

Chapter

Drivers using Sound Pryer – Joint Music Listening in Traffic Encounters

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1 Introduction

We here present Sound Pryer, an application that lets drivers jointly listen to music in traffic. Sound Pryer is a ‘collaborative’ car stereo that allows its users to play their choice of music, but also tap into the stereos in other cars and hear what they are playing at any given moment. This ability to ‘pry’ into the music being played on other stereos is limited to a certain range, and only nearby stereos can be overheard. Sound Pryer also displays a simple graphic representation of the car currently providing music. Consequently the user at the receiving end may, if the driving situation permits, determine the source of the music being heard.

Driving is a widespread phenomenon and is firmly integrated into many peoples’ lives. Our work with Sound Pryer seeks to make it more interesting and fun. Driving is sometimes experienced as tedious and lonely, but it can also sometimes be enjoyed for its own sake. Hence Sound Pryer is both about relieving boredom and augmenting something pleasant. To achieve this, we add a new sensory channel to the driver’s perception of surrounding road users and their vehicles. This draws on two activities that drivers already enjoy performing, and by combining the two we hope to bring about a safe yet entertaining alternative. The first is listening to music. This is popular for several reasons; it is easy to combine with driving and the car is a good listening environment. The second is the enjoyment that we believe drivers sometimes derive from looking around and forming impressions of nearby road users and their vehicles.

Here we account for a field trial of the Sound Pryer prototype undertaken to determine if it is successful at being entertaining as such. In order to get realistic feedback from a small group of users we imposed certain constraints. For instance, we restricted the driving to a particular route to increase the number of encounters,

and we set up individual starting points to keep the users apart and anonymous. We also decided to accompany the participants to learn about their immediate reactions to Sound Pryer. We have learned that when using Sound Pryer, receiving or transmitting music was enjoyed the most when the user could see the “other end.” Also, looking around to locate the source of pried music was entertaining, and compensated the poor audio quality and the fact of only hearing snippets.

The work presented here is a contribution to *mobile music sharing*. It is currently very popular to share music files between desktop PCs using various peer-to-peer internet applications such as BitTorrent and Kazaa. Meanwhile, a growing number of portable digital devices are capable of storing and playing music files away from the desktop, such as MP3 players, PDAs and car stereos. A number of research projects in the mobile computing domain have begun to investigate the sharing of music files between such devices. Sound Pryer contributes to this in two original ways. First, inasmuch as it focuses on sharing the experience of music rather than sharing files, the awareness of other users is an important issue. Second, it investigates such joint listening experiences under conditions of driving. Most research into mobile music sharing concerns movement on foot.

The paper is structured as follows. In section three we present the Sound Pryer concept, describe a user scenario and provide a brief technical overview of the prototype. In section four we state the motivation behind our work. In section five we introduce the field trial we performed to collect user feedback. In sections six and seven there follows a detailed presentation and analysis of the video and interview materials we collected. Finally, there is a summary of the key findings in section eight.

2 Related Work

Collaborative music listening is already a topic in CSCW and related communities. In 1998 McCarthy and Anagnost presented the MUSICFX system (McCarthy and Anagnost, 1998), which enabled members of a fitness center to influence the music selection while they exercised. This is one of the first examples to draw on a social practice surrounding music listening, namely selecting appropriate music that fits the taste of a group. The system uses a set of stationary computers to collect feedback from the members and select a track. The tracks are grouped into genres and then selected randomly. The probability function is weighted such that the genre that the most members prefer has the highest probability of being selected.

More recently, in 2001, following the growing popularity of peer-to-peer Internet applications, Brown et al. expose and examine music sharing (Brown et al, 2001a; Brown et al, 2001b). Based on their findings from a study of enthusiasts’ general music habits, they derive some implications for design and propose two systems: the “Music Book” and “Music Buddy” (Brown et al, 2001b). The “Music Book” re-introduces tangibility to digitally stored music. Brown et al. envision a “CD sized book” that would connect to an online copy of the music. The music could then be

stored, shelved, shared, sorted etc. much like the ubiquitous CD. The “Music Buddy,” on the other hand, aims at augmenting the socializing that emerges around music sharing. Brown et al. present a prototype in which a user publishes his or her music selection on the web. Any user may then examine this collection. More interestingly, a user may also determine which other users that have the same items in their collections.

An early investigation of *mobile music sharing* is Kortuem’s et al. mobile peer-to-peer platform: the Proem platform (Kortuem et al, 2001). They account for three scenarios where Proem can support music file sharing. The scenarios highlight various technical issues, such as security and privacy that the platform supports. The scenarios do not investigate design or the experience of using the platform. Mikael Wiberg’s FolkMusik prototype (Wiberg, 2004) on the other hand addresses mobility (i.e. walking) and touches on the experience of mobile music sharing. This prototype contains functionality that lets a user select any song on any other user’s playlist within range. The FolkMusic prototype represents an interesting development in mobile music sharing, as it uses physical proximity to filter the available music selection.

Through a series of field studies and workshops Åkesson et al. found that a group of commuters were often bored while driving and longed for alternative entertainment (Åkesson and Nilsson, 2002). They proposed ShoutCar, a mobile music player that allows interaction while driving to alleviate this situation. The prototype consists of a text-to-speech playlist browser, a music player and a wheel-shaped input device. The playlist is prepared in advance and is made available through a web interface. The browser is installed in the car and reads aloud the items as the user cycles through the list with the input wheel. In itself ShoutCar does not concern music sharing per se, but is a relevant example of a mobile music application specifically designed for the driver.

3 The Sound Pryer Concept

Sound Pryer can be thought of as a ‘collaborative’ car stereo. A user can listen to his or her favorite music much like with a regular stereo. However, he or she can also ‘pry’ into what *other users* in *other cars* currently are playing on *their* stereos. In this way Sound Pryer provides joint listening experiences. The provision is limited to a certain range; i.e. only stereos in close proximity may be overheard. Furthermore, while playing another car’s music, the Sound Pryer interface also displays a simple graphic representation of the vehicle from where the music is coming (Figure 2). If the driving situation permits, the icon will help the user determine the source of music.

3.1 User scenario



Figure 1. (Left) Sandra is driving listening to her favorites. (Middle) Lorry appears and its music is heard. (Right) Sandra thinks: “Good music! I’ve got to get it.”

As an example, we envision the following scenario (Figure 1). Sandra attaches her PDA to the dashboard and starts the Sound Pryer application for a captivating musical experience. As she hits the road, Sound Pryer starts playing her favorite music. After a while she finds driving a bit lonely and tedious. Suddenly, the icon of a red lorry appears on the screen. She says to herself: “It must be that one up ahead”, as the latest Cardigans song fills her loudspeakers. Sound Pryer returns to playing her own music after the lorry has passed and fallen behind. Sandra thinks “Cool guy. Good music. I have to get it at the next stop.”

3.2 The Sound Pryer Prototype

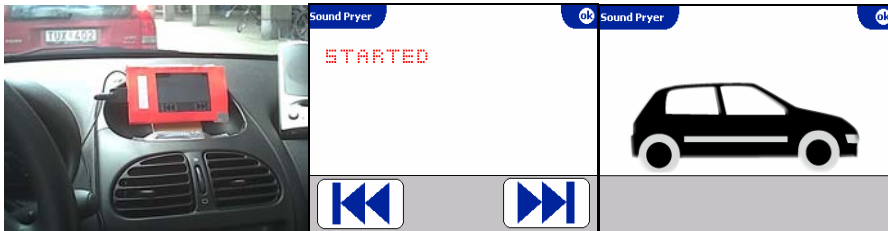


Figure 2. The Sound Pryer Prototype. A PDA and loudspeakers on the dashboard (left). The Sound Pryer Interface: Local play (middle) and remote play (right).

The Sound Pryer prototype is an application of wireless mobile ad hoc networking (MANET) for PDAs (Östergren, 2004). MANET technology enables cost-free broadband exchange requiring no other networking infrastructure than the wireless transmitters already in the PDAs. MANET between cars moving in traffic is limited to the range of the transmitters. Generally this is considered a disadvantage, but we exploit it to restrict the joint music experience to when the cars are in close physical proximity, i.e. when they encounter each other in traffic. The user interface is carefully designed to entertain the driver safely (Figure 2). It combines two modes of music playback: *local play* and *remote play*. Local play allows the user to listen to his or her favorite music. It cycles through a playlist of MP3 files stored on the PDA. While the music is playing it is also broadcast onto the wireless network. Remote play, on the other hand, allows a user to hear what someone else is listening to at exactly that moment. In this mode Sound Pryer captures and plays the music being broadcast from another PDA within networking

range. The interface is also designed to automatically switch from local play to remote play whenever a transmission is detected on the network. It *negotiates switching* to ensure that within a group of PDAs one will remain in local play mode, guaranteeing music provision for the others. The interface also indicates the presence of other users and helps to determine of the source of the music. Whenever remote play is activated the interface displays a stylized figure giving the shape and color of the other user's vehicle.

4 Motivation

The motivation behind this work is simple: we would like to make driving more fun than it already is. Driving is a ubiquitous global phenomenon involving vast numbers of people spending an ever greater number of hours in traffic. Driving could benefit from alternative entertainment, but that is not to say that driving is always a boring experience. Driving is sometimes also enjoyed for its own sake. Making driving more fun would therefore have to include entertaining the bored driver as well as giving the contented driver a heightened experience. The issue we tackle is that of finding the appropriate level of entertainment to do so. Our hypothesis is that we can accomplish this by elaborating on those things to which the driver already must pay attention, such as encounters with other drivers and their vehicles. We want to add a novel flavour to these and tease the driver's curiosity, and in this way enrich the experience of being in traffic.

More precisely, Sound Pryer draws on two ways that drivers already entertain themselves in traffic. First, it is about in-car music listening. Such listening is very popular; e.g. in a recent study of the habits of a group of music enthusiasts, it was found that they listened to music 82 % of the time they spent in cars (Brown et al, 2001a). The reasons for music being popular are that it can easily be combined with driving, and that the car provides a good listening environment in that the selection or volume rarely disturbs others and a driver can unconcernedly sing along etc (Bull, 2004; Öblad, 2000). The second activity is that drivers enjoy looking at the surrounding cars and forming impressions apart from gleaning the information necessary for co-ordination. Drivers primarily look at surrounding cars to determine where they are heading, scan for an opening, maintain proper distance etc. However, we have good support for the idea that looking at surrounding cars also adds something positive to the highway experience.

We have found in our studies of motorbikes that bikers particularly enjoy the visual interaction of traffic encounters (Esbjörnsson et al, 2004). They like taking a quick look at the other bike and its rider as they meet in traffic. In addition they often make an effort to greet each other, and discussions sorting out who was who in such encounters are frequent topics on web chats. We have developed an application for sharing web pages in such encounters (the Hocman prototype). Our field trial showed that motorcyclists particularly appreciated its contribution to the experience of brief traffic encounters (Esbjörnsson et al, 2003). Our ideas here are in line with what Donald Appleyard and Kevin Lynch already argued in 1964, that traffic

encounters are central to the experience of driving. Their statement concerned the general road user and not just bikers:

“Most impressive of all is the motion of the accompanying traffic, to which he is forced to be attentive, and which even passengers will watch with subconscious concern (Appleyard et al, 1964).”

These architects never formulated what exactly was impressive about the surrounding traffic, but we would argue that our findings about bikers are generally applicable for all road users. Any driver takes an interest in the other drivers encountered and their vehicles. In addition we believe his or her experience contains the same qualities that appealed to the classic 19th century literary figure known as the ‘flâneur.’ According to Charles Baudelaire:

“He marvels at the eternal beauty and the amazing harmony of life in capital cities...He delights in fine carriages and proud horses, the dazzling smartness of the grooms...the sinuous gait of the women, the beauty of the children, happy to be alive and nicely dressed (Baudelaire, 1859).”

Obviously, Baudelaire has not based this observation on empirical facts. Still his ideas about flaneuring seem to have relevance today, particularly for modern drivers. For instance we find in Michael Bull’s recent investigation of sound and automobility that one interviewee claims:

“When I’m sat in a traffic jam or at traffic lights, in town especially, to ease the boredom, I quite enjoy watching what’s going on around me. I look in other people’s cars, and watch people walking down the street. I like to see what they’re doing and where they’re going. As I am in my car a lot, I do need something to take away the boredom (Bull, 2004).”

In conclusion, we suggest that a modern driver-flaneur would not mind sharing music, currently listened to in private, with fellow road users. Further he or she would particularly enjoy prying into the music being played in other cars.

5 Field Trial Method and Procedures

It was necessary to acquire realistic feedback on Sound Pryer, the concept and our assumptions about being in traffic. There are a couple of practical challenges that need to be addressed to obtain useful data: drivers being *anonymous*, and their *briefly* meeting each other in traffic. Sound Pryer is intended for encounters between unacquainted drivers. Most joint listening situations will be brief and can occur potentially anywhere along the vast road network. A study where we merely handed out a few devices would not be successful, as the likelihood that a small number of unconstrained drivers would encounter each other often enough is very low. In such a case the opportunities for making observations would be scant, brief and hard to predict. Therefore, we decided to conduct a field trial where the subjects used the prototype for a limited period of time and their movements were restricted to one

particular route. With this set-up we could accompany each individual user throughout the test to be able to watch their immediate reactions and activities. We also decided to interview each individual directly following the trial to follow up on their experience of it. The interviews were loosely structured and performed in parallel.

We conducted three separate trials, which engaged thirteen test subjects in all. We provided the users with vehicles equipped with a handheld device and two portable loudspeakers mounted on the dashboard. Each device was prepared with the test subject's favourite music. The drivers were received at individual rendezvous locations along a circular route to remain anonymous during the trial; they only met the other test participants during subsequent traffic encounters, to best represent realistic situations. They travelled four laps, all at the same time, and each lap took about ten minutes at the speed limit of 50 km/h. This created a large number of events where the Sound Pryer concept was experienced.

The participants were recruited either through mailing lists or through friends of our friends. They (two women and eleven men) were between 26 and 57 years old. Eight drivers owned or had access to private cars, which they used for commuting to and from work, but also for occasional longer trips. They all frequently used either the radio or CD player when driving. Finally, all the users were familiar with the MP3 music format and were aware that such files could be acquired through the Internet. Eight participants had experience of downloading music through peer-to-peer file sharing tools.

All the drivers were video recorded during the trial by a researcher sitting in the front right seat (Figure 3). All in all we collected and analysed about six hours of recorded data. The video material was collected in order to conduct an analysis of the test subjects' visible behaviour and increase our understanding of their experiences. We wanted to find visual evidence, such as smiles, laughter, or comments, of the experience of joint listening in traffic. By recording facial expressions from close-up we risked influencing the data, but the drivers could not be too preoccupied with the camera since they had to drive.



Figure 3. Still captures from the video material.*

Video recorders are increasingly used to collect data during HCI evaluations (Hindmarsh et al, 2002). However, there is, as of yet, no common standard for transcribing video recordings similar to the coding schemes used in conversation

* The drivers have agreed to the publication of their pictures.

analysis (Heath and Hindmarsh, 2002). Consequently, we have developed a coding scheme that accounts for the details of the drivers' activities of relevance for this study.

All the video recordings from the thirteen participating drivers have been transcribed and coded. The transcriptions were first divided into 179 distinct Sound Pryer *events*. Such event began when the interface started to negotiate which device is to stay in local play and which is to commence remote play. The event ended when local play resumed, which could happen for two reasons. First it could be due to negotiation i.e. one party was assigned to remain in local play. The other is when the parties would travel out of wireless range.

The coding scheme we developed encoded five variables along a timeline. The first variable captures the duration, quality and source of the music coming out of Sound Pryer. The quality was categorized according to five qualities: silence, noise, choppy, acceptable and good. The drivers received remote music with a quality coded as acceptable or good during 37 of the events. Second we noted their facial expression if other than appearing neutral. Third we transcribed the conversations during an event. Fourth, the users' focus of attention was described in terms of apparent gaze and body movements. Fifth and finally, we also annotated the road context i.e. the particular location or surrounding traffic whenever we could discern it.

The video analysis and the field trial were intended to generate as much feedback on the experience of Sound Pryer as possible. Thus, the primary concern is not to discern general and quantitative trends. Therefore we have included as many aspects of the user experience as we could find, rather than focusing on the statistically most frequent events. Because of this the coded material gave insights into many design issues despite the somewhat limited scope of the field trial.

6 Video Analysis

The purpose of the video analysis is to study how the drivers behave during Sound Pryer events and interpret their experience of them. We have found four main categories of how the drivers observably relate to their experience of Sound Pryer, i.e. how they direct their attention and express themselves. The first category covers events where drivers display the visible behaviour of intensely *looking around*. The second category denotes the observable behaviour of showing interest in *remote music*, but not looking around. The third category combines both of these observables i.e. *looking around and paying attention to music*. Finally, we will discuss situations where Sound Pryer events were *disregarded* and no reactions were observable on the part of the driver. We include the transcript for the first example, but subsequently exclude them for brevity.

6.1 Looking around

Here we discuss the category of Sound Pryer events where the drivers were intensely looking around. In the following we will discuss an event which occurred while Eric was driving on a straight section of the road (Table 1).

Table 1. Transcript of Eric looking for a source of music.

Time	Sound Pryer	Facial Expression	Attention	Comments	Road Context
	Local play		Looks ahead		Going straight
23:04				Green car!	
23:05	Silence, 4 sec	Smiling	Looks at screen		Two cars pass in opposite lane
23:08	Good remote play, 3 sec Silence, 2 sec		Hits turn signal	We're entering here? Right? Res.: You said before even.	
23:14	Local play		Looks at intersection	Res.: mmm right ... we should enter there...	
23:15					Turns

Here Eric is gazing forwards and suddenly he says “green car!” Local play is then interrupted by four seconds of silence (23:05) which was caused by the negotiation. As two cars pass in the opposite direction he smiles and then takes a quick look at the screen. Remote play starts, continues for three seconds and then ceases as the parties leave wireless range.

We interpret his smile as a consequence of him spotting the car shown on the screen in the oncoming traffic. It is clear that his comment “green car” is about identification, and his smile comes before the music has begun to play. It seems that he recognizes the car and that he looks at the screen to confirm this. Looking around and identifying the car seems to be an enjoyable experience given his smile.

Interestingly, the same kind of emotional attitude was displayed in situations where drivers believed that someone was listening to their music. For brevity, we have excluded detailed transcripts. Ruth is waiting for a green light and her vehicle is standing still. Sound Pryer starts to negotiate at the same time as she adjusts her seat. Local play comes back on after a few seconds of remote play. She looks out the window trying to identify the source of the music she just heard. However she says to the researcher that she is not sure of where it was coming from. She starts smiling and then laughing. She tells the researcher she realized that the other driver is probably listening to her music.

Here, her emotional reaction is about realizing that she is playing music for someone else. Although she failed to accurately locate the listener, this example shows that doing identification work is an experience for ‘both sides’ and that

providing music for others also triggers interest in the surrounding drivers. Being ‘listened to’ is a fun experience when we know someone nearby is doing it.

We found that there were two kinds of emotional attitudes displayed in “looking around” events. In 30 events the subjects’ facial expressions displayed positive appreciation, and in 61 events they had a neutral face. Having a neutral face does not necessarily imply the subjects were indifferent, but it is hard to interpret their emotional experience. Still these cases show that the concept was understood and the subjects were engaged.

6.2 Paying Attention to Remote Music

We could also identify events where the drivers’ observable behaviour was related to remote *music*, but without their looking around. Mark is waiting for a green light at an intersection. Sound Pryer initiates negotiation and his local play is paused; a second of remote play follows and then another pause. Then Sound Pryer plays nine seconds of remote play (snappy Latin music) and Mark whistles along. The remote play continues and Mark starts talking to the researcher.

In this event Mark’s visible behaviour is “whistling along” and he seems to do so while listening to the remote music. It is clear that Mark is not concerned with locating the provider. Still, we interpret the event as a positive experience for Mark.

Thus, Sound Pryer can provide an interesting experience without the subjects seeking to discover the source of music, however such occasions were few in number. There were only six examples where the drivers enjoyed listening to remote music *only* and did not try to identify the source at all. This could, of course, be explained by the fact that it is hard to tell whether a subject is listening to and enjoying music. It could very well be the case they would be doing it without showing it. The rather poor audio quality of Sound Pryer was probably another reason why there were so few such events.

6.3 Looking Around and Paying Attention to Music

The most complex behaviour occurs in events where the driver looks around in conjunction with displaying some emotional attitude vis-à-vis the music.

In the following example, John approaches an intersection with traffic signals and stops his car. His local play jumps to the next song on the playlist. Remote play commences and jazzy music fills his vehicle. He glances at the screen and in the rear-view mirror. He smiles and says, “now we didn’t get to listen any more,” as his own music is interrupted. He leans forward to get a look in the mirror. He continues to look carefully in the rear-view mirror as he gets a green light and proceeds out of the intersection. He looks out towards the other lanes. After half a minute of remote listening he says: “strange tune” and laughs.

Here we interpret John’s comment “strange...” and him laughing as some sort of engagement with the music. Furthermore, we cannot be sure that the provider was identified, but he was looking for it. Hence, he is showing some sort of attitude

towards the music and he is curious about its source.

All in all there are fifteen such events. This indicates that Sound Pryer is not only about looking for who is providing music, though that was the dominating category of events. Knowing the source, or at least looking for it, contributes to the experience of listening to someone else's music.

6.4 Disregarding Sound Pryer

In 67 events Sound Pryer was ignored. This was due to two principal reasons. First, we suspect there were occasions where the driver did not engage in looking at Sound Pryer due to poor prototype performance. In some events the negotiations were 'lost' i.e. local play was interrupted with a couple of seconds of silence instead of music from a remote source. This occurred mostly in situations where the cars quickly passed in and out of wireless range, e.g. when meeting someone in the opposite lane. In any case, the silence was probably experienced as a long pause in local play rather than a failure of joint listening with some remote source, and the user did not bother to look at the screen. Second, drivers "time share" their attention and manage their focus to fit the current situation. Naturally driving had top priority and Sound Pryer was ignored when the driver was performing complex manoeuvres such as turning or co-ordinating with traffic. Furthermore, in several cases the drivers did not bother to look at the display when they were talking with the researcher. Thus the drivers here prioritize their focus of attention much like how previous research has described the way drivers handle and talk in mobile phones (Esbjörnsson and Juhlin, 2003). The design of Sound Pryer apparently allows drivers to leave it unattended if other things are prioritized.

7 Analysis of Interviews

The questions in our interview concerned four themes: the capability of the prototype, concept comprehension, the experience of service and traffic safety. Twelve drivers were interviewed directly following the field trial. The interviews were loosely structured and were conducted by five different researchers. A loosely structured interview has the advantage of letting the researcher investigate issues raised by the individual participants. In this case, we wanted to collect as many comments as possible about the system, rather than comparable results from the interviewees. All the researchers had a common set of topics to cover, but they also had the freedom to skip any deemed irrelevant to the test subject's experience. This means that not all the participants answered all the questions, and therefore we show the answer frequency in conjunction with each question.

7.1 Capability of the Sound Pryer Prototype

It was discouraging that out of the twelve drivers interviewed, ten complained

about the quality of the audio in remote play sessions. Also, in line with such criticism, a further two users were negative in more vague terms towards the technical performance of the prototype. Thus, the prototype was marred by some deficiencies in sound reproduction. The problem was mainly due to three technical issues. First and foremost, weak computer processing timing together with wireless network transfer problems, such as lost data frames and transfer delay, sometimes inflicted short breaks and noise in the reproduction (i.e. playing) of many remote play sessions.

Further, the negotiation performed by auto mode sometimes introduced short pauses in the audio. Consequently a user sometimes heard music come on and off a few times until it settled into either remote or local play. In total, four users noted that they were concerned about this issue.

Finally, the handheld devices together with the loose speakers used in the setup by no means constituted a hi-fi sound system. A couple of users commented that the audio quality was poor by their standards, even when there was no streaming, i.e. in local play.

In some cases, although Sound Pryer did deliver acceptable quality sound in remote play, the sessions were experienced as too short. All in all, five users commented that they wanted to hear more of the music they received in some traffic encounters.

On the other hand, from the video analysis we know that almost all users had at least one remote play session of acceptable quality that yielded a good enough listening experience of appropriate length. And although only four users explicitly stated, while talking about performance, that they also experienced transfers of good quality, we are confident that the prototype was able to demonstrate the concept well enough for them to give constructive feedback on its design.

7.2 Understanding the Sound Pryer Concept.

All the users expressed that they could determine when remote play commenced. Furthermore, five users could also describe that it happened whenever they were in the proximity of another car with Sound Pryer. Finally, four users made reference to the moment the eavesdropping commenced by describing which cars they had encountered:

“Red station wagon, yellow station wagon, silverish station wagon, small blue car. I think they were the ones I noticed.”

Three users stated that they quickly learned which other cars were involved in the test and therefore could determine the music source quickly without looking at the display. However, ten users had experienced some situations where this was difficult and where they felt unsure where the music was coming from. For example:

“Yes, absolutely! Several times. The first time I thought it was the car behind me, but it was probably the car in front. Then, since I didn’t know whether there were three or more cars in the trial, I was of course uncertain.”

When asked whether the display was helpful in understanding the source of the music most users were ambiguous. They noted that it was helpful in most situations. But some users had experienced or thought of situations where it did not help much such as:

“Yes, a little. I mean if I’m in dense traffic then ‘red car’ is not enough because there are so many around.”

Accordingly, three users noted that it was hard to pick out the source when there were several similar cars in the surrounding. Also, two users found it difficult to understand when the car was out of sight, for instance, or when a particular source was far away or otherwise obscured. And finally, two users found it hard to identify the cars because it was dark; colours did not show very well at a distance.

7.3 The Experience of Using Sound Pryer.

Nine drivers enjoyed listening to other Sound Pryer players. A typical comment was:

“I liked one tune. I don’t know the band, but it was rap. It was groovy when we entered the last turn. It was cool to listen to some rap music. I found that really cool.”

Four users also claimed they enjoyed trying to determine the source of the music. For instance:

“It was a little choppy in the beginning, but then when you could hear the music it was fun to listen to somebody else. It was fun to be able to see on the display what the car should look like, because then you could look and see if there was anyone around: yes it has to be that car! Then you could figure it out.”

However, because of the prototype’s technical deficiencies, three users stated they could not describe their impressions of what the concept is supposed to be:

“It can’t be done really. The experience was of it being exciting as soon as you were approaching somebody. Since it didn’t work the way it was supposed to, or the way I suspect it should work, it is a little hard.”

No user approved of the other participants’ music preferences. Still at least two users could make out which tune had been received. For instance:

“I don’t really know what it was. It was some ‘Depeche Mode’ and some obscure synth music. Then there was some more common ‘Boney M’ and something else. Ordinary music, so to speak.”

Remote play interrupted local play whenever there was an external source available, and in line with the comments above, eight users found this principle fun. However, six of them also wished to have a little more control, for instance the possibility to override the automatic selection and only hear songs from the playlist.

Remote play also means that sometimes others can hear what you are playing. When asked about how this felt, four users claimed they did not think of this as either fun or intimidating. For example:

“Didn’t think much about it. On the other hand. Don’t know. Nothing that I care about really.”

Another six users expressed that they enjoyed this aspect. For instance, a user describes his feelings when realised he was streaming music to another user:

“It was really a spontaneous reaction, I must say. It was not like I was sitting there thinking: I wish my music would come on soon. Rather it was like: ‘yes’ now we are listening to mine.”

A closely related question we asked the users was whether they were willing to distribute music to surrounding cars as demonstrated by Sound Pryer. All the users who were asked this question, which amounted to eight people, had no problem with this at all. One user explained:

“Because music is nothing controversial. You’re not sitting there listening to something others won’t feel good about.”

Finally, we asked the users whether they found the Sound Pryer concept interesting. Encouragingly, out of the twelve answers we collected nine said it was a fun concept. As one user noted:

“Absolutely, I think. If you just get it properly organized why not? It is completely new and I haven’t even heard that it was possible to do it before.”

Only three users rejected the idea. Their objections had to do with using the prototype for entertainment. They were looking for something that would make a more practical, functional improvement in their lives.

7.4 Driver Safety

When asked if the Sound Pryer prototype interfered with their driving, seven subjects said it did not. On the other hand, three of them acknowledged some sort of impact on their driving, but considered “interference” to be too strong a word. Similarly, another three users described an impulse to drive a little differently than they normally would do. For instance:

“One time I drove to try to get away from it just to see when you lose contact with that car.”

Finally, only three users objected to Sound Pryer and claimed that it interfered with their driving.

8 Summary

Despite a somewhat artificial field trial with a flawed prototype we were able to collect valuable insights and feedback on its design as well as the general concept. In the below, we summarize these key findings from the trial:

- The video analysis and the interviews indicate that the users understood that Sound Pryer is about providing joint music listening in traffic while at the same time making them aware of other users.
- Users seldom enjoyed remote music while ignoring where it was coming from.
- Hearing or providing remote music was enjoyable when it was possible to see who was receiving or broadcasting it.
- Looking around for the provider of music was enjoyable, and seemed to compensate the poor audio quality and only hearing snippets of songs.
- Many users used the shape and colour ‘hints’ when looking for the source vehicle. Hence, providing awareness of users contributes to the experience of mobile music sharing.
- A minority of the users also experienced situations where the graphics were insufficient to determine the source of music. Such situations occurred e.g. when there were many similar cars around and when it was dark.
- Problems determining the source of the music could also be due to Sound Pryer playing remote music from sources that were out of sight. This means that the range of the wireless transmitter did not always reflect the users being visible to each other.
- The prototype needs improvements in order to better implement the Sound Pryer concept. These improvements concern audio technical issues e.g. switching between local and remote sources and transferring music data.
- Poor switching performance, such as when meeting cars in the opposite lane, was particularly detrimental to the experience of using Sound Pryer, as it caused users to disregard it.
- Sound Pryer is not dangerously distracting. The video analysis showed that drivers did at times ignore the prototype to cope with driving, e.g. when turning in a busy intersection. The interviews confirmed that Sound Pryer did not interfere with driving.
- Sound Pryer does not invade privacy. In the interviews no users stated that it was particularly intimidating to reveal the shape and the colour of their car, and a majority of the users were willing to distribute music in this manner.

9 Conclusion

In this paper we have explored a novel approach to mobile music sharing. We propose the concept of joint music listening for drivers near each other. Furthermore, we have presented the Sound Pryer prototype implementing this concept. An extensive field trial shows that the participants enjoyed the concept and particularly the awareness hints Sound Pryer provides to help locate users in the surrounding traffic. On the other hand we have also uncovered some performance shortcomings which need to be addressed in order to better implement the concept. These shortcomings mainly concern aspects of transferring audio information.

Our work on Sound Pryer draws on two activities that drivers already perform to entertain themselves. The first is listening to music. The second is a flaneur-like behaviour that it is our conviction that drivers enjoy, i.e. forming visual impressions of fellow drivers and their vehicles apart from the minimum required to co-ordinate smooth traffic flow. Despite a flawed prototype, the field trial showed that users often wanted to know the source of the music, and that seeking it was particularly enjoyable. We argue that hearing someone else's music gives an additional reason to look around. Therefore this experience is still very much visually oriented, i.e. the kicks are in *seeing* who is providing music. Similarly, flaneuring, as we have described it above, is also essentially visually oriented. Hence we have good support for our hypothesis that drivers enjoy forming impressions of other drivers and their cars.

This conclusion is somewhat contrary to contemporary social theory on listening to music and driving. Michael Bull recognizes that driving (in traffic) is essentially an *accompanied* enterprise, but puts particular emphasis on *solitude* as something much desired [6]. More precisely, he argues that the car realizes the "... desire of urban citizens to maintain a sense of privacy, to create a mobile bubble, while on the move." Furthermore, driving a car is the "... dominant means of escaping the streets..." He argues accordingly that the places travelled though become uninteresting, and listening to music "... appears to bind the disparate threads of much urban movement together..." We agree that driving is an accompanied solitude, but the emphasis is on 'accompanied' and not so much on 'solitude.' Driving is a social practice, and the fellow drivers with their vehicles constitute an ever-changing scene which gives practically endless inspiration and delight for the modern driver-flaneur. Jointly listening to music adds to his or her experience in a positive way, bursts the "mobile bubble" and makes driving less detached, yet without invading privacy.

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