Using Gamification and Metaphor to Design a Mobility Platform for Commuters

Rod McCall, Interdisciplinary Centre for Security, Reliability and Trust, University of Luxembourg, Luxembourg City, Luxembourg

Vincent Koenig, EMACS Research Unit & Interdisciplinary Centre for Security, Reliability and Trust, University of Luxembourg, Luxembourg City, Luxembourg

Martin Kracheel, Interdisciplinary Centre for Security, Reliability and Trust, University of Luxembourg, Luxembourg City, Luxembourg

ABSTRACT

In this paper the authors explain the use of gamification as a way to optimize mobility patterns within a heavily congested European City. They explore this from two perspectives, first by outlining a gaming concept and secondly by explaining how the use of a mobility game that took place in two locations can be used to explore incentives and design issues.

Keywords: *Commuter Congestion, Driver Behaviour, Gamification, Mobility Platform, Persuasive Gaming, Real Life Game, Traffic Congestion*

INTRODUCTION

Traffic congestion and the associated economic and environmental damage are serious problems across the world and novel solutions are required to help reduce them. To date many approaches have been tried, for example car sharing with priority lanes for shared vehicles as found in Seattle, charges for driving in the city centre such as in London, introducing cycle lanes or improving public transportation options. However, in all these cases there are a number of problems which apply to all or some of these options, namely that they require large amounts of additional government spending, increase inconvenience on the commuter or require significant changes in the daily routine of drivers. They also largely ignore the complex social or personal motivations that people have when undertaking different journeys, for example shopping on the commute to work, dropping of passengers on the school run or the weekend excursion; some of which are possible as a ride share. Our work aims to complement the top down policy driven approaches by Governments and drivers' existing behaviours. With these issues in mind we explore how particular motivations shape mobility decisions and how, through

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understanding these motivations, incentives can be provided that could help change driver behaviour. We believe this can be done best by relying on a game-like approach. As part of this we are exploring how location-aware game-like environments can be used to encourage changes in mobility behaviour.

We take the position that we must understand the motivations that people have for individual or groups of journeys, whether they are via car, bike, foot or public transport. In doing so we explore how incentives in the form of game-like aspects such as scores, collaboration, competition or via direct/indirect benefits can be used to change behaviour. As described more fully below, our position is largely derived from the idea that mobility in urban environments, particularly in respect to commuters who drive to work, can be viewed in a game-like context; even if the drivers themselves are not specifically aware of the game-like nature of their interaction. One of the key aspects of the current project is the use of contextual enquiry (Beyer & Holtzblatt, 1998; Holtzblatt, 2004) and game-like simulation as approaches in order to elicit requirements as well as to identify how incentives can be used to encourage small changes in behaviour.

The paper begins by exploring the underlying problem Luxembourg is facing, then provides an overview of the I-GEAR project (Incentives and Gaming Environments for Automobile Routing; a project run at SnT / University of Luxembourg and financed by Luxembourg FNR) and its underlying approach. The final part of the paper explains the use of gaming in two contexts, firstly in a pilot study and secondly in another game, which was played during the MobileHCI 2012 conference in San Francisco. Within these contexts we illustrate how mobility games that are played indoors can be used as a method to test game logic, observe mobility behaviour and the usage of incentives to change these.

BACKGROUND

The Problem

Our research is motivated by an immediate and pressing traffic congestion problem: the City of Luxembourg (population ca. 85,000) was in 2008 the 10th most congested city in Europe (TomTom, 2008) with approximately 120,000 daily intra-city commuters (PWC, 2006) resulting in increased journey times by nearly 21% (Inrix, 2010). The situation is also exacerbated by the 60% rise in road haulage traffic between 1999 and 2009; a trend which is set to continue as the Luxembourg Government seeks to make the country a European freight transport centre. Furthermore, many of these problems are not unique to Luxembourg and in Europe around 1% of GDP (or €105bn) is lost per year due to traffic congestion (Euractiv, 2007). The problem is also similar in the United States, in 2005 an estimated $90bn (Schrank, 2005) was lost due to traffic congestion.

Luxembourg also has the highest level of car ownership in Europe with 659 cars per 1000 people (European Commission, 2006). Additionally, the level of luxury car ownership indicates that it is not simply the act of owning a car, but likely an effect of social status and other social pressures. Indeed a qualitative study about the mobility behaviour of the younger (age 18-35) population and commuters in Luxembourg (Milmeister & Roob, 2010) asked about their preference between public transport and private car, and their motivations for these preferences; and from this study, we extracted potential reasons why people who live and/or work in Luxembourg choose to drive to work rather than take public transport or other transportation modalities. These include:

- Practicality;
- Time (quantity and quality);
- Cost;
- Public space / private space;

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- Security (both individual and for this particular mean of transport);
- Information (availability) and dissatisfaction with public transport options;
- Environment;
- Status e.g. in social group or at work.

Our objective is not to stop people from driving or commuting in their cars, but rather to encourage people to occasionally change their behaviour in such a way that would lower or minimize traffic congestion for themselves and others. For example, by taking a different route, leaving home a little later or earlier, or perhaps a few times per week changing their mode of transport from car to bus or bicycle. Thus, we aim to encourage modest changes in mobility patterns and to do this within a multiplayer game-like environment. An outline of some small potential behaviour changes are presented in Table 1. Indeed, on an individual level, modest changes have the potential to make a significant impact. Using a simplified example, we can assume that a person makes 10 single-purpose commuter journeys per week, i.e., Monday to Friday both to and from work. Motivating this person to take the bus one day per week would reduce his/her car use by 20% during week days, and more importantly during commuting peak times. As a result, if this pattern was adopted by more drivers, the potential reduction in traffic congestion would be significant. Or conversely, by encouraging the same person to take a less crowded route one time per week, or to share the ride with a colleague, it would likely yield a similar reduction in congestion. This is in stark contrast to current methods that often penalise drivers as is the case with the London Congestion charge, or force them partially off part of the road (e.g., bus lanes). Although more commercially available systems (discussed later) do go someway towards incentives rather than penalties.

OVERVIEW ON CURRENT MOBILITY PLATFORMS AND RELATED PROJECTS

There is a noticeable and general increase in traffic optimization initiatives. These range from research projects to available ready-made applications and games. Some of these overlap partially with I-Gear concepts, while others adopt different approaches. As a result, we illustrate below (in a non exhaustive way) a range of current initiatives, each representing an interesting approach, be it in terms of green initiatives, behavioural change or game aspects. The reasons for optimizing mobility are diverse and include – amongst others - the trend towards a more ecological way of thinking (mainly CO2 footprint reduction), travel time or distance reduction, cost reduction, social aspects

Table 1. Possible Changes in Mobility Behaviour

Objectives	Requested behavioural change
Distribute traffic over time	- Leave home or work after peak traffic times - Stop at a place or other venue during peak time traffic
Distribute traffic over space	- Encourage people to take an alternative route - Encourage drivers to drive in conveys on less used roads
Reduce Cars on the Road	- Encourage ride sharing - Encourage use of public transport - Encourage use of a bike or walking

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and solutions to congestion. It seems there is no initiative that could address all of these issues alone. In the following sections, we present a selection of projects that stand out and offer interesting views on mobility issues and how each of these tries to deal with their particular challenge; we provide a short overview on each of these initiatives.

Waze ®

This mobile GPS application ("Waze, outsmarting traffic together", 2012) builds on community based information for navigation and traffic anticipation. This allows it to be adaptive, location-specific and real-time. By combining both information about the planned trajectory (e.g., traffic issues, road works, speed traps, bad weather conditions) and actual car data (e.g., velocity, identified driver, GPS tracking), it suggests an optimized route to destination. Furthermore, it integrates message exchange functionalities and some basic game-like incentives in order to increase user involvement. For instance, credit points are awarded to drivers who cover less explored map zones or areas that need further community input. The system works using a crowd sourcing approach; for example, the more people use the application and cover the various zones the better the system works. Recently, Waze ® has proven to be very popular, reaching some 12 million users in January 2012. However, it is currently US centric and does not provide support for Luxembourg (September, 2012).

Foursquare ®

Foursquare ® (https://foursquare.com/) is both a mobile application and accessible on the web. It relates less to mobility as an activity and much more to the places you actually visit. Checking into these places and sharing this check-in information with other users can earn you credits. The user who checks in repeatedly into the same venue earns more and more points up to the level where, if they have checked into a specific place more often than any other registered user, they can achieve the virtual status of a mayor for that specific venue. Some businesses even provide benefits for their mayors. In essence, the application aims matching social network with location-based data, by offering mainly social status points as incentives to participate. The success of foursquare ® (more than 20 million users in 2012) illustrates how strong social incentives and a visible status can act as incentives. This is an idea that is also of importance to the game concept developed in I-GEAR.

simTD

simTD ("Sichere Intelligente Mobilität, Testfeld Deutschland", http://www.simtd.org) is a large German research project consisting of many research institutes and industry players (e.g., car manufacturers, car manufacturers' suppliers, telecommunication companies). Its main focus is on increasing traffic safety and efficiency while also launching new services. The project started back in 2008 and is expected to deliver final results in 2013. "C2X" communication (car-to-X) plays a central role and describes how data is exchanged from cars to cars and from cars to road infrastructure in both directions. During 2012 the project was deployed on a large test bed of 120 cars. Data communication is handled through WIFI and 3G networks. In contrast to mobile devices that also use these kinds of networks, the simTD application directly connects to the cars' data bus systems through a proprietary "ITS vehicle station" and thus is also an integrated part of the car's hardware. The main benefit of this research project is the integration of technologies that were formerly separated, relating to the car's on-board system, traffic management technology and telecommunication technology. User adoption for the final product seems to be sought through the expected advantages in terms of safety, efficiency and added services.

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Greenway ®

Greenway ® (http://greenway2012.wordpress.com/) is an innovative mobile application that puts its main focus on decreased CO2 emissions. It introduces new routing algorithms that go beyond distance considerations and that take into account swarm behaviour. The algorithm allocates virtual traffic- and time-slots to participating cars and anticipates those cars' positions at any point in time. This results in traffic models that try to avoid jams while still considering the shortest possible routes. While most navigation systems are capable of reacting to existing jams and suggest alternative routes, Greenway ® actually tries to actively prevent those jams. The authors claim that using Greenway ® results in a traffic flow twice as fast (http://greenway2012.wordpress.com/). Obviously the application requires a critical mass of users in a defined area in order to deliver reliable results and take sufficient control over the traffic flows. According to the authors, more than 10% of the drivers in a defined area need to use Greenway ® in order to enable the algorithms to derive additional data needed for a reliable routing model. Before starting the actual routing, the app leaves the driver with the choice between a conventional (jam-prone) routing and the optimized route; estimated time and fuel savings are also indicated.

Drivescribe (The Safe Driving Coach)

Drivescribe (http://drivescribe.com) is an innovative mobile and web application developed by Drive Power. It aims to induce behavioural changes in the way people drive their cars, with a major focus on traffic safety. The app tries to facilitate safer driving behaviour by offering real-time driver coaching and awarding points for safe driving behaviour. These points act as incentives as they can be exchanged for real products or discounts when buying products. Furthermore, a social incentive arises from the game aspect when collecting points and comparing those to other drivers' points. Currently it is hard to reliably judge the success of Drivescribe as it started in June 2012.

AIDA (Affective Intelligent Driving Agent)

This research project (http://senseable.mit.edu/aida/) at the Massachusetts Institute of Technology (MIT) is led in collaboration with Volkswagen America and brings together a "personal robot" and an innovative navigation system. The main idea is improving the robot companion's behaviour so as to make him behave in both a friendly and intelligent way as one might expect from a human co-driver. Part of the intelligent behaviour is the learning capacity that enables the robot to analyse the driver's behavioural patterns. This leads the robot to a model that lets it anticipate recurrent patterns, e.g., on specific days the driver passes by a school to drop his children or passes by a grocery store. In addition, real-time information, such as weather conditions are injected into the model that helps predict the best suitable route in relation to the driver's habits and preferences. The results of this R&D project were presented to the press in 2009; however, it is relatively unclear how well the developments of AIDA have found their way into car manufacturing product development.

CO2GO

Another interesting research project (http://senseable.mit.edu/co2go/) conducted at MIT, in collaboration with French SNCF railway company, focuses on ways to reduce CO2 emitted by mobility. The researchers rely on existing smartphone devices in order to use their sensors for analysing the user's pattern of mobility. Through specific algorithms, the mobile application is able to interpret sensor data (mainly GPS and accelerometer) to derive what means of transportation have been used to

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cover what distance. A bus ride, biking or walking episode produces very distinctive patterns, which the application can reliably recognize. In a further step, CO2 footprints and calories-spent-profiles are established and allow the user to monitor his own mobility behaviour and potential impacts resulting from behavioural change. In addition, sharing CO2 optimized routes is foreseen to raise awareness among other users. An ultimate incentive is offered by the game-like situation that allows the users to challenge each other heading for the lowest CO2 footprint. The application was meant to be available in 2011, however as of September 2012 it seems to not yet be available.

In the interest of showing how these initiatives compare to each other and how they compare to the I-GEAR project, below we present a series of selected criteria that reflect the main ideas developed in each of these projects:

1. Game aspects: these relate to any idea of challenge, competition, game-like measurement of performance, etc.;
2. Social aspects: these relate to any idea of social sharing, i.e., exchanging messages, sharing how many points have been gained, obtaining and/or sharing a status, etc.;
3. Incentives: these relate to any idea of promising rewards in order to stimulate user involvement; these rewards may be social (e.g., status) or real (e.g., vouchers, discounts, money);
4. Green aspects: these relate to any explicit idea of saving fuel, limiting CO2 emissions, etc. As most initiatives dealing with mobility issues are to some extent motivated – also – by an underlying green idea, we consider this criterion only for those projects that explicitly and visibly translate the green idea into their project;
5. Routing: this relates to the functionality meant to guide users to specific waypoints or destinations given by the user;

Table 2 illustrates common ideas and differences between the projects. It appears that social aspects and routing are the most frequent features, while explicit green actions tend to be less used for "selling" the initiatives. The success of social aspects may be explained by the overwhelming success that social media have demonstrated over the last few years and the strong attraction these communication features represent to the users. On the other hand, one may assume that green actions may not be perceived attractive enough to entice a broad audience. Finally, in terms of comparison, it appears that with its blend of game and social aspects, its routing capacities and incentives, Waze ® seems to be the closest initiative to date when compared to I-GEAR.

This also demonstrates that a community-based and game-like tool can both be accepted and successful. Nevertheless, user adoption and incentives are likely to depend also on geographical and cultural aspects and thus cannot necessarily be transferred from a North-American success model (Waze ®) to a European context. Some differences can already be mentioned, but presumably many more exist: for example, road layout and geographical situation (denser situation in Europe), fuel price and its impact on car mobility, green political movements are stronger in Europe (public transport favoured and subsidized), cross-border travelling occurs frequently in Europe (involving financial roaming impacts on cell phone usage), ecological awareness of the population (strong increasing tendency in Europe).

Thus, it appears the European context, particularly the Luxembourgish context, are rather specific. Furthermore, we are convinced that putting an even larger emphasis on the gaming aspects than Waze ® for example, could help address the specific issues in Luxembourg and help quicken user adoption, which is necessary for developing a critical mass. While the gaming aspects in Waze ® mainly focus on improving map coverage, I-GEAR goes further by motivating people toward more behavioural change, e.g., decide for later departures, stop at a café to have a free or discounted coffee, pick up additional passengers, choose public transport in specific situations, etc.

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Table 2. Comparisons between Different Platforms

	Game aspects	Social aspects	Incent ives	Green aspects	Routing
AIDA					x
CO2GO	x	x		x	
Drivescribe	x	x	x		
Foursquare		x	x		
Greenway				x	x
I-GEAR	x	x	x		x
simTD				x	x
Waze	x	x	x		x
TOTAL / 8	4	5	4	3	5

Viewing Mobility as a Pervasive Game

While there is already some work on in-car gaming, for example (Helbing, Schoenhof et al., 2005) tested a commuter game under laboratory conditions. Also there has been an increasing interest in in-car games for passengers (Palazzi, Roccetti et al., 2010; Palazzi, Ferretti et al., 2009) or so-called micro-entertainment at traffic lights (Alt, Kern et. al., 2010). The I-GEAR game proposes to extend these ideas to a real environment and for drivers, passengers and other commuters. A mobility game such as the one proposed in this paper essentially seeks to make the entire urban area, the mobility participants and associated transport methods part of a pervasive game space. Pervasive games as noted by Montola (2005) seek to break the magic circle that is prevalent within more traditional board and computer games. The "magic circle" is the field of reference that a game exists within for example in a game such as Monopoly it is clear who the players are, what the rules are, when it will be played and what physical elements form part of the game. In contrast, location-aware pervasive games break these boundaries; or as Monotola argues, they expand the social, temporal and physical boundaries of the game. For example passers-by who are not directly part of the game can have an impact upon it, the game could be played over an unlimited time and in different sessions where the start/end are unclear and the precise objects used could range from a mobile phone to a table. In the case of the mobility game proposed in this paper and in our project, the participants range from other people (who are not specifically part of the game) driving on the road (who are not specifically part of the game) and who are causing congestion through the registered participants, such as the drivers or the persons who agree to walk to work rather than taking their cars. Furthermore, the physical aspects of the game include the roads, paths, bus network, motorways, cars and mobile devices with the temporal aspects also being expanded in the sense that people can play the game when

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they choose, even if and when others are not participating. This is a similar approach to that used within Geo-caching where people can start and stop playing at the time of their choosing.

A Behaviour Changer

In light of the problems discussed earlier we are currently working on solutions that use social gaming coupled with incentives as a method of persuading traffic participants to undertake new behaviours. In order to support this idea we take the view that moving in traffic can be considered a serious and pervasive game (Montola, 2005), in the sense that people complete a series of goals or sub-goals within a gaming environment where the precise boundary between game and non-game is unclear. Furthermore, there exists a set of social norms (e.g., the project leader can park nearer the office) and laws (e.g., right lane driving, speed limits, etc.) that encourage traffic participants to behave in certain ways.

Tools Needed

We are developing and testing a pervasive game that will encourage traffic participants to undertake certain courses of action, with the aim of reducing congestion. We will draw on the idea of gamification (Deterding et al., 2011) by introducing elements such as leaderboards, challenges, competitions and collaboration. We will also introduce social and other incentives within a game-like context. For example, building on the work of Bliemer and van Amelsfort (2008) where people could receive small amounts of money for leaving home at a different time, the I-GEAR game could award them points for leaving home early every day. In return, whoever tops the leaderboard that particular week could receive a financial incentive. Such an approach would likely encourage players to compare their success with others and in doing so motivate them to change their own behaviour. One major challenge is to encourage drivers to use alternative modes of transportation, while including them in the pervasive game. Therefore, the building of a community of traffic participants (including motorists, bicyclists, public transport users, etc.) via the use of a website and a mobile application is a key aspect. The website tools could be both, a content community and a social networking site according to categories of social media (Kaplan & Heanlein, 2010). A content community can be defined as one whose main objective is to share information (e.g., traffic situation, alternative routes, alternative activities) between users without obligating users to create a personal profile page. A social networking site encourages users to create personal profile sites and to invite friends and/or colleagues to join their page. As a combination of both, the application could be used for sharing a high amount of personalized information between users, which would allow the joint co-construction of traffic avoidance behaviour and foster social exchange and community building by suggesting for example good music, audio books or language learning CDs for driving, real time sharing of interesting radio stations, gas prices and so on. Our application will also allow the forming of communities whose members interact in real and digital life, build relationships between participants, create interdependence through interactions and accumulate shared experience as grounds for membership.

Sample of the Final Game Concept

The following is a sample of the final game that we will develop within the I-GEAR project. The final system will be derived from a requirements gathering phase based on contextual design coupled with an iterative usability testing process.

I-GEAR operates on the principle of giving drivers incentives for "good" behaviour, if drivers comply with the particular suggestion, for example they can take an alternative route rather than a busy motorway and they will receive points (a reward). Although the details are subject to change, described below are the two broad categories of rewards we envisage, which are drawn from airline programmes:

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- **Instant rewards:** these are given immediately at the time of a particular act, these could be a ½ price coffee at a place near a car park which can be visited by the driver that evening rather than driving home immediately, or a voucher for a discount in a shop which can be spent during the weekend.
- **Status rewards:** which are dependent on maintaining the same good behaviour over a period of time; for example, a driver who completes five good deeds in any week and does so for two or more weeks, becomes a gold member. For as long as they maintain this pattern they are permitted unlimited free public transport on weekends. Failure to complete the set number of tasks would result in them dropping a level; for example, a silver level person may receive only free transport on a Sunday, while a bronze member would receive a free two hour bus ride.

Collaboration and competition are important elements and participants also have the option to join a team of drivers that compete against other drivers and/or their teams. Both teams and drivers can obtain additional rewards if they win. For example if a team obtains the most points they may be entitled to a free item from a local company.

REQUIREMENTS CAPTURE APPROACH

Creating a game-like environment in which people undertake their mobility activities (e.g. going to work) requires an understanding of the roles that contexts and motivations have on their actions. In order to support this process we have adopted a thorough requirements capture approach drawn from contextual design (Beyer & Holtzblatt, 1998; Holtzblatt, 2004), whose primary goal is to identify "(sic) interests, emotions, hopes, passions, fears, and frustrations (that) are important and powerful factors in choosing, learning, and using a technology" (Kaptelinen & Nardi, 2006, p. 78). This coupled with the relatively simple game testing approaches outlined in the next section makes it possible to explore incentives and motivations in a range of settings.

THE MOBILITY GAME AS A METAPHOR

First Version

Overview

One of the key assumptions in I-GEAR is that small behaviour changes can lead to reductions in traffic congestion and also other social and economic benefits for the individual. Additionally we take the view that it is possible to simulate some of these behaviours through the use of simplified games that represent key behaviours people would undertake while driving; in particular, where these behaviours relate to the reasons for congestion, the use of immediate versus delayed rewards and the formation of mobility groups. In order to complete these tasks we adopted a metaphorical approach to representing these issues.

Based on observations of everyday work patterns it became clear that during 12:00-14:00 (around the lunchtime period) there was nearly always a queue of people waiting for coffee, water or waiting to use the microwave. We saw the similarities to everyday traffic congestion within our everyday office environment. A proportionally high number of people want to go at certain times of a day to one place, or area, to perform certain actions that have to be performed there. As a result we took this as representing an average traffic jam of commuters that have to go in the morning and evening to Luxembourg city in order to work or bring children to school, etc. This common everyday problem was an ideal platform to explore the motivations of peoples mobility behaviour and the use of incentives in order to change them.

We designed an indoor mobility game, where participants had the opportunity to

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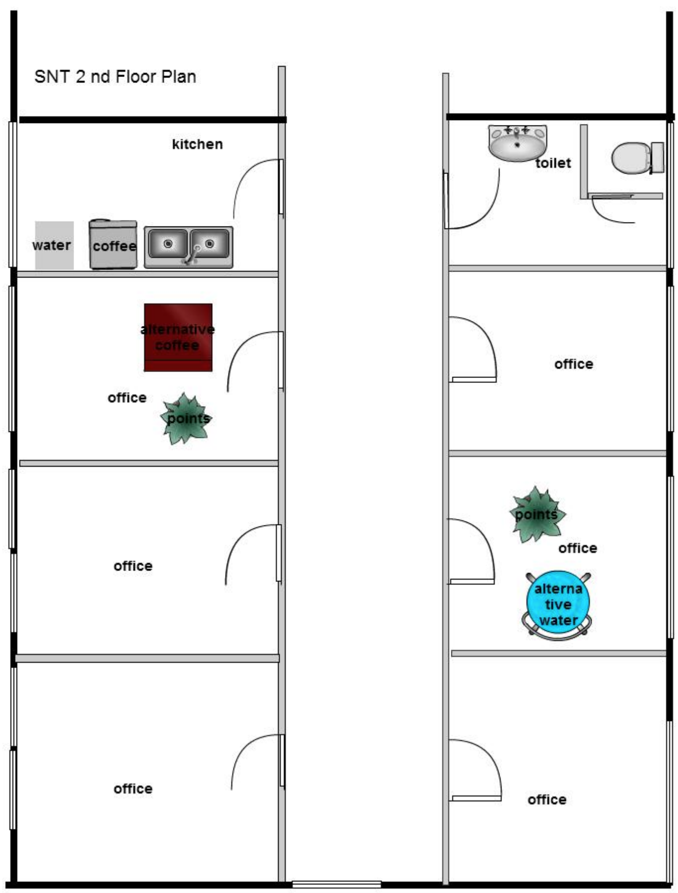
slightly change their local mobility behaviour, notably during lunchtimes. If they did this they would reduce the overall "congestion" in the kitchen during this time and get small rewards for this.

We extended this metaphor; ride sharing, for example, was represented by encouraging people to perform collaborative actions such as collecting drinks for others. The idea of encouraging people to take other roads (rather than busy ones) was represented by providing other rooms where drinks could be collected. Additionally off-peak mobility was represented by encouraging people to collect drinks after the busy period. The possibility of radically different behaviour change, like not using your car, was also an option for registered players as they could NOT collect any coffee or water at the game relevant points during the duration of the game and then they received an even higher number of points. The floor plan of the study is presented in Figure 1.

If players undertook the good deeds as outlined above they were given leaves in different colours, each colour representing one resource of the game. Each leaf represents one point. In order to test immediate versus delayed gratification players had the option to accumulate points in order to compete for a bigger reward or trade them in immediately for a tangible benefit such as a chocolate bar. We also explored the use of social incentives through

Figure 1. Plan of the central game area in the first pilot study



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the use of publishing a leaderboard for those taking part after each day of the study. Field notes were taken independently by two different researchers during the study, one of them trained in ethnographic field work. Shortly after participating, the players were asked to complete a small questionnaire about their experiences.

Game Logic and Rules

The game was played in a university building and on 2 consecutive days from 12-14h. Players could participate in the game at any point during this time; however, they were not expected to participate during the whole time span, but rather to make one or more moves during one round. The critical aspect of the game is that it is about getting drinks in locations other than the kitchen; as the latter is in a metaphorical sense suffering from traffic congestion. If players went to these other locations they received points. The players could change these points later for chocolate bars, fruits or they could save their points and use them towards their final score. After the first round of the game the results for each player were announced and the final scores were announced at 15:00 on the second day. The player with the highest number of points won a prize.

Timing and Participants

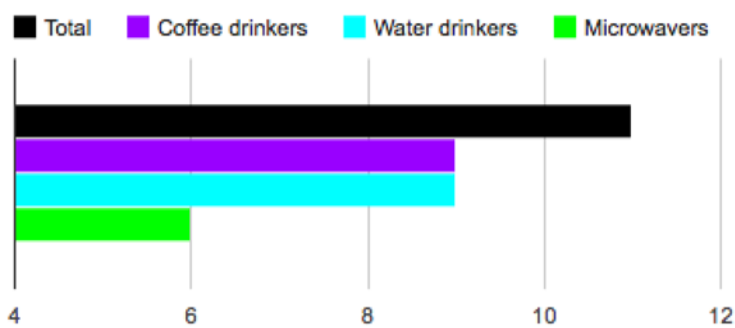
The study took place over two days and spanned the lunch breaks. We invited all colleagues to take part and from about 30 potential players, 11 participated. Of these participants 9 indicated they drank coffee and water, while 6 indicated that they used the microwave. (Figure 2).

Preliminary Results

The results are based on the analysis of field notes and on the discussion of these findings within the I-GEAR team. As noted in the "Challenge" section, mobility behaviour can be shaped by social status; for example, a manager may not wish to ride share with lower status colleagues. Also, in our game, a female colleague indicated that collecting coffee for others did not match her status. This shows us that we have to address the issue of social status as a potential inhibitor of ride sharing groups in the final I-GEAR traffic game conception.

As noted by (Salen & Zimmermann, 2004) there are several classes of rule observance within games, including those who play strictly by the rules but interpret them in a way which may seem unfair to others. This also applied within this game with some participants developing new game moves not foreseen or regulated against. For example, one player collected a lot of collaboration points by not providing his colleagues with drinks at their workplaces, but by bringing them all to the drinking areas and then collecting the drink points. This was not really in the spirit of the game but as the player noted this was for competitive reasons. From this we learned that that we have to have explicit rules

Figure 2. Overview about the participants' preferences for the game relevant resources



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that might to be adapted during the practical game. In contrast another player disliked the competition elements and the leaderboard. Some players also traded or donated their points even though this was again not specifically foreseen within the gaming rules.

A number of players participated on a minimum level, just to get a chocolate bar once in a while; while other players changed their strategy during the game from collecting the points in order to compete for the main prize to getting the instant reward. Interestingly, even though the participants did not know what the "bigger prize" was they all declared themselves competitive players and saved their points and did not trade them in for chocolate bars.

Responses from the questionnaire indicated that around half of the players joined due to curiosity and the other half to support the research objectives. Interestingly, half of the players declared they changed their behaviour, for example due to a better understanding of the game rules. Approximately half of the players indicated that they had a strategy during the game or that they developed one. However, the other participants indicated that they had no strategy. More interestingly, and perhaps unsurprisingly, the majority of participants indicated that material incentives were a stronger motivator for change than social status.

While this was only a small internal study used to test the idea of incentives for different mobility behaviours, the various attitudes of collaboration and forms of competitive play employed by the players point to the need for supporting a variety of game playing styles. For example, minimal or occasional participation, high competitive involvement, not wanting to be part of a leaderboard, etc.

Second Study

During a workshop at MobileHCI 2012 we ran a second version of the mobility game, our objective was not to compare it with the first version, but rather to understand how such games can be played easily in other contexts. This presented us with a number of challenges that are relevant not only to the I-GEAR project but also to those who are interested in conducting similar studies. Among the aspects that we could not control were:

- Who or how many people will take part; this is identical to the problem we will face when making the I-GEAR app publicly available;
- The layout of the building and which spaces we can use; this is again identical to the challenges we face in the project as we cannot change the city to better fit our game, but we need to do it the other way around;
- The provision of drinks and their timing; however, there is a certain predictability, as it exists for congested times and locations;
- The smooth functioning of the conference; again the same situation applies to any congestion situation and therefore to applications foreseen for these.

As can be seen above, the list of constraints represents in many ways the same problems faced by mobility games or systems such as I-GEAR. As a result they presented an ideal opportunity to explore mobility game logic and mechanics. In terms of game mechanics the players could collect drinks from the main coffee area. The organisers of the conference encouraged this during specified break times, but again people were free to go as often and when they decided to do so. The specified time often resulted in congestion and as a result we offered the players the chance to collect points for going off-peak; for example, five minutes after the start of the break or during the session. Points were also given for going to a completely different location rather than collecting a drink within the conference. Furthermore, they could collect points by collecting drinks for other players. Scores were made available via twitter and players could trade their points for chocolates immediately if they reached the needed number

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(4 points equaled one reward) or accumulate points and try to win the main prize.

Results

In total eight people took part, which was the majority of the workshop participants. The number of people who subscribed to the Twitter feed suggested that not many people were interested in the social or co-operative aspects. However, this was contradicted by the competitive, yet collaborative, game play undertaken by two particular players. The lack of interest in the Twitter feed indicates that perhaps social media are not a key element of such experiences. One player tried to collect as many points as possible by undertaking multiple actions in one round, such as going for coffee more than once or collecting many coffees for others. While this was encouraging behaviour it was also against the rules which allowed only one action per round; for example, going outside OR getting a coffee. Another player who went on to win the game had apparently different strategies. While the player collected points "passively" in the first round she engaged in bringing coffees for many people at off-peak times in the second round.

According to our data none of the participants collected coffee or drinks at peak time at all, which means that all participants changed their behaviour. Participants took part in various "ride shares", i.e., coffee collection grouped at different points during the day. In terms of incentives four participants traded in all or some of their points for chocolates whereas none of those in the top three did so. Interestingly the highest number of points on an individual basis was collected during the last round of the game. This may in part be explained due to the increased familiarization with the rules.

DISCUSSION

Based on the two small studies undertaken, it would appear that the use of simple simulation games are a useful way to capture issues relating to game design and the use of incentives to change individual and group behaviour. Clearly chocolates are not a practical incentive within commuter scenarios, but the comparatively low value of these indicates that not much is required to change behaviour. Furthermore, providing incentives which fit the needs of the participants, in this case linking them with getting a coffee at break time, is a useful approach.

From a game logic perspective, we encountered many issues across both games with people making interesting interpretations of the rules. This is a beneficial aspect as it means that people do try to play the system to win, so in that sense ambiguous rules are useful. It does however at times also point to the need to provide clearer rules. Based on our experiences in both games it was those who interpreted the rules in their own way which were the most competitive but also engaged in the highest degree of collaborative behaviour. As a result it is possible to argue that on a higher system level (e.g., the overall impact) the more competitive players may also encourage others to take part in group like behaviour in order to advance their own objectives.

From a logistical perspective we have shown that the apparent limitations of a space or the options within it can actually be beneficial for designing such games. For example, metaphorically speaking, it forces the game to adapt to situations that are similar to the real world. Furthermore it forces an emphasis on rules and logic that are entirely space neutral; that is to say, the game can take place in almost any location. This of course is ultimately beneficial in the design of a real world traffic application.

CONCLUSION

Although both games consisted of a relatively small number of participants they were useful in identifying behaviour changes as a result of introducing rules and incentives. They also pointed to the relatively small value of incentives that are required to change behaviour. At this stage the method is not complete and does require further development. However, it

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has one major advantage in that it allows and illustrates that such methods can be used to test underlying game design and logic without the need for implementing everything in a simulator or within a mobile application. As a result it has the potential to save significant time and results in a more rapid approach to prototyping game logic and ideas. Clearly future work is required, not only in terms of developing the I-GEAR game on mobile devices but also the approach itself.

In conclusion, we have presented a method that uses metaphor in order to test underlying gaming concepts. The approach is potentially useful in a range of scenarios including mobility where participants must undertake actions in the real environment but where doing so may be costly in terms of time or money.

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Rod McCall is a post-doc researcher at the Interdisciplinary Centre for Security, Reliability and Trust (SnT) at the University of Luxembourg where he leads the I-GEAR and LiveCity projects. He is a member of the SECAN-Lab research group and he specialises in human-computer interaction aspects of mobile systems and mixed realities. He has authored a number of papers on topics ranging from virtual environments through to location-aware augmented reality games. He has previously held positions at Fraunhofer FIT, CRP-Gabriel Lippmann, Edinburgh Napier University and Runtime Revolution.

Vincent Koenig joined the University of Luxembourg in 2007 as a post-doc member of the EMACS research unit and initiated the set up of the University's HCI-usability laboratory that he is heading up since. In 2009 he also joined the newly created Interdisciplinary Centre for Security Reliability and Trust (SnT) that he stays co-affiliated with. Prior to his research at the University of Luxembourg, he held a researcher position at the Université Libre de Bruxelles. With a background in psychology as applied to HCI, his work covers several topics: human factors in air traffic control, user centered design and usability assessment, computer-based assessment and more recently usable security (socio technical aspects of security) and automotive HCI

Martin Kracheel is a PhD student at the Interdisciplinary Centre for Security, Reliability and Trust (SnT) at the University of Luxembourg. He is a member of the I-GEAR project and is involved conducting the contextual studies in the project, including the development of the mobility game. Prior to starting his PhD, Martin conducted research in a number of areas including interaction analysis, ethnography and collaborative design.

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