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Human Centred Design of a smart phone alert application for drivers

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Abstract

Smart phone applications developed to support driving task could be powerful tools to contribute to drivers' safety, eco-mobility and comfort, by allowing real time and quick widespread of critical road information, using geo-location and social networking. Furthermore, downloading smart phone applications is easily accessible at low cost for the drivers. Nevertheless, several issues such as distraction linked to the use of smart phone while driving and reliability of the transmitted information might be critical. In this framework, a survey has been conducted in order to evaluate drivers' usability and acceptability of a collaborative mobile service related to critical road events alert. This analysis showed that drivers are more confident in information displayed by the mobile service than any other sources of road alerts such as radio and variable message signs. Furthermore, senior drivers were motivated to use the mobile service, with a main concern dealing with road safety, and senior participation to the social network in order to generate information to the community was important even if their mileage was lower than younger drivers. Only few drivers recognized some interference with the driving task while using the application. Real road experiments would need to be conducted to evaluate positive versus negative impact of mobile services use while driving.

Keywords: driver safety, traffic information, human factors, mobile transport service, driver generated content, social network in transport, design, acceptability, usability, alert information.

Introduction

At the end of 2011, there were about 6 billion mobile subscriptions, estimates "The International Telecommunication Union" [1], which corresponds to 87 percent of the world population that would be concerned. Within this context, the worldwide smartphone market grew 54.7% year over year in the fourth quarter of 2011 [2]. In relation to this deployment of smartphone, there is a corresponding increase access to sophisticated services such as internet and geo-location [3](Figure 1).

Indeed, over 300,000 mobile applications have been developed in the last three years, with 10.9 billion times downloads; and demand for download mobile applications is expected to peak in 2013. Japanese consumers are still more advanced in mobile behavior, using mobile Web, applications and email more than US or Europeans [4].

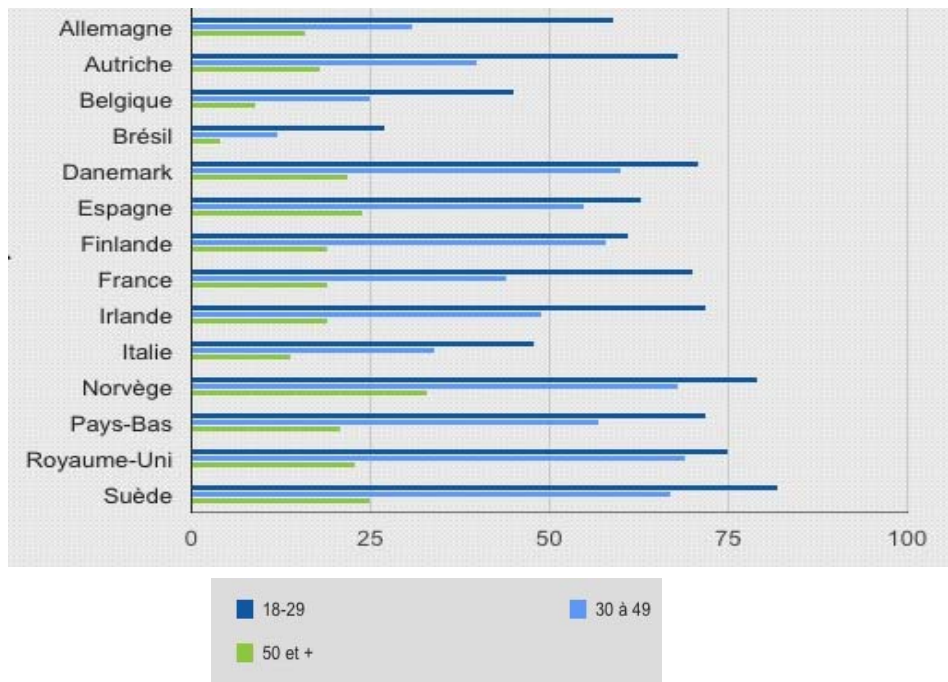


Figure 1: Smart phone audience by age group in 2012.

In this framework, distraction related to the use of mobile phone while driving has been seriously studied as it can induce an important decrement in road safety. Indeed, even when it is a hand free device, which intends to reduce or eliminate the distraction arising from manual operation, the mobile phone conversation impacts on situation awareness and performance. It has been shown for young and senior drivers [5] as well as for experienced and novice ones [6]. Even if novice drivers committed generally more driving infractions in terms of speeding, collisions, pedestrians struck, stop signs missed, and centerline and road edge crossings, and were less aware than their experienced counterparts, however, the two groups suffered similar decrements in performance due to cognitive distraction while speaking on the hand free mobile phone. An other experiment on real road using hands-free devices confirmed these results, showing that drivers changed their visual behavior due to cognitive load [7]. Changes in visual behavior were most apparent; when looking outside of the vehicle, drivers spent more time looking centrally ahead and spent less time looking to the areas in the periphery. Drivers also reduced their visual monitoring of the instruments and mirrors, with some drivers abandoning these tasks entirely. Furthermore, when approaching and driving through intersections, drivers made less inspection glance to traffic lights and their scanning of intersection areas to the right was also reduced. Vehicle control was also affected; during the most difficult cognitive tasks, there were more occurrences of hard braking.

So, driver distraction induced by conversation on mobile phone, even hand-free, has been clearly demonstrated by several experiments among diversified drivers population and various driving contexts. But conversation is an activity disconnected to the driving task, and has to be conducted by the driver in addition to the control of his/her driving task, inducing then a high potentiality of interference.

The issue of distraction is more complex to evaluate when considering smart phone applications devoted to support the driving task, that could both bring useful information to facilitate the driving task and create distraction and interference linked to the requirement for the driver to manage this information.

Among these mobile applications, some of them are aiming at increasing drivers' comfort, eco-mobility [8], ridesharing [9] and safety. Scopes of these applications can be real time feedback to the drivers related to their fuel consumption, but also anticipation about road events (traffic and critical zones) and information about critical distance of the vehicle in front,

For example, some low cost smart phone applications allow giving information to the driver about the distance with the vehicle in front based upon the phone camera (Figure 2). Three levels of information are transmitted to the driver corresponding to the levels of criticality: green for safe, orange for careful, and red for danger.



Figure 2: Example of display for smartphone application informing the driver about the safety of the distance with the vehicle in front (on the picture, the color green symbolizes that the distance is safe).

Closely linked to the widespread of the smartphone use, there is a tremendous increase in social networking activities. The mobile media technology allows drivers and travelers to communicate and to collaborate in virtual communities and networks [10] (Figure 3).



Figure 3: Example of display for ride sharing smartphone application informing the driver about the location on real time of a pedestrian belonging to the community and asking for a ride. This application raises several issues in terms of distracting effect on the driver in addition to personal data privacy.

Networking is also used to make real time road events circulating among members of a community in a process that can be called “ *user-generated content* », where each member sends information to the others on a voluntary basis. These innovative applications could constitute an efficient and low cost tool to inform drivers about real time events happenings with positive impact on road safety. Indeed, there is a clear drivers' need to be quickly and

accurately informed about critical road events, traffic information and critical zones in order to anticipate, or even to avoid these events. Nevertheless, little is known about actual drivers' use and needs of these applications while driving, and little is known about trust and motivation of the drivers' social community to participate to this activity, neither about its actual efficiency.

Objective of the survey

An investigation has been conducted among drivers of a dedicated mobile service centrally managed based upon the principle of "driver-generated content" for road alert information, in order to understand usability and acceptability of this service. This service allows drivers to inform the members of the community about location and type (accidents, roadwork, obstacle, etc...) of critical road events. Community participation is on a voluntary basis principle for the driver with an easy access to the buttons allowing communicating information in real time to the network via the service management system whenever the driver detects critical event on the road, with touches on tactile screen available anytime on the main screen of the system. A survey using internet media has been launch in cooperation with the service provider to investigate several issues linked to the use of this service. This survey was composed by a set of 141 questions, covering various issues such as users' profile, frequency and context of use of the service, understanding of functionalities and interfaces design, evaluation of the type of buttons the driver would use to inform about road events such as obstacle on the road, accident, icy road illustrated by photos, trust in the information displayed by the service. Several questions were dedicated to the social network level of participation to the community, motivation regarding this participation, potential interference and annoyance while driving when informing or validating information for the community, current number of stars symbolizing driver's reliability, trust in the other network members.

Most of the questions were closed-ended, some of them were open in order to better understand reasons and motivations regarding answers. Filling the survey required about 20 minutes. The announcement of the survey has been sent by mail to about 20 000 drivers using the smartphone service and selected according to two criteria: an annual subscription to this service and more than 6 months of experience. A total of 988 of these drivers filled in completely the survey.

Results

Drivers are using the mobile service very often, mostly several times per week or every day, with 42,3% on motorway, 38% on national/departmental roads and 19,65% in urban area. The service is considered as being the more comfortable to use in motorway context for 85% of respondents and in urban area for only 1%.

The main essential reason for using this application was "to keep points of the driving license" (87%), knowing that, in France, each violation to road code leads to demerit points withdrawn from the 12 original driving license points, and over speeding in a dangerous zone can result to points loss, with 1 demerit point for over speeding under 20 km/h of the speed limit and 2 demerit points for over speeding between 20 to 30 km/h over the speed limit. Being informed in advance about these zones allowed drivers to adopt the right speed.

The other reasons to use the service, far less priority, were "reliability of the information coming from the community" (45%), "size of the community" (44%) and "road safety issue" (44%), in comparison with other issues such as "system easy to use" (28%), "friends recommended the service" (18%), "innovative technology" (15%) and "to belong to the community" (13%).

Generally speaking, efficiency of the social network and reliability of the alert information is closely linked to the size of the community, with the requirement that at least one member has

the opportunity to identify a critical road event and the willingness to inform the network about it, for a given area at a given time. In this framework, it is understandable that the choice of this type of service is based upon the item “size of the community”. What is interesting is that an analysis of responses according to 3 main age groups (18 to 30 years old, 31 to 60 years old and more than 61 years old, splitting made with a clear objective to contrast generational culture typical of each group), revealed that the senior group is not that much aware about the importance of the “size of the community” and that their main objective in using this service is rather linked to “road safety” (Figure 4).

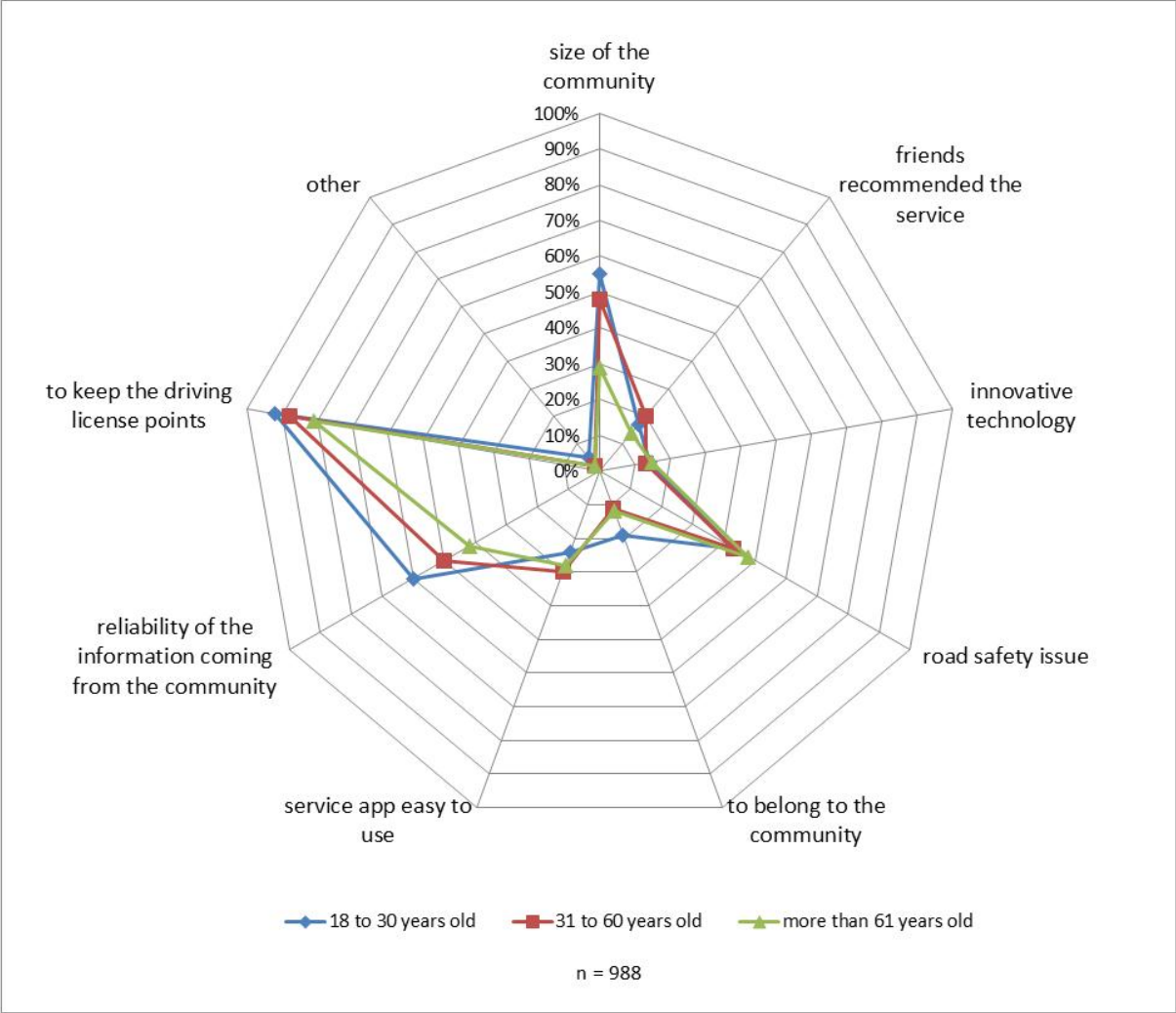


Figure 4: Reasons for using the mobile service by age groups

Furthermore, “belonging to the community” per se is not a major motivation for the sample of drivers, obviously less important than “road safety” and “system easy to use”; the younger group is the more concerned by the item linked to community belonging.

The impact of the community activity allowing road alert reliability would not be clearly perceived by the seniors. Then, not surprisingly, the level of participation to the community decreases as the drivers’ age increases, with a “systematic participation” of about 83% for the young drivers and 52% for the drivers over 61 years old (Figure 5). It can be noted that seniors ‘participation is still quite high.

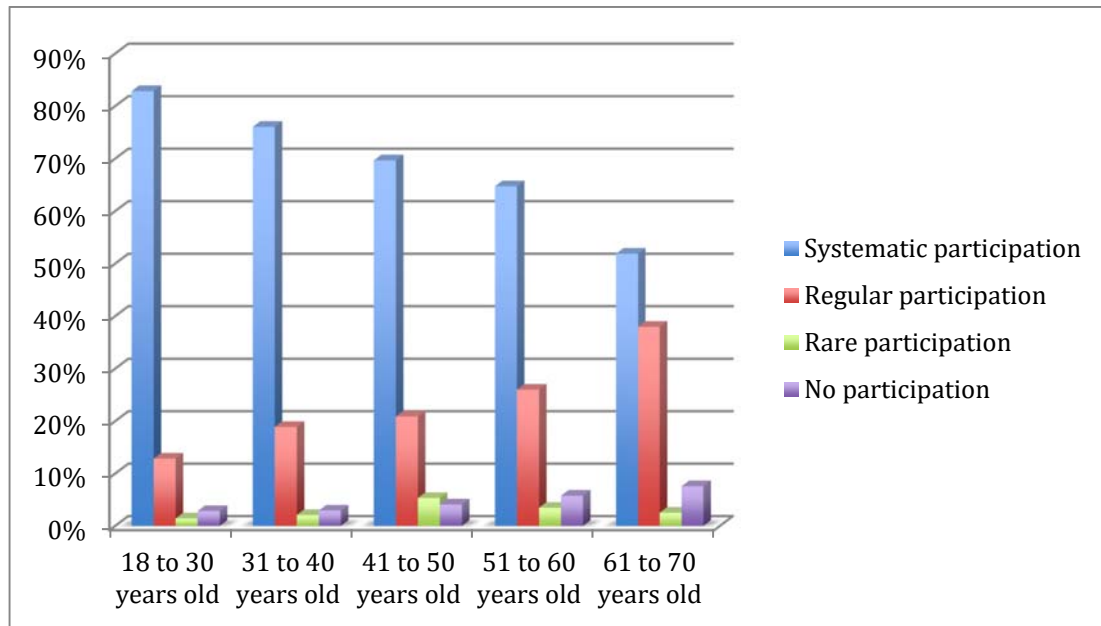


Figure 5: Participation to the community by drivers' age

The main reasons to participate to the community is the willingness to have a good functioning of the system for 68%, and, to a lower extent, by solidarity with the community for 29%. "Gaining stars" or "playing with the service" are very marginal reasons.

Negative impact of this participation to the driving activity is rated "weakly disturbing" for about 50% of the drivers, "a little disturbing" for 44%, "disturbing" for 6% and nobody found it "very disturbing", with similar findings whatever the drivers' age. This result is very important taking into account road safety concern. It is clear that drivers chose if they want to inform the community about an event and when, being then in full control of the interaction with the device, and able to manage any interference with the driving task. Nevertheless, these results are based upon subjective comments and impact of using the system on the driving task would deserve to be evaluated in real road context by recording drivers' behavior, in order to confirm this low level of interference.

Concerning drivers' ranking, half of them did not know their own number of stars, commenting that they were not too much interested to participate to a "competition with award", but nevertheless, they considered it is important to be informed about stars of drivers ahead in order to evaluate the reliability of the information ("very important" for 47%, and "important" for 42%).

Regarding drivers' interest to be ranked, 43% are willing to gain stars while 43% did not understand what is the purpose of stars or did not know the exact process to get them. In this last case, surprisingly, an important amount of drivers did not manage to make a clear link between having stars and being considered as reliable in the community.

For the group of drivers aware about the stars meaning and purpose, most of them are really motivated to participate and to be well ranked to guarantee the good functioning of the system, "more stars, more reliable information, more confidence of the community".

Indeed, confidence in the social network is a crucial issue for a driver community generating content. Taking into account the important ratio of drivers unaware about the logic and the issue linked to get stars, it seems that this process would deserve more pedagogy toward the drivers to increase motivation of participation.

Road alerts displayed by the service are considered as reliable “most of the time” by 86% for “danger zones” corresponding to critical constant zones, and by 73% for “disruption zones” corresponding to temporary critical zones.

Information coming from the community is considered more reliable than the one coming from the variable message sign and from the radio (figure 6).

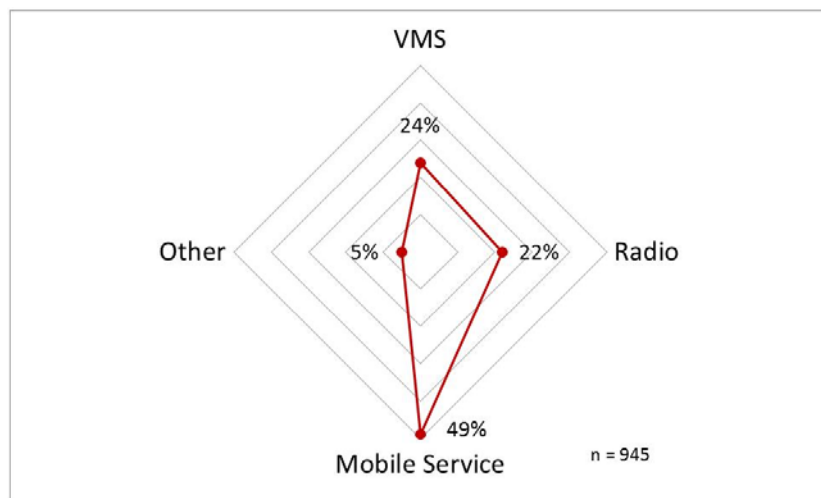


Figure 6: Drivers' evaluation of reliability for the road alert information by sources of information

In the same vein, a recent research demonstrated how information on weather warnings coming from social network was efficient to make drivers changing behaviour [11]. In this study, weather warnings information disseminated through network was a powerful tool to convince driver to change decisions such as route planning and trip cancellation. The overall opinion of the service was very positive, especially when compared to other sources of traffic weather information and alerts.

Generally speaking, mobile devices are primarily used for personal communication, while traditional road information channels such as VMS, and including radio, are more impersonal and research shows that people remember better information that affects them personally [12].

Conclusions

Relying on social networking to improve real time communication among drivers could be a powerful tool to contribute to safety and comfort, by allowing quick widespread of critical road information through “driver-generated content”. This communication process, based upon application downloaded on smartphone, is easily accessible with usually low cost. Nevertheless, several issues such as distraction for the driver and reliability of the transmitted information with resulting level of drivers' trust might be critical.

The investigation conducted to gather data on a service aiming at informing drivers about dangerous and critical zones in real time showed that mobile services can be considered as a good candidate to display critical road information to drivers, with positive results in terms of acceptability and motivation of use, even by seniors drivers who did not have the same generational culture than young ones regarding social networking but seems to be motivated to participate as other researches already showed [13]. Nevertheless, further investigations on drivers' visual strategy, cognitive load and performance while using these services through

experiments on real road will allow identifying potential negative consequences in terms of road safety linked to the use of these supportive applications while driving.

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