Designing Motivational Features for Sustainable Urban Mobility

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Abstract
This paper describes the User-Centred Design process followed within the SUPERHUB project in order to investigate requirements, elicit user feedback and refine motivational features of a mobile app fostering the adoption of sustainable behaviors for urban mobility. We report the main lessons learnt from focus groups, participatory design sessions, and low-mid fidelity prototyping of the motivational features designed. These lessons are currently informing our implementation work in SUPERHUB and could be of interest for designers in the eco-sustainability field.

Author Keywords
Behaviour Change; Persuasive Technology; Sustainability; Self-coaching interfaces;

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design; Experimentation.

Introduction
Traffic in cities is responsible for about 40% of CO_2 emissions from road transport and 70% of other pollutants [1]. Making urban transport greener, more

user-friendly and better organized is an important objective of the European Union in order to meet climate protection and energy saving goals, as well as to improve public health. In the SUPERHUB project [12, 3] we are developing motivational technology aimed to support the adoption of more sustainable transport choices and behaviors by citizens of large urban areas. This paper reports the main lessons learnt from design and user research activities conducted during the project's first year to understand how to combine different digital intervention strategies in the three target cities of Milan, Barcelona and Helsinki. We first introduce related work on persuasive strategies for behavior change in the related domain of sustainability, then we describe the user-centred approach followed to investigate, prototype and refine initial strategies for motivating change in our target users. We conclude by deriving the main lessons learnt that can inform future design of motivational features in the sustainability field.

Related Work

In the field of persuasive technology many applications have been developed to help people acquire and then maintain desirable behaviors and life-styles, particularly in the area of pro-environmental behaviors [4] and healthy living. In this brief review, we focus on five main types of persuasive strategies for behavior change that have been investigated more extensively [5, 10]: goal-setting, rewards, games, self-monitoring, and sharing.

Goal-setting has been used to stimulate energy saving, finding that households that received a difficult goal and feedback about their performance conserved the most with respect to a control group [14]. Goals have been shown to be most effective when they are important to the individual (e.g., self-set rather than assigned), when they are realistic, when it is possible to monitor progress, and when positive feedback for progress towards goals is provided [7].

Rewards have been shown to be effective even if they are nominal (they reinforce a desirable behavior), but they should be closely linked to the target behavior [13]. They should be assigned when a person achieves specific goal milestones, which is why they are considered a core element of gaming technology, where points, levels etc. are assigned in order to motivate players' engagement and facilitate their acquisition of the target behaviors.

Self-monitoring refers to a particular feature of some applications where user data are recorded for subsequent review and self reflection on past behavior. Often associated to reminders and feedback modalities to improve or change a specific behavior, self-monitoring can become an effective motivational strategy [8]. In the sustainability field the most effective feedback interfaces contained multiple feedback options (e.g., consumption over various time periods, comparisons, additional information like energy saving tips), were updated frequently, were interactive (e.g., the user could "drill-down" into data), and/or were capable of providing detailed, appliance specific breakdown of energy usage [2]. More work is needed to determine if these results translate also to other forms of pro-environmental behavior, such as urban mobility; however, these findings show the potential of eco-feedback technology.

Sharing of data, within the same application or through Social Media, can also provide accountability and pressure to engage in pro environmental behavior [6] using competitions, social comparisons, and public commitments. While previous work has argued for the

potential benefits of sharing data through social networks, it has also identified several obstacles and challenges. People are often concerned about sharing personal and sensitive data with others, they do not want to bore their friends with mundane posts or to share with others their modest achievements [9, 11]. There are also mixed predictions for the effectiveness of sharing goals, so more research is needed in order to understand how to best deploy this motivational strategy.

Designing the Motivational Features

We investigated user requirements for a mobile application deploying a novel combination of the digital intervention strategies mentioned above, in order to motivate our potential target users to adopt sustainable transport choices.

Focus Groups

Ten focus groups were organized in the three target cities for understanding citizens' expectations and attitudes towards behavior change technology for urban sustainability. Participants (5 to 8 for each session) were balanced in terms of gender and represented different categories of project stakeholders (e.g., commuters, non commuters, drivers, non-drivers, etc.). Results showed that drivers (non-commuters) in Barcelona had some willingness to change for the sake of the environment, but admitted being far more influenced by other issues such as journey time. Participants in Milan suggested several forms of feedback on performance, including emissions, cost, calorie consumption, fitness. However, they also suggested that collective data (shared with others within SUPERHUB or Social Networks) would motivate people more than individual feedback. Regarding the possibility of deploying serious games, participants in Milan suggested that a game should be local and realistic, should allow the user to do something during travel time (not only when at home). The game should also provide relevant feedback and rewards (e.g. public transport discounts), educate and inform users about transport systems in the city, support users with simulations, include competitive elements and show how the user's behavior impacts their environmental footprint. To ensure players' engagement it should also link actions in the real world with effects in the game environment, be aligned with real-time information about traffic and transport, present specific game scenarios for tourists (e.g., treasure hunt games related to tourist guides) and be fun.

Participatory Design Workshops

Two Participatory Design (PD) workshops were held in Milan to further inspire the design of the motivational features for the mobile app. They involved four and eleven participants respectively, belonging to different user categories relevant to the project. Simple mockups of the five types of motivational strategies identified were developed (by using *Justinmind Prototyper* free version 1.1.1, justinmind.com) and presented to participants as screenshots of a prospective mobile application, in order to elicit their feedback on functional aspects of the interaction. Outcomes of the workshops showed that participants' had difficulty in clearly understanding the difference between the setting of eco-mobility goals and the setting of preferences regarding how to travel in the city (a way of personalizing the recommendations provided by the system). Some participants asked for a mobile app able to match different goals to different time periods (e.g., days of the week, evenings, etc). Also, in terms of the

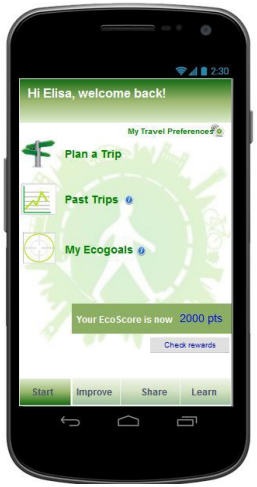

Fig.1: Mockup of the Home screen

Fig.2: Mockup of the Improve screen

type of goals to be reviewed participants showed interest in the possibility of knowing the quantity of calories burned over their trips. Like participants in the focus groups, PD participants highlighted the importance for the SUPERHUB system to provide rewards to users that exhibit desirable transport behaviours (e.g., a free toll option for travelling in an area of the city where traffic restrictions have been introduced). Another important feature for them was the possibility of sharing with other users relevant information about mobility and updates on the traffic situation. Some participants said they would appreciate the possibility of reviewing, once at home, historical data about their previous trips and related eco information by connecting to the SUPERHUB website or platform. They put particular emphasis on the possibility of reviewing data about costs of journeys instead of other types of eco-related data.
Regarding sharing strategies, participants showed a preference for the option to share their itineraries with other users, give feedback on travel options or suggest them to other users. Anonymity was desirable to the participants as was the ability to view other authors reliability / history in a similar way to eBay user profiles or Waze profiles.
Regarding serious games, participants suggested to develop specific educational games for schools and expressed preference for games that do not need to be downloaded and installed in the mobile phone, but can be accessed from the SUPERHUB web site or platform.

Low-Mid Fidelity Mockups of the Motivational features
Based on the suggestions collected, we developed a revised version of the motivational features mockups initially designed.

From the 'Start' screen (Fig. 1) the user can make a journey plan request, review her past trips, set ecogoals and travel preferences. S/he can see what is the total ecoscore achieved and click on the three tabs at the bottom of the screen to directly access the 'Improve', 'Share' and 'Learn' features of SUPERHUB. The opportunity of checking the rewards available with the ecoscore achieved is provided (e.g., special discounts on public transport tickets, free tickets for touristic events, etc.) as this was strongly suggested by our participants. In the 'Improve' screen (Fig. 2) the user can set very simple, mobility relevant goals to achieve in a particular timeframe (e.g., week or month). Goals relate to choices regarding the mode of transport used to reach their destinations during the timeframe. By moving the onscreen sliders users can see how, by increasing the quantity of journeys made with sustainable modes of transport, it is possible to get more points (e.g., when choosing sustainable means) or lose points (e.g., when using a private car). The 'Improve' feature allows users to review their real past trips, by comparing simple graphical representations showing how much they used the different modes of transport over a timeframe, and how closely they matched the eco-goals previously set. The feature enables viewing details of each single trip previously made. In this way, users are given the opportunity of monitoring their travel behavior and choices, to foster self reflection and possible improvement of transport habits over time.
The 'Share' screen (Fig. 3) provides the user access to a city map where s/he can localize sustainable mobility offers and services, share/compare scores with friends, post mobility relevant messages (e.g., events, trip plans etc.) and see posts made by other users. This feature intends to support the creation of a SUPERHUB

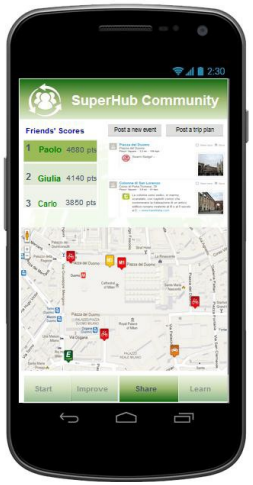

Fig.3: Mockup of the Share screen

Fig.4: Mockup of the Learn screen

community where social influence factors (e.g., social pressure) can facilitate user adoption and maintenance of desirable behaviours as well as spread the use of the system in the city over time. In the 'Learn' screen (Fig. 4) the user can access the Eco-Dealers game to potentially get more points and rewards, and find links to any relevant sustainable transport resources or initiatives in their city. The main objective of this feature is to offer an opportunity of learning more on the topic of sustainability by using engaging and playful interaction means such as serious games.

Formative Evaluation

The motivational mock-ups were subsequently assigned to three usability experts for an Heuristic Evaluation. Experts provided several comments and suggestions for improvements of the funtionalities designed. Two mid fidelity prototypes (for Android phones) of the functionalities designed were also developed by the design teams in Finland and Italy and are currently being tested through longitudinal, contextual user studies that, due to lack of space, will not be discussed further in this paper.

Main Lessons Learnt

In this section we summarize the main lessons learnt during this first design phase of the motivational features of SUPERHUB.

(i) *Not all users are motivated by environmental concerns*: focus groups showed that some citizens might not be very interested or prepared to change their behavior just for the sake of the environment. In order to change their transport habits it would be worth focusing on providing them with recommendations that can more closely match their transport needs or their criteria for making transport choices (e.g., journey time, costs). We also found evidence that individual feedback on environmental footprint might not be motivating enough in order to trigger a user behavior change; collective, real-time data about pollution at city level could be perceived as more meaningful and convincing by some individuals, as well as collective *vs* individual goals.

(ii) *Personalized behavior change triggers are better*: The PD sessions showed some participants' sensitiveness towards personal triggers for behavior change, based on the possibility of monitoring consequences of sustainable transport choices also in terms of fitness and personal health. This suggests the opportunity of developing motivational strategies for the sustainability field that leverage on healthy living interventions in a broader and synergic sense.

(iii) *Users prefer real vs nominal rewards*: although designing an effective rewarding feature remains a challenge, in this study we found participants' request for the implementation of a rewarding system which is not just 'nominal' but brings concrete benefits in the real-life usage of urban mobility offers (e.g., discounts on public transport tickets, which would be feasible to provide by SUPERHUB thanks to the presence of transport operators in the project). This was considered important also for engaging users in the Eco-Dealers game, at least initially when extrinsic motivation may play a stronger role in supporting viral mechanisms of dissemination, thus fostering participation.

(iv) *Sharing of mobility data only when meaningful and safe*: Regarding sharing features, feedback from participants was that they would be willing to share with other citizens relevant real-time information about traffic, disruptive events and transport choices, in circumstances when this is critical for sustainable mobility. However, (as expected) concerns were also

raised on the safety of the data exchange, with a request for making notifications anonymous or restricting data sharing within a user's network of family and close friends.

Conclusion

In this paper we have reported insights from a user-centric research conducted during the first year of the SUPERHUB project in order to better understand user requirements for a mobile app providing a novel combination of motivational features for sustainable urban mobility. Differently from previous work, our contribution is based also on feedback from target users that are not very green, but used to drive their private car for daily commuting to a busy city centre. This has shown for example that behavior change features need to be tuned also to users that are not motivated by environmental concerns and might need concrete rewards in order to change their transport habits. We are now in the process of implementing a mobile app including the motivational features presented and a Journey Planner that will be deployed and tested with users in the three trial cities in 2013.

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