employ a cost benefit analysis strategy when deciding whether to appropriate the satnav system (See: *4.5*).

This new and interesting finding showed the conditions in which the device is taken up. An explicative example is the following. During a single ride, all expert drivers tended to oscillate between a state of reliance to one of non-reliance on the device, in accordance with a number of contextual factors. They often questioned the satnav guidance and weighed the costs of following it with the benefits of doing so, as explained in *Figure 5.1*.
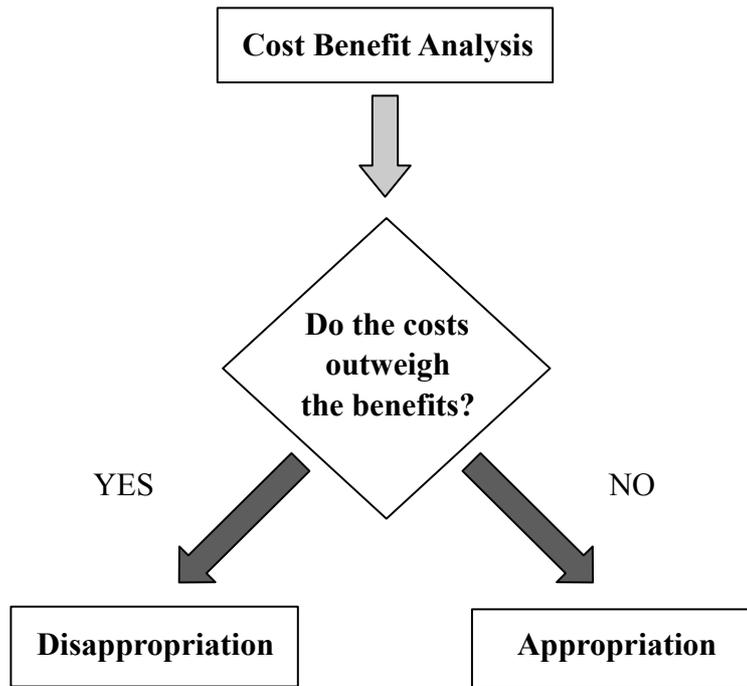
Figure 5.1. Cost benefit analysis outcomes

Examples of costs of following the satnav guidance are: additional time spent driving, travel in non-scenic routes, stressful roads to drive in. Examples of benefits are: reduction in time spent thinking about way finding, early arrival, traffic jam avoidance, travel in scenic or driver-friendly routes. For instance, the driver will not follow the satnav guidance, if this leads them in areas well-known for their traffic congestion. Overall, when the costs outweigh the benefits, the driver will not use the device and opt for alternatives. When the benefits outweigh the costs, the driver will adopt the device and follow its guidance.

Nevertheless, this strategy has limitations because the driver cannot always know all the costs and benefits of undertaking the satnav guidance against other alternatives. Therefore, the driver cannot formulate the best choice. As the *satisficing heuristic* of Simon (1957) states, their bounded rationality will lead them to choose not what is

optimal, but what is *good enough* for them (between the satnav suggestions and the available alternatives). For instance, the driver will decide to completely rely on the satnav guidance if they do not have time to think about alternative routes.

Finally, a cost benefit analysis is carried out also when the driver decides what functions to use. In fact, a tight link between appropriation and usability was found in many of the drivers' stories: appropriations often arose not only from a mismatch between the user's work practices and the technological features, but also from a number of usability-related problems (e.g. visibility of menu functions). For instance, many drivers disappropriated several functions, such as mid-points and "Save my route", mainly because of the inconvenience of searching for them and setting them up every time. This led them to develop new strategies. For instance, rather than setting their mid-points, they prefer to do deviations from the suggested route and let the device recalculate the journey. However, such strategy is not always optimal: the satnav, unable to support such degree of flexibility, often suggests them to return on the previous route; this eventually leads them to *disappropriate* the device by switching it off.

Implications for the design

Implications for the design of satnav systems can be drawn from this pattern. They are intended to help designers understanding how and why expert drivers and users adopt or reject the device in particular use scenarios.

The driver often performs a cost benefit analysis whose results determine the

adoption of the device. To *understand the threshold* between their perception of convenience and inconvenience might enable to suggest guidance matching the driver's real needs. For instance, in regards to guidance instructions, the satnav could suggest to take one route rather than another, only if it will save a significant amount of time (e.g. more than 15 minutes). In fact, several participants mentioned that to blindly follow the device, only to potentially save a few minutes of their time, does not change much. This means that the user should be able to *tailor their "convenience threshold"* and *receive information* on the consequences of following the satnav guidance. In this way, the adoption of the device could be more conscious.

In regards with the device functions, the cost benefit analysis could be positively balanced towards their adoption by *improving their visibility* in the menu hierarchy. Tailorable, usable and well-structured menus, which prioritise fundamental functions but also encourage the user to explore, might make the technology more appropriable. In other words, the satnav interface should give the user the ability to operate on the menu items, "both acting *with* them and *through* them" (Dourish, 2001, 173). This tailorability of the menu could enable the user to better match the technology into their working practices (MacLean *et al.*, 1990).

Finally, the satnav functions should *support the flexibility and situatedness* of the travel experience. This means that the user should be required to input certain information only when they have it, and that the device should learn from the driver's history of use.

5.4. Appropriation and social relationships

This pattern regards the fact that the use of the satnav is affected by the social interactions happening in the car, and that the driver often develops new unpredicted "social" uses of the technology (See: *4.6*).

Firstly, the drivers sometimes attributed agency to the satnav, giving it a name, referring to it as a "he" or "she", and talking to it. This was also found in Leshed *et al.* (2008), where the participants interacted with the satnav as if this was a passenger in the car.

Secondly, the satnav was often shared and the way finding practices negotiated between the driver and the passengers in the car. Differently from how designers conceive the device, this is often used not only by the single driver but also by the passengers. They interact with it, use other navigation tools (e.g. maps, indications) and collaboratively work out the route. This finding is coherent with the study of Leshed *et al.* (2008), who also found that the passengers were helping the driver by using the device, switching settings and searching for information.

Thirdly, the satnav facilitates the driver's social life. On one hand, it enables to recover in advance from socially uncomfortable situations (e.g. by giving the possibility to advise of any delays to appointments). On the other hand, it often plays the role of a communication facilitator when other people are in the car. These can be both considered appropriations of the device in terms of *unintended uses*.

In particular, it is interesting to speculate on the reasons why the satnav becomes the

motive of so many conversations. It might be argued that the device is not simply a "transparent" tool providing information and aid for decision-making. Rather, it is a visible and interactive tool which emerges from the ecology of the objects in the car and calls attention every time it suggests guidance. This potential centrality of the satnav role might make of it a topic of conversation. For instance, if it suggests an inconvenient route, a passenger familiar with the environment will begin to question its guidance and, eventually, replace it. On the other side, it might be also argued that the innovative character of this technology makes of it an interesting topic. This might be especially the case if the driver is a novice user trying to master his satnav at the presence of other people.

Implications for the design

Implications for the design of satnav systems can be drawn from this pattern. They are intended to help designers understanding the dynamics occurring when the device is used with passengers in the car.

The driver is not the only user of the technology. A collaborative use of the satnav and a negotiation of the way finding practices occur when other people are in the car. This means that a design which *augments the "social appropriability"* of the technology might enhance the collective experience of use of the device. For instance, the device could be used in *two modes*: driver and social. The first mode could provide limited interaction, in order to ensure safety. The second mode could provide additional functions, such as the possibility of *information push and pull* on places, points and surrounding areas of interest. Sharing of information might

augment the travel experience and engage people with both the environment outside and inside the car.

The pattern presented here were intended to shed light on the possible paths of interaction between drivers and satnav systems, and give suggestions on how to improve the "appropriability" of this technology.

In the following Chapter 6, conclusions and reflections will be drawn from the study.

6. Conclusion

In this final chapter, the conclusions and limitations of this study are presented, followed by a glance to possible future research.

This thesis aimed to look at the use and appropriation of in-car satnav systems. In particular, it focused on understanding how appropriation develops over time, whether and how different people use, adapt and appropriate the technology into their driving practices, and what factors influence their appropriations and disappropriations.

The crucial importance of these issues was demonstrated by the findings of this study, which showed that different users adopt and adapt the technology in different ways, to better address their needs. Their flexibility in interpreting the technological possibilities of use was found valuable and indispensable to the process of appropriation. While novice drivers tend to integrate their satnav into their driving habits and rely much more on it, expert drivers tend to consider it as a redundant navigation tool. Moreover, while novice users tend to openly explore the possibilities of the technology, expert users tend to use it in the same way throughout time.

Furthermore, the identification of a variety of factors (e.g. contextual) for appropriation was insightful, as it shed light on the modalities and reasons for appropriation and disappropriation behaviours. For instance, it was found that expert drivers often employ strategies to overcome the technology limitations, such as a cost benefit analysis in which they evaluate the convenience of using the device against the alternatives available in the situation at hand.

Finally, the identification of (mainly social) unintended uses of the technology was

fruitful, as it demonstrated how appropriation does not only mean integration into the user's practices, but also development of new opportunities. Therefore, appropriation becomes a creative process through which the user shapes the technology in accordance with their needs. To design for supporting and enhancing this process becomes particularly critical for satnav systems, whose users have mobile and ever-changing needs.

The qualitative approach chosen enabled to address the research questions. The choice to gather different participants from different environments enabled to obtain a broad spectrum of users and scenarios. This revealed to be beneficial to understand how and at what degree appropriation manifests itself. The observations in the car were a suitable method to obtain situated data on the use of the satnav (i.e. the actual user's behaviour and attitudes, and the contextual factors influencing it). The interviews enabled to explore the topic of appropriation in-depth, gathering self-reported data on user's broad practices, attitudes, relationship with the satnav over time, stories of use, appropriations.

Nevertheless, there were a number of limitations which need to be acknowledged. Firstly, the short-term character of the study constituted a limitation. The observations were single occasions in which to investigate into the user's behaviour and interaction with the technology. Appropriation is, instead, a phenomenon intrinsically challenging to observe because it becomes evident throughout time. Therefore, while the observations were a valuable technique to shed light on the contextual factors driving appropriation, a large part of the findings regarding the appropriation of the technology over time was derived from self-reported data and

from a comparison between different users (e.g. novice and expert users, novice and expert drivers). For instance, it was impossible to observe how current novice users, who are also novice drivers, will appropriate the device with the growing experience. However, we can expect that their appropriation of the technology will take different paths from those of expert drivers.

Secondly, to investigate appropriation in terms of "unintended uses" was challenging, especially because this meant to make assumptions on the designer's intentions.

Thirdly, the choice of recruiting participants from two different countries, characterised by very different driving cultures, might have affected the results. While the effect of culture was not in the focus of this study, it is important to acknowledge it.

Thirdly, the finding that the satnav often becomes a communication facilitator for the people in the car was largely supported. However, the presence of the researcher, despite of their attempt to unobtrusiveness, might have affected it by encouraging the participants and the passengers to discuss about the device.

However, the choice to administer a validation questionnaire to the participants enabled to ameliorate and strengthen the findings, and ensure validity for the study.

Finally, this thesis presented implications for the design of satnav systems. Appropriation patterns were identified, together with a set of suggestions on how to improve the adoption, integration and "appropriability" of the technology. While these patterns need to be considered in light of the limitations of this research, they will hopefully help designers to envision the user's possible interaction paths and their interpretations of the technology over time and in accordance with their needs.

6.1. Future research

A glance to future research is finally given.

In order to study appropriation over time, long-term studies could be conducted. For instance, the user could be followed from the moment they acquire the technology to the moment they gain mastery with it. The methodology could consist not only of repeated observations and interviews, but also diary studies. These could enrich the understanding of the adoption and adaptation of the technology throughout time, by asking the user to record their experience with the technology (e.g. conditions and purposes of use, functions used during the ride, breakdowns, disappropriations, considerations).

Moreover, drawing on the methodological suggestions raised by Salovaara (2008), it might be insightful to carry out more controlled experiments. For instance, it could be interesting to manipulate the interface design and observe the changes in the user's degree of appropriation of the technology.

Finally, investigations on the effect of culture on the appropriation of satnav systems could be carried out. Given the large widespread of this technology, it could be interesting to compare the appropriations and disappropriations of people adopting it in different driving cultures. Implications for the design of malleable interactive systems could be drawn from this.

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Appendix A – Interview outline

Set of topics

- Attitudes towards technology
- Years of driving and using the satnav
- Purposes for using the satnav and frequency of use
- Before and after the satnav
- Relationship with the satnav over time
- Exploration and discoveries of functions over time
- Use in familiar and unfamiliar places
- Configuration and personalisation of satnav
- Trust of the satnav
- Use of other tools
- Social presence in car
- Good and bad stories
- Breakdowns
- Observation-related questions
- Wishlist
- Demographics

Questions

- What is your attitude towards technology? What kinds of technology do you own?
- Since how long do you drive? Since how long do you own a satnav?
- Do you remember how and why you acquired it? Why did you acquire this one?
- What is the frequency of use of your satnav? When was the last time you used it, apart from today?
- What are your purposes of use (travel, work, daily routine etc.)?

- How did the satnav change the way you orient yourself and drive? How did you orient yourself before the satnav?
- Did your use of the satnav change over time? How? What did you do with it in the beginning, and what now?

- Do you use the satnav in familiar places? How did the device change the way you drive here?
- Do you use the satnav in unfamiliar places? How did the device change the way you drive here?
- Do you use it in a passive and/or active way? Do you use it for location awareness and/or route finding?

- Think about your first period of use of the satnav. Did you explore the device functions? Did you discovered something interesting?
- Do you spend time configuring or personalising the satnav? Do you configure

your route? What do you pay attention to and why?
- What kind of functions do you use the most/least? Why?
- Do you update your satnav?

- Do you trust your satnav? How much would you say you trust it?
- Do you use the satnav together with other tools (e.g. maps)? Why? How?
- Do you ever avoid listening to the satnav and take your own route? Why?

- When you are in the car with somebody else and the satnav is on, what does happen?
- Who does use the device? Who is in charge of it? Why?

- Think about one time when your satnav was helpful to you. Tell me what happened. Did this change the way you use the device?
- Think about one time when your satnav was not helpful to you. Tell me what happened. Did this change the way you use the device?

- During the route, I have noticed that... Why? What happened there? Tell me more about that.

- Imagine the perfect satnav for you. What does it have?

- Is there anything you would like to add?

Appendix B – Validation questionnaire

Questionnaire

This is a short follow-up questionnaire in which you will be asked for your opinion with regards to the findings from my study on the use of satellite navigation systems. Please, take your time when completing it. Thank you!

1. About you

1.1. How long have you been driving?

0-5 years
More than 5 years

1.2. How long have you owned a satellite navigation system?

0-1 year
2-3 years
More than 3 years

Please, express your opinion with regards to the following three themes which I have identified from analysing your and the other participants' data.

2. Relationship driver-satellite navigation system over time

2.1. Novice drivers rely much more on the satellite navigation system.

> Strongly Disagree 1 2 3 4 5 Strongly Agree

2.2. Experienced drivers adapt the satellite navigation system to their needs and sometimes choose not to follow its suggestions.

> Strongly Disagree 1 2 3 4 5 Strongly Agree

2.3. Once I acquired my satellite navigation system, I was free to explore and discover the possibilities of use.

> Strongly Disagree 1 2 3 4 5 Strongly Agree

2.4. When a problem occurs with my satellite navigation system, I do not use other tools or strategies for way finding.

Strongly Disagree   1   2   3   4   5   Strongly Agree

2.5. Throughout time, I have began to use the satellite navigation functions for purposes other than way finding. For instance, I use the information on "arrival time" to warn people if I will be late for meeting them; I use the "speed camera warning" to control my driving speed; I use the "Points of Interest" as landmarks to orient myself.

Strongly Disagree   1   2   3   4   5   Strongly Agree

3. Cost benefit analysis

3.1. When using the satellite navigation system, I try to understands the convenience of doing this. For instance, I work out whether it is more convenient for me to follow its guidance or take my own route.

Strongly Disagree   1   2   3   4   5   Strongly Agree

3.2. The decision whether it is convenient to use the satellite navigation system is affected by several factors. Below there is a list of these. Please, select the ones that you think apply. You can choose more than one.

- Familiarity with the environment
- Awareness that the satellite navigation system might be wrong
- Awareness that the satellite navigation system might suggest something which does not fit the driver travel needs
- The presence of passengers in the car
- The mood of the driver
- None of the above
- Others. Please, specify:

4. Social dimensions of use

4.1. When I use the satellite navigation system in the car with passengers, I rarely take the route suggested by the passengers over that of the navigation device.

Strongly Disagree   1   2   3   4   5   Strongly Agree

4.2. When I am in the car with passengers, I rarely share the use of the satellite navigation system with them.

      Strongly Disagree   1   2   3   4   5   Strongly Agree

4.3. When I am in the car with passengers, the satellite navigation system often becomes topic of conversation.

      Strongly Disagree   1   2   3   4   5   Strongly Agree

5. Is there anything you want to comment on?

Please, now send me back this questionnaire with your saved changes to my e-mail address: m.protano@ucl.ac.uk

Thank you for participating to my study! Your contribution has been very valuable. If you have any questions or comments, please do not hesitate to contact me via e-mail.

Mara Protano

Appendix C – Summary of participants

P1

1. Attitudes towards technology	He has several technologies. He is interested in technology but not particularly enthusiastic.
2. Acquire satnav	It was a gift. He was not interested in buying it.
3. Purposes and frequency of use	Security of travelling without getting lost, ease in reaching any destination with only few information (e.g. postcode). Occasional travel in unfamiliar places, frequent use in home city chaotic quarters and highway.
4. Before and after the satnav	Before the satnav, he needed longer to plan his travels, he would look at paper maps, printed routes, online guides, Google maps. Now with the satnav, planning has become easier and quicker. Nevertheless, he always has a physical map in his car. Moreover, when it comes to long trips, he always prefers to inform himself in advance and be aware of the possible routes. He recognised that the sense of distance is changed over time, now he feels more free to organise long journeys.
5. Relationship over time	Reliance is decreased with experience. The use of the satnav functions is unchanged.
6. Exploration/ discovery of functions over time	After the first times spent exploring the possibilities of the satnav, he left the configuration unchanged. He does not consider the satnav as a mobile phone, for instance, with which he likes to play around when he is bored. The satnav is in the car and the only times he uses it are those when he has a purpose (i.e. getting to X destination).
7. Use in familiar places	In the first days of use, he discovered the utility of the satnav in familiar places, while trying to "test" its accuracy. He discovered that it is good for driving in his home city where, if anything happens on the way, he can always recalculate the route very quickly. The satnav also enabled him to discover new routes not imagined before. After this, he began to use the device in familiar places to navigate and orient himself. Moreover, he feels a sense of security that he will not get lost, especially in his city where streets are often chaotic and without indications. Nevertheless, over time, he has discovered that the device is not good for picking up contextual factors such as traffic, construction works, inaccessible or narrow streets. The signal is often inaccurate, leading him to miss the turn or take the wrong one. For these reasons, he often decides to switch it off and take his own route.

8. Use in unfamiliar places	He always uses the device in unfamiliar environments. Nevertheless, he always carries a map with him and remains aware of what is around him, the indications, the environment. He prefers to choose his own route when the device is clearly wrong or he has the feeling that there is a better way. In that case, either he keeps the device on and lets it recalculate the route, or he switches it off. This depends on the time available to him, the availability of other navigation tools in the car, and the presence of trustworthy people in the car.
9. Passive and active uses	He uses the device primarily in an active way, i.e. for way finding. One of the things that he finds particularly useful are POIs as they help him to orient in the environment. For instance, he was used to not remember the exact address of his partner's workplace; when he needed to get there, he arrived in the area, switched on the satnav, searched for a POI, an hospital which he knew was close to his destination, and drove there. Sometimes, he uses it passively, as a map to increase awareness.
10. Configuration/ personalisation	He did not configure much in his device. He affirms that it is pretty old, therefore the number of functions is limited. Initially he set up the fastest and toll roads route. Only rarely he changes it, e.g. when he he has an idea of the distance to destination and knows that it is not convenient to pay the highway.
11. Most/least used functions	Most: route, map, POIs. Particularly, time of arrival. It helps him planning and knowing whether he will be in late for social events; in that case, he can call his friends and avoid "brutte figure" (bad impressions). This function revealed to be particularly useful when he had to meet people for the first time. It made his life just easier, more relaxed. Least: voice feedback (disabled as it increased his anxiety level), mid-points (he prefers to decide by his own and insert the journeys each time as anything can happen in between things).
12. Updating satnav	He is not able to update it on the website. This leads to problems, e.g. the satnav cannot find streets. He complains because an updated map is important in places like his hometown, where directions change all time and new construction works are often in place.
13. Trust of satnav	It changed over time. In the beginning, he relied much more on it. Now, especially when he is in familiar places, he tends to question it almost naturally. In unfamiliar places, he trusts it but maintains a critical attitude towards it. Moreover, he is always very aware of the environment, the indications, the overall route. For instance, if he notices that the suggested street is in bad conditions or if he feels like the satnav guidance is not satisfactory, he does not follow the device instructions.

14. Use of other tools	In unfamiliar environments, he uses also paper maps to increase awareness. For instance, when he went abroad, he found maps very useful in order to make sense of the places and the distances. He always looks at indications to remain aware of the situation and to have an idea whether the satnav is correct or not. Moreover, he eventually asks people in the street for help.
15. Social presence in car	Especially when driving in unfamiliar places, it happens that the passenger reads the satnav (or map) instructions. This helps him concentrating on driving in the new location and maintaining awareness of the physical world. Moreover, the other person and he jointly decide the route, with the help of the satnav and other tools. Sometimes, the passenger's opinion prevails on the satnav, and he switches it off. This is because other people always notice what happens around, look at the traffic, know short-cuts and understand his language.
16. Good/bad stories:	Adaptation of the technology throughout time: in his home city, the device often tells him to take a very high-traffic toll road. In the beginning he followed him, then understood it is inconvenient. Now he has the habit to either deselect the "toll road" option when he thinks the device will choose a route including that toll road, or he intentionally misses the turn and lets the satnav recalculate the route. Good: The satnav helped him to get home when riots happened in his home city. He thinks that he would have spent the night stuck in the traffic and chaos, if it was not for the satnav. He was able to arrive home much sooner that expected. He thanked the device for showing him a route that he did not know or imagine before. Bad: Once, in the first period of use, he entered the car expecting the satnav to recognise his destination street, but this did not. He had to go back home, use Googlemap to find another street close enough to his destination, go back in the car and input the new destination address. Once arrived there, he oriented himself with the satnav map. After that episode, he often plans earlier his journeys in unfamiliar environments.
17. Breakdowns	Problems with signal, wrong instructions, inability to look up traffic information. Over time, these led him to rely less and less on the device.
18. Observation-related questions	He tends to question the satnav guidance, and follow it mainly when he realises that it is really convenient to do so. This is why, during the ride, he preferred to drive straight rather than going through a series of turns as the device suggested. He could not know whether he would find traffic jams or inaccessible roads on the route suggested by the sat nav. Therefore, he preferred to go straight because the road accessibility and traffic conditions were visible. Moreover, driving straight was also easier to do than driving through turns.
19. Wishlist	Traffic information, automatic update.

P2

1. Attitudes towards technology	He has several technologies. He does not feels particularly skilled at using them. He uses them for precise purposes.
2. Acquire satnav	He bought the satnav for the main purpose of detecting speed cameras. He soon considered it as a "tool", as any mobile phone or calculator which he uses when needed.
3. Purposes and frequency of use	The main purpose is to avoid speed cameras, plan trips and know time and distance. He uses the sat nav daily in familiar environments, and for every occasional trip in unfamiliar environments.
4. Before and after satnav	The satnav gives him a sense of tranquillity and serenity during the travel: whenever there is an improvise change of plans, the satnav will always bring him to destination. He also does not feel anymore the need to ask people for indications. However, he realises the importance to set it up properly or the output will be wrong. In fact, he affirms that the satnav is not a "human being".
5. Relationship over time	Not particularly changed, as he always uses the same kind of functions. However, in the beginning he was more reliant on it. Now he has learned to check the journey the satnav suggests him and decide if following it or not. For instance, he remembers a particular story: Once he chose the shortest journey to go to Rome and the satnav guided him through small villages with traffic congestion. He realised that following the satnav guidance was not the best choice and that the device functions need to be used carefully. In regards to speed cameras, he preferred his previous satnav systems as their satellites could detect speed cameras more accurately.
6. Exploration/ discovery of functions over time	He explored a few functions: for instance, once he tried the Neapolitan voice, but changed it because it was not tellhing him the names of the streets. Overall, he did not feel like exploring much of the device, mainly because he has no time and the device itself is not something he would easily sit and play with. The device has a purpose and he uses it just for that.
7. Use in familiar places	He uses the device on a regular basis, every time he drives the car. In his home city he likes to use the satnav for city canoeing, speed camera tracking and for "company" when he is alone in the car.
8. Use in unfamiliar places	He always uses the device in unfamiliar areas. The satnav helps him finding the route and tracking new speed cameras. Also, the satnav makes planning easier, as it displays duration and arrival of the trip.
9. Passive and active uses	He uses the device actively, as a route finder. However, especially in his home city, he often likes switching on the map to better orient himself or to receive information about speed cameras.

10. Configuration/ personalisation	The fastest route is his first choice. He is not interested about traffic updates as he tends to drive in low-traffic hours. He often talks to his satnav and likes to address it as "him".
11. Most/least used functions	Most: speed camera and POIs. Least: various functions, such as mid-points. He is not interested in that.
12. Updating satnav	Every six months he updates his satnav to detect speed cameras accurately and have the correct street directions. Nevertheless, this often remains a problem, especially in his home city where directions change every few weeks.
13. Trust of satnav	He does not always trust his satnav, he prefers to understand what is around him and what the satnav guidance consists of: "Sometimes he wants me to do the shortest route. It might seem the shortest, but when there is traffic that's not the shortest route anymore. One example is when I almost arrive at home, I arrive in the middle of San Nicola Square... at that point, he tells me to drive around the square... instead I don't go around, I just drive through this other street which is longer, but longer like 100 metres! The GPS doesn't realise that, but I wanna avoid the traffic of the city, so I need to make my choices too!"
14. Use of other tools	He often gets mad when the satnav fails in giving guidance. He switches it off and uses other tools, such as maps or road indications. Because he knows this can happen, he always pays attention to the road. Doing this, he is never "lost". Many times his familiarity with the environment or the fact that he is confident in exploring the places by himself lead him to replace the satnav.
15. Social presence in car	He does not think that other people affect the way he uses the satnav in the car. Given that his main purpose is speed camera detection, he is not often used to share the use of the device with other people. However, on long trips, he likes if others participate and help him finding the way. It happens and the satnav is shared with them, especially when these are quicker in using technology than him.
16. Good/bad stories	Good: He thinks that the satnav prevented him from getting bills for speed excess. This is critical for him. Bad: In the beginning, once he went abroad and his satnav suddenly lost the signal. He had to stop and wait long until it worked again. It was a very stressful situation: he could not do much, he did not know the language and had difficulties in orienting with the physical maps available to him.
17. Breakdowns	One of the major breakdowns was the time when he was abroad and the satnav lost the signal. That slowed down everything and made his journey very complicated. After that, he prefers always to pay more attention to the environment, have accurate paper maps and, eventually, print routes off the Internet.

18. Observation-related questions	As noticed in the observation, he often speaks to the satnav when he is mad (e.g. when directions change and the satnav does not pick this information) or when he wants to compliment with it. Talking to the satnav is natural for him, it is the same as when he swears at his computer because it does not work properly. During the ride, he did not know the correct address of destination. He chose the "centre of the city" as destination and, once there, he used several POIs. These aided him in making sense of the space and getting an approximate idea of how to get to destination. POIs constituted his landmarks in an unfamiliar environment, of which he had only scarce and approximate information.
19. Wishlist	More accuracy and a higher number of satellites to detect speed cameras.

P3

1. Attitudes towards technology	He is very skilled with technology, he uses computers everyday, mainly for work. He is enthusiastic about technologies and owns several ones.
2. Acquire satnav	He decided to buy a satnav to find streets more easily and efficiently. His initial idea was that, while the satnav finds the route, he can do other things (e.g. talking on the phone, listening to music).
3. Purposes and frequency of use	He uses the device as a general guidance for any travel he embarks in. He uses the device for frequent travels in unfamiliar places, and for everyday routine. He likes to use it in his home city, mainly for city canoeing.
4. Before and after satnav	Before the satnav use, he relied much on physical maps and indications suggested by pedestrians. Once bought the satnav, he felt like planning his travels on the spot, even while driving. He felt more relaxed and often did not engage much with the way finding activity. However, a few trips made change his mind: he realised that the satnav often suggests inconvenient and slow routes. One of the things he did to understand the efficiency of the satnav was to use the device in his home city. Here, although he discovered many limitations, he also saw that the device is good for finding unknown routes which can save him from the traffic congestion of the main streets. After the sat nav, he also began to pay more attention to his driving speed, because the device always shows him his speed and the allowed limits.
5. Relationship over time	Over time, he began to use it for other things, e.g. for controlling his speed, for discovering new places in his well-known city. However, he became less and less dependent on the satnav, because he realised that it is just a tool.
6. Exploration/ discovery of functions over time	In the beginning he had a very curious attitude towards technology. This is how he usually behaves with technology. Afterwards, he tends to keep the configurations initially set. Certainly, discovering the speed limit visualisation helped him control his driving behaviour, be safer and respect the law. Moreover, he began to use POIs not only to discover new places (e.g. new shopping malls), but also to aid his orientation in places not very familiar to him. For instance, he can work out where to go by using POIs and landmarks. In some cases, he uses them to explain where he is to someone he has to meet somewhere.
7. Use in familiar places	He began to use it in his city, just to test its functioning. Then, he discovered its utility in discovering alternative and low-traffic routes. Here, he also began to use POIs for better orientation and for discovery of new places (e.g. shopping malls, fuel stations).

8. Use in unfamiliar places	Whenever he embarks in unfamiliar places, he switches his satnav on. It helps him navigating, finding his way and being sure he will arrive to destination. However, he knows he needs to use also other tools in order to drive efficiently. Adaptation/workaround: When the satnav cannot find the exact number of his destination address, he inputs the same street but another number. Once arrived in the area, he switches off the device and looks outside to find his exact destination.
9. Passive and active uses	He mainly uses the route finding function. He sometimes uses the map-only view, mainly when the satnav is wrong and he has no physical maps in the car.
10. Configuration/ personalisation	He had set the fastest route and never changed. When he needs different kinds of routes, he simply does not follow the satnav guidance and lets the device recalculates a new route. This is faster and more convenient than setting up every time a different type of route. He had set a few configurations: daily/night view (to avoid lighting problems with the screen), favourite routes and points he frequently goes to. Overall, he does not feel particularly bounded to this satnav. While for his computer he feels something strong because he knows it is a valuable computer, this satnav is not much for him. It has its functionalities, but it also has many limitations.
11. Most/least used functions	Most: route function, map, POIs. Voice instructions are good for catching attention but can be confusing (especially when other people are in the car or there is a chaotic situation outside the car). Least: mid-points, because they are not convenient and need time to be set. Often he does not have a precise idea of where he is going to, therefore they would not make much sense for him.
12. Updating satnav	Initially every month. Then, he did not do it anymore, even if the satnav maps are clearly unreliable. Recently, he has bought a smart phone with satnav, which is fairly updated. When he really needs to have the most updated map, then he switches this on. Overall, the update is not a big concern for him. This is mainly because he never finds himself in a situation of total reliance on the satnav. He always has other tools and his orientation skills too.

13. Trust of satnav	He believes that the satnav is simply a machine which gives guidance on the basis of parameters which are not flexible. Therefore, the fastest route might be not the best one, if it will bring him in a stressful or dangerous area. For this reason, he prefers understanding where the satnav will bring him. If this is not good, he will come up with something else. Nevertheless, it has happened that, when he had time, he decided to follow the satnav guidance for the whole journey, in order to discover new places and get "amazed". When he sees that the satnav makes mistakes or does not suggests intelligent routes, he switches it off and uses other means of orientation. Other times, he simply does not follow the satnav and lets it recalculate the route. This automatic recalculation is critical for him, as he often considers more than one source to make his decisions on where to go.
14. Use of other tools	His orientation skills, asking people, smart phone, physical maps, documents printed off the Internet, guides. It sometimes happened that the sat nav was clearly wrong but he had no other tools: he preferred to follow the satnav to approximately get to the destination; then, he switched it off and asked people or walked the rest of the way. Interestingly, when he has an important meeting, he prefers to use both the satnav in the car and the satnav on the smartphone. This guarantees him to double-check the route.
15. Social presence in car	As found in the observation, he has to pay more attention to driving when he is in the car with other people. He has to switch his attention between driving with the satnav, entertaining discussions and deciding what turn to take (on the basis of his awareness of the place, the satnav instructions and other people's opinions). In fact, he says that driving and using the satnav are more stressful when there are others, because everyone says something about the route and questions either the device or their driving practices. However, he does not think of these situations negatively.
16. Good/bad stories	Good: once he went in a rural area in the South of Italy, where there were no indications or accurate physical maps. The satnav became indispensable as it showed him the way. It did not matter to him whether it was the best route or not, what was important was that it brought him to destination. To follow it was the only choice he had. Bad: when he is doing several things (e.g. talking on the phone, listening to the radio), he has problems in using the satnav and gets mad at it. He thinks the device does not understand when to be quiet/invisible or loud/visible.

17. Breakdowns	In the first period of use, he realised the necessity to be always aware of the environment and have a back-up plan: one particular time, he was in an unfamiliar city and the satnav battery went suddenly down. Luckily, he had looked at road indications the whole time and had an additional map printed off Googlemap.
18. Observation-related questions	Social presence affected his behaviour and choices, slowing these down (but not negatively). The passengers in the car only had a formal relationship with him. The satnav was the first thing they began to talk about, once the journey started. In fact, after a few meters, the device gave clearly wrong guidance and the participant complained about this. Following this, everyone was talking about the satnav, asking questions, sharing experiences. The passengers began to question the satnav guidance and suggest their idea of what route to take. An atmosphere of conversation established, as confirmed in the interview. The participants said that this helped to alleviate his tension and break the ice.
19. Wishlist	Automatic update, online connection, traffic information update, more GPS accuracy, user-generated content on POIs.

P4

1. Attitudes towards technology	Positive attitude towards technology, he is interested in it. He uses several technologies for work and at home.
2. Acquire satnav	He bought his satnav because he had to move to a new city for work. He thought it might help him learning the city and going to work easily, especially in the beginning.
3. Purposes and frequency of use	He use it often, almost every day for city canoeing, highway, and occasional trips in unfamiliar places.
4. Before and after satnav	Before the satnav, he used maps, routes taken from travel websites, and often asked people in the street. Acquired the satnav, he felt more safe to travel, began discovering alternative routes (to escape traffic) and drive more freely.
5. Relationship over time	In the beginning, he was reliant much more on satnav. He went off to trips without maps, thinking that the satnav was enough. However, one or two times he found himself in situations where the satnav failed and left him "alone". Afterwards, he began to be more careful about the route, plan his travels in advance and have always back-up plans. Now he prefers to consider his satnav as a tool as any other tool. It is just an "improved map", but nothing "trascendental".
6. Exploration/ discovery of functions over time	The first times he used the device, he explored the menu functions, trying to figure out what he could do with the satnav and how to do it. He discovered that the satnav compares his current speed with the limits allowed by law. He began to use this as a way to control his drive and not make infractions. In particular, he found himself amazed by "how low the limits are" and began to respect them with more attention. Moreover, he remembers to have organised a weekend trip with his colleagues at his new work, where he was able to try out the device. He was very enthusiastic about this experience: he visited new places, bounded with his colleagues and also tried the device, learning better what it is good or bad for. Afterwards, he began to travel more: the satnav helped him making his new city familiar to him and explore the surrounding areas in his free time. He thinks he probably would have not done all this without the security of the satnav: the device, even when is only used as a map, is still more flexible than a small map or a route printed off the Internet.
7. Use in familiar places	In familiar areas, he switches the satnav on whenever he is stuck in the traffic or is driving along narrow streets which all look the same (due to this, some quarters of his city are still obscure to him). He uses the device guidance for quickly calculating a new route to escape the traffic or avoid "getting stuck" in areas he does not know.

8. Use in unfamiliar places	He always uses the device to drive in unfamiliar places: in the first period of use, he felt like the device could provide relaxed and serene explorations. However, a few negative episodes made him change his mind (e.g. a few months after moving to a new city, he followed the device to go back home, only to end up in a very unsafe quarter in the middle of the night). Afterwards, he kept using the device; however, he always carried with him either routes on paper or he always looked at road indications. His relationship with the device has become more active and conscious.
9. Passive and active uses	Mainly active use, for route finding. Sometimes, he just switches on the map to increase his location awareness, receive information on traffic lights, speed limits, POIs and speed camera tracking.
10. Configuration/ personalisation	He has set the fastest route and does not change it often. Sometimes, when driving through places he intends to to see, he now does not select the option of toll roads, so that he has more chances to see interesting landscapes. However, he thinks that the satnav does not select very beautiful routes. For instance, in the first period of use, he explored the surroundings of his new city: he always followed the satnav which guided him to toll roads, only to discover that there were better landscapes to see, if he only had planned the travel by himself. This is why now he always organised the travel earlier and with the help of Internet.
11. Most/least used functions	Most: fastest route as he is always in a hurry. Least: mid-points function, save my route.
12. Updating satnav	He updates his satnav as soon as a new update is available. The streets often change directions, the speed limits as well, and often new construction works are in place in his city. He prefers to have an updated map, otherwise he would just use a normal physical map.
13. Trust of satnav	It changed with time. In the beginning he tried to give trust to the device, only to discover that it was inconvenient. Now he follows it only when he weird or unsafe routes are suggested. In fact, he affirms to always look at the screen map to understand where the satnav is bringing him, and maintain a certain level of awareness. If the route is good/interesting/potentially traffic-free, he will follow the device; otherwise he does not follow it and works out the route by himself. This happens very quickly for him. However, when he is somewhere unfamiliar, he prefers to stop the car and sort out what to do next (rather than keeping listening to the device). In many cases, he found himself switching the device off, when it suggest him inaccessible or unsafe routes.
14. Use of other tools	Yes, mainly physical maps, road indications, awareness of where he is.

15. Social presence in car	Overall, he thinks that his use of the satnav does not change negatively when other people are in the car. However, he realises that he often needs to pay more attention to the voice instructions or look more often at the satnav screen, especially when conversations are in place (as observed in the ride too). On the other side, he feels like he can relax and talk to the others, because the satnav is doing his job for him. When travelling with his partner, he prefers that she is in charge of the device, so that he can better concentrate on looking for cues in the world outside the car (especially when they are driving in an unfamiliar area). While she explains him what the satnav next turn will be, he tries to understand whether that is convenient or not. He finds this collaboration a good way to engage with the destination and make the whole journey more enjoyable. He believes that this way of travelling and way finding makes everything more memorable.
16. Good/bad stories	Good: He distinctly remembers his first day at his new job. He was in a new city and he was happy to not have to think about how to get to work, as the satnav was doing it for him. He felt much less stressed and was able to arrive in time and at the right place. Bad: Various stories. Once he drove very long to get to a place, only to discover that the way could have been much shorter if he had looked at the map before. The destination was only a few minutes away from his starting point, but the satnav made him drive a long circle around the area (for no reason at all). After situations like this, he began to use more actively the device, trying to question the satnav guidance and always look at road indications.
17. Breakdowns	He remembers several episodes where the satnav proved not to be "perfect" (See above). Over time, he gained mastery with it, began to see what is good and what is bad for, and consciously decided to be more active in way finding.
18. Observation-related questions	As in the observation, he often listens to what people in the car have to say about the route. The satnav is not the only tool for him. People are better at detecting and responding to situations where there might be traffic, a road might be closed or unsafe to drive. Moreover, as in the observation, it might happen that they do not exactly know where to go from the start. Therefore, they might come up with an idea or change idea on the way. The satnav does not understand that, it always needs a "destination". On the other side, people are more flexible.
19. Wishlist	Larger screen, automatic update, suggest more than one route, give information on places/areas while driving by.

P5

1. Attitudes towards technology	He loves technology and is very skilled. He owns many different technologies.
2. Acquire satnav	He bought the satnav because he moved to a new city and because his job as a sales representative requires him to spend long time driving in the car. He has three satnav systems: one mounted in the car, another integrated in his smartphone (which he often prefers for its portability) and another in his computer mounted in the car (which he almost never uses because it takes time to switch the computer on every time he needs it).
3. Purposes and frequency of use	He uses the device for work everyday, at least twice a day. He uses it particularly when going on the highway because he still does not know well the connections between one city and another. As he often goes in familiar places, he rarely uses the satnav for travelling to holiday destinations.
4. Before and after satnav	He believes that he could not have started to work without the satnav, as his job is highly dependent on driving and he has always worked in unfamiliar cities. Moreover, he thinks that other navigation tools like maps are not enough for the job he does, where he spends most of his time in the car, driving from one place to another. The satnav is flexible and always "connected". In the beginning, he considered the satnav very useful but was convinced that trust is something that should be earned. In fact, he soon discovered several pitfalls in its guidance. However, he still believes that, especially when he does not know the way, the satnav is useful.
5. Relationship over time	In the beginning, he was more reliant on the satnav, as every place he was driving in was unfamiliar to him. Now, he knows most of the places. However, he still prefers to switch the device on in most of the cases, especially because he does not know well the connections between cities. To have the device on has become a natural thing now. He compares the different models of satnav he has used in the past and he realises the advancements of the technology. For instance, he likes his current satnav because it has a good visualisation of routes and maps. However, he still thinks that the satnav often complicates his life and multiplies his problems, rather than simplify or resolve them.

6. Exploration/ discovery of functions over time	In the beginning, he was particularly curios to try out things. He spent time looking at the different functions, trying to understand what it was possible to do with the satnav (other than route finding). He did what he tends to do with other technologies as well, right after purchasing them. However, this attitude changed soon: his main purpose is to get from A to B and as soon as possible. All the rest does not matter much to him.
	Interestingly, he knows that there is the possibility to use voice recognition in his satnav (which could make it easier for him to interact with the device while driving). However, he is not able to find it and set it up. A few times he tried to do it but gave up.
7. Use in familiar places	He uses the device in familiar areas because it helps him controlling his speed and checking the approximate arrival time. Moreover, it has now become very natural for him to switch the device on at the beginning of a ride. However, he always remains aware of the places he is driving in, his overall route and the indications in the street. This enables him to account for any contingency or to check whether the satnav is guiding him appropriately or just slowing him down.
	In regards to the city where he lives currently, Naples, he uses the satnav in a very particular way: he thinks that the satnav help is almost pointless in such a chaotic city (where the driving rules are slightly different that the "official rules" which the satnav is programmed to follow). For instance, the first time he had a commission to do in the city, he followed the satnav and ended up in a very narrow street, stuck in the traffic. He learned that now all the streets the satnav suggests are accessible or convenient in reality. For this reason, once arrived in the city, he tends to switch off the instructions and use only the map to help himself navigating there.
8. Use in unfamiliar places	He thinks that the device did not change much the way he drives in unfamiliar places. He employs the satnav to arrive to destination as soon as possible, and does not care much of what is in the middle. The satnav facilitates his way finding and reduces dead points (e.g. using a physical map would take longer). However, he is aware that the device does not always "understand" what he wants: "When you have to visit 20 people in one day you need to be real fast... The navigator helps me achieving that but I also have to make my part. He does not think like I do!"
9. Passive and active uses	He mainly uses the device actively, as a route finder. He only switches on the map without instructions when he is in the centre of Naples, where he finds using the satnav almost pointless.
10. Configuration/ personalisation	He did not spend much effort in configuring the satnav: he configured the colours on the screen, the type of route, the visualisation of time and speed and a few other things. After the first explorations, he stopped.

11. Most/least used functions	Most: voice instructions, map. Least: mid-points, because he prefers to organise the visits to clients by himself, using a physical map where he can more easily and efficiently work out the optimal order.
12. Updating satnav	He rarely updates the device and this is bad because road directions change often. Nevertheless, he is often bored to take the device, connect it to the computer and update the maps. He resolves that by working out the route by himself when the satnav is wrong.
13. Trust of satnav	He trusts his satnav but knows that a complete reliance on the device is not a good choice: he often tries to work out where the device is guiding him and quickly looks on the map to see if there are better ways to reach his destination. If there are, he will not listen to the satnav. For instance, "I learned that in [Street name], instead of going to the traffic light and then turning right, I can just turn earlier and avoid stopping at the traffic light. So every time I'm there I don't listen to the satnav anymore. He might be right that that is the fastest way... but in a world of no traffic jams! *(laughs)*"
14. Use of other tools	He always has a map with him, to make sense of the space and organise the order of his visits to clients. Moreover, he always pays attention to road indications.
15. Social presence in car	He thinks that the presence of passengers does not affect the way he uses the device. However, he knows that he needs to be more careful with the satnav when he is driving with his children, as he can easily miss the turn. When travelling in unfamiliar areas with other people, these sometimes use the device. However, as he has gained a certain mastery and automaticity with it, he often is in charge of using it.
16. Good/bad stories	Good: He was thankful to his satnav especially in the first months of his work. He would have never started working without it: the satnav helped him making unfamiliar places familiar to him, organising his work on the go and feeling more comfortable in doing his job. Bad: Several stories. Once the satnav led him in dangerous areas; another time it stopped working and left him incapable of working (as he did not have maps with him on that day).
17. Breakdowns	Shortly after the first usage, he discovered the pitfalls of the technology. The bad stories (See above) were perceived as serious breakdowns which disrupted his practices. After that, he understood the importance to use other tools, such as maps, and to be always "present" during the ride.

18. Observation-related questions	He talks to the device when it does not understand his needs. It is very natural for him to talk to it, especially when he spends a long time in the car and the device is always on.
	During the ride, he did not have the correct address for one of his destinations. He entered "city centre" as destination. Once there, he helped himself with the screen map, road indications and cues in the (partially familiar) environment.
19. Wishlist	The satnav should distinguish between main and secondary streets, because this matters to the driver. Improve visualisation with 3D photos. More intelligent routing which takes into account traffic information, traffic lights, construction works. Automatic update.

P6

1. Attitudes towards technology	He is very interested in technology. He is skilled and owns many different devices.
2. Acquire satnav	He intended to buy the satnav, then he found a promotion and acquired it.
3. Purposes and frequency of use	He uses the satnav for occasional travel in unfamiliar areas, on the highway and wherever he is not very sure of where to go. The frequency varies: for instance, lately he uses it almost every weekend.
4. Before and after satnav	Before the satnav, he found the act of driving a real problem. Often he had to print the route off the Internet, ask people in the street or rely on road indications (which often did not work out very well for him). He was not comfortable to start long journeys, as he was unsure whether he would arrive to destination safely. After the satnav, things changed. He began to drive much more, embark in trips with his friends to try the device out, discover new places. His idea of travel and distances changed, now that he did not have to worry about working out the route. The device was doing it for him step-by-step. However, he is afraid that his orientation skills have lost elasticity, now that he heavily relies on his satnav. At the same time, he does not intend to change his attitude, as it saves him time and effort.
5. Relationship over time	In the first period of use, he liked organising trips with his friends to try out the device. More than once he offered to drive his parents to places so that he could have an excuse to use the satnav. It was a good practice, thanks to which he learned much about the device and appreciated its utility. Moreover, these also became moments for spending time with other people and travel to new places. Over time, he began to use the device also in his home city, despite of his familiarity with the location. In fact, before the satnav, he had found driving there very challenging: road indications are poor and the driving practices are stressful and dangerous. The satnav helps him concentrating on the road and gives him plenty of time to plan the next move.
6. Exploration/ discovery of functions over time	In the beginning, he likes exploring the satnav functions, often together with his friends. He changed the colours of streets and arrows on the map, he set the preferred type of route and a few other things. Over time, he left these settings unchanged, being happy with the satnav performance. One of the things he discovered very useful was to see the time of arrival. To know whether he is going to be late enables him to advert his friends and reschedule their meetings.

7. Use in familiar places	He often uses the satnav here. The road indications are poor, the people drive very stressfully and, overall, he finds it difficult to remember streets and routes. Moreover, although he thinks to have acquired a certain automaticity with driving, he still gets stuck in chaotic or high-traffic situations. Thus, he prefers to use the satnav and follow it. It "calms" him down.
8. Use in unfamiliar places	He always uses the satnav here. He likes planning on the spot, as it takes less time, and begin driving with the help of the satnav. He sometimes thinks that his over-reliance on the satnav is negative. It does not stimulate him to work hard for getting to destination. He feels like he is missing out the pleasure of discovery, the pleasure to appreciate the beauty of certain places. However, he feels bounded to use the satnav, as it makes his driving experience easier. He hopes this will change in the future.
9. Passive and active uses	He uses the device mainly as a route finder. He almost never uses the satnav as a simple map.
10. Configuration/ personalisation	In the beginning, he spent time configuring his satnav, now he rarely changes his configurations. He is fairly happy with his satnav.
11. Most/least used functions	Most: route finding, visualisation of arrival time, distance, speed (which he believes is more accurate than the speedometer in the car) and energy consumption. Least: mid-points, he is not interested in it. He knows they exist but he never found the occasion to use them.
12. Updating satnav	Yes, twice a year. It is important for him, as in his home city directions and street accessibility change often.
13. Trust of satnav	He trust it, especially because he feels like he "has to" trust him. Often he realises that the satnav is not perfect, but he still needs it for finding the way and for a sense of tranquillity. He never really switches it off. However, he sometimes asks for indications to people in the street (as confirmation, in extreme cases).
14. Use of other tools	No other tools. "I see my satnav as an evolution of maps... I wouldn't use both at the same time... it is the same thing as talking on the phone with someone while writing a letter with the same words you are just using."
15. Social presence in car	When other people are in the car, he likes using the satnav as he has the possibility to talk to them, without the need to pay attention to the way. Moreover, it becomes fun when they are all involved in using the device or commenting on its guidance. However, he often tends to trust more his friends than the satnav, because they can consider all factors, such as traffic.

16. Good/bad stories	Good: The first times he went to his partner's hometown, a completely unfamiliar place, he was able to arrive at her university to surprise her. He says that he would have never done something like that without the satnav. Bad: During a night out, by following the satnav guidance, he drove into a very unsafe area in the suburbs of his hometown. He felt uncomfortable and also mad at his satnav. Another time, he got lost with the satnav and had to ask pedestrians for help; he is still now unable to understand why the satnav led him "out of route".
17. Breakdowns	When breakdowns happen, he tends to keep following the satnav or he asks people in the street. Often, he feels like there is not much he can do without the satnav. He does not want to carry maps with him, because he thinks the satnav replaces them and does a better job.
18. Observation-related questions	He talks to the satnav. For instance, during the ride, he was complaining with it for making him stressed: the satnav kept repeating him to go to the right, when this was the only possible option for him.
19. Wishlist	He would like a touchscreen satnav (as his satnav has only keys). Improve GPS accuracy. Traffic information. Input landmarks which use the human language (e.g. bring me "opposite to that red building next to the supermarket").

P7

1. Attitudes towards technology	He embraces the technology and is not shy to explore it. He likes getting stuck into it and never open manuals. He is very skilled with technologies and own several ones.
2. Acquire satnav	He bought the satnav because he thought it might be easier than reading a map and working out where to go. "Everyone can turn left or right if the satnav tells them to do". This first impression changed throughout time.
3. Purposes and frequency of use	He mainly uses it for occasional travels in unfamiliar areas. In the past, he was using it more often, because he had a personal car and did not discover yet all the pitfalls of the technology.
4. Before and after satnav	Before the satnav, he rarely organised long trips. When he did, he mainly relied on road maps. After the satnav, he stopped using maps only to discover that this was a bad idea. Now, he uses the satnav as a back-up: when he enters in the car, he switches it on, inserts the destination, looks at the map, tries to understand where he is and where the destination is. Then, regardless of the device suggested route, he mentally breaks up the journey in small pieces (begin point, mid-point 1, mid-point 2, mid-point 3, arrival) and uses the road indications to get to these locations, step-by-step. When such indications are not present or he thinks the place is difficult to find, he checks the device and follows its instructions.
5. Relationship over time	Initially, he relied on it much. Now he uses it as a support, mainly for the final part of his journey or where he finds it difficult to orient only with road indications.
6. Exploration/ discovery of functions over time	He liked playing around with his first satnav, right after purchase: he changed the colours, set the night vision, customised the map view. He felt the need to configure it to his needs, but he was also curious to see what the satnav allowed him to do. Now, with his current satnav on smart phone, he has left the default settings. This is mainly because he uses it as a redundant tool, in his own particular way. When he had his first satnav, he complained about the absence of scenic routes: he knew he could use the mid-points function to overcome such limitation, but he did not because it was inconvenient: "It was really embedded, you had to go in the menu and search search search, it's not obvious."
7. Use in familiar places	In the beginning, he tried to use the device in his home town, only to discover that it was not efficient. The device often suggested major roads, which might be shorter but are not faster (due to traffic). Now he prefers switching the device off in familiar areas.

8. Use in unfamiliar places	He uses it, but in his own particular way. In fact, he prefers to rely on road indications and his own orientation skills. This is why he remains always aware of the environment and the whole situation. He also thinks that over-reliance leads to disengagement with the environment. For instance, in regards with his first period of use, he soon realised that he was paying too much attention to the satnav screen and did not enjoy the view of the world outside.
9. Passive and active uses	He uses it as a journey planner but then adapts it in his way. He sometimes uses it as a simple map to find the nearest fuel stations and car parks.
10. Configuration/ personalisation	He kept the default configuration in his current satnav. He does not change it even when he needs it. Rather, he lets the device recalculate the route. If the device keeps sending him somewhere he does not want to go, he simply switches it off and looks exclusively at road indications or asks people. He did not configure or personalise the satnav much, as he considers it just a redundant tool: "If I give this to you and you change everything, I won't care". Moreover, he chose not to insert his home address in the device. He is afraid that if someone steals his satnav, they can find his address and, eventually, break in his house. Rather than his precise address, he has just saved his home town. Thus, every time he needs to go back home, he quickly selects that address.
11. Most/least used functions	Most: photographic images of areas where he is driving in, as a redundant cue to confirm the correctness of his direction. This function is particularly useful when driving in big cities, where it is important to drive in the correct lane (in order to avoid getting stuck in the traffic). Least: many functions such as POIs and mid-points.
12. Updating satnav	His first satnav was often not updated. His current satnav on smartphone updates automatically.
13. Trust of satnav	If he has no clue of where he is, he relies on the device. However, he overall does not trust or rely much on it. He believes it is always better to make use of your own orientation skills and road instructions, which are more certain than the satnav guidance. Appropriation story: his current satnav on smart phone does not precisely indicate his position and the North. Therefore, he cannot know if he is heading towards the right direction. In order to overcome this limitation, he chooses a road, drives along it and then checks on the screen if it is the correct one. If not, he goes back and orients himself differently.
14. Use of other tools	For every journey. Road indications, ask pedestrians for suggestions, road maps (only for long travels).

15. Social presence in car	When other people are in the car, he moves the device to his side, so that the passengers cannot see or touch it. He prefers to be in control and be the one who knows where to go. Sometimes he asks passengers for confirmation about the route, but only if he trusts them enough. When there are people who are familiar with the place, he prefers to be guided by them rather than the satnav, because they take into account traffic or road closures, know shortcuts, suggest scenic routes. The satnav does not do all this, it simply brings him from one point to another.
16. Good/bad stories	Good: Once he was late to go to the airport. He switched the device on and followed it without questioning it. In that case, he needed to get to destination as soon as possible, and the satnav took away the stress of getting there with no surprise. Bad: Major breakdown (See below).
17. Breakdowns	A major breakdown occurred with his first satnav: it needed to be reset and he did not have any needle or paperclip to fit in the appropriate small hole. He was stuck, with no clue of where to go, because he had relied on the satnav the entire time. The only thing he could do was to drive for very long time, before finding a road indication which was recognisable to him.
18. Observation-related questions	During the observation, he kept his satnav on smartphone hidden for the entire ride. For the law, he is not allowed to use phones while driving. This is, however, in line with his way of using the satnav: he only needs to look at it a few times, to check what is the next landmark to drive to or to confirm the correctness of his directions. For most of the observation, he did not use the device at all, as he could find all the road indications he needed. He affirms that "it was useless to look at it, as the instructions to reach [Location] were all out there in the environment."
19. Wishlist	Indications of his direction (as his current satnav does not have this function). Suggestions on the nearest parking place when approaching a destination. Possibility to record own route, in order to better make sense of the journey (e.g. in holiday trips) and connect it to the photos taken. Activate user-generated content.

1. Attitudes towards technology	He likes it as it makes his life much easier. He owns a range of technologies.
2. Acquire satnav	He moved to England a few years ago, then he bought his car and his satnav. He would have never started driving in London without it, because the city was completely unfamiliar to him. He still now has problems in orientating himself.
3. Purposes and frequency of use	He uses the satnav to drive around London, everyday. Occasionally he also uses for any travel in unfamiliar places.
4. Before and after satnav	Before using the satnav, he was living in another country and, whenever needed, he was used to consult maps. Nevertheless, he found that planning everything in advance was boring and inconvenient. With the satnav, he feels less stressed: he has just to enter in the car, switch on the device and start driving.
5. Relationship over time	He feels very "bounded" to his satnav. Since the beginning, he gave it a female name, because of its female voice. He addresses it as a "she", often talking to and getting mad at it, as if this was a real person. Overall, he does not think that his relationship with the device has changed much throughout time. He did not have any major breakdowns or any situation in which the satnav "disappointed" him. Even when he experienced small problems with it, he always thought it was his fault (e.g. for not updating the device or for not realising that a road was closed).
6. Exploration/ discovery of functions over time	In the beginning, he played around with the menu and the satnav functions. He already knew much about this satnav, as it was the same as his fathers'. Therefore, having configured the device, this exploration was quickly over.
7. Use in familiar places	He uses the satnav in his city everyday, as this is only partly familiar to him. He finds it to be very chaotic, stressful and unpredictable. The satnav helps him being prepared and planning his next move in the car. Moreover, if anything happens on the way, the satnav will be always there to show him an alternative for getting to destination.
8. Use in unfamiliar places	He uses the satnav every time he drives his car in unfamiliar areas. He enters the car and starts, without the need to plan anything in advance. He feels safe, knowing that he will never get lost and that he can concentrate on driving, enjoying the ride and the scenery, talking to any passengers.
9. Passive and active uses	He mainly uses it as a route finder. He never uses the screen map alone.
10. Configuration/ personalisation	He always chooses the fastest route. Although he realises that this is not always the fastest one (due to traffic jams), he still prefers to follow it all the time. It gives him a sense of tranquillity.

11. Most/least used functions	Most: route finder, speed cameras tracking. Least: mid-points, POIs.
12. Updating satnav	He bought a life-time update a few months after purchasing the device. Having realised that this satnav was working efficiently, he thought it might be worth to keep it for long time.
13. Trust of satnav	He trusts it at "110 %". Sometimes, he hesitated and did not follow its guidance, only to discover that it was not a good choice. For this reason and also because the satnav never disappointed him, he tends to rely on it almost always. He finds it is the best solution possible to the problem of navigation in the car.
14. Use of other tools	He does not use any other tool or strategy. He says that if his satnav stopped working, he would rather wait that it works again than do something else (e.g. trust the advice of pedestrians).
15. Social presence in car	When other people are in the car, he needs that the satnav calls his attention. Therefore, the voice instruction becomes fundamental. Otherwise, when he is alone, he often switches the voice off and just looks at the route on the screen. Generally, when he is in the car with other people, these are in charge of the device, set the route and tell him the satnav instructions. During these occasions, they often end up talking about the satnav efficiency. If a passenger knows the route well, he prefers to switch the device off and follow them. He thinks it is more respectful to prefer a person over a machine; moreover, people better know what to do if a road is closed or there is traffic.
16. Good/bad stories:	Good: He affirms that every single time he has embarked in a new journey, especially in unknown areas, he thanked his satnav. Bad: He does not recall any event in which the satnav failed particularly.
17. Breakdowns	He did not experience any particular breakdown. Small problems occurred but he always resolved them, and never blamed the technology for them.
18. Observation-related questions	As observed in the ride, he often talks to his satnav. Also, he often likes talking about his satnav to the people in the car, and explain them why he is so happy to have it and how it works. During the ride, the satnav lost its signal because of cloudy/rainy weather conditions. He preferred to stop and wait for the signal to come back, because he did not know where to go. Even in familiar places, he adopts this behaviour because, if the satnav can free him from the burden of way finding, he will follow him.
19. Wishlist	Larger screen.

P9

1. Attitudes towards technology	He is open to technology, he would like to try everything which can make his life easier and his activities more satisfying. He owns a satnav and a few other technologies.
2. Acquire satnav	After a travel abroad, where he had the chance to drive with a satnav, he decided to buy it for his car. He was very enthusiastic about it, especially because it had a traffic information system. It also had additional functions (e.g. music player) but he was not interested in them.
3. Purposes and frequency of use	He mainly uses it for frequent travels in unfamiliar places, weekend trips with his partner discovering "hidden gems in the countryside". Occasionally, he uses it for driving in the city and escaping traffic. In fact, he has a traffic information system, constantly updated, which enables him to take the quickest route and always know where is congestion.
4. Before and after satnav	Before the satnav, he was used to organise his travel in advance, making use of routes printed off the Internet, travel guides and physical maps. After the satnav, he thought the planning activity would change: he began to plan his journeys on the spot, only to discover that the satnav was often suggesting non-scenic routes. Therefore, soon he changed his relationship with it: now he plans in advance not only his destination, but also the places to drive by. He also employ other sources before and during the travel: travel websites suggesting interesting stops to do on the way, maps, travel guides, road indications. These help him discovering gems (e.g. national trusts, small villages). The satnav alone cannot provide all this.
5. Relationship over time	It changed from an enthusiastic attitude towards the technology to a more realistic attitude and the realisation that the satnav often does not match his travel needs (See above).
6. Exploration/ discovery of functions over time	In the beginning, he tried several functions, such as POIs, but soon stopped exploring, because he did not find anything interesting for his travel practices. One of the things he discovered was the speed camera warning, and the visualisation of his speed against the allowed speed. These help him controlling his driving habits. During the first period of use, he tested the functioning of the traffic information system and concluded that it works.
7. Use in familiar places	He does not use the satnav for places he knows, unless he needs a new route to escape traffic.
8. Use in unfamiliar places	He uses it to ensure that he will arrive to destination. Given that he likes wondering off the route, to discover new places and "get lost", the satnav non-scenic routes are an obstacle to his travel experience. Thus, he does not always follow it. Rather, he uses the device as a general guidance, to know time of arrival/speed.

9. Passive and active uses	He mostly uses the device for route finding. Sometimes, when his maps are not clear enough, he uses the screen map to increase his location awareness.
10. Configuration/ personalisation	He configured the device in the beginning, changing the map view and the night vision. He did not do much to personalise it. For instance, he knows he could have saved his favourite routes; however, as the device automatically stores in memory all the routes, he does not do that.
11. Most/least used functions	Most: route finder, traffic information system. Least: mid-points, music player.
12. Updating satnav	He updates the satnav every time before a trip. The first time that he did not updated it, the satnav suggested him to go on railway tracks. From that moment on, he decided to update it every time.
13. Trust of satnav	His trust changes. When he is in holiday, he does not like relying on it, as his way to conceive travelling does not match with the satnav possibilities. Moreover, he often realises that there might be a better way than the one suggested by the device. However, when it comes to escaping traffic congestions, he always follow its guidance. The traffic information system has proved efficient throughout time.
14. Use of other tools	Online route finders, travel guides, physical maps, road indications, orientation skills (his and of his partner).
15. Social presence in car	The passenger (mainly his partner) tends to take control of the satnav. For instance, his partner sets the device up, uses it, proceeds the same satnav voice feedback, checks outside whether their direction is right. She also looks for interesting places they might be interested in on the way. He likes this way of travelling as it makes the travel more enjoyable for both of them. He prefers listening to the passengers suggestions over the satnav guidance, because these are able to better understand what happens outside the car.
16. Good/bad stories	Good: Once there was a major accident along the way: the satnav picked up such information, sent him in a 5 miles detour and avoided that he would get stuck in the traffic. While driving, he could see the traffic congestion from far and felt thankful to have the device. Bad: Once the device was not updated and suggested him to drive on railway tracks.
17. Breakdowns	Overall, small episodes occurred, suggesting him the technology limitations. He laughs about such breakdowns and maintains a positive attitude. As he is not so reliant on the technology, he feels sure to always find another way to get to destination.
18. Observation-related questions	He tends to let his partner to take control of the device. His partner employs also other sources (map, indications, guides) to understand the correctness of the device and discover the presence of interesting places to stop by.
19. Wishlist	Voice recognition. Improve portability.

P10

1. Attitudes towards technology	He is not very interested nor particularly enthusiastic about technology. He uses a computers just for work and communication with friends.
2. Acquire satnav	A few months after buying his car, he also bought his satnav. He always heard about the qualities of his driving instructor's satnav and decided to purchase one too. He decided to buy a similar model, but with fewer functions.
3. Purposes and frequency of use	He mainly uses it for occasional trips in unfamiliar places and for use in familiar places, whenever he feels in need of help.
4. Before and after satnav	Before the satnav, he spent only a few months driving. He was rarely going in unfamiliar places without having a map, another person, or a route printed off Googlemap. He never did very long journeys because he did not feel secure enough about his driving experience. After the satnav, he began to feel more free to drive around and go to unfamiliar places, for visiting friends or doing small trips. During these occasions, he learned how to use the device. Now he satnav helps him feeling always "covered", "never lost".
5. Relationship over time	He has always relied on the device, because he does not want to be worried about the road, the lane in which to drive, the indications, the possibility to get lost. The satnav is easy to use, convenient and tells him where to go. Now, he has the time to concentrate on the road and never feels lost. Moreover, he prefers the device to physical maps, where he had to work out his position and the right directions. This contributed to his reliance on the device over time.
6. Exploration/ discovery of functions over time	In the beginning, he played around with the device, trying several types of voices and customising the map. Sometimes, he now changes these settings. He discovered that he can save routes so he began to do it. Then, he also discovered that the device automatically stores in memory the most recent journeys. After that, he decided not to waste time saving his routes. He also discovered the speed camera tracking function, which he finds extremely useful to control his speed. Throughout time, he began to use the estimated time of arrival to avoid or recover from uncomfortable social situations. He can advert his friends of his (frequent) delays and save himself from any embarrassment.
7. Use in familiar places	He uses it when he is unsure of where to go, and when there is a chaotic situation where he feels the need to concentrate on the road in a more focused way. For instance, when he misses a turn, he prefers to switch the device on, because this will tell him exactly and quickly what to do.

8. Use in unfamiliar places	He always uses it in unfamiliar areas. He tends to plan the journey in the car. During the ride, he does not pay attention to where he is, he tends to listen to instructions and never looks at the screen map.
9. Passive and active uses	He mainly uses the device as a route finder. He never uses the device passively, as a map.
10. Configuration/ personalisation	He set the fastest route. The configuration has not changed since the first experiences of use. Only in one case (when he visits a friend) he changes the type of journey because, from previous experience, he discovered that the fastest journey brings him in a dangerous area.
11. Most/least used functions	Most: voice instruction, postcode input (as it is the most precise way to get to destination), speed camera warning, details on roundabouts and lanes in which to drive, time of arrival. Least: many functions such as mid-points. He does not understand their utility.
12. Updating satnav	Not yet, as he has never had misadventures because of that.
13. Trust of the satnav	He trusts his device most of the times. He does not find useful to question the satnav guidance, as this would only make driving more difficult for him. Even when there are people who know the route, he prefers the satnav over their guidance, because it helps him driving. He believes he is too reliant on the device and that this has led him to deskilling in orientation. He affirms to never pay attention to the environment more than necessary.
14. Use of other tools	He rarely uses other tools now that he has the satnav. Only a few times, when the travel was particularly long, he also carried a map with him. It was a contingency plan, which she never used.
15. Social presence in car	Overall, he tends to trust the device and prefers its guidance over the one of passengers. However, the only passengers he trusts are his parents, because they have years of driving experience and have travelled much. When there are passengers in the car, he tends to pay more attention to the voice instructions. He often feels the need to stop talking and listen to the satnav (this is why his device has also a very loud volume). He likes to talk about his satnav when there are other people in the car. For instance, lately he was in the car with a friend who just got his driving license, and he suggested him to buy this model of satnav.
16. Good/bad stories	Good: In several occasions, especially when he felt lost in areas unfamiliar to him, pushing the "bring me home" button suddenly gave him a sense of tranquillity. Overall, he thinks his satnav makes driving experience easier and less stressful. Bad: Once a road was closed but the device kept suggesting him to drive there. He had to drive far away from that point, before the device suggested a completely different route.

17. Breakdowns	Particular breakdowns never occurred. Sometimes it happened that the device did not find the exact address of destination. Therefore, he follows the device until the centre of the city and, once there, he called his friend who gave him instructions on the phone.
18. Observation-related questions	The satnav kept falling from the glass. After a few times, he positioned it on the dashboard, in a way that prevented him from seeing the screen. Asked why, he said that he does not care about the screen (because he needs to concentrate on the road). What is important is the voice instructions.
19. Wishlist	Traffic information update.