



# SUNSET

## Sustainable Social Network Services for Transport
## www.sunset-project.eu

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# Deliverable D3.3
# "Impact of Incentives"

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# Summary

This deliverable contributes to the understanding of potential incentives to change people's travel behaviour and to support sustainable ways of travelling. The main innovation of the task has been: a) identification of the incentives that have most potential to change travel behaviour; b) design features of incentives to increase feasibility and efficacy in changing travel behaviour; and c) identification of complementarity of city contexts and social categories and incentive types.

Specifically, we investigated four types of incentives, including:

- Real-time travel information (i.e. system provision and peer-to peer exchange);
- Feedback and self-monitoring;
- Rewards and points;
- Social networks.

Those incentives were selected based on reviews on existing literature, trends in the current smartphone app development, and the innovation of the SUNSET project within the area of social networks. A combination of quantitative (i.e. online survey) and qualitative (i.e. focus group) techniques were chosen next to investigate potential SUNSET users' preferences towards those incentives in the three Living Lab cities (Enschede-NL, Leeds-UK, and Gothenburg-SE). We further focus on studying users' attitudes towards the incentives; their intention to use; their beliefs on the impact of incentives on their travel behaviour; and their ideas, fears, difficulties, and needs.

The results of the study gave some indications on how to create feasible and productive incentives. Our specific findings are:

- **Real-time information in a peer-to-peer exchange system:** the evidence gathered both from qualitative and quantitative sources found that the accuracy is a must for its attractiveness and productive use. In addition, timeliness and relevance are the key design principles to make real-time information useable.
- **Feedback and self-monitoring:** our results indicated that this incentive type can be mainstreamed into everyday travel behaviour and there is evidence of a positive attitude to feedback and targets. However, there were some variations in participants' beliefs between cities, indicating that there is some reluctance to believe that setting targets can impact on their own (travel) behaviour.
- **Rewards and points:** we found that points, without the ability to exchange with a tangible reward, are often perceived as a game. Thus, they may only be attractive to smaller social groups who enjoy gaming and their attractiveness tends to wear off over time. In addition, the results showed that points associated with tangible rewards have the potential to be feasible and productive and they could impact on travel behaviour. However, rewards and points provided by the third parties require more careful handling to ensure their attractiveness and to avoid some risks (e.g. the privacy issue).
- **Social network and incentives:** results found diverse responses to sharing and competing based on a (point) performance. In addition, since users themselves are the main source of innovation for this inventive type, the SUNSET system has to support users in the social network exchanges.

  **General issues:** outcomes of the qualitative study also highlighted the privacy issue. Privacy is a major concern and it needs to be considered to develop efficacious incentives.

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# 1. Introduction

The SUNSET project aims to reducing traffic congestion and CO2 emissions; improving personal safety and well-being of citizens; and contributing to the environmental protection. To address these goals, the SUNSET app, named Tripzoom, is developed. The app will offer its users incentives to encourage more sustainable travel behaviours and to attract potential app users to using the system. This deliverable is intended to study the effectiveness of incentives through empirical works. This work is directly linked to: Task 2.4 responsible for the implementation and the design of the interfaces, implying as well the presentation of the most effective incentives; Task 4.3 concerning the incentive marketplace; Task 6.4 on the methods selected to evaluate the effectiveness of incentives; and indirectly connected to Task 7.1 on the planning of the Living Labs.

This deliverable focuses on conducting in-depth literature reviews on incentives that can be used to encourage sustainable ways of travelling based on input and directions given in D3.1. As a reminder, D3.1 has identified a number of potential incentives based on individuals' objectives, policy objectives (in three Living Lab cities: Enschede, NL; Leeds, UK; and Gothenburg, SE), and the SUNSET system objectives, as listed here below:

- Saving time;
- Changing the productivity of time;
- Offering more control over how time is spent;
- Offering more control over how time is planned;
- Saving money;
- Generating money;
- Recognition of progress and success;
- Self-generated communities of practice;
- Information;
- Ways to swap information with others;
- Information real-time;
- Information and promotion of non-car modes emphasising pleasurable aspects derived from individual or generic, e.g., physiological feeling of walking, jogging, cycling, tranquillity of bike ride; experiencing nature;
- Messages around: enjoying 'slow living' and not being a member of the 'rat-race' member but able to downsize. Probably most relevant to particular social categories e.g. deprived without children and least deprived with young families;
- Population segmentation according to attitude to car use including dissatisfied car owners and users, in UK expect to have a category of frustrated cyclists;
- Other aspects of identity and cultural roles – being a good mother or father, being good friend, being good neighbour, being good employee, gendered roles;
- Status. Culturally specific and patterns and perception of ownership and consumption of goods but also behaviour – shopping local, growing own food, cycling, walking;
- Messages around: Being green;
- Information on being healthy and fit.

We will focus our literature review on the above incentives. Accordingly, we will review different publications originated from various research domains, such as transportation, psychology, and persuasive technology. The results of this activity would be incentives with more focus than the ones indicated in D3.1, allowing us to test them in the empirical

work setting. The main objectives of the empirical works are to give indication about potential users': a) preferences towards every incentive type; b) intention to use; c) expectancies of usefulness; d) effort to learn and use the system; e) influences of their social environment; f) ideas, fears, difficulties, and needs; and g) reflections based on their personal history with every incentive type. Because Tripzoom will be operational in three Living Lab cities, it is important to conduct cross-country studies, focusing on those cities.

## 1.1 Goals

The Work Package 3 objectives are:

- Research the relationship between individual and system objectives;
- Investigate key factors that influence the use of information messages;
- Develop a set of feasible and productive incentives to change mobility.

Task 3.3 contributes to the above objectives through the accomplishment of the following tasks:

- Investigate potential and effective incentives based on literature reviews;
- Develop the design of the empirical works to test incentives identified in the previous point;
- Execute the empirical works in three Living Lab cities;
- Discuss and report the results.

## 1.2 Main results and innovations

The main innovation of the task has been (a) identification of the incentives that have most potential to change travel behaviour; (b) design features of incentives to increase feasibility and efficacy in changing travel behaviour; and (c) identification of complementarity of city contexts and social categories and incentive types (Table 1).

**Table 1 Contributions of this deliverable to SUNSET innovations.**

| SUNSET innovations | Contribution of this deliverable |
|---|---|
| Social mobility services that motivate people to travel more sustainably in urban areas | N/A |
| Intelligent distribution of incentives (rewards) to balance system and personal goals | (a) Identification of the incentives that have most potential to change travel behaviour;<br>(b) Design features of incentives to increase feasibility and efficacy in changing travel behaviour;<br>(c) Identification of complementarity of city contexts and social categories and incentive types. |
| Algorithms for calculating personal mobility patterns using info from mobile and infrastructure sensors | N/A |
| Evaluation methodologies and impact analysis based on Living Lab evaluations | N/A |

The main results were identification of incentives with the potential to reducing car driving and encouraging the use of alternative transport modes through the desk-based review. We focused on investigating (real-time) travel information, feedback, rewards, and social networks. Moreover, we were able to detail these incentives further and test them in the empirical works in the three Living Lab cities. Both qualitative and quantitative studies were carried out and their outcomes supplement each other. The results showed that that real-time travel information is a favourable incentive type, in particular when such information comes from the system by itself. However, when travel information is provided by other users, through a peer-to-peer exchange system, some issues arose concerning the accuracy and the relevance of the information to the individuals' users. With regard to feedback and setting personal travel targets, we found that this incentive type, to some extent, has the potential to be mainstreamed into daily travel behaviour and there is evidence of users' positive attitude to it. Some experiments were also done to investigate people's preferences towards rewards and points. In brief, results indicated that points which are not associated with rewards have a higher probability to be perceived as a game. Therefore, they are only attractive to smaller social groups. Points which can be redeemed into tangible rewards have more chance to be feasible and productive. However, qualitative data showed the participants' worries and concerns related to data security and ownership, especially when the third parties are involved in the provision of rewards. Social networks (in relation with other incentives) were also tested. The results indicated diverse responses to sharing performance and competing through social networks. Since social networks are a system in which users generate their own content, users themselves are the source of innovation for this incentive type. Therefore, feasible and productive incentives have to allow users to develop the social network exchanges. At last, the results of this study also helped us identify several operational issues and other important issues related to the interaction between users and the system, such as users' privacy concerns and fears. In addition, issues related to the design and presentation of the app were also discussed by the participants. For instance, users would like to have the freedom to opt-in and opt-out of the incentives, to get only relevant information, and not to be disturbed by constant notifications.

## 1.3 Approach

A combination of both qualitative (i.e. focus group) and quantitative (i.e. online survey) approaches were used in the empirical study and their results complement each other. Focus groups are often used in research to gain more in-depth explanations that cannot be obtained using a quantitative study such as survey. Therefore, several focus groups were carried out in Enschede and Leeds. In addition, several surveys were made available online in all Living Lab cities. Both techniques were used to measure attitudes, beliefs, and intentions surrounding the predetermined incentive categories. Focus groups were used further to probe aspects that are liked and disliked from every incentive and the reasons. In addition, the focus group setting encouraged the participants in the same group to discuss, enhancing their thoughts and ideas that may be beneficial for the design of the system. It also gave the flexibility to explain the concepts of the incentives to the participants which otherwise will be very difficult to do (e.g. in the online survey).

## 1.4 Document structure

The remainder of this deliverable is structured as follows: in Section 2 we will present relevant literature reviews on incentives from various research domains. We further focus

on reviewing four broad incentive categories: travel information, feedback and self-monitoring, rewards and points, and social networks. This activity gives a base to select a number of incentives to test further in the empirical works, which will be detailed in Section 3. At last some conclusions will be given in Section 4.

# 2. Literature review: Incentives for sustainable travels

## 2.1 Introduction

Growing population in urban areas has caused a greater demand for faster mobility often linked to the use of cars. This has contributed to several problems in a city due to the decreasing in air quality, the increasing rate of traffic accidents and the rising number of traffic congestion. One of the most popular solutions to reduce car use is by implementing *travel demand management* (TDM) or often referred to as *mobility management* (Loukopoulos 2007). TDM includes any policy to encourage better ways to use transport resources (Litman 2003), for instance by offering people *incentives* to reduce their car use (Victoria Transport Institute 2010). The term "*incentive*" itself can be interpreted rather broadly. Locke et al. (1990) defined incentive as: "*event or object external to the individual which can incite action*". In the transportation research field, incentives may take various forms, ranging from positive to negative incentives (Litman 2003). '*Positive incentives*' aim to reducing car use by improving travel choices and offering rewards. This way, car drivers who reduce their driving are benefited but those who do not are not negatively affected. Examples of such incentives are park and ride, teleworking, transit improvement, and TDM marketing. *Vice versa*, '*negative incentives*' focus on mechanisms that make car drivers be at disadvantage if they do not reduce their car use. Therefore, most (if not all) pricing policies fall into this category, such as fuel tax, parking fees, and congestion charges.

At the same time, advanced technological development of smartphone and mobile internet connections are not likely to slow down. This allows people to keep getting improved technology and faster internet connection at reduced price. Consequently, it has contributed to the increasing use of smartphone in the world (including in Europe). City authorities should make the best use out of this trend, for instance by developing and providing citizens with smartphone applications (apps) that offer travel-related incentives to persuade sustainable ways of travelling. Using various smartphone sensors (GPS, accelerometer and digital compass) and mobile internet connection, individuals' (daily) mobility patterns can be obtained and recorded. These mobility data may include habitual route, transport mode, location, and departure time choices, making it possible to give personalized incentives tailored to individuals' mobility choices. Moreover, mobile internet connection allows smartphone users to obtain real-time travel information at any time. This makes a smartphone a powerful tool for persuasion and it has been identified in the *captology* area. *Captology*, an acronym from Computers As Persuasive TechnOLOGY, is a relatively new research domain that was emerged in the early 2000s (Fogg 2002). It studies the use of different types of computer-related technology as a medium of persuasion (e.g. websites, smartphones, video games, apps, smart environment, and virtual reality). Persuasion here is connected with behavioural, attitude, motivational, and world view changes, and is associated with compliances (Fogg & Hreha 2010).

This chapter aims to providing literature reviews from various research domains to find out about incentives, given through smartphone app(s), that are effective to reduce car use, CO2 emissions, and traffic congestion. We focus only on specific incentives that can

be delivered via a smartphone because such reviews have not been done before, at least to the best of our knowledge. Many previous studies have provided thorough reviews on "more general" incentives to influence travel demand, such as in Cairns et al. (2005). Therefore, it is not our intention to repeat this type of study.

Given that a smartphone is the media to deliver the incentives and in line with the conception of SUNSET, only positive incentives explained in an earlier paragraph are highlighted. This suggests a direction towards '*TDM marketing*'. *TDM marketing* is an approach originated from the marketing field and it covers several activities to persuade people to travel more sustainably, such as by using campaigns. Sustainable travel behaviour can be defined rather broadly as travel behaviours that can lead to the reduction of pollutions and traffic congestion. These behaviours should not be associated only with transport mode choices but also with other travel decisions, such as trip execution, route, and departure time.

Besides campaigns, another example of TDM marketing activities is by giving customized information and feedback. It typically starts by identifying different groups of people in the area, such as car drivers who like to shift to the alternative transport modes. and those who do not. Following that, those who already have a positive attitude towards car reduction are targeted. Surveys and other data collection techniques are used further to recognize factors that can accommodate these shifts, such as people's preferences, knowledge, needs, barriers, and opportunities (Cao and Mokhtarian 2005). Subsequently, customized incentives are given, for instance travel information and personalized feedback on how to reduce car use. Existing studies (Brög 1998; Beale & Bonsall 2007; Thøgersen 2007) have shown that marketing strategies were able to increase the use of the alternative transport modes. Similarly, Victoria Transport Institute (2010) indicated that TDM marketing has increased the use of the alternative modes by 10-25% and reduced car use by 5-15%. A study conducted by Spears et al. (2011) found that such a program could reduce the number of vehicle trips by 5-8%. Specifically, (personalized) travel information and feedback programs have successfully reduced car driving in Japan, as reported by Fujii & Taniguchi (2006). These relatively high success rates could also be caused by the spill-over effects happened when non-participants learn about TDM marketing programs through media coverage or contact with participants.

Another type of incentives that may be successful in making people exhibit certain travel behaviours is rewards. The effectiveness of monetary rewards has been studied in the Spitsmijden project, a project that rewarded travellers to avoid car use during peak hours in some areas in the Netherlands (Ben-Elia & Ettema 2009). The results showed positive implication of monetary reward in changing people's travel behaviour, at least during its introduction period. Outside the transportation domain, different reward schemes have been implemented. For instance, various gaming applications reward game players with points, stars and badges. Even though in most of the cases these players are not able to redeem their points to more tangible rewards, many of them are not discouraged and still spending their time playing games. Another successful example of reward scheme is a so-called loyalty card, commonly be used by supermarkets and airline companies. It works by giving points to customers whenever they buy products. When a certain number of points are collected, customers can get a discount or a tangible reward. A similar scheme could perhaps be transferred to the transportation field, in particular to reduce car use.

At last, several studies (Wellman et al. 1996; Cotterell 1996) have indicated that social media/networks can be used to motivate or to give pressure to people to behave in certain ways. Nowadays, along with the increasing usage of mobile internet, the number of people who use their smartphone to access social networks is also growing. In the Netherlands alone, there are around 21 million mobile phones and around 15% of them are used at least on a weekly basis to support social network activities (TNS n.d.). In the UK, the use of social networks is also relatively high. For instance, in 2010, 15% of the internet visits there were for social networks (Gadsby 2010). In addition to the more famous social network sites (e.g. Facebook, Twitter, and Google+), there are many other smaller ones. Some of them are linked to sports and life-style apps, such as Endomondo, RunKeeper, and WeightWatchers. These apps provide users with communities to exchange information about performances, to keep each other up-to-date, and to link their account with other networks. In the transportation field the use of social networks are also emerging. For instance, Twitter has often been used as a medium to share news and tips about road conditions. Additionally, Facebook has been used to post travel-related news to rise people's awareness of the impact of excessive car use on the environment. Since social networks are an emerging trend and their applications are growing very rapidly, it has a high potential to persuade people to reduce their car use.

Given the above descriptions and in line with the recommendations of D3.1, this chapter focuses on reviewing incentives around personalized travel information, feedback, points and rewards, and social networks. To narrow down our effort further, this study focuses on incentives to support people's daily travels and not on incentives for tourists/travellers in unfamiliar cities. Tourists may desire different types of incentives than daily travellers, such as information related to way-finding and travel guide. We further define daily travels as travels for the following purposes: work/school, bring-and-get, grocery shopping, and leisure shopping in own city centre. These travels are particularly selected because they largely contribute to the total number of trips in a city. Consequently, targeting them may bring about the reduction of daily traffic congestion and CO2 emissions.

Thus, we subdivide the remaining of this section based on four broad incentive categories previously mentioned: personalized travel information, feedback, points and rewards, and social networks. We acknowledge that these categories are not mutually exclusive. In practice, they are often interlinked with each other. Separating them into these groups is done only to simplify the structure of this report. Each category will be discussed in a section. To start with, incentives around travel information will be presented in Section 2.2, followed by feedback in Section 2.3. Incentives around points and rewards will next be disclosed in Section 2.4. Subsequently, social network based incentives will be presented in Section 2.5. Some literature reviews from relevant domains, case studies, and real-life applications (e.g. smartphone apps, websites, and games) will also be described in these sections. At last, in Section 2.6, we will present our conclusions and recommendations regarding potential incentives to test further in the empirical works.

## 2.2 Travel information

The importance of travel-related information in reducing car use has been stated briefly in Section 2.1 and will further be described in this section. To start with, providing people with information about the alternative transport modes is a common practice in a TDM marketing program. In general, TDM marketing aims to introduce various transport options and let people decide on which option(s) to take. Such programs are designed depending on their target groups. For instance, in several marketing programs that

address the mobility needs of commuters, employers are usually invited to participate. Their involvement and support have been identified as an important factor that determines the success rate of such programs (Modarres 1993; Hendricks & Joshi 2004). Besides personalized information, TDM marketing may also include campaigns to market travel alternatives or to de-market car use. For instance, a campaign strategy to promote cycling and walking could highlight issues of stress reduction from not having to search for parking and being in congestion, enjoyment of being in the open air, improvement of personal health, and elimination of travel costs.

However, the success rate of TDM marketing in reducing car use usually depends on participants' initial attitudes towards public transport. For example, people who do not like nor want to use public transport should not be expected to frequently use it (Victoria Transport Institute 2010). Changes are typically made one step at a time, such as from not wanting to considering taking public transport, from only thinking about it to occasionally taking it, as indicated by the theoretical model of behavioural change (Prochaska & DiClemente 1983). With the right information (and sometimes combined with encouragement), some people may eventually reduce their car driving. It is worth mentioning here that TDM marketing is commonly a part of a comprehensive car use reduction program and is supported by government agencies or non-profit organisations. This happens because marketing programs can only work properly when the infrastructure and services of the transport mode alternatives are already adequate (Victoria Transport Institute 2010). For instance, even with personalized bus timetables and encouragement, people will not be interested to take a bus if the frequency is low.

### 2.2.1 Travel Feedback Programs

A TDM marketing approach that focuses on personalised information is often referred to as Travel Feedback Programs (TFPs) or Voluntary Travel Behaviour Change (VTBC). It generally works by giving people some information designed to reduce car use, such as bus timetables and locations of bus stops within walking distance. This is done to create behavioural awareness, an important element of behaviour modification (Dahlstrand & Biel 1997), and to give some knowledge that can empower people to modify their behaviour (Verplanken et al. 1997). As a result, this type of program is generally able to effectively decrease car use, increase public transport use, and reduce car emissions (Fujii and Taniguchi 2006; Brög et al. 2009). TFP projects have been referred to in several ways. For instance, Socialdata implemented a so called IndiMark® in several German cities. In Australia, the UK and the USA, they were launched under the brand name of TravelSmart®. In addition, in Japan, several TFPs have been introduced with different names.

There are several techniques and procedures to conduct TFPs (Fujii and Taniguchi 2006). In brief, they may come with and without motivational support. The latter is commonly applied to people who already have some intention to change their behaviour. TFPs with motivational support typically starts by giving participants insight into the importance of their travel behaviour followed by detailed information on how to use the alternative transport modes.

With regard to the types of information involved, there are two groups of TFPs: individualized and general TFPs. In the former case, participants are given certain information that they ask for, whereas in the latter case, participants are given non-personalized information. Personalized information can be designed based on travel diary data provided by participants or data derived from a survey/interview. In either group, a behavioural plan can be used. Behavioural plan is a detailed planning on how

to implement the intention, for instance to use a public transport: "*I will leave home at 08:00 and walk for around 10 minutes to the bus station. I will catch Bus 25 scheduled to depart from Platform-1 at 08:15. The trip will last for about 20 minutes and I will stop at the bus stop nearby my office. Afterwards, I will walk to my office and should be there before 08:45*".

A series of meta-analyses by Fujii and Taniguchi (2006), comparing ten TFPs in Japan, showed that TFPs with behavioural plan resulted in better reduction of CO2 emissions and car use and higher increase of public transport use. Moreover, when comparing individualized advice derived from seven-day and one-day travel diaries, the study showed that the former gave better results. This suggests that advice should be made based on richer information about individuals. In addition, results indicated that TFPs work better for new residents than the old ones, confirming the outcomes of a study by Fujii & Gärling (2005). They concluded that changes in personal-household situations (e.g. moving house or changing job) generate an opportunity for behavioural change. A summary of Fujii and Taniguchi (2006) can be seen in the comparison table in Appendix A.

TFPs in Europe and Australia commonly work by initially establishing direct contacts with households, for instance by telephone or in-home visits, and subsequently grouping people into three categories (Brög et al. 2009, p. 282): "*existing regular users of sustainable travel modes; non-regular users who are interested in receiving information on alternatives to the car; and those who are not interested in taking part*". People in the second group are usually targeted. These people are asked to select travel-related information and materials that they want to receive. The selected items are compiled as individualized packages and delivered to the households. They are also offered a number of extra services and incentives, such as home visits by local bus drivers or travel experts, free bus tickets, and a cycle trip computer. People in the first group are also offered small rewards and a customized travel information package if desired to strengthen their existing behaviour.

Perth is a city in Western Australia in which several TFPs (called TravelSmart) have been introduced. A pilot test involving households was conducted in 1997 in the suburb of South Perth and the results showed that the program was able to reduce the number of car travels by 13%. A program that targeted commuting-students were launched in 2010, involving students from 10 schools. The results indicated that the program increased walking by 5%, cycling by 64%, and carpooling by 126%, and decreased single family car use by 9.9% (Department of Transport, Government of Western Australia 2010). TravelSmart also launched a program that targeted employers to reduce unnecessary car trips to their work place. Several employers were asked to commit themselves to the program. Commitment is an important requirement in such programs (Cialdini 2001). Once people or organizations commit themselves to follow certain activities, they tend to honour the agreement and are unlikely to quit. Then, employers were guided by some experts from the program to make plans suited to their needs. A number of activities were arranged with the employees according to the agreement with their employers, such as forming carpooling group, carrying out workplace awareness campaign and a cycle commuting workshop, setting a challenge to cycle or walk to work, and teleworking. Akin to the previous programs, the employer program also had a high success rate, as can be read further in Thom (2009).

To sum up, various TFPs have shown the importance of personalized information, in particular about the alternative modes (such as bus and bike), and a travel planner (in

relation with behavioural plan). However, due to the limitation of this technique (i.e. survey and/or travel diary have to be done a priori), both types of incentives are designed solely based on static information. Such a technique cannot accommodate other types of travel-related information relevant in making travel decisions because they are very dependent on real-time information streaming, such as information on road networks and alerts/hazards about road conditions. These incentives could address individuals' travel objectives by minimizing people's scheduling effort, travel time, and cost and maximizing certainty (or reliability) and safety.

### 2.2.2 Weather conditions and transport mode choice

Besides personalized travel information described in the previous section, weather forecast is another type of information important in determining travel-related decisions, in particular related to mode and departure time choices. An existing qualitative study (Kusumastuti et al. 2010) has been done to investigate the underlying factors that influence people's transport mode decisions, and they found that weather conditions play a very important role in decision-making. A quantitative study conducted by Cools et al. (2010) also confirmed that outcome. They found high associations between various weather conditions and traffic intensity based on traffic count data in Belgium. Their results specifically indicated that precipitation, cloudiness, and wind speed decrease traffic intensity. On the contrary, high temperature and hail significantly increase traffic intensity (Table 2).

**Table 2 Parameter estimates on the relationship between weather conditions and traffic intensity (Cools et al. 2010, p.66)**

| | Estimate | Standard error | Value |
|---|---|---|---|
| **Hail** | 2.734 | 0.831 | ** |
| **Snowfall** | -3.822 | 0.945 | ** |
| **Precipitation** | -0.019 | 0.004 | ** |
| **Wind speed (max)** | -0.418 | 0.062 | ** |
| **Cloudiness (mean)** | -1.639 | 0.160 | ** |
| **Temperature (max)** | 1.034 | 0.071 | ** |

** Indicates *p* value <0.01, n=4386

Considering the importance of weather conditions in people travel decision-making as also reflected in the significant increase and decrease of traffic intensity, giving accurate and detail weather (forecast) information to people could be useful. Such information may increase people's certainty when making travel decisions and therefore may encourage people to bike when the weather is nice, to cancel the trip or to adjust departure time when the weather is bad, and to ensure the return trip back home.

### 2.2.3 Current applications

The descriptions above highlight the effectiveness of personalized travel information in reducing car use and increasing the use of transport mode alternatives. However, as stated in Section 2.2.1, current TFPs are not able to deal with real-time travel-related information. Real-time information is essential because it accommodates changes that happen due to sporadic events on the road networks (e.g. delays, road works, and accidents). For instance, traffic accidents may cause some delays in bus timetables, road works may cause detours resulting in longer travel times, and bad weather conditions may cause traffic congestion. Provision of real-time information will allow people to adjust and update their travel decisions accordingly. For instance, by adjusting departure time or taking other route to avoid congestion. Real-time parking information is also valuable as it can make people choose other modes, especially when

there are no available parking spaces in/nearby the destination. Advanced sensors and mobile internet connection allow smartphone users to obtain this kind of travel-related information, personalized and also in real-time.

To date, several apps have been developed offering real-time and personalized travel information. Specifically, they can be categorised into: a) information about transport mode alternatives; b) information about conditions on the road networks; c) travel planner; d) notifications (e.g. alerts and hazards about travel conditions); and e) weather information. Some of these apps have been previously reviewed by Vautin and Walker (2011) and they are listed below:

- Personalized and real-time information about transport mode alternatives
  This includes time to depart from the nearest transit stop. The main purpose of this type of information is to minimize people's waiting time and to reduce the impacts of schedule deviations on their travel. Some examples can be seen in Transporter, OneBusAway, NextBus, and BayTripper.
- (Real-time) travel planner
  This includes single-mode and multiple-mode planners. Multiple-mode planner offers additional benefit because it allows users to obtain route and schedule information and make them seamlessly able to switch between car, transit, bike, and pedestrian. There are several websites that offer this type of information and some of them also develop smartphone apps with similar features. Examples of this are Google Transit and 9292ov Mobile from the Netherlands.
- Personalized and real-time information about road networks and parking
  Examples of this are Google Now and Google Transit. They give users information about how much traffic to expect before making a trip. This may significantly help car users to switch to other modes or adjust their departure times, especially when there are disturbances on the road networks (e.g. congestion).
- Notifications and alerts
  The main purpose is to notify users about disruptions on the road (e.g. traffic accidents and road works) or related to particular services (e.g. train cancelation) using emails or SMS. Several apps are able to send non-personalized information about the road networks (e.g. NJ Transit, FileWekker, and InMaps). However, this feature can be annoying for people who are not affected by the disruptions because the same information is typically sent to all users. Apps that can provide personalized notifications are fewer than the former type. An example of this is a Dutch app called Ónderweg.
- Weather information
  The main purpose is to give detailed weather forecast information. Some examples are Buienradar.nl and WeerAlarm.mobi, both are applicable for the Netherlands.

In most of the examples above, specific services and authorities provide users with real-time travel information. However, travel-related information can also be collected from other app users (such as in Google Transit and Google Now). This information is processed afterwards and used for different research purposes. Other examples are Mobile Millennium developed by the University of Berkley and Waze. Mobile Millennium collects and processes mobility data monitored using the smartphone's GPS and use the data to redistribute real-time traffic information among users. Waze is a social app that provides navigation based on the actual road conditions collected from the users.

## 2.3 Feedback and self-monitoring

Another type of incentives that could be useful in reducing car use is self-monitoring and personalized feedback. Rose & Ampt (2001) argued that people are often not able to reflect on their past travel behaviour because in many cases the consequences of travels cannot directly or indirectly be seen. For instance, CO2 emissions that people contribute to the environment because of their travels and the amount of exercises that they can do when cycling or walking. Therefore, people do not have any tangible evidence that reducing their car use may result in some "beneficial" outcomes. To solve this, a travel diary is often used in travel behaviour research that aims to change people's attitudes and increase people's awareness of travel costs, CO2 emissions, and the alternative modes of transport. People travel patterns are monitored for a period of time and accordingly individualized feedback is given periodically. This section highlights the potential of self-monitoring and personalized feedback to reduce car use based on several existing studies and current applications.

### 2.3.1 Individualised feedback

Several studies have been carried out to investigate the impact of having insight into own travel behaviour on car use reduction, such as those from Tertoolen et al. (1998) and Rose & Ampt (2001). Interestingly, conflicting results were found from both studies and therefore they are discussed further below.

Tertoolen et al. (1998) carried out a study in Gouda, a Dutch city, to investigate the influence of self-monitoring and feedback on the environmental and financial consequences of car use. 350 car users have participated in an 8-consecutive-week experiment. Every participant was assigned to one of the five groups. The participants in the first to the fourth groups were able to self-monitor their travel behaviour. A specific additional treatment was also assigned for each of these groups. In the first group, the participants were given regular feedback on the environmental impact of their car use. In the second group, the participants received regular feedback on their travel costs. In the third group, the participants were given both environmental and financial feedback. In the fourth group, participants were only able to monitor their travel behaviour and no feedback was given. This group was intended to measure the influence of feedback. The last group was the control group and therefore the participants in this group were not able to monitor their behaviour nor to receive any feedback. The self-monitoring was set as a straight forward and direct process for the participants, because they had to fill in their trip diary, registering mode and distance travelled during the course of experimental weeks. The feedback was given once every two weeks. The researchers and every participant in the first to the third groups had a person-to-person talk in which direct consequences of an individual's car use in the last 2 week period were explained. Some conclusions of that research are relevant to be presented here:

- Self-monitoring alone is not sufficient to establish environmental awareness among people and therefore it should be combined with other types of information;
- Self-monitoring combined with both environmental and financial feedback resulted in the reduced frequency of considering the financial consequences of car use, suggesting the appearance of psychological reactance (or reverse psychology);
- Without any feedback on the negative consequences of car use to the environment, providing people only with financial feedback only resulted in better estimates of car costs;

- None of the incentives (i.e. self-monitoring and feedback) caused the decrease in car use;
- Results also confirmed the social dilemma: people do not want to sacrifice themselves (such as by reducing the CO2 emission) for the collective interest and would only behave in a "good" way if others do the same.

Another research was conducted by Rose & Ampt (2001) as a part of Travel Blending program in Australia. This project included a pilot study in Sydney with 50 participants and another study in Adelaide with 100 households. In the pilot study, qualitative in-depth interviews were conducted as an exploratory study to determine the direction of the program, and some findings were found:

- Focus on achievable changes and viable car reduction;
- Give customized feedback that focuses on "how to" rather than "should do";
- Allow people to try out different ways to reduce car use;
- Let people self-monitor their car use reduction.

Based on the points above, another research was set in Adelaide. To begin with, every participant was asked to fill in a detailed travel diary recoding every trip that was made: destination, mode, duration (including start and end times), and odometer reading at the start and end of the trip (if applicable). Thus, self-monitoring of own travel behaviour were enabled during the experimental period using the individuals' self-recorded travel diary. After 7 days, feedback on the kilograms of carbon monoxide (CO) and hydrocarbons and oxides of nitrogen (NOx) was given. Moreover, several tips on how to reduce car use were delivered. Examples of these tips can be seen below (Rose & Ampt 2001, p.100):

- "*Craig, would it be possible for you to travel by public transport one day a week or one day a fortnight? You could catch the train from Blaxland Station and change to the 301 bus at Central Station. We have enclosed copies of the train times which seem to suit your travel pattern.*"
- "*Julie, we noticed that there were never any occasions on which you did two or more things on one car journey. This is often called trip chaining and many people use it to reduce their car trips.*"
- "*Graham, when you have the choice of using the Commodore or the Statesman, try to use the Commodore (if permitted) because it is less polluting.*"
- "*Everyone: Remember when you share a ride with someone instead of driving yourself, this is a real benefit to the environment in Adelaide. On the other hand, when someone makes a car driver trip especially to take you somewhere that you could walk, ride or even take a bus or train to, travelling as a car passenger does not help to reduce congestion and pollution.*"

After customized feedback was given, the participants were asked to exercise on their own travel pattern for 4 weeks before a second travel diary was handed to every participant. Similarly, the participants were asked to record every trip information for 7 days. This allowed the researchers to analyse the effectiveness of feedback. Based on that, another feedback is given to the participants along with the comparison between their travels recorded in the first and second diaries and changes that they made in terms of distance travelled and emissions. Additional feedback and tips were also offered where appropriate. At last, they were suggested to keep monitoring their travels even after the project was completed. In contrast to the results obtained by Tertoolen et al. (1998), the results of the Travel Blending program showed the reduction of total distance travelled (by 10%), the total number of car trips, and total time spent in the car.

Clearly, regardless of the same emphasis on self-monitoring and feedback, both studies by Tertoolen et al. (1998) and Rose & Ampt (2001) did not adopt the same methods perhaps due to the differences in their research goals. Rose & Ampt (2001) gave participants customized tips on "how to" reduce their car use and let them exercise on these tips whereas Tertoolen et al. (1998) focused on making people aware of the consequences of their travels on costs and CO2 emissions. Findings of those studies allow us to note down that self-monitoring could be a useful tool to help people reduce their car use because it conveys people's travel behaviour into more tangible forms (e.g. total costs, distance, time, calories, and CO2 emissions). However, alone it may not yield satisfactory results. Self-monitoring should be tailored to other customized information, such as travel information, tips, and mobility coaching on how to reduce car use.

### 2.3.2 Current applications

Today, there are several smartphone apps and websites that allow users to monitor and track their own activities. They are designed based on specific target fields, such as sports (running and cycling), transports (mode detection and walking), and life-styles (weight and calorie). Besides, many of these apps also let users set their own targets (such as CO2 reduction and weight lost) and help users achieve them through tips and monitoring. Self-monitoring own travels, combined with setting travel targets and individualized tips/information, could certainly be an interesting incentive type to reduce car use and it is in line with our evaluation of the existing studies in Section 2.3.1.

Some examples of the current apps on self-monitoring are listed below:

- Mode detection
  It collects data from the phone's sensors to predict the transport mode. An example is Stanford mode detection. It detects a mode based on accelerometer and uses this information to do an offline classification of transport modes and to predict travel times. Further information can be found in Nham et al. (2009).
- Travel-activity tracking
  There are many apps that allow users to track their activities and provide users with figures related to the tracked activities. For instance, Endomondo and RunKeeper help users in their training (e.g. walking, cycling, and hiking) by giving them feedback on the distance, speed (minimum, average, maximum), and route taken on a map. They also provide users with their own communities in which users can share and compare their performances with others and keep each other motivated. There are many other apps developed around the idea of tracking, feedback, and sharing, such as calorie tracking (e.g. WeightWatchers) and CO2 emission and carbon footprint tracking (e.g. CarbonDiem, Carbon Tracker, and Commute Greener!). Another app dedicated for cyclist is Biketastic. It gives users information about the level of quality and safety of bike paths. A slightly different app than the above is walkit.com. It allows users to plan their walking route and gives them static-information regarding distance, time, calorie, and the number of steps for the specified route.

## 2.4 Points and rewards

It has been briefly explained in Section 2.1 that rewards could be a useful incentive type to persuade people to reduce their car use. However, the potential of rewards to altering people's behaviour should also be discussed from the viewpoint of the psychological research. Many studies have been done within the psychological research field to investigate people's motivations, an important aspect of behavioural activation. Therefore, in this section, research related to people's motivation will be

reviewed. Following that, an example of the implementation of monetary reward in the Spitsmijden project will be discussed. At last, the current application of points in gaming, as a type of rewards, will be addressed.

### 2.4.1 Rewards and intrinsic motivation

Methods to influence people's behaviour are rooted deep into the concept of extrinsic (Skinner 1953; Hull 1943) and intrinsic motivations (Maslow 1943; White 1959; Harlow 1958). Rewards and punishments are examples of extrinsic motivation, defined as external factors outside individuals that aim to encouraging people to accomplish a goal. Both rewards and punishments are also regarded as methods to discipline people, making them retain the promoted behaviour. Rewards are varied from simply giving a verbal complement to monetary reward. Likewise, punishments also have a wide range, from verbal warning to financial punishment (e.g. speeding ticket) and social exclusion. Many behavioural (Carver & White 1994; Gable et al. 2000) and transportation research (Bliemer et al. 2009; Ben-Elia & Ettema 2009; Bliemer & van Amelsfort 2010) have found that reward strategies are generally more preferable than punishments. Kohn (2006) argued that punishments make people suffer to teach something and are effective to give compliance only when the punisher is around. Kohn (2006) also stated that even if punishments eventually can change people's behaviour, they may give negative effects on people's motives and values as they teach some worrying lessons about the use of coercion and power instead of reasoning.

While the ineffectiveness of punishment to support a lasting behavioural change has been verified by many behavioural studies to date, the effectiveness of rewards is still a subject of debate. For instance, Kohn (2006) found that rewards can lead to effective results but only for a short period of time. Cameron and Pierce (1994, 1996) argued that rewards can be used to motivate and maintain people's self-interest in doing certain activities. On the contrary, Deci (1971, 1972); Harackiewlcz (1979) found that rewards, in fact, reduce people's intrinsic motivation. Intrinsic motivation is defined as motivation linked to people's innate psychological needs, such as senses of curiosity and exploratory. It can also be motivation derived from an activity itself. Deci (1992) argued that intrinsically motivated behaviour requires no reward because it is performed out of interest and enjoyment. These differences of research outcomes have caused a series of scientific debate, published in various journals.

Cameron & Pierce (1994, 1996) conducted a series of meta-analyses from around 100 studies. The results found that rewards can be used effectively to increase and maintain people's intrinsic motivation and interest in certain activities. Specifically, they indicated that verbal rewards (or prizes) can be used to increase people's intrinsic motivation and unexpected tangible rewards (such as financial rewards) can maintain such motivation. They further argued that the negative effects of rewards on people's intrinsic motivation only appear in specific conditions and circumstances that can easily be avoided. However, Deci et al. (2001) published a paper which indicated some flaws of meta-analyses conducted by Cameron & Pierce (1994, 1996).

Deci (1971) conducted two lab-based and one field-based experiments to find out about the influence of extrinsic motivation on individuals' intrinsic motivation. In the first experiment, two groups of undergraduate students were formed each served a function in either a control (n=12) or an experimental group (n=12). All participants in these groups participated in three sessions scheduled in three different days. In these sessions, the respondents were asked to solve Soma cube puzzle tasks, assuming that this activity would intrinsically make the students motivated. The Soma cube is a puzzle made out of

seven pieces of cube units, allowing for different types of configuration such as a 3x3x3 cube. In the experiment, the participants were given a piece of paper showing four configurations, and they were asked to reproduce those configurations while being timed. Both control and experimental groups received the same treatments in the first and third sessions. However, in the second session, the participants in the experimental group were offered 1 USD for every puzzle they solved in time. In the middle of every session, the researcher left the room for an eight-minute break but informed the participants beforehand that they could do anything they liked in that timeslot, while actually being observed. The time that the participants spent during the break to continue working on the puzzle was measured and used to determine motivation. The results showed that the respondents in the experimental group spent more time working on the puzzle during the break in the second session when the rewards were involved than in the first and third sessions. Moreover, in the third session, the participants in the experimental group performed worse than in the first session in terms of less time spent working on the puzzle. In the end of each session, all participants indicated that the tasks were interesting and enjoyable, confirming the initial assumption that the students were intrinsically motivated to play the Soma puzzle game. This study concluded that in fact there is a decrease in intrinsic motivation after the monetary reward is introduced as extrinsic motivation.

In the second experiment, Deci (1971) carried out a field-based experiment involving eight students who worked at a college biweekly newspaper. Four participants who worked on Tuesdays were assigned in an experimental group while others who worked on Fridays in a control group. All subjects were not aware of being observed. The first observation time was for ten weeks, separated in three time slots. The participants were given a task to write headlines for the newspaper. In the second time period, the participants in the experimental group received 50 cents for every headline they wrote. In the end of the second period, the participants were told that they would not be paid in the next periods because the newspaper were facing some financial problems. The participants' intrinsic motivation was measured by the amount of time spent to write the headlines. Their attitude was determined by the number of times being present and absent. Five weeks from the third observation period, the forth observation period was conducted for two weeks, allowing to assess the stability of the observed effect. The outcomes of this experiment were similar to the first experiment: monetary rewards cause the reduction of intrinsic motivation.

The last experiment by Deci (1971) was set as another lab-based study and was identical to the first experiment. However, instead of using some financial rewards, this experiment gave verbal prizes, in the second session of the experimental group, to indicate the social approval. The results showed that the participants significantly performed better during the third session in comparison to the first one. This showed that a verbal prize strengthens performance and intrinsic motivation. Furthermore, Deci explained why the two types of external rewards (i.e. monetary and verbal rewards) affect people differently. He argued that the introduction of monetary rewards make people re-evaluate the importance of the task at hand and shift their intrinsic motivation from having enjoyment to gaining the financial rewards. However, verbal prizes do not affect the importance of the task and therefore, people's views on the task remain the same. The increase in intrinsic motivation was also explained by the increase in the perceived locus control to perform the task. The outcomes of this experiment support, to some extent, Maslow's theory (Maslow 1943). The theory grouped people's needs into five categories (hierarchically, from the lowest to the highest); namely physiological needs,

needs of security, needs of affiliation, esteem needs, and self-actualization needs. Verbal prizes serve the latter type of needs as they show acceptance of self and others.

Subsequently, Pritchard et al. (1976) conducted research to re-evaluate Deci's studies on the role of extrinsic motivation on intrinsic motivation. For this purpose, they conducted two data collection sessions using chess problem tasks for the control and experimental groups. In the beginning of the session, the participants were asked to indicate the amount of time they usually spent to play chess in a week, the number of years they played chess for, and the amount of enjoyment they gained from the game. Afterwards, the researcher excused him-/herself out from the room for ten minutes arguing that he/she would use the time to enter information from the participants into the computer. During this time, the participants were welcome to do whatever they liked while secretly being observed through one way glass. The room used for the experiment was equipped with several chess problem tasks and magazines. The participants' intrinsic motivation was measured by the amount of time spent on chess tasks during this break. Once the researcher returned back to the room, the participants were told that they would be given monetary rewards and the amount would be based on the number of chess problems they could solve (in the first session for the experimental group). In the second session, there were no monetary rewards offered. The participants in the control group did not receive any reward in both sessions. Similar to the results of Deci (1971), Pritchard et al. (1976) indicated that there was a significant decrease in the amount of time spent in the second session in comparison to the first one for the experimental group. Other studies have also been conducted around this issue, such as Lepper & Greene (1975); Amabile et al. (1976); Harackiewlcz (1979).

### 2.4.2 Rewards in the transportation field: the Spitsmijden project

Section 2.4.1 has shown the controversy surrounding the influence of rewards on people's intrinsic motivation and some heated discussions in the psychological research field. In the transportation research field, a project named Spitsmijden was conducted to investigate the effect of monetary rewards on reducing traffic congestion in the Netherlands. For this purpose, several experimental studies were carried out on congested roads in Zoetermeer, Hollandse Brug, and Moerdijk Brug.

Different situational factors were pre-determined; i.e. maintenance works (on Moerdijk Brug), construction works (on Hollandse Brug), and daily congestions (on Zoetermeer). In this project some tangible rewards were offered to several travellers who frequently used one of the above roads. They were encouraged to avoid travelling between 07:30 and 09:30 (Zoetermeer), between 06:00 and 10:00 (Hollandse Brug), and between 15:00 and 19:00 (Moerdijk Brug). There were two types of rewards and the participants could choose which one they would like to get: a daily financial reward for every compliance (in all experiments) and credit points to earn a smartphone (in Zoetermeer). To gain the rewards, the participants had to adjust their travel decisions; such as by adjusting their departure time to before or after the period above, shifting their transport mode choice from car to other alternatives, taking another route, or cancelling their trips (for instance by working at home). In addition, a group that selected financial reward was split into two, the participants in one group received either 3 or 4 Euro while the others were offered 6 or 7 Euro. This way, the researchers were able to study the impact of low (3/4 Euro) and high levels (6/7 Euro) of rewards on people's travel behaviour.

The results showed significant changes in people's travel behaviour due to the introduction of the rewards, specifically with regard to departure time, route, mode choices, and trip inclusion. These results are summarized in Table 3. A large percentage

of participants reacted to the incentives by shifting their departure time, especially when route changes were prohibited such as in the Zoetermeer case. This created a high peak of travellers before 07:30. In addition, the results showed that a higher financial reward of 7 Euro gave a larger impact than a lower level reward of 3 Euro. However, the differences between the two levels of rewards were still relatively modest. This implied that low financial rewards already fulfilled most of the participants' expectation to change their departure time.

**Table 3 Summary of results from rewarding studies in Spitsmijden project (Bliemer et al. 2009, p.12)**

| Location | Travel behaviour | | | | |
|---|---|---|---|---|---|
| | Reward | Departure time shift | Route shift | Mode shift | No trip |
| **Zoetermeer** | €3 | 35% | - | 10% | 1% |
| **Zoetermeer** | €7 | 44% | - | 14% | 3% |
| **Hollandse Brug** | €4-6 | 16% | 9% | 7% | 6% |
| **Moerdijk Brug** | €4 | 15% | 28% | 5% | 6 |

The Spitsmijden experiments in Hollandse Brug and Moerdijk Brug actively encouraged route changes. In the former case, there was only one alternative route which was substantially long and congested. Besides, it crosses another busy route. This explained its relatively low intake by the participants. In the latter case, two alternative routes were introduced. Both routes had equally low levels of congestions. In addition to that, real-time route information was provided to the travellers. These explained a higher shift on route choice in the Moerdijk Brug experiment, even though the participants in the Hollandse Brug experiment were offered a higher amount of rewards than in the Moerdijk Brug.

Reasonably, the results showed that when good alternative modes are available, modal shift becomes more attractive. For instance, a good public transport system (including trains and buses) is available in and around Zoetermeer. As a result, the modal shift was higher in this case in comparison to in Hollandse Brug and Moerdijk Brug. However, the results also suggested that people prefer to shift their departure time or route instead of changing their transport mode. Only a small percentage of the participants responded to the reward by eliminating the trip. This could happen because other options, such as teleworking or cancelling the activity, were infeasible or more difficult to arrange (implying higher mental efforts). Further details regarding the experimental design and the results of the project can be found in several reports, such as those from Bliemer et al. (2009); Ben-Elia & Ettema (2009); Bliemer & van Amelsfort (2010).

At last, the results of the Spitsmijden project clearly showed the effectiveness of monetary rewards to changing people's behaviour, at least in the short run when the rewards were offered. Unfortunately, the long-term effect of this reward type has not been investigated nor reported, at least to the best of our knowledge. Thus, the sustainability of the evoked behaviour after the expiration date of the reward still remains a question that needs an answer.

### 2.4.3 Current applications

Interestingly, rewards as a point system (such as scores, stars, and badges ) are a common practice in any game applications. There are a large number of computer and smartphone games that use a point system to motivate players to play. Reasons of why such a reward system is successful can perhaps be explained by using behavioural model of Fogg. He argued that an activity which can easily be done (such as playing

games) requires only a low motivation. Accordingly, triggers, such as points, may be sufficient to make people play a game. However, when an activity is hard to do, it requires much higher motivation. Therefore, different kinds of triggers may be needed to boost people's motivation. For many people, changing travel behaviour is harder than playing a smartphone game. Therefore, only highly motivated people can alter their travel behaviour. To increase people's motivation to the limit of behavioural activation, incentives can be used. However, the question remains whether or not points are a sufficient trigger for this activity.

A more dedicated game for travel is Chromaroma. It makes use of an Oyster card (i.e. a public transport card in London). The game players have to swap their Oyster card in the reader and they can collect points whenever they travel using public transports. It also gives several missions to complete and the players can compete with their friends. This can be considered as an innovative idea to make using public transport fun and enjoyable. Another example of real-world games is Geocaching. It is a treasure hunting game and it works by asking players to locate hidden containers (called geocaches) using GPS-enabled devices such as a smartphone. Once a geocache is found, a player can pick an item inside the cache as a reward and leave another personal item as a replacement. Subsequently, that item can be picked by other players who trace the same geocache in the future.

Other real-world games that use a smartphone as a medium to play are Foursquare and SCVNGR. Both offer rewards to users in the form of points, stars and badges. Some of these points can be redeemed to more tangible rewards provided by the 3rd parties. In return, the 3rd parties are allowed to put their logos (as advertisement) in the apps. Additionally, these apps also provide users with their social networks to exchange tips, preferences, and experiences on different locations and places. Social networks could also be a sufficient trigger to make people keep "playing" such games, and this incentive type will be discussed further in Section 2.5.

## 2.5 Social networks

Nowadays, social networks are becoming a new phenomenon in the world of internet and has lead us to the Web 2.0 era. Social networks allow users to communicate, create, share, and get information, tips, and other content. Boyd & Ellison (2007) defined social networks as: "*…web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site.*" Therefore, using various social network services, people can connect not only with their acquaintances but also with strangers who share the same interests, activities, or certain world and political views. A qualitative study conducted in the UK by Binsted & Hutchins (2012) mapped individuals' usage patterns of social networks (Figure 1), namely: keeping in touch with contacts, sharing photos, playing games, following celebrities, organizing social events, getting recommendations, as well as gaining and sharing information. Social networks have also been used in the political arena, to facilitate election and to find information during political unrest.

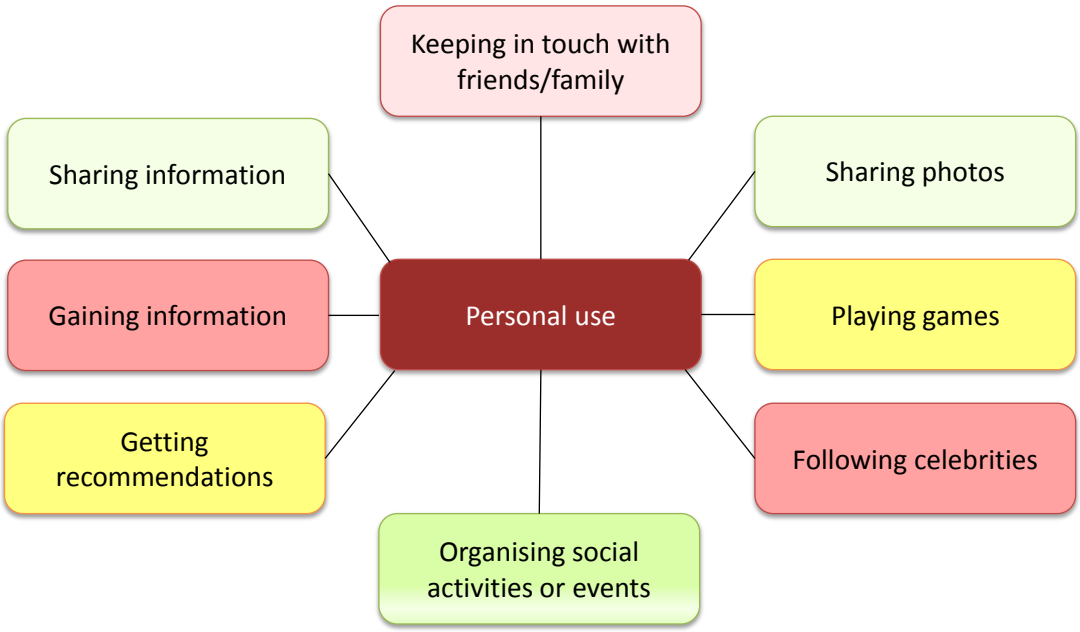


**Figure 1 Personal use patterns of social networks (Binsted & Hutchins 2012, p.38)**

Some social network services work globally, covering a variety of users and an extensive geographical area, while others focus on specific regions/nations, languages, religions, and so on. Many of these sites also provide users with additional features, such as mobile connectivity, blogging, and photo/video sharing (Boyd & Ellison 2007). There are a large number of social network services to date and certainly the figure is getting higher periodically. Many of them have been mentioned in existing publications (nextMEDIA 2010; Binsted & Hutchins 2012). Therefore, we will put our effort in reviewing only literature that focuses on the use of social networks to support behavioural change. Afterwards, we will investigate the potential of social networks in travel behaviour, especially to persuade sustainable ways of travelling.

### 2.5.1 Social networks and behavioural change

Attia et al. (2012) have conducted an in-depth literature review to develop a conceptual framework of the impact of social networks on behavioural change. From the existing literature, they identified trust, relationship, loyalty, value, and word of mouth as relevant aspects in shaping people' perceptions towards social networks. These aspects are briefly summarized below:

- Trust: an important aspect that determines long-term relationship. People in social networks are usually more eager to trust others who share the same expertise, identity, thoughts, beliefs, and choices. They tend to depend on trust to reduce social ambiguity.
- (Perceived) relationship: in many cases, especially among the youth, social networks are used to maintain and build relationships with like-minded others. As the connection and emotional attachment among users increase, social networks are used to influence each other.
- Loyalty: interactions among users in a social network may increase their personal satisfaction, leading to loyalty to particular services or communities.
- Value: social networks are able to offer not only social value (from building and maintaining contacts), but also other values. First, they give an economical value because they can act as a "marketplace" where companies and sellers "meet" their potential customers. They also offer informational and institutional values

because they can be used as a medium to communicate service information, to exchange ideas, and to solve problems. In addition, they include a utilitarian value derived from the task accomplishment, and an entertainment value from the enjoyment of having interaction with others.

- Word of mouth: this happens when people talk about products or services that they like or dislike. Word of mouth has been proven by many existing studies to be able to influence people's buying decisions because such information are often value as more trusted.

Attia et al. (2012) further link the above aspects with the Theory of Planned Behaviour (TPB), a well-known framework developed by Ajzen (1991) that explains human behaviour, taking into account the self-efficacy theory by Bandura (1977) and the theory of reasoned action (Fishbein and Ajzen 1975; Ajzen and Fishbein 1977). In brief, TPB bridges different concepts of beliefs, attitudes, intentions, and behaviour. It argues that individuals' intention (or motivation) plays an important role in determining the amount of effort spent to perform the given behaviour. However, intention is not a single determinant factor. Another important factor that also influences behaviour is the 'actual behaviour control', defined as non-motivational factors that affect the activation of certain behaviour. Examples of this factor are people's availability of opportunities and resources (e.g. time, money, and skills) (Ajzen 1991). These aspects of behavioural control could be in the form of facilitating factors (Triandis 1977), the context of opportunities (Sarver 1983), resources (Liska 1984), or action control (Kuhl 1984). Moreover, TPB postulates that individuals' intention to perform behaviour is influenced by three factors: perceived behavioural control, attitude towards behaviour, and subjective norm. The perceived behavioural control has a similar meaning to the perceived self-efficacy (Bandura 1977), suggesting that people's behaviour is strongly influenced by their self-confidence about their ability to accomplish a task. The attitude towards behaviour signifies people's positive or negative evaluation on certain behaviour. And, the subjective norms are perceived social pressures to carry out or avert the behaviour. The links between aspects in TPB are illustrated in Figure 2.

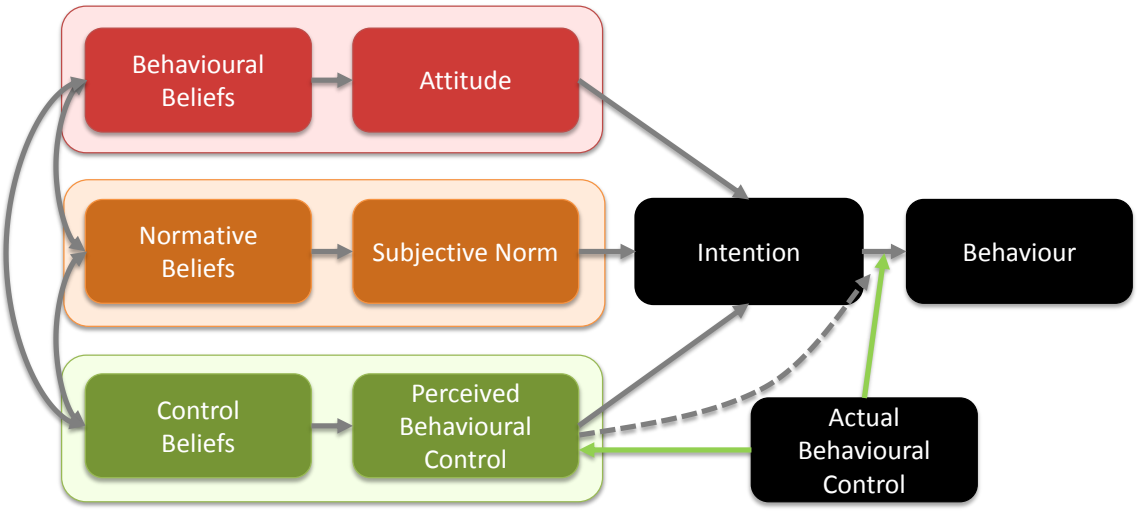




**Figure 2 Theory of planned behaviour**

In line with the TPB framework, social networks have the opportunity to persuade and activate certain behaviour through their influence on people's attitude (e.g. through

word of mouth), subjective norm (e.g. from relationship with others and social acceptance), or perceived behavioural control (e.g. from trust and motivations from peers or from seeing other peers' achievements). From the theoretical point of view, this sub-section shows that indeed social networks can be a useful medium of persuasion. This premise has also been proven by several experiments discussed in the following sub-sections.

### 2.5.2 Social Networks as a persuasive tool

Foster et al. (2009) have conducted a study to investigate the use of social networks to persuade people to change their behaviour in the domestic energy consumption. They conducted open-ended questionnaires to a small number of participants, focusing on people's attitudes towards an existing consumer product that allows users to monitor their domestic energy use through Facebook. Additionally, the users can also see their friends' energy consumptions. Grounded theory is applied next in the analysis. The results indicated that even though some users rise their confusion and concerns about their privacy, there are some balance opinions about the reduction of people's energy consumption because of peer influence and competition.

Another recent study by Centola (2010) was done to investigate the spread of behaviour through social networks. In brief, he investigated the type of social networks that can better facilitate persuasion among users to exhibit certain (health care) behaviour. For this, he tested two types of social networks: the first type is a network in which users have many (distant) connections (refer to as a "long tie" network) to resemble a "mini-world" and the second type is a dense cluster network in which users are more closely related. Researchers would argue that the first type of network would spread behaviour faster than the second type, akin to a contagious disease or information that can spread through a contact with an "infected" individual. However, Centola's study revealed the contrary. To be convinced to adopt certain behaviour, people need to have multiple contacts with multiple sources (or referred to as a complex contagion). Specifically, information will be adopted into behaviour when many people near an individual keep stating the same thing. This could happen due to a stronger subjective norm created by close-related peers rather than far-distance ones.

### 2.5.3 Social Networks to persuade sustainable ways of travel

In the transportation field, Binsted & Hutchins (2012) have conducted a study to investigate the role of social networks in changing people's travel behaviour in the UK, focusing in particular on sustainable transport. For that reason, they conducted several focus group sessions (with 22 participants) and a survey (with the total number of 141 valid responses). The focus groups were aimed to having in-depth insight into people's perceptions and thoughts about social networks, such as advantages and disadvantages, patterns of use, and the potential to change their travel behaviour. The results of the focus groups stated that social networks have some potential to spread information and increase people's awareness required for the behavioural change. However, there were a few participants who strongly opposed to that idea. Next, it is suggested that an emphasis should be placed on the individuals' benefits (e.g. cost and health) rather than on the society's (e.g. pollutions, CO2 emissions, and carbon print). This may come in line with the results of Tertoolen et al. (1998) about social dilemma which was discussed in Section 2.3.1.

A survey was conducted afterwards. Results indicated that, in general, participants (around 75%) agreed that social networks can change (other) people's travel behaviour. However, only around 50% of the participants thought that those sites can

change theirs. Only around 20% of the participants have used social network sites to access information related to public transport and 15% have used social networks to arrange car sharing. In spite of this, many participants have considered using social networks to access public transport information and arranging car sharing, indicating a potential use of these sites in the future. The survey outcomes also confirmed the focus group results: social networks can increase awareness of the impact of travel behaviours and give motivation to change.

Hence, based on the existing reports, it would be interesting to study the use of social networks in changing people's travel behaviour. This should be done not only in terms of giving travel information and sharing tips but also facilitating other activities, such as posting performances, receiving challenges and arranging "game-like" travels. Social networks have been often used to support car sharing. This could perhaps be extended for other modes, such as to find travel companions to cycle or to take public transport. Besides, it could perhaps be used to make people feel safer when traveling in unfamiliar places by letting friends or family know their current location, akin to Foursquare that allows users to share locations through geo-tagging.

### 2.5.4 Current applications

The current applications of social networks have been previously mentioned and described in the earlier sections (i.e. Sections 2.3.2, 2.4.3, 2.5.1, 2.5.2, and 2.5.3), such as Endomondo, RunKeeper, WeighWatcher, Foursquare, Facebook, and Twitter. In addition, there are many existing publications (nextMEDIA 2010; Binsted & Hutchins 2012; Boyd & Ellison 2007) that have given thorough reviews on several social network services. Therefore, we will not repeat the previous discussions here.

## 2.6 Conclusions and recommendations

To conclude, in-depth literature reviews provided in Sections 2.2 to 2.5 allow us to see the potential incentives to encouraging travel-related behavioural changes and supporting people's daily travels. These incentives are identified within the four categories of travel information, feedback, points and rewards, and social networks. They are further detailed below.

- Travel information
  Many studies have shown that providing people with personalized travel information could eventually alter people's travel decisions, for instance with regard to mode, route, and departure time choices. This could be strengthened by providing this information type in real-time. It has also been described in Section 2.2 that travel information could take various forms, namely:
  - Real-time personalized travel information about road networks, such as delay information, road works, and parking availability. This may also include alerts about road conditions.
  - Real-time personalized travel information about transport mode alternatives, such as (the closest) bus stop and departure time information.
  - Other relevant information in making travel choices, such as accurate weather forecasts.
- Feedback
  Feedback may have the ability to alter people's travel behaviour and retain the changes for a long-term. Allowing people to self-monitor their behaviour will let them have a full control over their own travel choices. This could happen because people would be able to see direct impact of their travel behaviour on

the environment (CO2 emissions) and on themselves (e.g. calories, costs, and time). However, alone, it may perhaps be a tricky incentive. It could be useful for those who, to some extent, have already positive attitudes towards the environment, health, or costs, but may not work as intended when their attitudes are somehow negative. However, any conclusion about this incentive type cannot yet be made. Empirical works should test this incentive further to find out about potential SUNSET users' preferences towards self-monitoring combined with the possibility to set personal travel targets (e.g. related to time, cost, distance, CO2 and calorie).

- Rewards
  This incentive type is particularly interesting because of the mixed results of various studies. Some argued that tangible rewards (such as monetary rewards) can reduce people's intrinsic motivation. However, non-tangible rewards (such as verbal prizes) do not necessarily influence people's intrinsic motivation. In games, points, another form of non-tangible rewards, are often used. The empirical works should investigate this further by studying potential SUNSET users' attitudes towards this incentive type, in particular related to: points when performing "good" behaviour, and tangible rewards (or possibilities to redeem the collected points).
- Social networks
  It has been confirmed by many studies that social networks can be used to alter people's behaviour due to the peers' influences. Thus, social networks should be used as a medium to enhance other incentive categories. For instance, combined with self-monitoring and setting personal targets, social networks will allow SUNSET users to share their performances and to trigger competition with others. Combined with individuals' recorded mobility patterns, SUNSET users with similar mobility patters can be identified. Therefore, the system would be able to suggest users to cycle, walk, or to take public transport together with others who have similar travel patterns. Or in other words, it can be used to search for a (travel) companion(s). Combined with the location tracking, social networks could perhaps be used to make trusted friends or family 'watch over' a traveller when making a trip, making him/her feel safer when walking on a dark road or being in an unfamiliar city. This feature can also be used to setting a meeting place with a friend. At last, social networks are a very useful medium for people to exchange tips and experiences, such as tips related to certain modes or routes.

To test the above incentives further and to find out about potential SUNSET users' preferences towards them, some experiments will be done in the empirical work setting, which will be detailed in Section 3.

# 3. Empirical works

## 3.1 Introduction

The primary aim for Task 3.3 is to develop feasible and productive incentives through primary research. The research aimed to fulfil the following objectives:

- Explore key features of incentives that influence the use of information message;
- Investigate the role of social networks in making incentives more effective;
- Investigate the use of incentives using rewards and points;
- Identify the significant design components in incentives.

This work complements the review work presented earlier in Section 2. This section will contribute to understanding the attitudes, beliefs and intentions towards a number of different incentives. The incentives investigated in this research work included:

- Real-time travel information (i.e. system provision and peer-to peer exchange, e.g. alerts and hazards);
- Feedback and self-monitoring;
- Rewards and points;
- Social networks.

These incentives were chosen because they utilise the novel features of the SUNSET system and/or they have been identified in Section 2 as having the potential to support and encourage behavioural change.

The underlying theoretical framework for the empirical work was the social theory of travel rather than the orthodoxy of utility maximising. We theorised that there are social benefits to travel which arise from the increased opportunity for encounters with others and social network development and management, the health and fitness benefits integral to active modes, and the pleasure that can be integral to some forms and incidences of travel. The Tripzoom application in the SUNSET project is founded on the basis that the benefits to travel can be formed, identified and made.

An understanding of what individuals see as their own objectives for travel, is not an uncontested area. Understanding why people travel is one of our fundamental research questions and in the study of transport, obviously, the orthodoxy has been using utility maximizing theory (Button 1993; Jara-Diaz 2007) and there are some who argue that there is broader social significance and meaning to travel for individuals (Jones et al. 1983; Anable 2005; Grieco 1995; Larsen et al. 2006; Hodgson 2012) and others who assert that there is empirical research to suggest positive utility from travel (Mokhtarian et al. 2001). What is clear from the SUNSET Description of Work, as evidenced by the scenario used to illustrate how individuals may use the SUNSET system, is that there is an implicit acknowledgement of the wider social significance and the potential for positive utility in travel, as one of the incentives is described as a stimulus to social norms. In the scenarios used in Work Package 1 (Task 1.1), it is assumed that individual travellers are able to form social networks in which members are able to recognize and to reward the travel behaviour of other members in order to encourage sustainable travel behaviour at the individual level. For example, in car sharing initiatives those who ride are able to reward those who share with a positive mobility recommendation shown on the members' profile page. The emphasis on social networks in the project implicitly and explicitly requires us to acknowledge, develop, and potentially use alternate understandings of

why people travel (drawing on the extensive field of social networks) which can incorporate the role of individuals in social relationships (networks) with others. Fundamentally, this involves an understanding of the significance and potential of social norms and social practices in motivations to travel and particularly as incentives (rather than something to transgress).

## 3.2 Methodology

### 3.2.1 Design

Research work investigating incentives was conducted in the three Living Lab cities: Enschede, Gothenburg and Leeds. The empirical research aimed to complement the review of existing work by investigating in more detail incentives that build on and support the innovative aspects of the SUNSET project. Each city was treated as a case study and the research work was tailored to each city's circumstances, but using a common approach including the same types of incentive categories and scenario descriptions, data collection techniques and impact categories.

### 3.2.2 Problem analysis

The research work began with a problem analysis to ensure the work was relevant and applicable to the immediate real-world circumstances of each city and would thereby fulfil the aim of 'feasible and productive' incentives and also increase the potential to make a substantial and sound contribution to incentive development and design in the Living Lab work package (WP 7). Problem identification was done using D3.1 'Objectives' and confirmed in discussion with municipality and regional government technical staff. The other factors taking into consideration in the design and dataset generation were the need to provide clear incentives for use by the software developers, clear incentives for potential with third parties as well as answering the research questions.

In Enschede, the problem analysis concluded that there was a need for an additional focus on city centre car travellers who are not necessarily commuting but may be shopping, also modal choice from bike to car as a response to rain. In addition, the municipality was interested in information messages to provide choices for travellers. In Enschede there were sensitivities associated with the municipality being a project partner which meant that the data generation through online questionnaire had to complement existing policies and other research work and projects.

In Leeds, the problem analysis with the municipality and the analysis of the policy documents in D3.1 'Objectives', concluded that the principal problem was one of commuting traffic on the main arterials and during peak hours in the morning and afternoon. The main aim of policy and traffic management was described as 'congestion busting'. It was decided to focus on people who worked in the city area. In addition it was clear that the municipality had a number of initiatives in real-time information provision that we could tie-in to the data collection exercise but did not want to duplicate what would already exist by the time the Living Lab was introduced.

The Gothenburg problem analysis concluded that it would focus on small number of commuter who were driving two cars into the city from the same address. This problem analysis led early on to the recruitment of 50 families from the suburbs around the outskirts of Gothenburg .

The problem analysis was used to inform the research design and the population in each city from which we would recruit and, in the case of Enschede, the selection of the incentives to be tested in the questionnaire.

### 3.2.3 Incentives

The research work looked at four incentive types:

- Real-time transport information provided by transport system and real-time information provided by other users
- Feedback: target and goal setting for travel behaviours
- Rewards and point systems for rewards
- Social networks.

Each of the incentives is looked at in turn and descriptions are provided of the portrayal of the incentive to the survey participants and then the findings on attitudes, beliefs, intentions are explored as appropriate. In Enschede and in Leeds all incentives were included in the focus group qualitative dataset generation; and all are investigated in the online surveys in all cities except in Enschede. The online questionnaire in Enschede focused on investigating travel information and feedback incentives .

### 3.2.4 Techniques

**Focus groups**

The primary research used a mixed method approach building a qualitative and quantitative datasets. Six focus groups were held in Enschede and Leeds and an online questionnaire was conducted in Enschede, Leeds, and Gothenburg. Both focus groups and questionnaire surveys were used to determine beliefs and intentions surrounding a number of different incentive types. Focus groups were used to 'drill-down', that is to explore in more detail some of the beliefs and attitudes held towards the incentives. The appropriate use for focus groups is to use them in design and exploration; to develop theory; or identify and highlight design features in new technologies. The nature of the focus group means that it has another advantage in the design process. In focus groups, participants can stimulate each other. Therefore, in circumstances when a new technology is being designed, it is difficult for any design team to foresee all the attitudes, beliefs, values, and uses that it might be subjected to. However, a focus group allows a set of significant design factors for any of the new technology to be expanded, thus increasing understanding and explanation of acceptability and potential use. In addition, focus groups provide the opportunity to explore incentive types that are not fully formed which is much more difficult in questionnaires.

**Questionnaires**

The qualitative data generated from focus groups was complemented with the quantitative data generated from the questionnaires. The questionnaires are a very important step in generalising theoretical precepts and were used here for the quantification of beliefs, attitudes, and intentions in a larger sample than what possible with focus groups.

### 3.2.5 Sampling and recruitment

The summaries of the population under study, the sampling technique and the recruitments of participants in Enschede, Leeds, and Gothenburg are presented in Table 4. The details of the sampling technique and the recruitment can be seen further in Appendix B.

**Table 4 The summary of recruitment and sample characteristics**

| City | Population | Sampling techniques | Recruitment & participants |
|---|---|---|---|
| **Enschede (Survey)** | • Adults (at least 17 years old)<br>• Live/work/study in Enschede or sometimes visit Enschede<br>• Smartphone and non-smartphone users<br>• Car and non-car users | Non-probability sampling techniques:<br>• Facebook & Twitter page<br>• Paid & unpaid advertisement<br>• Pop-up banners<br>• News brief of UTwente<br>• Flyers | • Online survey available from May to June 2012<br>• 136 total responses<br>• 46 incomplete responses<br>• 90 complete responses for the analysis |
| **Enschede (Focus group)** | • Smartphone owners<br>• Users of Social networks/life-style app or players of real-life games<br>• Those who sometimes drive to, from, or in Enschede | • Posters<br>• Emails | • 3 focus group sessions in June in UTwente<br>• The total number of 15 participants |
| **Leeds (Survey)** | • Smart phone users<br>• Car and non-car users | The West Yorkshire Travel Plan Network was used as the sampling frame. The participants were recruited using:<br>• Social media and professional networks<br>• Leaflets<br>• Emails<br>• Facebook & Twitter page | • Online survey and mediated sessions in UnivLeeds<br>• 92 complete responses for analysis |
| **Leeds (Focus group)** | | | • 3 focus group sessions in June in UnivLeeds<br>• The total number of 15 participants |
| **Gothenburg (Survey)** | • Smart phone users<br>• Suburb dwellers<br>• Commuting to go to work | Non-probability sampling techniques | • Online survey available from April to May 2012<br>• 48 people agreed to participate<br>• 40 complete responses for analysis |

### 3.2.6 Participants' characteristics

The participants' characteristics of the online survey in Enschede, Leeds, and Gothenburg are summarized below.

**Enschede**

The details of Enschede sample, including participants' socio-demographics characteristics, travel pattern and smartphone ownership can be seen in Appendix C. In brief, 51% male and 49% female respondents took part in the survey. A large percentage of the participants were aged between 31 and 40 years old (39%); followed by 51 years old and older (20%); and between 41 and 50 years old (19%). There was a relatively balance proportion of household with 2 persons (31.34%) and 3 persons and more

(36.67%). In addition, 67.75% of the participants were either employed or self-employed and 16.18% were university or colleague students. Among those employers, 45% indicated that they have flexible working hours. These figures have some degrees of similarities with the demographic figures of Enschede. In 2011, there were 51% male and 49% female (Centraal Bureau voor de Statistiek n.d.). The age category of 15-25 years old is well-represented in the sample, however other age categories are either slightly over or slightly under represented in the sample (in comparison with the figures reported by CBS). Unfortunately, we could not find other comparable figures that can be used to check how well the sample represents the population of Enschede.

With regard to the travel patterns, 79% of the participants had a driving license and 4% own non-car license (e.g. motorbike and moped). Among those having a driving license, nearly 60% indicated very frequent access to a car. In addition, 64% had a public transport pass, such as a season card or a discount card for bus or train. Additionally, 91% of the participants indicated that they are healthy enough to walk or bike. A large percentage of the participants stated that their main transport mode is bike. However, there is a quite large percentage of the participants how usually travel daily with a car. Data showed that driving is very popular for bringing and getting activity (e.g. children and elderly). In addition, more than 20 participants indicated that they drive more often than in the past years, indicating the importance of reducing car use. Thus, the figures showed that the survey collected attitudes and intentions towards certain incentives from various types of travellers, such as car drivers, cyclists, and those who use other modes.

We also asked the participants to indicate their smartphone ownership and use. The majority of the participants (68%) had a smartphone. 34% of those without a smartphone stated that they are planning to buy one in the next 6 months. 26% of the smartphone owners had an iPhone and 61% had an Android phone. In addition, the majority of the smartphone owners (92%) had mobile internet connection. Smartphone ownership and mobile internet connection are particularly important for the SUNSET project. For us, these figures give some assurance that the participants were able to imagine the scenarios in the survey.

**Leeds**

The descriptions of the participants as well as their travel pattern and smartphone use can be seen in Appendix D. A total of 92 people completed the survey online of which 50% men and 50% women. The overall population gender breakdown for Lees is 50.69% female and 49.31% male. The majority, 69.5% were aged between 18 and 35 and almost a fifth (19.6%) were aged between 36 and 44, and 8.6% aged between 46 and 57 and only 1 person at retirement age. This is plausible given that we targeted working people at their place of work and the corollary of this is that 92% reported that they were employed or studying and the rest were carers or could not work. In addition the age distribution is plausible given what we know of smart-phone users. Unfortunately a population profile for smart-phone users in Leeds is not available, however we do know that the age profile of Leeds citizens shows 22.5% aged under 20 years, 29% aged between 20 years and 35, and 13% aged 36 and 44, and 12% aged between 46 and 57 and 23% aged over 55 years and on the basis of that we can conclude that the age profile of the sample matches that of the sample.

In response to a question on regular travel by different modes 32.2% reported that they drive themselves every day in car, and this rises to 52.9% if frequency changed to 2-4 times per week. 11.5% reported that they travel by bus every day and 2.5% report that

they cycle everyday. In addition 72.4% reported that the journey to work took 30 minutes or less by car and 25.9% reported that the journey to work would take 30 minutes or less. These patterns indicate that there is potential to achieve significant congestion relief if we can find the right 'levers' for the group of city centre workers represented in this sample.

91 participants indicated their smartphone usage and 93.4% of them said they used their smartphone daily for texting and calling. 61.1% responded that they used social media apps on their smartphone everyday and 14.8% said they used their smartphone for gaming everyday. In response to the question about use of navigation apps and travel apps the majority said they used them weekly or monthly which is to be expected.

**Gothenburg**
The descriptions of the participants as well as their travel pattern and smartphone use can be seen in Appendix E. In brief, there were 64% male and 36% female participants in the Gothenburg survey. Almost half of them fell within the age category of 36-45 years old. This makes sense because Gothenburg targeted small families with children. In addition, all of the participants were employed in either a private company or a governmental organization.

With regard to the daily travel, 51% said that they use public transport daily for commuting. However, quite a large percentage of the participants (46%) stated that they do not cycle or walk when commuting. This could happen because of long distance between home and work place. 49% of the participants indicated that it takes them around half to one hour to commute and only 31% said that their commuting time takes between 10 and 30 minutes. 46% indicated that they have to change modality twice when commuting.

39 participants indicated their smartphone use during commuting and outside the commuting time. During commuting, news (67%) and social networks (38%) were usually accessed. Besides, they sometimes used entertainment apps (45%), travel planning apps (41%), and maps (46%). Outside the commuting time, news (59%) and social networks (49%) were also accessed often with a smartphone. In addition, gaming apps were sometimes played (36%).

## 3.3 Real-time travel information

### 3.3.1 Description (system provision)

The empirical work, across all three cities, involved taking a scenario depicting types of real-time information and asking people to place themselves into a specific context and to base their answers on that context. This was to ground the responses in their own experiences and to ensure that all the participants had a common description of the incentive. Real-time information has, in Section 2.2, been identified as having the potential to change travel behaviour and practices. In addition:

- We already know that information has to be supported by other initiatives, for example, free ticket for public transport 'tasters';
- The scenario linked real-time information with feedback information;
- The scenario depicted real-time information delivered onto a handheld mobile device which should have intensified the effect of the information if the individual user has the ability to see transport system conditions upstream;

- Respondents were asked to imagine that they were using the next generation of real-time information where the information is (a) available on handheld mobile devices/technology and (b) is more tailored, more personalised to the circumstances of the individual;
- Previous research and policy practitioners work on real-time information demonstrates its efficacy at changing travel behaviour but there is little work on using real-time information with mobile applications and not all of it is relevant to European contexts. We gave examples of a number of different existing real-time information sites with textual explanation and graphic representation.

We asked the respondents to imagine that the travel app can track the user's journeys and gives back information about travel with information about the travel on the transport system. See Figure 3 as an example, taken from the focus group description. The complete focus group protocols for Enschede and Leeds are attached (in Appendices F and G in turn).

**Real Time Travel Information**

**Imagine that you have a travel app that tracks your journeys and gives you back that information and then provides you with information about the conditions on the transport system, roads, buses etc. The aim being to help users to meet targets they may have set and to change travel patterns.**

**Imagine that the app. Has a feature that links to travel info. Site provided by Leeds City Council, www.leedsliveinfo.com and www.walkit.com and http://wypte.acislive.com/ reminding users when they pick the phone up in the morning that there may be alternatives to routine or habits. You can use this to motivate you further or find others who want to join in and do the same.**

**An example of information website from Leeds Travel Information providing information about problems on the road network.**


**An example of information from www.waklit.com providing information about walks that others have done in Leeds.**


**Figure 3 Real-time travel information incentive, Leeds, 2012**

### 3.3.2 Findings (system provision)

*Overall attitude*

The qualitative and quantitative exploration of the impact of real-time information raised issues of trust and accuracy and the gap between attitude and intentions. The real-time information system was placed in the context of having targets for travel behaviour and assisting with behavioural change. An exploration of the impact of real-time information to meet goals or targets they have set for themselves using the questionnaires and focus

groups asked questions designed to reveal beliefs about usefulness, and the impact on behavioural intentions and specific behaviours such as using the car less, for example:

- *"I will make the effort to use a smartphone app that gives me real-time road network information and traffic"*
- *"Links to real-time information would ...be useful for me"*
- *"Links to real-time information would ...help me to use my car less"*

The initial findings from this exploration, using both qualitative and quantitative datasets, indicate that there are positive attitudes and beliefs towards real-time information and this is the same in all three cities and is consistent with the findings of previous research and is a plausible conclusion.

*Usefulness and behaviour changing*

The incentive was perceived as being of use and useful on both routine and familiar and non-routinized and unfamiliar travels. The qualitative dataset indicates that this is a feature and incentive that would be useful for planning for infrequent disruptive events such as road works, and also to reduce uncertainty in regular travel patterns such as giving parking information and reducing search time.

The qualitative dataset revealed remarkable similarities between the Leeds and the Enschede focus group responses to the questions about the usefulness and impact of real-time information (Table 5 and Table 6).

**Table 5 Focus group responses to real-time information incentive, Enschede, 2012**

| | Strongly Agree | Slightly agree | Neither | Slightly disagree | Strongly Disagree |
|---|---|---|---|---|---|
| **Links to real-time information would…** | | | | | |
| **...be useful for me** | 6 | 1 | 2 | 0 | 0 |
| **...be something I would use to make travel choices** | 5 | 3 | 1 | 0 | 0 |
| **...help me to use my car less** | 3 | 3 | 3 | 0 | 0 |
| **...Help my family to use the car less** | 1 | 3 | 5 | 0 | 0 |
| **...Help me to feel more in control of my travel** | 3 | 5 | 0 | 1 | 0 |
| **...Help me with my scheduling** | 5 | 2 | 2 | 0 | 0 |

Highlights indicate the most responses

**Table 6 Focus group responses to real-time information incentive, Leeds, 2012**

| | Strongly Agree | Slightly agree | Neither | Slightly disagree | Strongly Disagree |
|---|---|---|---|---|---|
| **Links to real-time information would…** | | | | | |
| **...be useful for me** | 8 | 2 | 0 | 1 | 0 |
| **...be something I would use to make travel choices** | 6 | 4 | 1 | 0 | 0 |
| **...help me to use my car less** | 3 | 3 | 3 | 0 | 2 |
| **...Help my family to use the car less** | 2 | 2 | 5 | 0 | 2 |
| **...Help me to feel more in control of my travel** | 5 | 6 | 0 | 0 | 0 |
| **...Help me with my scheduling** | 6 | 3 | 1 | 1 | 0 |

Highlights indicate the most responses

Each city explored the antecedents to behavioural choices including intentions, perceptions of the outcomes of using the incentive as an application feature and the attitudes to the incentive using quantitative techniques. The majority of the respondents in each of the quantitative datasets held a positive attitude to the real-time incentive (Table 7). Positive attitude is measured using bipolar semantic Likert scale measuring agree/disagree to specific belief statements such as: *"Being able to get real-time road network information and traffic alerts through an app will... give me a good feeling"*.

**Table 7 Overall behavioural antecedents for real-time information incentive in three cities, 2012.**

| | Enschede | Gothenburg | Leeds |
|---|---|---|---|
| **Positive attitude** | 63% (n=90) | 93% (n=40) | 84% (n=90) |
| **Negative attitude** | 17% (n=90) | 3% (n=40) | … |
| **Intention** | 57% (n=90) | 36% (n=40) | 45% (n=90) |

Table 7 also indicates that real-time information has the potential to influence behavioural change but that other measures may be needed to be able to make real-time information a significant determinant of behavioural change. There is also some variation between cities. Gothenburg and Leeds show more positive attitude to the incentive but the respondents are less likely to say that it will impact on their behaviour. The beliefs about intention and beliefs about people's ability to control their own behaviour change were explored for each city. These are measured using belief statement and a 5 or 7 point Likert scale of agree/disagree.

The survey work in the city of Enschede shows positive attitudes and beliefs (Table 8 and Table 9) that the incentive would be of use in everyday life. There is some variation in the strength of belief between pleasant and useful and that can be explained by the incentive itself. It has clear functionalities and its attractiveness is not really built on how pleasant it is.

**Table 8 Real-time information incentive attitudes, Enschede, 2012**

| | 1 (+++) | 2 (++) | 3 (+) | 4 (Neutral) | 5 (-) | 6 (--) | 7 (---) |
|---|---|---|---|---|---|---|---|
| **Useful** | 8 (8.9%) | 21 (23.3%) | 30 (33.3%) | 11 (12.2%) | 11 (12.2%) | 6 (6.7%) | 3 (3.3%) |
| **Valuable** | 3 (3.3%) | 21 (23.3%) | 30 (33.3%) | 19 (21.1%) | 10 (11.1%) | 5 (5.6%) | 2 (2.2%) |
| **Pleasant** | 3 (3.3%) | 27 (30%) | 28 (31.1%) | 24 (26.7%) | 3 (3.3%) | 3 (3.3%) | 2 (2.2%) |

Highlights indicate the most responses

**Table 9 Real-time information incentive intentions, Enschede, 2012**

| | 1 (+++) | 2 (++) | 3 (+) | 4 (Neutral) | 5 (-) | 6 (--) | 7 (---) |
|---|---|---|---|---|---|---|---|
| **Would like** | 13 (14.4%) | 17 (18.9%) | 28 (31.1%) | 12 (13.3%) | 12 (13.3%) | 5 (5.6%) | 3 (3.3%) |
| **Plan** | 12 (13.3%) | 15 (16.7%) | 24 (26.7%) | 15 (16.7%) | 9 (10%) | 10 (11.1%) | 5 (5.6%) |
| **Effort** | 8 (8.9%) | 11 (12.2%) | 26 (28.9%) | 26 (28.9%) | 7 (7.8%) | 8 (8.9%) | 4 (4.4%) |

Highlights indicate the most responses

Clearly we can see that whilst attitude and belief are an antecedent to behaviour they are not always the only antecedent. The dataset from Enschede shows clearly that there are positive beliefs yet those beliefs are not as strong when it comes to actual behavioural change and using the incentive to impact on travel behaviour.

The dataset from the Leeds questionnaire (Table 10 and Table 11) clearly shows that there are, similar, positive beliefs about the capacity of the incentive to help with planning activities yet less agreement with statements about increasing and improving control of travel and scheduling of activities and finally an emphatic change in beliefs about its effectiveness to reduce car use.

**Table 10 Real-time information incentive attitudes, Leeds, 2012**

| | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Don't know |
|---|---|---|---|---|---|---|
| **Usefulness** | 51 (56.7%) | 31 (34.4%) | 5 (5.6%) | 0 | 1 (1.1%) | 2 (2.2) |

Highlight indicates the most responses

**Table 11 Real-time information incentive control beliefs and intentions, Leeds, 2012**

| | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Don't know |
|---|---|---|---|---|---|---|
| **Would use** | 43 (48.3%) | 33 (37.1) | 7 (7.9%) | 3 (3.4%) | 2 (2.2%) | 1 (1.1%) |
| **Plan travel** | 52 (58.4%) | 29 (32.6%) | 4 (4.5%) | 2 (2.2%) | 1 (1.1%) | 1 (1.1%) |
| **Improve control of travel** | 36 (40.9%) | 34 (38.6%) | 13 (14.8%) | 2 (2.2%) | 1 (1.1%) | 1 (1.1%) |
| **Fit with other activities** | 35 (39.8%) | 32 (36.4%) | 15 (17.0%) | 2 (2.2%) | 2 (2.2%) | 2 (2.2%) |
| **Reduce car use** | 14 (15.9%) | 24 (27.3%) | 28 (31.8%) | 11 (12.5%) | 4 (4.5%) | 7 (8.0%) |

Highlights indicate the most responses

In Gothenburg, we see the same pattern as in Leeds (Table 12). There is a positive belief that this is a useful incentive but the strength of the belief changes dramatically when asked if they would act on the information they receive from this incentive.

**Table 12 Real-time information incentive attitude and intention beliefs, Gothenburg , 2012**

| | 1 (+++) | 2 (++) | 3 (+) | 4 (Neutral) | 5 (-) | 6 (--) | 7 (---) |
|---|---|---|---|---|---|---|---|
| **Useful** | 19 (47.5%) | 16 (40.0%) | 2 (5.0%) | 2 (5.0%) | 0 | 0 | 1 (2.5%) |
| **Follow advice** | 5 (12.8%) | 13 (33.3%) | 12 (31.0%) | 8 (20.5%) | 1 (2.5%) | 0 | 0 |

Highlights indicate the most responses

The dataset indicates that people's (outcome) beliefs about the impact of real-time information are that it would be useful. This is consistent across the three Living Lab cities. The datasets at city level also demonstrate beliefs that this kind of information has the potential to make users feel more in control of planning and scheduling their travel and that translates into action to change mode for a significant proportion of those asked. However, the strength of belief about whether this kind of information feature will help them to reduce their car use is not as strong as the beliefs expressed about usefulness. This indicates that (a) there are factors other than knowledge of the alternatives that are constraining choices; and (b) that additional incentives may be needed to make changing behaviour feasible, attractive and worthwhile. Generally in transport planning it is the constraint of the return journey in an individual's decision-making that is neglected. For an individual the real-time information about the specific immediate journey is off-set by plans and obligations on the return journey. This constraint is further exacerbated if the return journey is time-pressured for example, in households with children who need collecting from childcare and school. Real-time information needs to prove its worth on the return journey to ensure that it can satisfy the needs of travellers particularly if individuals are being encouraged to swap from car travel to public transport. Real-time information incentives have the potential to be used as a key part of a 'bundle' of incentives to reinforce the attractiveness of alternatives to travelling by car.

*Accuracy, reliability and trust*

The qualitative dataset indicates some of the issues that are relevant to increasing the usefulness of this type of incentive and the potential for this incentive to support travel behaviour change. The issues that arose in different focus groups across different cities were similar and included usefulness, accuracy, trust and presentation.

Accuracy was a significant issue across all cities. The important issues here included the accuracy of the content of the messages. In particular users with experience of existing real-time information systems in Leeds commented that one of the existing systems was:

"*[r]ubbish*"…because…"*It's not accurate*" (120607 Lds, male, p33).

Some users reported that they had found their own ways of verifying information from real-time information systems and also alternative ways of finding real-time information about existing road traffic conditions including using Twitter sites to:

"*Find out if there are people… generally just interested where people are complaining about road works*" (120607 Lds, female, p33).

In the same discussion, another suggestion was made for designing the SUNSET application and incentives which anticipated incentives that would subsequently be put to them:

"*I was just thinking as I was going through this it would be really good rather than relying on a system to tell you when the roads are blocked on the tracker it would be ace if you could, people who are sat on the bus that can tag into it going: oh god, more road works*" (120607 Lds, male, p33).

This suggestion is also notable for the implication that there would be a map representation of events that could be tagged by users.

A related aspect of accuracy was the timing and the relevance of messages. The suggestions were that alerts and messages should be sent to be timely and relevant and that messages should be spatially appropriate so that only relevant alerts and messages (e.g. on usual routes, on a route planned today, on current route) are given to users to avoid unnecessary alerts and messages:

"*I want information of the road I just planned for today*" (200612 II-v-25:00 Ens, female).

"*It would also be nice if the app understands that I am not in my usual route and then just try to guess where I am trying to go, that is if you do not plan your travel before you start it…*"(200612 II-v-27:00 Ens, male).

"*Or [the app knows that] you do not travel on your usual route today, [then the app asks] do you want traffic information for other destination?*" (200612 II-v-27:30 Ens, female).

"*Or if you do not plan the trip, it may be possible that the app gives you all traffic information within 2 km radius from your location…*" (200612 II-v-28:37 Ens, male).

*Presentation of real-time information (system)*

There were a number of comments about the presentation of alerts. Common to all cities was the clear and firm suggestion that messages and alerts should not be disturbing and could be designed to be a small icon in the corner that lit or flashed or changed colour when a relevant message was sent. The underlying principle is that users want control over the messages and to be able to choose whether to 'use it' or 'opt in' or not. It was not thought to be attractive to have an incentive function that disturbed users during their daily activities. In addition the suggestion was made in one focus group that there should be a function that allows users to filter information based on their own preferences:

"*This notification, it was also mentioned before, how strong will they nag me? Can I still… I mean will it be [given] during phone call or it will be something on the top [of the phone] that I can choose to open when I want to?*" [researcher asked which one that she prefers] "*The one that I can open when I choose to*" (200612 II-v-11:30 Ens, female).

"*Don't make it [notification/information] so annoying*" (200612 II-v-11:45 Ens, male).

"*Why can't I just select it [when to be given information/notification] in the settings, some people like to get a pop up while others prefer no message to appear when calling…*" (200612 II-v-13:00 Ens, male).

"*I want information on my own demand*" (200612 II-v-26:00 Ens, female).

"*I do not want it to be a pop up again, I want it to work only when I tell it to work …*" (200612 II-v-27:56 Ens, female).

### 3.3.3 Description (peer-to-peer exchange)

The research work looked also at the provision of real-time information by other users. This is an incentive whereby individuals using the application send in alerts and experiences. The survey work involved a scenario depicting a situation where users can share information with each other about travel conditions. This would be instantaneous information available to all users of the application. So offering a real benefit to being involved in using the application and a service to provide other users with early warnings of delays and other travel conditions both expected and planned and unexpected. Examples included bus users sharing information on delays, walkers providing information on delays, hazards on the footpath, and cyclists sharing information on deep puddles or hazardous turns and camber. The scenario depicted an aim of forming a community, a network using the social media opportunities provided by the application, which keeps each other up to date so that information can be used to make travelling more efficient and pleasurable.

A scenario was used to 'ground' responses in experiences and to reduce speculation and to ensure a common description of the incentive. The scenario was able to draw on Twitter (Figure 4) as an example of how this incentive would work so many of the users had a very good idea of how they might share experiences for mutual benefit.

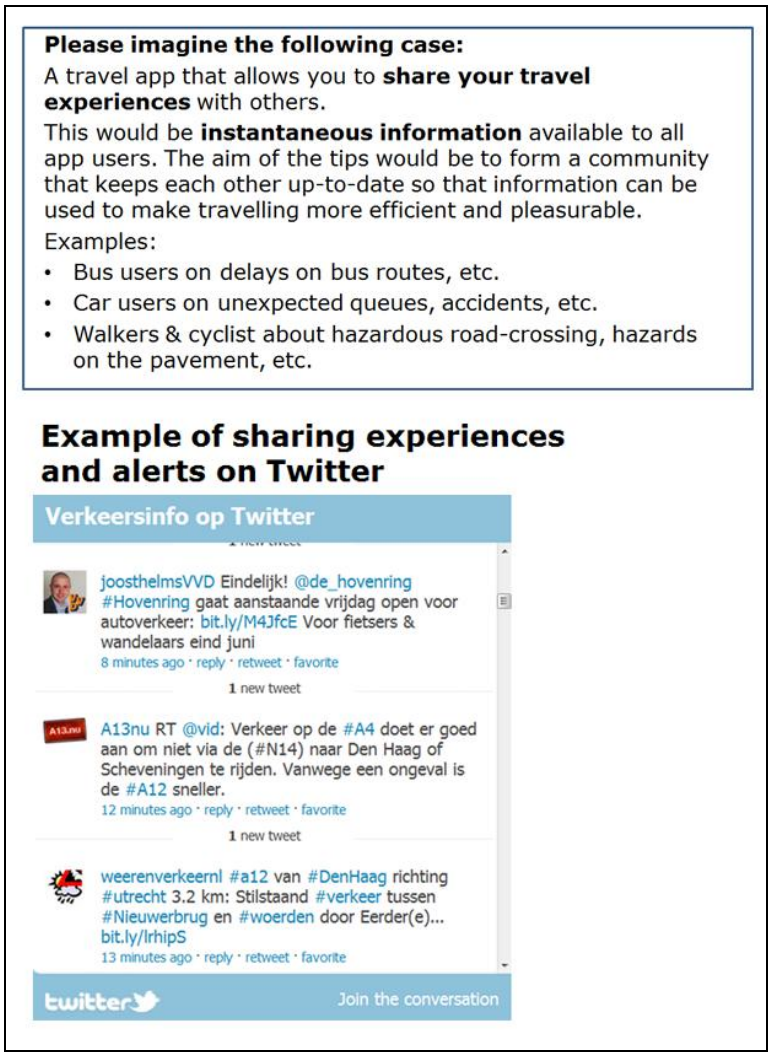


**Figure 4 Alerts and experiences incentive, Enschede, 2012**

### 3.3.4 Findings (peer-to-peer exchange)

A number of key issues were raised in response to this incentive. In particular, concerns were expressed in Enschede about the usefulness of the information and whether it would be as attractive as actual traffic information. In Leeds as shown earlier a different view was that this kind of information could augment existing traffic information systems and be more immediate.

A further issue raised in all cities was the trustworthiness of the source of information. We observed that there is a common positive attitude to this incentive with 66% of those asked in Leeds (n=90) and 73% of those in Gothenburg (n=40) indicating they agree they would be happy to contribute to such a system (Table 13). In Enschede, participants also have positive attitudes towards this incentive even though they are not as strong as real-time information (system provision) incentive (Section 3.3.2). We explored the trust that would be given to information provided by individuals and then the impact if the transport authorities were also involved in the exchange of information. Our exploration demonstrated that the most obvious attribution to any incentive designed to share information is to include transport system authorities. This was common response from people and one that could be done to authenticate or to moderate any information

sharing or both. Exploration using quantitative datasets in Leeds showed that attitudes changed if transport authorities were involved and in general confidence increased if they were involved.

**Table 13 Attitude to sharing information incentive in three cities, 2012**

| | Positive*** | Neutral*** | Negative*** |
|---|---|---|---|
| **Enschede*** | | | |
| **Happy to contribute** | 87% | 12% | 0% |
| **Trust the information** | 75% | 25% | 0% |
| **Happy if road authority involved** | 50% | 37% | 12% |
| **Leeds**** | | | |
| **Happy to contribute** | 66% | 17% | 12% |
| **Trust the information** | 56% | 22% | 16% |
| **Happy if road authority involved** | 52% | 27% | 15% |
| **Gothenburg**** | | | |
| **Happy to contribute** | 73% | 5% | 21% |
| **Trust the information** | 78% | 12% | 11% |
| **Happy if road authority involved** | 77% | 10% | 12% |

*From Enschede focus group questionnaire (N=8)
** From survey
***Rounding and don't know mean answer will not sum to 100

In Gothenburg and Leeds beliefs about the trustworthiness of information provided in this way were explored further and the impact of using quantitative techniques and enumerated. In Leeds this issue was explored in some detail and one participant reported that they could imagine how others might send in false reports to watch and enjoy any ensuing changes and reactions:

*"My problem with it is, I'm not a very nice person at times and I will lie about this sort of stuff just for the sake of it, I mean, (inaudible 1:19:37) [my partner] all the time just to see her reaction. So I think... it could be misused by people just lying"* (120612 Lds, male, p29).

In response, the influence of involving transport system authorities was explored as a way of ensuring valid and authentic information is shared:

*"Yes, you can use it to wind people up, but if you have done something... Like a passenger has alerted, immediately the authorities can validate that and say, 'yes, that's true, that's what the realities are', and then that way it authenticates it"* (120612 Lds, male).

The suggestion of involving transport system authorities to authenticate messages was explored and it was argued that in some ways having them involved negated the need for people to do it for themselves, however; it was pointed out that the people travelling are an immediate source of information and one that can be used to help each other. In Enschede, similar issues were raised and it was argued that rewards are important to retain people's interest in the application and to keep people sharing.

In general, in the Enschede focus groups, the issue of trustworthiness of the source of information was not raised as strongly as in Leeds. There were more positive responses towards the concept of having a community in which users can share travel experiences and tips. However, users' anonymity was one of the important remarks noted by participants several times:

*"I like the idea of a sort of community where you can put information about Tripzoom… Also, even if it is not a real community but a place to put information of what*

*happens on the road and if you are not obliged to be recognized by your name, that I think is always good"* (200612 II-v-33:34 Ens, male).

Other issues relevant to the design raised in qualitative exploration of the incentives include how responsive it is to individual's circumstances. This issue was raised in two different ways. The first was that messages broadcast to individuals should be tailored to individual's own circumstances. The concern here was the same as that expressed earlier about real-time information systems, that irrelevant messages are of less interest and a deterrent to using the application. The second issue relates to the time period for retrieval of messages because some messages are of immediate value but others retain value over a period of time. The suggestion was made that messages about the transport system infrastructure and provision should be a searchable dataset of messages because some alerts and information about transport system might only be of relevance in the immediate future such as delays to services, but other kinds of alerts and information might be as relevant over a period of time, such as potholes for cyclists and motorists and dangerous junctions for pedestrians:

*"Would it be a searchable thing? Obviously real-time information is relevant to public transport, if a train's broken down or there's a bus has been moved, that's obviously immediately relevant, but for walkers or cyclists it might be a pothole which... Someone might have said six months ago, 'oh be careful on this section, there's a pothole that you can't see till this last minute, or this might be a dangerous junction.' And that's still relevant but no one's going to be saying it every five minutes"* (120612 Lds, male).

In addition there are types of information that only become relevant and informative over a period of time such as repeatedly risky areas and roads. The first principle expressed is that a productive incentive is one that can be tailored and personalised to an individual's own circumstances and preferences and the second is, again, that the individual user wants to have control and exercise choice over which functions, features and aspects they join contribute to and interact with.

Other issues introduced included the need for messages to be presented so that they are not disturbing and to be clear that messaging should not be done whilst driving and cycling so that the Tripzoom system is not causing hazardous conditions or against the legal system:

*"If I experience traffic jam on the road, then how would it [sending tips and alerts] work? Do I have to report it manually?... But I am not allowed to use my phone while I am driving, then how can I report the road problem?...when I am in the car and the engine is running on the road I am not allowed to use the phone"* (200612 II-v-36:00 Ens, female).

### 3.3.5 Summary

To create feasible and productive incentives using real-time information in a peer-to-peer exchange system the evidence gathered both from qualitative and quantitative sources supports the following findings:

- Accuracy is an absolute must for attractiveness and productive use;
- Timeliness and relevance are the key design principles to make real-time information useable;
- Trust for users sharing information and alerts can be increased through the introduction of authentication and validation techniques;
- Authentication and validation can be provided by transport system authorities;
- Message design should not be disturbing – the 'opt-in' in principle;

- Potential to impact on behavioural antecedents yet still a 'gap' between positive belief and intentions;
- Productive if included as part of user-defined grouping of incentives to provide accumulation and reinforcement of behavioural change.

# 3.4 Feedback

## 3.4.1 Description

In this work we built on the fundamental design feature of the Tripzoom application; that of being able to see one's own travel. The 'feedback' incentive was designed to allow people to actively use this Tripzoom capability. It was designed so that users could see their own travel patterns and use that awareness and knowledge to be able to enumerate and set targets for themselves for travel behavioural change. The selection of goals for which targets could be set was informed by the understanding of those factors which have an impact on travel and it was decided to include:

- Distance travelled by car, or bus, or bike or walking;
- Time spent travelling by car, or bus, or bike or walking;
- Calories spent whilst travelling by car, bus, bike or walking;
- Money spent whilst travelling by car, bus, bike or walking;
- CO2 emissions produced from travelling by car, bus, bike or walking.

Obviously we set the direction of change for each goal to ensure that there was consistency with the transport system and policy aims and aspirations particularly around reduction of car use and CO2 emissions and increases in active modes. A lot of these categories are mutually reinforcing, for example, if you set a target of reducing distance spent in car then you will at the same time increase the amount of calories expended and reduce costs. It is this articulation of the individual and separate effects and benefits and the ability to enumerate and measure them which has the potential to work in combination with real-time information on alternatives. In addition, this incentive is intended to help to provide an 'immediate reward', so an immediate feedback on the effort that the individual has exerted to encourage them to stay with their change.

In this work we designed a scenario on which the participant was asked to imagine that they had the capacity to set targets for their own behaviour (Figure 5 and Figure 6). This was an incentive designed to assist people to enumerate the changes they wished to make in their daily life and associated with their travel. The incentive was specified so that different aspects of daily travel could be enumerated and targets set. The concept of an incentive presupposes that there is a target to be met. In this incentive we gave the user the opportunity to be in control of those targets and to use them to make changes to travel behaviour and to meet personal goals of CO2 emissions, fitness, costs and savings.

**Please imagine the following case:**

A travel app that allows you to **set your OWN travel targets** and to help you to achieve them.

These could be targets to do with:

- **Distance** travelled by car, bus, bike, or walking
- **Time** spent travelling by car, bus, bike, or walking
- **Calories** spent whilst travelling by car, bus, bike, or walking
- **Money** spent whilst travelling by car, bus, bike, or walking
- **CO2 emissions** produced from travelling by car, bus, bike, or walking

**Example of setting CO2 target in COMMUTE GREENER**

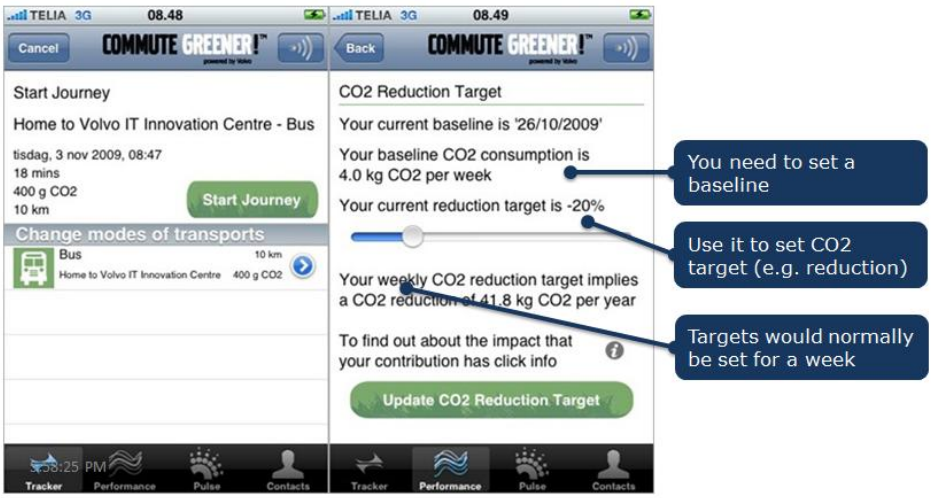


**Figure 5 Personal targets incentive, Enschede, 2012**

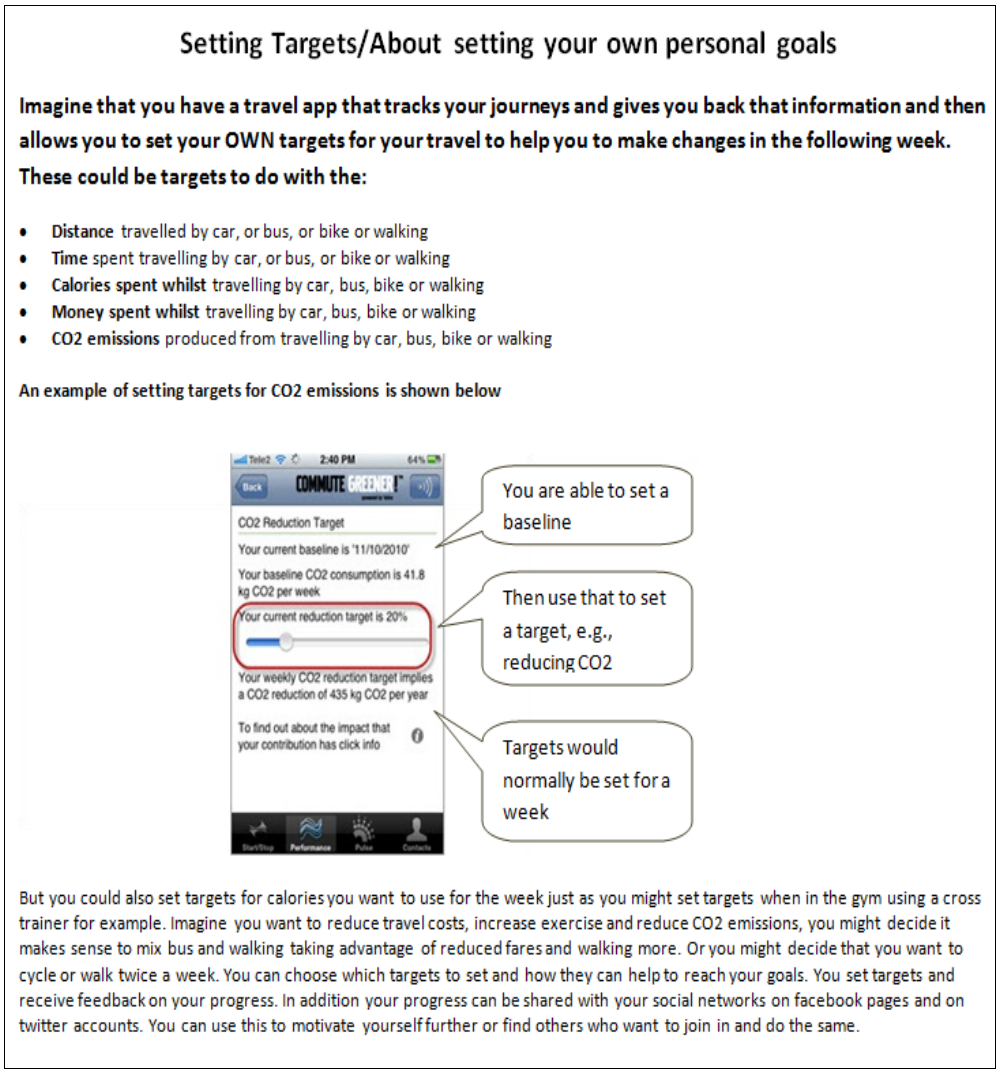


**Figure 6 Personal targets incentive, Leeds, 2012**

### 3.4.2 Findings

A number of issues arose from the qualitative dataset, the first was that potential users are quite aware of the wider political and cultural context and as a result are looking for the motivation underlying incentives in the mobile Tripzoom application. They could see clearly how the work on setting targets could be placed within a general media discussion of political aspirations to reduce car use and CO2 emissions. The result of this was that when car travel was discussed, there was a focus on relative behavioural change. Users looked at car travel and indicators for car travel in relation to other modes and the suggestion was made that the incentive should be presented as a change from car travel to other modes using a slide rule display so that individual can monitor their own behaviour in a simple graphic which can reinforce the change that the individual user wants to see.

A corollary of this issue was the extent to which the application was there to be a tool for advising rather than lecturing users and the view was that a lecturing tool would not be attractive. To be attractive these features of the application should have variety and encourage curiosity:

*"Punten zouden me aanzetten, zolang het maar niet dwingend overkomt. Het moet je niet de les lezen, maar het moet als een beloning voelen" [Translation: Points would motivate me, but only if it isn't imperative. Advice/feedback should not be lecturing, but it should feel as a reward] (180612 75 Ens, male)*.
A related issue was that feedback should be placed within a context so that people could compare their performance with meaningful examples such as, average distances between some cities. The need expressed here is for some form of context and arguably this would be provided by the Tripzoom function which allows individuals to review previous mobility patterns:

*"Perhaps [setting target about] kilometres of driving would be nice, for instance [the app tells me that] I already travel from here to Paris… or in the Guiness [World Records] someone did it in a week, so something that can keep you motivated"* (200612 II-v-52:27 Ens, male).

*"Like Endomondo, it tracks me how many times I travel from here to the moon and around the world"* (200612 II-a-53:00 Ens, male).

*"Een virtuele boom: als je iets goeds doet, dan groeit en bloeit je boom" [Translation: A virtual tree: if you do something good, the tree will grow and flourish]* (210612 91 Ens, female).

A related issue that emerged from the qualitative dataset is about 'immediate rewards'. The Tripzoom feature has the potential to impact on user retention and interest by providing the relatively 'immediate reward' of showing an individual the benefit of changing travel behaviour particularly if the change is from car travel to active modes then benefits can be shown in reduced CO2 emissions and calorific burn and travel costs savings, as was articulated in one of the focus groups:

*"Something I'd be interested in is if you saved money on your travel and then say you've saved 50 pence this week you've now banked 50 pence"* (120607 Lds, female).
This kind of insight into personal travel behaviour change and its impacts was positively received. There was some comment on the accuracy of calculation for some of the metrics and the suggestion that the CO2 emission should be based on vehicle and fuel types which is no different to what is found in many car purchase guides.

Beliefs about the impact of the incentives are important to understand as behavioural antecedents. Measuring intentions in very speculative scenarios often results in unreliable findings that cannot be used to accurately predict take up and impact and as we have seen elsewhere. The constraints of travel behavioural change are often related not only to having the right information and feedback, but also practical solutions to some of the scheduling problems integral to everyday family life. In such circumstances no predictive model would be able to explain all the variation in behaviour.

We looked at beliefs and variation in beliefs across the three cities to inform an understanding of the impacts of the incentive and potential antecedents of behaviour. Across all three countries we asked about possible use and impact of the incentive in travel and in key aspects of travel such as modal change, increased calorie usage, cost savings and CO2 emissions reduction. Each factor chosen to support the policy aspirations at city and EU level as described in D3.1, 'Objectives'. The main focus of the research was to determine the extent to which it was feasible to 'mainstream' the setting of behavioural goals or targets in the areas of costs, time, distance, CO2 emissions, health and wellbeing. This would be different to the current range of applications available. At present target setting behaviour in travel can be seen in specialist apps such as those that appeal to people who have already made the decision to reduce CO2 emissions such as 'Commute Greener', and in lifestyle apps such as those

monitoring diet and fitness, for example, 'Weightwatchers', or those applications designed to appeal to niche markets that which to improve sport performance and health and fitness applications such 'STRAVA' (social media based cycling performance monitoring and competing) or 'Mapmyrun' or 'Runkeeper' (social media based running performance monitoring). 'Walkit.com' is a social media based walking mapping which is based solely on sharing performance statistics but not necessarily competing.

Overall we found a generally positive attitude to the incentive (Table 14) and can conclude that the majority of those surveyed had a positive attitude to setting targets and the impact on behaviour. The implication of this is that there is potential to have an incentive on setting targets in everyday travelling and commuting which broadens the target setting behaviour out from niche behaviours and into mainstream behaviours such as the daily commute. It is possible to conclude that there is a positive attitude to a mainstream application which could enable the travel behavioural changes that policy makers would like (improved health and reduced CO2) to see in ways which are meaningful in the everyday lives of individuals (saving costs, keeping fit).

**Table 14 Overall attitude to setting targets incentive in three cities, 2012**

| | Positive | Neutral | Negative | Sample size |
|---|---|---|---|---|
| **Enschede** | 40 | 36 | 24 | 90 |
| **Gothenburg** | 46 | 23 | 30 | 39 |
| **Leeds** | 47 | 30 | 14 | 90* |

* 9% don't know

The work looked in some detail at the beliefs about the impact of setting targets in everyday life (Table 15). We see variation between beliefs indicating that there is less belief on its efficacy to reduce CO2 emissions and variation between cities. In the variation in beliefs across cities the direction of the belief is similar but the magnitude is different, so fewer people in Gothenburg have as positive belief as those in Leeds. In Enschede, people's positive beliefs are even lower than those in Gothenburg.

**Table 15 Beliefs about impact of setting targets incentive in three cities, 2012**

| | | Enschede* | Gothenburg* | Leeds* |
|---|---|---|---|---|
| **Reduce car use** | Agree | 22% | 35% | 51% |
| | Neutral | 31% | 26% | 27% |
| | Disagree | 47% | 39% | 13% |
| **Increase calorie use /improved well-being** | Agree | 34% | 39% | 61% |
| | Neutral | 27% | 22% | 21% |
| | Disagree | 39% | 39% | 11% |
| **Saving travel costs** | Agree | 29% | 52% | 81% |
| | Neutral | 32% | 21% | 7% |
| | Disagree | 39% | 27% | 7% |
| **Reducing Co2 emissions** | Agree | 30% | 41% | 52% |
| | Neutral | 29% | 36% | 31% |
| | Disagree | 41% | 23% | 9% |
| | | n=90 | n=39 | n=90 |

*Rounding and don't know mean answer will not sum to 100

Enschede is the main Living Lab for the SUNSET project and it was thought proper to attempt to model potential intentions if individual travellers were to use the Tripzoom app with the targets/setting goals incentive and so more detailed work was undertaken there to establish estimates of intentions. This analysis indicates that there is some agreement that this incentive would impact on intentions. It is possible to say that between 20 and

30% of those answering indicated that the application and incentive would impact positively on their intentions to use the incentive (Table 16).

**Table 16 Intentional beliefs for Setting targets in Enschede Survey, 2012.**

| | Strongly agree | Slightly agree | Agree | Neutral | Disagree | Slightly disagree | Strongly disagree |
|---|---|---|---|---|---|---|---|
| **Would like** | 4 (4.4%) | 10 (11.1%) | 23 (25.6%) | 20 (22.2%) | 7 (7.8%) | 12 (13.3%) | 14 (15.6%) |
| **Plan** | 2 (2.2%) | 5 (5.6%) | 19 (21.11%) | 24 (26.7%) | 13 (14.4%) | 7 (7.8%) | 20 (22.2%) |
| **Effort** | 2 (2.2%) | 2 (2.2%) | 18 (20%) | 42 (46.7%) | 11 (12.2%) | 5 (5.6%) | 10 (11.1%) |

N=90
Highlights indicate the most responses

An additional issue raised in discussions was that of 'trust' but in this context the issue was the extent to which the sensors and data would accurately detect location using the GPS sensor and accurately detect travel patterns. The focus group participants in Enschede were in particular concerned with the accuracy of the GPS sensor:

*"…I want to talk again about the accuracy [of the GPS receiver], what I want to add that actually the accuracy [of the GPS sensors] of these devices is very important for this kind of applications because if you do not have a good accuracy for particular use then it can be a big problem for the application…"* (200612 I-v-35:20 Ens, male).

*"I do not like to use apps that use GPS because it is really difficult to get good signal but there are many apps that locate you based on phone or WiFi signals, those I like…"* (200612 I-v-36:04 Ens, female).

*"…with Foursquare, I never use GPS but it tells me exactly where I am, perhaps not very exactly but very close to where I am…"* (200612 I-v-38:10 Ens, female).

*"How the mode can be detected?"* [the researcher explains that the mode is detected using accelerometer] *"Then how can you differentiate car and bus for instance?"* [the researcher explains that the system will learn and initially you may need to correct the detected mode manually and the respondent did not seem too happy with that] (200612 I-v-42:00 Ens, male) .

The potential users represented by those in the focus groups were keen to explore the levels of accuracy of the application and the extent that they could 'trust' it to achieve its stated functionality.

### 3.4.3 Summary

To create feasible and productive incentives using feedback, the evidence gathered both from qualitative and quantitative sources supports the following findings:

- It is feasible for feedback to be a mechanism that can be mainstreamed into everyday travel behaviour and there is evidence of a positive attitude to feedback and targets;
- Variation in beliefs indicate that there is some reluctance to believe that setting targets can impact on CO2 emission reduction;
- Variation in beliefs between cities indicate that there may be country and culturally specific constraints which impact on efficacy of the incentive;
- Productive incentives using feedback should explore immediate return of information;
- Productive incentives using feedback should explore using concrete metrics to enumerate the change;
- Productive incentives using feedback should provide context for individuals to know how well they are doing;

- Accuracy and the 'trustworthiness' of the data are also issues affecting use and eventually user retention.

## 3.5 Points and rewards

### 3.5.1 Description

One of the key innovations of the SUNSET project is to develop social mobility services that motivate people to travel more sustainably in urban areas through and benefit themselves from being involved in the application and from using incentives. In the empirical works, we designed a number of scenarios to try to understand the individual's beliefs and opinions about the different incentive features of the application. The scenarios were also used with the research participants to 'ground' their beliefs and opinions. One of the novelties we looked at the use of 'points based systems' as a mechanism to depict benefit and as a mechanism to be able to 'purchase' rewards, so the points are a kind of 'common currency'. This common currency provides flexibility in determining the final reward and provides for future enhancements of the system, whereby there can be cross-sectoral integration. Individuals can gain points through accomplishments such as achieving targets in travel behaviour change. In the scenarios used in the empirical work these travel behavioural changes are designed to contribute to more sustainable ways of travelling and reducing car use, thus achieving the system management goals of individual cities and the policy goals of individual cities and the European Union.

We asked respondents to imagine that they could collect 'points' each time they reached a target they had set for themselves (Figure 7). Exploration of the impact of points was done in focus groups in Enschede and Leeds, and in questionnaire survey in Gothenburg and Leeds. The following scenario was used in the qualitative and quantitative work throughout the three cities.

**We now want you to imagine that this app. allows you to set targets but also gives points for each target reached which is calculated automatically. For example if a target is set to increase calories used by 5% the app would then give points, e.g., 100 points every time that target is reached. In addition the number of points gained can be shared with your social networks on facebook pages and on twitter accounts. You can use this to motivate yourself further or find others who want to join in and do the same.**

**Figure 7 Target and points incentive, Leeds, 2012**

### 3.5.2 Findings

Our research work on this type of incentive found answers to the task research questions:

- Investigate key factors that influence the use of information messages;
- Develop a set of feasible and productive incentives to change mobility as detailed in section 1.1. Our investigation of the impact of points on beliefs and intentions looked at a number of key issues in the use of points and rewards based systems, including:
    - Collection of points;
    - Using points and exchanging them for rewards;
    - Using points to share within social networks;
    - Using points to rank with other app users;

- Collecting points as you would with a loyalty card.

The point based system was placed in the context of having targets for behaviour change which the individuals had set themselves such as reducing car travel or costs, to provide a relevant context for the use of points. Exploration of the impact of collection of 'points' on people's stated intentions to meet the goals or targets they have set for themselves was also explored using the question:
*"I will put in effort to achieve my objective if I receive points that I can use to…".*
Initial findings indicate that people are interested in tangible rewards for points. This was a common finding in all three cities and across data collection techniques. This is articulated by one of our focus group participants in Leeds who commented:

"*I'd be interested in [saving] money on your travel…I get my petrol from Morrisons [large supermarket with limited number of petrol stations] because I've got a card that gives me points…and when I get a certain amount of points I get £5 back*" (120607 Lds, female, working).

In Enschede, the focus group participants expressed a strong positive attitude and belief that points in exchange for a reward were likely to ensure they put in more effort to achieving their goals and they agreed more strongly than if they were asked about effort without being given points. However, the latter was seen only from individuals' answer to the question sheet and not verbally expressed in the discussions:

"*It can be something with practical value. There is a particular gas station, when I already reach 100 Euro then they give me 2 Euro back. Besides it is already the cheapest one, it still gives me back more so why I have to go to other ones. This is a kind of incentive, right? To go there. So it can also be something similar, if for instance you go [for certain kilometres] with the bike then we will give you a present, something nice that make me think…mmm why not.*" (200612 I-v-48:00 Ens, male).

"*I have to go to work with car [because of the long distance], of course if I go to the centre [of Enschede] if there is a nice incentive such as free muffin and coffee then I may use bike rather than take car…*" (200612 II-a-51:50 Ens, male).
There was a similar finding in Gothenburg. In Gothenburg, the majority of participants agreed with the statement that they would try harder to reach targets with physical rewards and loyalty points and similar proportions of the group (n=40) agreed and disagreed and the majority had no strong belief that they would not need points or rewards but were satisfied with reaching the target.

The analysis looked for impact on intentions and in answer to following, *"I would be in favour of challenges provided by third parties"*, we found broad agreement. Yet in response to the question *"The provision of challenges with tangible rewards by third parties would mean I would put more effort into achieving the targets",* we found more agreement and less uncertainty indicating potential to impact on travel behaviour. It was found that the proposal to have third parties provide rewards that can be given for reaching target was well received. Attitudes were accepting of this and one participant articulates how this would work for her and others:

"*There would have to be third parties that are linked to your interest because if… [the reward is unattractive to me] it's still not going to be any interest to me. So they have to be linked to a person's personality and their interests, which could become difficult I guess with so many third parties*" (120607:31 Lds, female, working).

Participants also articulated the problems they have in understanding the motivation for third parties to be involved in such an application and this raises issues around plausibility, trust and the exchange between third parties and themselves as users. Here a

participant shows that they are thinking about how third parties might use the application:

"*I think another good one could be with the bus companies that they might… if you travel on the bus three times a week they might give you a free journey or something like that*" (120607:31 Lds).

The effectiveness of the rewards is negatively impacted by lack of plausibility and trust. Users do not want to be involved in an application if they feel they have been 'lured'. One of the design principles to come from the work is the need for transparency, so users can see a clear rationale as to why third parties are involved and might benefit as well as the benefits to themselves. Otherwise a system can generate suspicion. One issue raised was the possibility of filtering offers based on identification of 'trusted companies'. There is an acknowledgement and a sense of inevitability that third parties will want something from users for giving rewards and issues of data ownership; the privacy of individuals and the social safety of individuals in Enschede:

"*How the third parties know that I have reached 200 points if the data are anonymous?*" (200612 II-v-09:00 Ens, male).

"*These discussions, I am also feeling a little bit nervous when the third parties are getting involved, what do they do with the data even if it is not personalized they can find out from which regions people are coming from*" (200612 II-v-10:00 Ens, female).

"*Ik zou alleen de gemeente of overheid mijn data willen geven voor het geven van gepersonaliseerde aanbiedingen, ik wil geen reclameboodschappen" [Translation: I would only want to give my data to the municipality or government for personalized offers, I don't want advertisements*" (180612 110 Ens, male).

Nevertheless users signal their willingness to exchange and to trade:

"*Een soort ruilhandel van diensten toevoegen, zoals carpoolen, fietsenmaker of jogginggroepje" [Translation: Add some sort of trading of services, like carpooling, bike repair of a jogging group]* (210612 117 Ens, female).

This willingness is especially if the 'reward' results in paying less for products and services they would normally purchase:

"*I was never interested in Tesco [a large company group] monitoring my consumption, but I kind of like turned it on its hand because every year we get our car serviced basically on Tesco points because £10 worth of Tesco points gets converted into £40. And literally I don't pay a single penny for the annual service of my car. So that's a huge incentive I'm talking about, not like £10, £20, I'm talking about £180*" (120612:23 Lds, male, working).

Tesco is a large supermarket which has a loyalty card scheme called Tesco Club Card. If you use a Tesco Club Card you get points for your purchases and Tesco get to know a lot about your shopping habits and preferences. This participant articulates a number of issues that arose in the focus group discussions. He articulates a suspicion about the monitoring of his activities, but he has found a way to make this into a personal benefit by using the club card points to pay for items he would have bought anyway; particularly non-discretionary items such as car servicing or house insurance. Here we can see a very instrumental and strategic use of an existing behaviour for additional household advantage evidenced in the use of savings from existing behaviour to pay for non-discretionary items. This does not have to be big purchases and this participant reiterates the attractiveness of using reward schemes to buy items that one would have purchased anyway:

"*Because I can see what it's for, rather than it being if I save up 10,000 over 15 years I can get 10% off something I wasn't going to buy anyway. I can see it's an*

*achievable goal. And it took me a year's worth of gas bills to collect enough to buy a CD… For nothing I was quite satisfied with it*" (120612:23 Lds).

"*Bij kortingen op reguliere uitgaven is 2% al een beloning, maar ik wil geen kortingen op producten die ik anders toch niet zou kopen*" *[Translation: with discounts/offers on things I would buy anyway, a 2% reduction is already an incentive. However, I don't want offers for things I wouldn't buy otherwise"* (180612 83 Ens, female).

In addition, these participants articulate a clear design principle: any points based system has to have a real value to the points, which is reiterated by other participants:

"*With a lot of points collection schemes you do collect a lot of points that don't really mean anything*" (120612:23 Lds).

"*…points are useless even it can mentally affect me, perhaps with Air Miles and discounts that would be more rewarding"* (200612 II-v-05:35 Ens, female).

"*Also the collecting points in Foursquare, I don't like. I just use it ah…I do not care about points in Foursquare. I just use it [Foursquare] to get useful tips from others and not using it to collect points"* (200612 II-a-54:53 Ens, female).

In Enschede, the focus groups reported that the collection of points without exchange for tangible benefit was similar to games and they comments that games could be addictive, but once it is realized that there are no benefits then the motivation to continue is lessened and is intrinsic only to the benefit of playing the game and they predicted that people will stop. In addition many participants expressed the perception that games were not effective in the long-term that the novelty effect was what primarily attracted people and that they were only exciting in the beginning and rapidly became boring:

"*Bij een spelletje gaat na een tijdje de lol er vanaf, omdat er geen uitdaging meer in zit en, in het geval van Foursquare, geen toegevoegde waarde heeft" [Translation: A gaming app loses its appeal, because it is not challenging anymore. In case of Foursquare, there is no added value]* (180612 30 Ens, male).

This participant expresses a very strategic view of using applications articulating a commonly held view but also indicates patterns of application adoption and use as the novelty of having applications wears and individuals become more adept and strategic/instrumental at identifying and using those technologies (including apps) that have strategic/instrumental benefit to them. Put another way, here we see evidence of a learning effect.:

"*There are two kinds of apps. I play with some apps because they are tech-y. For example, I've downloaded an app called Android,... And the second type of apps I'll say I'll have, which are utility apps, which just add value to what I do. For example, walking here, so I just switched on the Google Map*" (120612:13 Lds).

"*I remember that around one and a half year ago, I played a game in Facebook called Farm Ville, if you know, it was for some reasons addictive because you get some points, points that you cannot even spend in the real world, I really need to tell myself to stop spending my time with this game, so sometimes this points and rewards in this digital thing can stimulate you to keep coming… and I do not want to be that kind of person*" (200612 II-v-04:00 Ens, female).

In addition, participants articulated a need for rewards to be of interest to them. The effectiveness of rewards is compromised if the reward is not of interest to the individual. This means that users are looking for rewards that they would be interested in. They already 'sift' through many reward schemes and pricing schemes in retail and are not looking for a reward scheme that adds to their burden. *The example she gave was 5% off walking boots – which is of little interest to her because she does not like walking.* The

design principle here is to ensure relevance and to learn the individuals own interests. As well as contributing to the cost of non-discretionary items of the household budget.

### 3.5.3 Summary

To create feasible and productive incentives using points and rewards the evidence gathered both from qualitative and quantitative sources supports the following findings:

- Points have to be associated with a reward. When points are not associated with a reward there is a higher probability that they are perceived as a game that may only be attractive to smaller social groupings who enjoy gaming and potentially suffers from high rates of attrition as novelty wears off;
- Points with tangible rewards show potential to be feasible and productive. There are indications that they could impact on travel behaviour with people stating their intentions to put more effort into carrying out certain behaviours if there was a reward they were aiming for. Points are a key component of developing combinational and accumulative incentives and coupled with target setting;
- Points with tangible rewards necessarily involve third parties. These interactions and relationships require careful handling to ensure attractiveness and to avoid the twin risks of an offer being seen as 'too good to be true' or not attractive enough because gaining the reward it takes too much effort;
- The advantage of points is that they can be used as a 'common currency'. What has been observed is that users find attractive the idea of being able to decide how they want to spend their savings. Attractiveness also derives from the purchase options, i.e., how it can be spent;
- Gaining points which can be spent on non-discretionary items in the household expenditure are attractive;
- Incentives generate enmity if they are irrelevant spatially, temporally and to individual's interests. There is some indication of an asymmetrical response to incentives. If they are irrelevant they have a bigger deterrent effect than the attractive effect if they are relevant;
- The diversity of responses suggests that there may be niche markets for different incentive types and having a diverse range of incentives using points and rewards may be a productive way to ensure attractiveness and retain users;
- Incentives should be presented so that users have to actively choose to take part – the 'opt in' principle and it should be easy for them to choose to 'opt out';
- There is a need to manage announcements: not constant messages, but a small icon for new incentives with discreet glow when new incentives are on offer. Messages about incentives are a design issue which impacts on levels of relevance and generating irritability and acting as a deterrent to use.

## 3.6 Social networks

### 3.6.1 Description

An integral feature of the SUNSET project and application is the use of social media and social networks. We explored a range of social network and social media based incentives. Some of the incentives were designed so that the reward was working with a social network including 'sharing location', 'find-a-buddy', 'sharing alerts', and 'treasure hunts'. Other incentives were designed around other types of rewards such as points, but had an element of social networks integral to them as well. In addition some of the incentives were designed to introduce an element of gaming to patterns of daily travel.

In the empirical works, we designed a number of scenarios to try to understand the issues and individual's beliefs and opinions about the use of social networks in incentives. The scenarios were also used with the research participants to 'ground' their beliefs and opinions. The scenarios were also designed to explore the different types of exchange between people including: sharing, competition and cooperating. We theorised that individuals can gain benefits through sharing information; they may gain status through competition with others and ranking performances; and they may gain benefits and rewards through cooperation to provide different levels and types of transport service together.

A number of different scenarios was used including 'sharing location'. This scenario imagined that the travel app gave any one individual the capability to allow others to be able to know their location in real-time and to be able to follow them as they were travelling (Figure 8 and Figure 9).

**Sharing location**

**Imagine that you have a travel app that gives you a function to allow others to be able to know your location. You might use this when you returning late to home so that others know when to expect your arrival or can 'watch over' you as you travel from the bus stop. Alternatively it might be useful for business trips so that colleagues know where you are. The aim of the feature is to help users to improve their travel and feeling of safety when travelling.**


**Figure 8 Sharing location incentive, Leeds, 2012**

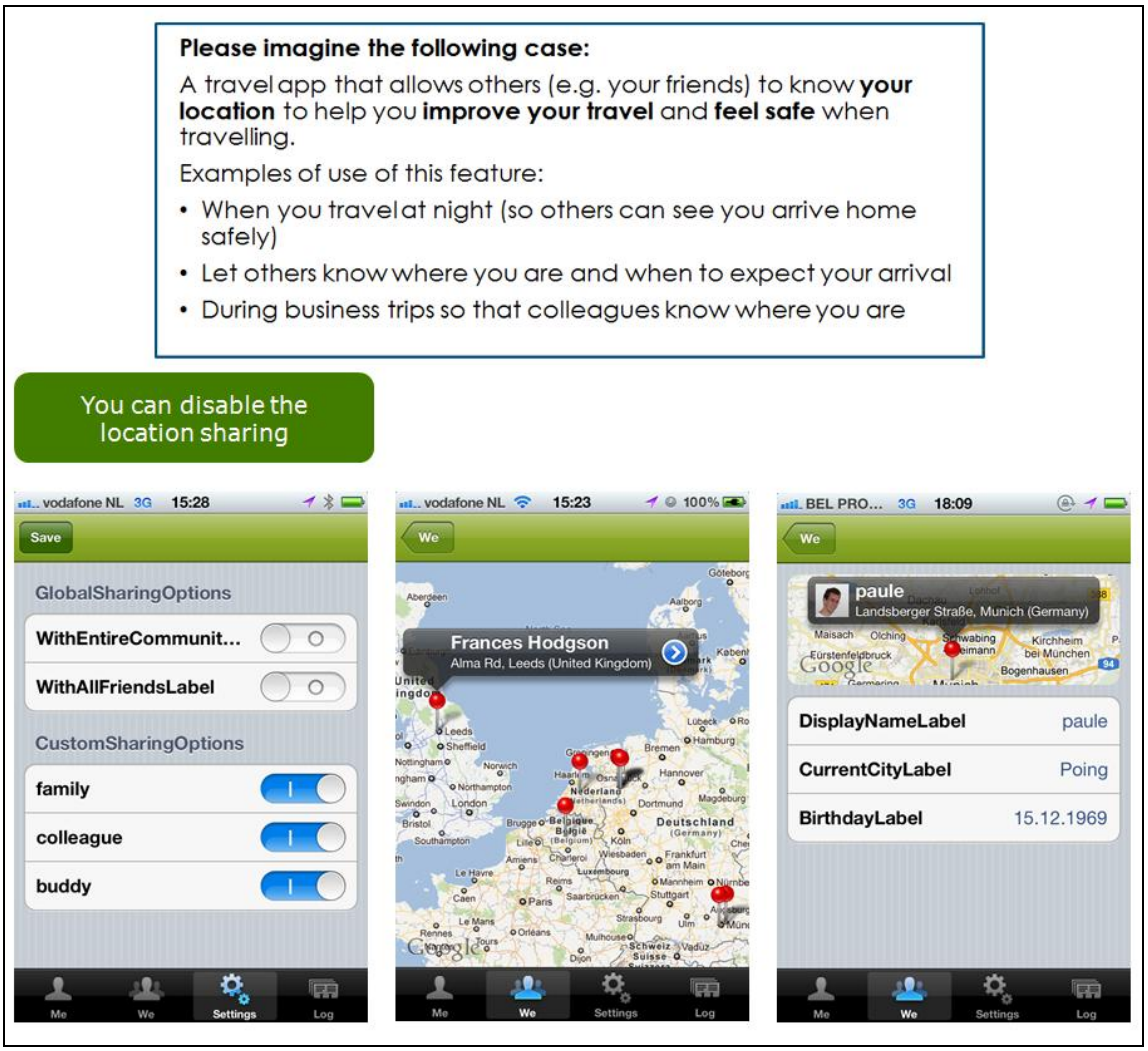


**Figure 9 Sharing location incentive, Enschede, 2012**

### 3.6.2 Findings

Exploration of social networks looked at:

- Different kinds of sharing and competing;
- Find a buddy; treasure hunt (points and rewards); sharing location and alerts and hazards;
- Sharing information;
- Trust;
- Usefulness;
- Impact on behaviour;
- Working together: 'find a buddy' and 'treasure hunt'.

Unsurprisingly privacy was one of the key topics to arise in the qualitative dataset. Other topics that were discussed included those groups or situations when sharing location might be useful; and failures in the system and user generated false alarms. Privacy was a concern; not everyone wanted to share their location all of the time. The suggestion was made that the application should be responsive to the user's needs, so this incentive could be disabled and enabled on demand and when required by the user, so that the user could decide which trip or portion of journey to share and with whom. The

suggestion was made that this might be useful in certain circumstances such as if parents or guardians wanted to 'watch over' youngsters returning home at night:

*"Voor de veiligheid van mijn kinderen zou ik weten waar ze zijn als ze in het donker naar huis fietsen" [Translation: For the safety of my children, I would like to be able to track them when cycling home through the dark]* (180612 108 Ens, female).

Another suggestion was that this might be reassuring if it could be used by the mothers of 'back-packers' whilst they were abroad. In addition, the suggestion was made that it might provide additional security for people in those professions that have to make home visits. It was clear that this incentive had some positive aspects and people could see how it would be used to improve coordination and social safety which was articulated as helping in unfamiliar circumstances or when setting an appointment with a friend:

*"It could be useful if you're going to visit someone where you've not been before and you're not quite sure where you are, and you can tell them via Facebook or whatever, 'Right, this is where I am. How far away'"* (120607 Lds, male).

*"My concern would be if the GPS stops working you'd think, oh, I'm going the wrong way, I'd better stop, why aren't they coming, when they've just lost GPS [laughter]"* (120612 Lds, male).

*"Niet altijd je eigen locatie delen, maar alleen wanneer het nuttig is, bijvoorbeeld op het moment dat je met een vriend hebt afgesproken" [Translation: Not constantly share my location, but only when it is useful, for example at the time of an appointment with a friend]* (180612 85 Ens, male).

We examined a number of different issues associated with using social media to share location and found a positive attitude, but beliefs varied according to the circumstances of use (Table 17). The quantitative work and the qualitative work demonstrated that foremost advantage of such an incentive was for coordinating between people and for some form of cooperative travel.

**Table 17 Attitude to sharing location Leeds and Gothenburg, 2012**

| | Positive | Neutral | Negative |
|---|---|---|---|
| **Gothenburg*** | | | |
| **Share own location to improve commute** | 27.5% | 25% | 45% |
| **Knowing where friends are improves commute** | 22.5% | 35% | 40% |
| **Sharing my location improves car pooling** | 65% | 20% | 25% |
| **Knowing where friends are improves car pooling** | 65% | 17.5% | 27.5% |
| **Sharing my location improves my confidence** | 22.5% | 35% | 40% |
| **Knowing where friends are improves my confidence** | 20% | 37.5% | 40% |
| **Would choose not to share location** | 20% | 17.5% | 60% |
| **Leeds*** | | | |
| **Share friends location** | 63.7% | 8.8% | 29.0% |
| **Share location of work colleague on business trip** | 50.5% | 15.4% | 31.4% |
| **Useful for me travelling at night** | 61.5% | 17.6% | 19.3% |
| **Useful for meeting up with others** | 72.5% | 6.6% | 16.9% |
| **Useful for travelling to unfamiliar places** | 65.9% | 11.0% | 18.1% |
| **Useful for ride-share** | 54.9% | 20.9% | 14.5% |
| **Increase feeling of safety when travelling** | 57.1% | 20.9% | 18.1% |

*Rounding and don't know mean answer will not sum to 100

Another of the scenarios we explored was based on introducing an element of 'gaming' into daily travel. The incentive was called 'Treasure hunt' and was not noteworthy or unique but helped to explore some ideas around social network sharing and cooperation. The idea is described in Figure 10.

**Treasure hunt**

**Imagine that one feature of the app. Is a treasure hunt. Treasure would be in the form of 'points' which are available for users to 'collect' at points on the travel system. This treasure would be placed at locations by users and the app. Service. Users of the app. Would have the opportunity to 'collect' treasure in the form of points. Users would be able to hide treasure in the city themselves by donating some of their own points. Third parties such as organisations could also hide treasure , for example bus companies could hide treasure on buses or at bus stops or a cinema could hide points which are redeemable for cinema tickets once they have reached the requisite amount. Treasure is logged as a coordinate and users collect the 'treasure' or points if they walk past it (it can only be collected by travelling past). Users are given an alert once they are on a road where treasure is hidden. The treasure is points which can accumulate and then be exchanged for tangible rewards, such as free cinema tickets or discounted bus tickets.**

**Figure 10 Treasure hunt incentive, Leeds, 2012**

This incentive raised the idea that there could be benefits associated with multiple incentives and realised that there could be multiple benefits. One respondent began by running through how the 'Treasure hunt' incentive might work:

*"So maybe if you say "If you walk to this location" (inaudible 1:37:48) with one of your daily routine to increase your walking from 20 minutes".* Researcher responds *"I don't know. Would that make it more attractive or less attractive if you did that?"* and the conversation continues: *"But if I knew I was going from A to B and if I actually get off the bus two or three stops early and just tagged that by walking past it I'd do that. So you've got me off the bus, reducing C02, and I've got something and I've got my calories: "Bonus, bonus, bonus, bonus…you're getting multiple rewards"* (120607 Lds, male).

However, in Enschede, some less positive to responses were made related to the treasure hunt:

*"Geocaching is leuk als doel bij het wandelen [recreatief] en contact met andere mensen. Het idee is leuk maar het vernieuwd niet, waardoor er geen uitdaging meer in zit" [Translation: Geocaching is fun as an objective/game during a recreational walk and to get in touch with other people. The idea is fun, but it does not renew. Therefore, there is no challenge in it.".* (180612 35 Ens, male).

*"I really don't know if the game side like treasure hunt is really useful. I would never use it, I think. But perhaps there are people who would do it but I can't imagine using it myself … no…"* (200612 II-a-54:29 Ens, female).

We also asked respondents about an incentive based around finding others to travel with as a way of encouraging non-motorised travel (Figure 11).

**Find-a-Buddy**

**Imagine that one feature of the app. Is the ability to find a 'buddy', that is find other people who share similar interests to you. For example you could find people who want to walk on the same routes, cycle together, set up 'friends of…' say a particular route or street or bus and finally people who want to share lifts. Now imagine that you could gain points for joining a 'buddy' group**

**Figure 11 Find-a-buddy incentive, Leeds, 2012**

For example you could find people who want to walk on the same routes, cycle together, set up 'friends of…' say a particular route or street or bus and finally people who want to share lifts. Now imagine that you could gain points for joining a 'buddy' group find others to cycle with etc.

Our first observation was that some of the participants already engaged in this type of behaviour but very informally and not routinely. Two participants in the Leeds focus groups reported using social media to start logs and Facebook pages associated with their public transport journeys, in both cases as a response to poor reliability. Other reported using apps such as STRAVA and RunKeeper to work with others in a community who shared a common interest albeit a distributed community. The find-a-buddy incentive description and scenario is deliberately designed to ask about bringing people together.

The general impression of this incentive was a mixed response. In both Enschede and Leeds focus groups some of the participants found it to be an attractive feature and said that they could see benefits to finding a companion during trips (e.g. biking, train); others expressed the desire to be accompanied by someone they know.

Adding points to the find-a-buddy scheme did not appear to make it more attractive.
"*This is a tricky one. I won't find buddies to gain points. I'll find buddies because they share common interests. For example running, so you can text them, would you like to go out for a run, rather than… Yeah*, [I would find them] *because I trust them, not to do the points though*" Male Lds 120612, p35.

Social networks and social media were included in the descriptions of other incentives. Social media was included in the description of points based systems and in that discussion the point was raised that points could be a common currency used with social networks as a way of increasing interaction but also to make the incentive and application more interesting:

*"If it was like what Alex was saying with Twitter where you meet people that you wouldn't normally meet and it was like six degrees of separation where you started to share out your pointes or whatever with people that you didn't know I think it would be a bit more interesting like that, trying to make it more of a social thing rather than I can trade it"* (120607 Lds, female).

Mixed results were found in the qualitative data related to the use of social networks to share performances, such as when making and reaching travel targets:

*"I do not really use Run Keeper or Adidas apps, I tried to but I don't like people to know how slowly I'm running [laugh]… so they do not have to know… perhaps I am using them in the future but it is not very useful"* (200612 I-v-15:30 Ens, female).

However, competition seems to be more attractive:

*"I would like to sign up with for instance my Facebook account to see what their achievement and to see if I am better, I think that would be fun. So a competition."* (200612 II-v-05:52 Ens, female).

### 3.6.3 Summary

To sum up, to create feasible and productive incentives using social networks, the evidence gathered both from both qualitative and quantitative sources supports the following findings:

- Diverse response to sharing performance in social networks, may be attractive to certain self-selecting cultural groups;
- Diverse response to competition and ranking points performance, again may be attractive to self-selecting groups;
- Productive incentives using social networks allow users to set sharing rights;
- Users themselves are the source of innovation for social network based incentives and feasible and productive incentives have to allow users to develop the social networks exchanges;
- Privacy is a major concern and needs to be considered to develop efficacious incentives.

## 3.7 Interaction and operation issues: 'using the app'

In the course of discussing incentives other issues relating to the operation of the application and interaction with others and interaction with the SUNSET system were raised. These are issues that affect all of the incentives. They are aspects of the functionality of the application that impact on the how attracted an individual is to an application, and impact on retention and the quality of the experience whilst using the application.

### 3.7.1 Retention

The first issue was one of attractiveness and retention. We asked potential users how they find out about applications and we found that costs, the reviews by other users and the star ratings give to applications can make a difference. Attractiveness relies on recommendation and retention relies on meeting needs and intelligent balance of immediate rewards and benefits that accrue over the longer term. This is one response to the issue of which applications people have and why they downloaded and paid for them:

*"It's like Alex was saying about the points; how many stars an application has. So if Jay has done it and has given it a four and then I try it and I give it a four then I think that will help it maintain that kind of exclusiveness also"* (120607 Lds, female).

### 3.7.2 Anonymity and safety

More concerns were raised during the focus group regarding data ownership and safety, besides the ones that have been mentioned beforehand related to the involvement of the third parties in providing rewards:

*"I have some privacy concerns, for instance all my data will be stored on-line? For how long? And who will have access on that? And how can you ensure the safety of the data? Because it is something very personal, right? Where I am going everyday, exactly my trip, it is actually too personal information, so how are you going to protect that?"* (200612 II-v-00:16 Ens, male).

*"I need to make sure that my personal data are protected, I do not have to scream all the time, I am here, I am here…"* (200612 II-v-52:50 Ens, female).

*"I only want to share my information with my friends but not [automatically] with someone I do not know, I don't want that someone I don't know see that I am not at home"* (200612 II-a-48:35 Ens, female).

### 3.7.3 Battery

Battery life has been one of the issues that was raised by participants and it could be one of the reasons that people do not use certain apps anymore:

*"If the app has to run in the background all the time then I think your phone battery will be off in three hours. If you use GPS all the time, my phone only last for 1.5 hours"* (200612 II-v-14:00 Ens, female).

*"When I have 10 applications running at the background that would be a really big problem… One time per day charging is enough"* (200612 II-v-14:25 Ens, male).

*"I will never use an app that always run in the background and using GPS. I see Foursquare that can detect me very accurately without GPS, so it has to be without [GPS]"* (200612 II-v-15:00 Ens, female).

### 3.7.4 Frequency of incentive offers

One issue to arise was the optimum frequency for offering incentives. The views expressed argued that messages on incentives should be sent if they were relevant. It was argued that messages about incentives that distracted you from normal activities such as driving and calling would be annoying:

*"I think if it was all the time it would be quite annoying, if you were driving and say you got a message to stop your car to have a look: "Oh, there's a reward"… It could get quite annoying"* (120607 Lds, male).

In Enschede similar point were raised:

*"I think the app should tell me hey there is a new addition… like once a week"* (200612 II-v-12:00 Ens, female).

Suggestions were made for the best way to optimise messages offering incentives. The chief suggestion was that there should be a way to opt in to incentives. Notifications alerting users to the opportunity should be non-intrusive, otherwise people turn off the notification and many said they already did this for Facebook messages and found it annoying when work colleagues did not:

*"I think it would have to be able to opt in to receive messages or go into a screen and look for them yourself; because I know when you get notifications they can be annoying. You stop paying attention to them"* (120607 Lds, female).

*"Yeah, I do. As I said, I turn mine off. If there's somebody on the desk opposite me who hasn't turned theirs off and their phone's buzz, buzz, buzzing constantly it's very annoying. I think an idea could be to set targets for the week and maybe say that these are the incentives for the week"* (120607 Lds, female).

*"Maybe some specific times as well: in the morning, lunchtime"* (120607 Lds, male).

*"I think for me it would have to be there and you can just touch it (over speaking 1:45:20), yeah. Because second reminders and that you just…Yeah, because if it's there all the time you can just touch it when you want"* (120607 Lds, male).

*"It would be interesting if it could, the same way that it picks up your mode of travel; it picks up your mode of picking up on occasions"* (120607 Lds, female).

*"I want to have a manual configure menu to choose what I want and don't and sub configure menu where I can choose incentives that I want. For instance treasure hunt has to work in this way…"* (200612 II-a-49:40 Ens, male).

The most interesting and novel point to emerge from the discussion was the suggestion that the application could anticipate an individual's pattern of need for an incentive through observation of the pattern of picking up incentives.

### 3.7.5 Summary on interaction and operation issues: using the app

To create feasible and productive incentives some overarching issues of user interface did arise.

- Presentation of incentives should be done without disturbing individuals from their everyday activities;
- The optimum frequency for offering incentives varied but potential users uniformly agreed that they did not want to receive irrelevant messages and one potential user suggested that the SUNSET application should 'learn' an individual's pattern of incentive acceptance;
- Retention requires meeting a user's needs and an intelligent balance of immediate rewards and benefits that accrue overtime;
- Potential users expressed a need to have assurance about data ownership and rights;
- The battery life was reported to detract from the attractiveness of the application.

# 4. Conclusions

The main innovation of this task has been (a) identification of the incentives that have most potential to change travel behaviour; (b) design features of incentives to increase feasibility and efficacy in changing travel behaviour; and (c) identification of complementarity of city contexts and social categories and incentive types. The main results are:

- Identify potential and effective incentives based on literature reviews;
- Sketch descriptions of a set of potential incentives for implementation;
- Identification of the potential impacts of a number of incentives on outcome beliefs and behavioural intentions.

This deliverable has contributed to the project by providing the ground to select certain incentives based on precedent case studies from various research domains and supported by our experiments in the three Living Lab cities (Enschede, Leeds, and Gothenburg). It has contributed to the fulfilment of the Work Package 3 objectives to:

- Research the relationship between individual and system objectives;
- Investigate key factors that influence the use of information messages;
- Develop a set of feasible and productive incentives to change mobility.

It also makes a positive contribution to the continuation of T3.4 and the evaluation work package (WP6) and the Living Lab implementation T7.2.

The review of literature revealed four main incentive categories: real-time information, feedback, points and rewards, and social networks. They were selected because some of them have been proven successful in the existing transport studies while others show the potential to change behaviour based on studies from other domains. In brief, the following incentives were identified:

- Real-time and personalized travel information
    - About conditions on the road network: delay information, road works, parking availability. This could also be alerts and hazards;
    - About transport mode alternatives (e.g. bus stop location and departure time information);
    - Relevant information to make travel decisions, such as accurate weather forecast.
- Feedback
    - Self-monitoring personal behaviour (this is in fact the key feature of Tripzoom);
    - Set personal travel targets (e.g. time, cost, distance, CO2 and calorie).
- Rewards
    - Points;
    - Tangible rewards.
- Social networks
    - Combine with self-monitoring and setting personal targets: sharing performances and competition;
    - Combined with individuals' recorded mobility patterns: searching for a (travel) companion(s);
    - Combined with location tagging or real time location sharing: having someone to 'watch over' a traveller when making a trip for a safer travel;
    - As a user generated content: exchange tips and experiences.

These incentives were then sketched out into descriptions and scenarios (Appendices F and G) for use in empirical data generation in the three living lab cities. The empirical work contributed to the aims of the Work Package 3 and the project overall by developing understanding of:

- Attitudes towards incentives;
- Beliefs about the usefulness of the incentives;
- Beliefs about the incentives impact on behaviour;
- Expectations about the influences of the incentives on their current travel behaviour;
- Ideas, fears, difficulties, and needs regarding these incentives based on their past experiences.

The results showed that there was an overall positive attitude towards the application incentives among the potential users we surveyed. One of the common themes running through a number of the incentives and impacting on attractiveness and attitude are beliefs about 'trust'. This was not unexpected and we will detail the different ways in which this was revealed as an issue with the incentives. Beliefs about 'trust' were expressed in terms of the accuracy and reliability of the data provided in the Real-time information incentives in relation to information provided by system managers and that generated in peer-to-peer exchanges. In looking at feedback incentives the potential users expressed concerns around data accuracy wondering if they could trust the GPS location and mobility reports. Trust was also an issue with points and rewards based systems particularly those that involved third parties and a commonly held belief was that third parties would want something in return. Finally, as would be expected, 'trust' was a foremost consideration in incentives using social networks as potential users reported wanting control over who they shared with and expressing concerns about privacy. Recommendations for increasing 'trust' in the incentives are reported at the end of each incentive sub-section.

A second highlight is the understanding we have gained about different 'sharing' mechanisms. 'Sharing' is an integral feature of the SUNSET system and is an integral feature to each of the incentives investigated in this task. 'Sharing', put simply refers to the interaction we have with others, both those known to us and strangers. The mechanism for 'sharing' is important because it is part of the reasons why potential users would want to get involved and use the SUNSET application. We looked at three common sharing practices: sharing information including location, competing, including ranking and co-operating. The research suggests that potential users want to choose the basis on which they interact with others and share and that the method of 'sharing' is context dependent. This means that some groups found the competing with others and ranking performance to be attractive but it was not the majority who wanted to engage in this way. It is sensible to assume that there is a close association between sharing and trust and that design features to increase trust will act positively on the attractiveness of sharing.

A third highlight is the impact on travel behaviour. All of the incentives showed some potential to impact on changing behaviour and it was clear that 'packaging' incentives together to get a bundle of measures is perceived to be attractive and could be effective at changing behaviour. The packaging has the effect of intensifying the attractiveness of behavioural change and if timing is managed can also be used to promote retention. Feedback on positive benefits (calories used and costs saved) of behavioural change coupled with some form of points system that could be used to pay for non-discretionary household budget items certainly seemed attractive. There is still a

measureable ‘gap’ between beliefs and intentions, so although potential users may report positive beliefs and attitudes towards an incentive that does not necessarily lead to a similar strength of positive belief about the impact on changing behaviour. Mobility changes often involve changes to the organisation of a household’s activities. With this in mind it would seem that making available a range of incentives; and allowing users to be able to choose to ‘opt in ‘ and ‘opt out’ of using them would be attractive. The principle behind the design of incentives is to enable the user to ‘tailor’ the incentives to increase effectiveness and attractiveness.

A fourth highlight is the role of ‘third’ or outside parties. The potential users who participated in these investigations were not hostile or opposed to the involvement of third parties. However we found that there was a mixed response to the type of incentive and variation in the efficacy of the incentive to change travel patterns. Some responded that they would change behaviour for small rewards whilst others wanted the reward to be a genuine ‘saving’ to the household budget.

In conclusion it can asserted that task 3.3 has identified incentives with the clear potential to be effective and which contribute to the development of social mobility services. ‘Sharing’ mechanisms are integral to the incentives we have investigated and developed and the dynamic nature of the incentives should allow users to be able to tailor bundles of ‘rewards’ to support their mobility. Developing this is the work that will be taken forward in T3.4, WP6 and T7.2. This Deliverable offers the innovation in social mobility that is required for the SUNSET system development.

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# Appendix A: TFPs implemented in Japan

Adapted from Fujii and Taniguchi (2006)

| City (year) | Target | Main objective | Techniques | Procedure & communication media | Effect | Control group |
|---|---|---|---|---|---|---|
| | | | ***TFPs in residential area*** | | | |
| **Sapporo and Ebetsu (2000)** | ca. 200 HHs | CO2 reduction | - Motivation<br>- No behavioural plan<br>- Individualised information | - Travel diary survey with leaflet for motivation (mail)<br>- Personalised comments (mail)<br>- Travel diary survey (mail)<br>- Provide personalised comments (mail) | ca. 15% reduction in CO2 | No |
| **Osaka (2001)** | ca. 100 HHs | Car use reduction | - Motivation<br>- No behavioural plan<br>- Individualised information | - Travel diary survey with leaflet for motivation (mail)<br>- Personalised comments (mail)<br>- Travel diary survey (mail)<br>- Personalised comments (mail) | ca. 35% reduction in CO2 (with 1-week travel diary), and ca. 20% reduction in CO2 (with 1-day travel diary) | Yes |
| **Suita (2002)** | ca. 500 persons | Promoting public transport | - No motivation<br>- Behavioural plan<br>- General information | Non-personalised information on bus with or without behavioural plan (mail) | Bus use frequency increase:<br>- 0% for frequent bus users<br>- ca. 25% for non-bus users no<br>- behavioural plan<br>- ca. 60% for non-bus users with a<br>- behavioural plan<br>- ca. 50% for new residents no<br>- behavioural plan<br>- ca. 90% for new residents with a<br>- behavioural plan | No |
| **Kawanishi/ Inagawa (2003)** | ca. 700 persons | Car use reduction and promoting public transport use | - Motivation<br>- Behavioural plan<br>- Individualised information | - Questionnaire survey (mail)<br>- Behavioural plan on how to change travel behaviour with personalised information on public transport (mail)<br>- Repeat first questionnaire survey (mail)<br>- Personalised comments (mail) | ca. 15% reduction in car use (2 steps, for PT users) ca. 25% reduction in car use (4 steps, for PT users) ca. 40% reduction in car use (4 steps and incentives to use PT, for non-PT users) [the average reduction in car use was ca. 25%] | Yes |
| **Obhiro (2003)** | ca. 15000 HHs | Promoting public transport | - No motivation<br>- Behavioural plan<br>- General information | Behavioural plan on how to use public transport with non-personalised information on bus (mail) | ca. 100% increase in bus use | Yes |
| | | | ***TFPs in work place*** | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Kanazawa (2001)** | ca. 50 HHs (100 persons) working in 10 companies | Car use reduction | - Motivation<br>- No behavioural plan<br>- Personalised information | - Travel diary survey (by hand)<br>- Personalised comments (mail, by hand)<br>- Travel diary survey (mail, by hand)<br>- Personalised comments (mail, by hand) | ca. 30% increase in bus use,<br>ca. 50% increase in bicycle use, and<br>no reduction in car use. | No |
| **Toyonaka (2003)** | 100 workers in one company | Car use reduction | - Motivation<br>- Behavioural plan<br>- General information | - Questionnaire survey (e-mail)<br>- Behavioural plan on to change travel behaviour (e-mail) | ca. 10 % reduction in car use | No |
| | | | ***TFPs in school*** | | | |
| **Sapporo (2000)** | 150 school students (5th grade) in an elementary school in Sapporo and their families. | CO2 reduction and Env. education | - Motivation<br>- No behavioural plan<br>- Individualised information | - Travel survey with a class for motivation (in class)<br>- Personalised comments (in class)<br>- Travel diary survey (in class)<br>- Personalised comments (in class) | ca. 15% reduction in CO2 | No |
| **Sapporo (2002)** | 130 school students (5th grade) in an elementary school in Sapporo and their families. | CO2 reduction and Env. education | - Motivation<br>- No behavioural plan<br>- Individualised information | - Travel survey with a class for motivation (in class)<br>- Personalised comments or behavioural plan (in class)<br>- Travel diary survey (in class)<br>- Personalised comments (in class) | ca. 35% reduction in CO2 with a behavioural plan, no reduction without a behavioural plan | No |
| **Izumi (2002)** | 200 school students (5th grade) in two elementary schools in Izumi and their families. | CO2 reduction and Env. education | - Motivation<br>- No behavioural plan<br>- Individualised information | - Travel survey with a class for motivation (in class)<br>- Behavioural plan (in class)<br>- Travel diary survey (in class)<br>- Personalised comments (in class) | ca. 15% reduction in CO2 | No |

# Appendix B: Sampling and recruitment

**Enschede**

*Population*

For the survey, the population is:

- Adults (at least 17 years old)
- Live, work, or study in Enschede or sometimes visit Enschede, for instance for shopping and entertainment
- Smart phone and non-smart phone users
- Car and non-car users.

For the focus group target is:

- Smartphone owners
- Either passive or active social network or life-style app (e.g. RunKeeper, WeightWatcher) users, or those who sometimes play real-life games (e.g. Geocaching)
- Drive at least once in a while to, from, or in Enschede

*Sampling frame*

For Enschede survey and focus group, we did not use random sampling techniques because of the time and budget limitation.

*Sampling*

Self-selection sampling was chosen. It is a non-probability sampling in which it requires participants to take part in the research on their own accord. This technique was chosen because the survey was available on-line (for 1 month). It has some advantages, such as reducing the amount of time to find participants and costs. Besides, participants are likely to be committed to complete the survey. We also asked participants who were interested to participate in the focus groups to fill in another (smaller) one-line questionnaire go get some insight into potential participants' smartphone use, social networks, and daily travels. We acknowledge that this technique is prone to a self-selection bias (e.g. related to characteristics/traits of participants) as well as sampling bias (i.e. sample is not a representation of the population). Therefore we checked whether the socio-demographic figures of the sample (of the survey), to some extent, represent the population under study.

*Recruitment*

Participants were recruited through cooperation with the municipality of Enschede. We used Facebook and Twitter of the Municipality of Enschede, paid and unpaid advertisement in some local newspapers, pop-up banners in several websites, news brief of the University of Twente, some flyers, and posters. The survey (called Smart Mobility) was available online from 7 May to 11 June 2012 and was hosted by the University of Twente. There were 136 responses in total, however, 46 of them were incomplete. Therefore, we only use 90 complete responses for the analysis. A few number of lottery prizes were available for participants (e.g. free public transport cards, theatre tickets, and one smartphone). The focus groups (in Dutch and English) were conducted on 18, 20, and 21 June in the University of Twente with the total number of 15 participants. Each participant received 20 Euro shopping voucher as a reward.

**Leeds**

*Population*

- Smart phone users
- Car and non-car users

In Leeds the population was all those who used smart phones who worked and studied in Leeds. This was representative of the population most likely to find the SUNSET application Tripzoom of use in their daily lives.

*Sampling frame*

The West Yorkshire Travel Plan Network was used as the sampling frame. This network has been developed by the Passenger Transport Executive which is one of the two governmental organisations together with the Municipality is responsible for the management and delivery of and transport system in Leeds. It consists of 167 employers located within the city region covering the vast majority of employers in Leeds and most of those within the city centre.

*Sampling*

The West Yorkshire Travel Plan Network was used to select 8 large employers within the North West sector of the city centre including the City Centre hospital, Mental Health management offices, further education centres, and the Betting Company 'William Hill'. This represented a mix of employers and a good method to reach a mix of employees including skilled professional and manual trades with a range of attendant income levels.

*Recruitment*

A targeted campaign using social media and professional networks was undertaken in a combined effort to ensure mutually supported actions and to create a 'conversation' amongst the employers we had targeted. At each of the employers included in the recruitment plan we identified a Travel Plan Network coordinator and they were sent a leaflet about the online survey and asked to distribute it through the employers email system to the employees. In tandem we made links between Facebook page for SUNSET which contained the same information and other Facebook pages and forums. In addition we contacted individuals working in the employers whose Travel Plan Network coordinators had received our leaflets and sent them the leaflet ad information. Using professional networks in this way was intended to reinforce and support the message from the Travel Plan Network Coordinators. We hoped we would create a 'buzz' or a conversation that would engage people's curiosity and prompt them to look at the online questionnaire. In a separate action we used a paid Facebook pop-up banner advert which was seen by Facebook users whose designated location was Leeds and invited them to click on the link to do the questionnaire survey. In Leeds, we also offered the opportunity to complete the questionnaire at mediated lunchtime sessions. This meant that people came to one of the computer clusters at the University and completed the questionnaire. The questionnaire was still completed online and without help or assistance but it was a technique that allowed us to recruit quickly. The technique built in social network recruitment as an integral feature into the recruitment. This was done using by asking people to bring a friend and was supported by a payment structure (£15) for taking part. We offered a payment for completion of the online questionnaire in mediated sessions within the University computer clusters and offered to increase that payment to £20 for themselves and for a friend if they brought a friend along with them. Our observation is that this method of recruitment was well received and everyone could find a colleague they worked beside or friend to do the

questionnaire. As of yet we have no reason to believe that this recruitment method biased the sample.

**Gothenburg**

*Population*

- Smart phone users
- Suburb dwellers
- Commuting to go to work

*Sampling frame*

No sampling frame was used in Gothenburg. All participants were approached individually.

*Sampling*

Non-probability sampling was chosen for Gothenburg pilot tests. Every (potential) participant was approached individually. In total, 48 people agreed to participate in the study and 40 participants completed the questionnaire.

*Recruitment*

The Incentive Survey was an online survey hosted by the Viktoria Institute, performed in collaboration with WP7, The online survey had the dual purposes: to retain the interest of the participants in the project and to produce data for Task 3.3. The survey was available online from 11 April to 7 May 2012.

# Appendix C: Participants' characteristics survey Enschede

## Socio-demographic characteristics

| | |
|---|---|
| **Gender (N=90)** | |
| Male | 44 (48.9%) |
| Female | 46 (51.1%) |
| **Age category (N=90)** | |
| <20 years old | 8 (8.9%) |
| 21-30 years old | 35 (38.9%) |
| 31-40 years old | 17 (18.9%) |
| 41-50 years old | 12 (13.3%) |
| >50 years old | 18 (20%) |
| **Number of people in a household (N=90)** | |
| 1 | 23 (25.6%) |
| 2 | 31 (34.4%) |
| 3 to 5 | 33 (36.7%) |
| More than 6 | 3 (3.3%) |
| **Duration (in years) of living at the current address (N=89)** | |
| 1 year or less | 13 (14.6%) |
| 2 to 10 years | 52 (58.4%) |
| More than 10 years | 24 (27%) |
| **Total yearly household income (after tax) (N=90)** | |
| Less than 20.000 EUR | 15 (16.7%) |
| 20.000-39.999 EUR | 32 (35.6%) |
| More than 40.000 EUR | 23 (25.6%) |
| I don't know or don't want to specify | 20 (22.2%) |

## Travel pattern

| | |
|---|---|
| **Driving license ownership (N=90)** | |
| None | 15 (16.7%) |
| Car[1)] | 71 (78.9%) |
| Others[2)] | 4 (4.4%) |

**1)** Alone or with combination with other licenses
**2)** Scooter, 2-wheel moped and 4-wheel moped, motorbike

| | |
|---|---|
| **Access to car (N=71)** | |
| Always | 37 (52.1%) |
| Usually | 9 (12.7%) |
| Often | 5 (7%) |
| Sometimes/rarely | 16 (22.5%) |
| Never | 4 (5.6%) |
| **Total (yearly) kilometres driven (N=71)** | |
| None | 5 (7%) |
| >3000 km | 22 (31%) |
| 3001-8000 km | 15 (21%) |
| 8001-16000 km | 17 (23.9%) |
| >16000 km | 12 (17%) |

**Public transport (PT) pass (N=90)**

| | |
|---|---|
| None | 32 (36.6%) |
| Any PT pass[3)] | 58 (64.4%) |

Student OV-chip card (discount for all PT at certain days of a week); NS *voordeelurenabonnement* (40% discount for train tickets: weekdays after 9 AM and during weekend); a NS *jaarabonnement* (yearly subscription for unlimited use of train); yearly bus subscription; other kinds of OV cards

**Disability that limit transport mode choice (N=90)**

| | |
|---|---|
| Yes | 8 (8.9%) |
| No | 82 (91.1%) |

**Occupation (N=90)**

| | |
|---|---|
| Employed or self-employed full time or part time | 67 (74.4%) |
| Full time student at college or university | 16 (17.8%) |
| Housewife/houseman | 1 (1.1%) |
| Unemployed | 3 (3.3%) |
| Retired | 2 (2.2%) |
| Unfit to work (e.g. long term sick, disabled) | 1 (1.1%) |

**Flexibility in working hours (for employed/self-employed) (N=67)**

| | |
|---|---|
| Yes | 30 (44.8%) |
| No | 37 (55.2%) |

**Number of people in the household who (fully or partially) depend on the participants for travelling (N=66)**

| | |
|---|---|
| None | 43 (65.2%) |
| 1 to 2 people | 15 (22.7%) |
| 3 to 5 people | 8 (12.1%) |

**Frequency of doing activities (N=90)**

| | Work/study | Grocery shopping | Leisure | Bring/get |
|---|---|---|---|---|
| 5-7 days/week | 63 (70%) | 10 (11.1%) | 2 (2.2%) | 7 (7.8%) |
| 2-4 days/week | 21 (23.3%) | 44 (48.9%) | 31 (34.4%) | 8 (8.9%) |
| ±1 day/per week | 0 (0%) | 31 (34.4%) | 31 (34.4%) | 11 (12.2%) |
| 1-3 days/month | 0 (0%) | 3 (3.3%) | 18 (20%) | 18 (20%) |
| Less than once/month | 1 (1.1%) | 2 (2.2%) | 7 (7.8%) | 20 (22.2%) |
| Never | 5 (5.6%) | 0 (0%) | 1 (1%) | 26 (28.9%) |
| N | 90 (100%) | 90 (100%) | 90 (100%) | 90 (100%) |

**Travel time to go to work/study by modes (N=85)**

| | Car | PT | Bike |
|---|---|---|---|
| Less than 15 minutes | 32 (37.6%) | 12 (14.1%) | 20 (23.5%) |
| 15-30 minutes | 36 (42.4%) | 26 (30.6%) | 27 (31.8%) |
| 30 minutes to 1 hour | 10 (11.8%) | 32 (37.6%) | 20 (23.5%) |
| More than 1 hour | 2 (2.4%) | 13 (15.3%) | 12 (14.1%) |
| I don't know | 5 (5.9%) | 2 (2.4%) | 6 (7.1%) |
| N | 85 (100%) | 85 (100%) | 85 (100%) |

**Main transport mode for daily activities**

| | Work/study | Grocery shopping | Leisure | Bring/get |
|---|---|---|---|---|
| Car as a driver | 23 (27.1%) | 25 (27.8%) | 20 (22.2%) | 33 (55.9%) |
| Car passenger | 2 (2.4%) | 7 (7.8%) | 5 (5.6%) | 4 (6.8%) |
| PT | 16 (18.8%) | 0 (0%) | 7 (7.8%) | 1 (1.7%) |
| Bike | 43 (50.6%) | 43 (47.8%) | 55 (61.1%) | 19 (32.2%) |
| Others | 1 (1.2%) | 15 (16.7%) | 3 (3.3%) | 2 (3.4%) |
| N | 85 (100%) | 90 (100%) | 90 (100%) | 59 (100%) |

**Frequency of visiting Enschede (for those who does not live/work/study in Enschede) (N=13)**

| | |
|---|---|
| Several times per week | 7 (53.8%) |
| Once every week | 3 (23.1%) |
| Once or several times per month | 2 (15.4%) |
| Rarely | 1 (7.7%) |

**Parking behaviour for the following activities/location**

| | Work/study | Grocery shopping | Go to Enschede city centre |
|---|---|---|---|
| Free parking | 34 (85%) | 44 (91.7%) | 8 (19.5%) |
| Paid parking | 6 (15%) | 4 (8.3%) | 33 (80.5%) |
| N | 40 (100%) | 48 (100%) | 41 (100%) |

**Changes in household/job situations for each of the following situation (N=90)**

| | |
|---|---|
| Moved house | 11 (12.2%) |
| Change in the number of people living in the household | 7 (7.8%) |
| Started working / changed your place of employment | 17 (18.9%) |
| Stopped working / retired | 4 (4.4%) |
| Started / finished university | 8 (8.9%) |
| Change in health conditions | 9 (10%) |
| Obtained a driving license | 5 (5.6%) |
| Bought / sold a car | 15 (16.7%) |
| No major changes | 43 (47.8%) |
| Others | 3 (3.3%) |

**Changes in the use of each of the following transport modes compare to a time two years ago (N=90)**

| | Car driver | Car passenger | Bus | Train | Bike | Walk |
|---|---|---|---|---|---|---|
| More | 23 (25.6%) | 14 (15.6%) | 14 (15.6%) | 23 (25.6%) | 33 (36.7%) | 30 (33.3%) |
| No change | 44 (48.9%) | 57 (63.3%) | 48 (53.3%) | 40 (44.4%) | 47 (52.2%) | 53 (58.9%) |
| Less | 23 (25.6%) | 19 (21.1%) | 28 (31.1%) | 27 (30%) | 10 (1.1%) | 7 (7.8%) |
| N | 90 (100%) | 90 (100%) | 90 (100%) | 90 (100%) | 90 (100%) | 90 (100%) |

## Smartphone ownership & use

**Smartphone ownership (N=90)**

| | |
|---|---|
| Yes | 61 (67.8%) |
| No | 29 (32.2%) |

**Smartphone type (N=61)**

| | |
|---|---|
| iOS | 16 (26.2%) |
| Android | 37 (60.7%) |
| Others (and not known) | 8 (13.1%) |

**Planning to buy a smartphone in the next 6 months if currently do not own a smartphone (N=29)**

| | |
|---|---|
| Yes | 10 (34.5%) |
| No | 19 (65.5%) |

**The frequency of using a smartphone for the following activities (N=61)**

| | Calling & texting | Emailing | Social networks | Gaming |
|---|---|---|---|---|
| Everyday | 43 (70.5%) | 29 (47.5%) | 44 (72.1%) | 14 (23%) |
| Once or several times per week | 16 (26.2%) | 15 (24.6%) | 5 (8.2%) | 13 (21.3%) |
| Once or several times per month | 2 (3.3%) | 8 (13.1%) | 0 (0%) | 6 (9.8%) |
| Rarely | 0 (0%) | 7 (11.5%) | 3 (4.9%) | 12 (19.7%) |
| Never | 0 (0%) | 2 (3.3%) | 9 (14.8%) | 16 (26.2%) |
| N | 61 (100%) | 61 (100%) | 61 (100%) | 61 (100%) |

| | Geocaching | Weather app | Travel app | Navigation app |
|---|---|---|---|---|
| Everyday | 1 (1.6%) | 15 (24.6%) | 5 (8.2%) | 2 (3.3%) |
| Once or several times per week | 5 (8.2%) | 20 (32.8%) | 15 (24.6%) | 5 (8.2%) |
| Once or several times per month | 3 (4.9%) | 15 (24.6%) | 21 (34.4%) | 23 (37.7%) |
| Rarely | 12 (19.7%) | 6 (9.8%) | 10 (16.4%) | 18 (29.5%) |
| Never | 40 (65.5%) | 5 (8.2%) | 10 (16.4%) | 13 (21.3%) |
| N | 61 (100%) | 61 (100%) | 61 (100%) | 61 (100%) |

**Mobile internet connection in smartphone (N=61)**

| | |
|---|---|
| Yes | 56 (91.8%) |
| No | 5 (8.2%) |

**Frequency of charging the smartphone (N=61)**

| | |
|---|---|
| More than once per day | 8 (13.1%) |
| Once per day | 39 (63.9%) |
| Once every few days | 14 (23%) |

# Appendix D: Participants' characteristics survey Leeds

## Section 1: Travel

| | | | | |
|---|---|---|---|---|
| **1.** How many cars do you or members of your household own or have available for continuous use? | | | | |
| 1 | None: |  | 21.7% | 20 |
| 2 | 1: |  | 51.1% | 47 |
| 3 | 2: |  | 25.0% | 23 |
| 4 | More than 2: |  | 2.2% | 2 |
| | | | | |
| **2.** Please can you tell us if you drive? | | | | |
| 1 | Yes I drive and I have a car that only I use: |  | 35.9% | 33 |
| 2 | Yes I drive and I share a car with another in my household: |  | 23.9% | 22 |
| 3 | Yes I can drive but I don't have a car: |  | 15.2% | 14 |
| 4 | Yes I can drive but I hire a car or borrow one occasionally because I don't have a car: |  | 6.5% | 6 |
| 5 | I do not drive: |  | 17.4% | 16 |
| | | | | |
| | Other *(please specify)*: |  | 1.1% | 1 |
| | | | | |
| **3.** Thinking back over the past 12 months, how often have you travelled in the following ways... | | | | |
| **3.a.** driving self in car | | | | |
| 1 | Every day: |  | 32.2% | 28 |
| 2 | Between 2 and 4 days a week: |  | 20.7% | 18 |
| 3 | About 1 day a week: |  | 10.3% | 9 |
| 4 | Between 1 and 3 days per month: |  | 3.4% | 3 |
| 5 | Less than once a month: |  | 11.5% | 10 |
| 6 | never: |  | 21.8% | 19 |

| | | | | |
|---|---|---|---|---|
| **3.b.** passenger in car | | | | |
| 1 | Every day: |  | 9.2% | 8 |
| 2 | Between 2 and 4 days a week: |  | 29.9% | 26 |
| 3 | About 1 day a week: |  | 25.3% | 22 |
| 4 | Between 1 and 3 days per month: |  | 19.5% | 17 |
| 5 | Less than once a month: |  | 11.5% | 10 |
| 6 | never: |  | 4.6% | 4 |
| | | | | |
| **3.c.** by bus | | | | |
| 1 | Every day: |  | 11.5% | 10 |
| 2 | Between 2 and 4 days a week: |  | 25.3% | 22 |
| 3 | About 1 day a week: |  | 14.9% | 13 |
| 4 | Between 1 and 3 days per month: |  | 10.3% | 9 |
| 5 | Less than once a month: |  | 25.3% | 22 |
| 6 | never: |  | 12.6% | 11 |
| | | | | |
| **3.d.** cycling | | | | |
| 1 | Every day: |  | 2.5% | 2 |
| 2 | Between 2 and 4 days a week: |  | 4.9% | 4 |
| 3 | About 1 day a week: |  | 4.9% | 4 |
| 4 | Between 1 and 3 days per month: |  | 6.2% | 5 |
| 5 | Less than once a month: |  | 18.5% | 15 |
| 6 | never: |  | 63.0% | 51 |
| | | | | |
| **3.e.** walking for more than 10 minutes | | | | |
| 1 | Every day: |  | 47.1% | 41 |
| 2 | Between 2 and 4 days a week: |  | 31.0% | 27 |
| 3 | About 1 day a week: |  | 6.9% | 6 |

| | | | | |
|---|---|---|---|---|
| 4 | Between 1 and 3 days per month: |  | 10.3% | 9 |
| 5 | Less than once a month: |  | 1.1% | 1 |
| 6 | never: |  | 3.4% | 3 |

| **4.** Thinking back over the last 3 months, how long does it take you (in total) to get to work using the following ways... | | | | |
|---|---|---|---|---|
| **4.a.** Car -- Please choose the most appropriate answer | | | | |
| 1 | Less than 15 minutes: |  | 40.2% | 35 |
| 2 | Between 15 minutes and 30 minutes: |  | 32.2% | 28 |
| 3 | Between 30 minutes and 1 hour: |  | 12.6% | 11 |
| 4 | More than 1 hour: |  | 1.1% | 1 |
| 5 | I don't know: |  | 13.8% | 12 |
| **4.b.** Bus -- Please choose the most appropriate answer | | | | |
| 1 | Less than 15 minutes: |  | 11.9% | 10 |
| 2 | Between 15 minutes and 30 minutes: |  | 25.0% | 21 |
| 3 | Between 30 minutes and 1 hour: |  | 26.2% | 22 |
| 4 | More than 1 hour: |  | 14.3% | 12 |
| 5 | I don't know: |  | 22.6% | 19 |
| **4.c.** Cycle -- Please choose the most appropriate answer | | | | |
| 1 | Less than 15 minutes: |  | 14.6% | 12 |
| 2 | Between 15 minutes and 30 minutes: |  | 6.1% | 5 |
| 3 | Between 30 minutes and 1 hour: |  | 15.9% | 13 |
| 4 | More than 1 hour: |  | 9.8% | 8 |
| 5 | I don't know: |  | 53.7% | 44 |
| **4.d.** Walk -- Please choose the most appropriate answer | | | | |
| 1 | Less than 15 minutes: |  | 9.4% | 8 |
| 2 | Between 15 minutes |  | 16.5% | 14 |

| | | | | |
|---|---|---|---|---|
| | and 30 minutes: | | | |
| 3 | Between 30 minutes and 1 hour: |  | 25.9% | 22 |
| 4 | More than 1 hour: |  | 24.7% | 21 |
| 5 | I don't know: |  | 23.5% | 20 |

| **5.** Again thinking back over the last 3 months, how long is your return journey from work by each of these ways... | | | | |
|---|---|---|---|---|
| **5.a.** Car -- Please choose the most appropriate answer | | | | |
| 1 | Less than 15 minutes: |  | 34.9% | 30 |
| 2 | Between 15 minutes and 30 minutes: |  | 33.7% | 29 |
| 3 | Between 30 minutes and 1 hour: |  | 16.3% | 14 |
| 4 | More than 1 hour: |  | 3.5% | 3 |
| 5 | I don't know: |  | 11.6% | 10 |
| | | | | |
| **5.b.** Bus -- Please choose the most appropriate answer | | | | |
| 1 | Less than 15 minutes: |  | 10.3% | 9 |
| 2 | Between 15 minutes and 30 minutes: |  | 21.8% | 19 |
| 3 | Between 30 minutes and 1 hour: |  | 28.7% | 25 |
| 4 | More than 1 hour: |  | 17.2% | 15 |
| 5 | I don't know: |  | 21.8% | 19 |
| | | | | |
| **5.c.** Cycle -- Please choose the most appropriate answer | | | | |
| 1 | Less than 15 minutes: |  | 14.5% | 12 |
| 2 | Between 15 minutes and 30 minutes: |  | 7.2% | 6 |
| 3 | Between 30 minutes and 1 hour: |  | 13.3% | 11 |
| 4 | More than 1 hour: |  | 13.3% | 11 |
| 5 | I don't know: |  | 51.8% | 43 |
| | | | | |
| **5.d.** Walk -- Please choose the most appropriate answer | | | | |
| 1 | Less than 15 minutes: |  | 9.2% | 8 |

| | | | | |
|---|---|---|---|---|
| 2 | Between 15 minutes and 30 minutes: |  | 17.2% | 15 |
| 3 | Between 30 minutes and 1 hour: |  | 25.3% | 22 |
| 4 | More than 1 hour: |  | 26.4% | 23 |
| 5 | I don't know: |  | 21.8% | 19 |

**6.** Please can you tell us about parking? How much do you pay for parking at the following places?

**6.a.** Work (all locations) -- Please choose the most appropriate answer

| | | | | |
|---|---|---|---|---|
| 1 | Parking is free: |  | 51.2% | 44 |
| 2 | Sometimes have to pay: |  | 22.1% | 19 |
| 3 | Always have to pay: |  | 26.7% | 23 |

**6.b.** Food shopping (all locations) -- Please choose the most appropriate answer

| | | | | |
|---|---|---|---|---|
| 1 | Parking is free: |  | 67.5% | 56 |
| 2 | Sometimes have to pay: |  | 26.5% | 22 |
| 3 | Always have to pay: |  | 6.0% | 5 |

**6.c.** Shopping in Leeds (all locations) -- Please choose the most appropriate answer

| | | | | |
|---|---|---|---|---|
| 1 | Parking is free: |  | 7.2% | 6 |
| 2 | Sometimes have to pay: |  | 55.4% | 46 |
| 3 | Always have to pay: |  | 37.3% | 31 |

**6.d.** Leisure activities (all locations) for example cinema, gym -- Please choose the most appropriate answer

| | | | | |
|---|---|---|---|---|
| 1 | Parking is free: |  | 38.8% | 33 |
| 2 | Sometimes have to pay: |  | 55.3% | 47 |
| 3 | Always have to pay: |  | 5.9% | 5 |

**7.** Thinking back over the past 12 months, have you experienced any of the following life events?

| | | | |
|---|---|---|---|
| Moved house: |  | n/a | 28 |

| | | | |
|---|---|---|---|
| Changes to jobs for you or your partner such as new job or changed the place of work: |  | n/a | 40 |
| Changes to do with children such as leaving home, new children, changing schools,: |  | n/a | 11 |
| Stopped working: |  | n/a | 6 |
| Retired: | | n/a | 0 |
| Bought a car: |  | n/a | 9 |
| Got rid of a car and not replaced it: |  | n/a | 4 |
| Obtained a driving license: |  | n/a | 3 |
| New health problem or illness of you or other family members: |  | n/a | 10 |
| No major changes: |  | n/a | 31 |
| Other *(please specify)*: |  | n/a | 7 |
| | | | |

## Section 2: Smart Phone use

**9.** Thinking back over the past 12 months, how frequently do you use our smart phone for the following activities?

**9.a.** Calling and texting -- Please choose the most appropriate answer

| | | | | |
|---|---|---|---|---|
| 1 | Everyday: |  | 93.4% | 85 |
| 2 | Several times a week: |  | 5.5% | 5 |
| 3 | Weekly: | | 0.0% | 0 |
| 4 | Several times a month: | | 0.0% | 0 |
| 5 | Every month: | | 0.0% | 0 |
| 6 | Less than once a month: | | 0.0% | 0 |
| 7 | Never: |  | 1.1% | 1 |

**9.b.** Emails -- Please choose the most appropriate answer

| | | | | |
|---|---|---|---|---|
| 1 | Everyday: |  | 57.8% | 52 |
| 2 | Several times a week: |  | 18.9% | 17 |
| 3 | Weekly: |  | 8.9% | 8 |
| 4 | Several times a month: |  | 2.2% | 2 |
| 5 | Every month: |  | 2.2% | 2 |
| 6 | Less than once a month: |  | 2.2% | 2 |
| 7 | Never: |  | 7.8% | 7 |

| | | | | |
|---|---|---|---|---|
| **9.c.** Twitter, Facebook or similar social network apps -- Please choose the most appropriate answer | | | | |
| 1 | Everyday: |  | 61.1% | 55 |
| 2 | Several times a week: |  | 23.3% | 21 |
| 3 | Weekly: |  | 4.4% | 4 |
| 4 | Several times a month: |  | 2.2% | 2 |
| 5 | Every month: | | 0.0% | 0 |
| 6 | Less than once a month: |  | 1.1% | 1 |
| 7 | Never: |  | 7.8% | 7 |
| | | | | |
| **9.d.** Checking weather forecast -- Please choose the most appropriate answer | | | | |
| 1 | Everyday: |  | 25.3% | 22 |
| 2 | Several times a week: |  | 29.9% | 26 |
| 3 | Weekly: |  | 13.8% | 12 |
| 4 | Several times a month: |  | 6.9% | 6 |
| 5 | Every month: |  | 2.3% | 2 |
| 6 | Less than once a month: |  | 10.3% | 9 |
| 7 | Never: |  | 11.5% | 10 |
| | | | | |
| **9.e.** Fitness apps (e.g., mapmyrun, STRAVA) -- Please choose the most appropriate answer | | | | |
| 1 | Everyday: |  | 3.4% | 3 |
| 2 | Several times a week: |  | 9.0% | 8 |
| 3 | Weekly: |  | 5.6% | 5 |
| 4 | Several times a month: |  | 9.0% | 8 |
| 5 | Every month: |  | 1.1% | 1 |
| 6 | Less than once a month: |  | 7.9% | 7 |
| 7 | Never: |  | 64.0% | 57 |
| | | | | |
| **9.f.** Gaming (e.g., angry birds, Foursquare, Geocaching) -- Please choose the most appropriate answer | | | | |
| 1 | Everyday: |  | 14.8% | 13 |

| | | | | |
|---|---|---|---|---|
| 2 | Several times a week: |  | 21.6% | 19 |
| 3 | Weekly: |  | 13.6% | 12 |
| 4 | Several times a month: |  | 10.2% | 9 |
| 5 | Every month: |  | 6.8% | 6 |
| 6 | Less than once a month: |  | 10.2% | 9 |
| 7 | Never: |  | 22.7% | 20 |
| | | | | |
| **9.g.** Using navigation apps (e.g., Google latitude) -- Please choose the most appropriate answer | | | | |
| 1 | Everyday: |  | 4.6% | 4 |
| 2 | Several times a week: |  | 24.1% | 21 |
| 3 | Weekly: |  | 19.5% | 17 |
| 4 | Several times a month: |  | 24.1% | 21 |
| 5 | Every month: |  | 10.3% | 9 |
| 6 | Less than once a month: |  | 9.2% | 8 |
| 7 | Never: |  | 8.0% | 7 |
| | | | | |
| **9.h.** Using travel apps (e.g., Virgin trains mobile app) -- Please choose the most appropriate answer | | | | |
| 1 | Everyday: |  | 3.5% | 3 |
| 2 | Several times a week: |  | 9.3% | 8 |
| 3 | Weekly: |  | 9.3% | 8 |
| 4 | Several times a month: |  | 22.1% | 19 |
| 5 | Every month: |  | 9.3% | 8 |
| 6 | Less than once a month: |  | 20.9% | 18 |
| 7 | Never: |  | 25.6% | 22 |
| | | | | |
| **9.i.** Using Leeds Travel Info. -- Please choose the most appropriate answer | | | | |
| 1 | Everyday: |  | 3.4% | 3 |
| 2 | Several times a week: |  | 3.4% | 3 |
| 3 | Weekly: |  | 5.7% | 5 |
| 4 | Several times a month: |  | 9.1% | 8 |

| | | | | |
|---|---|---|---|---|
| 5 | Every month: |  | 8.0% | 7 |
| 6 | Less than once a month: |  | 15.9% | 14 |
| 7 | Never: |  | 54.5% | 48 |
| | | | | |
| **9.j.** Using Metro bus information -- Please choose the most appropriate answer | | | | |
| 1 | Everyday: |  | 5.7% | 5 |
| 2 | Several times a week: |  | 4.5% | 4 |
| 3 | Weekly: |  | 5.7% | 5 |
| 4 | Several times a month: |  | 11.4% | 10 |
| 5 | Every month: |  | 6.8% | 6 |
| 6 | Less than once a month: |  | 18.2% | 16 |
| 7 | Never: |  | 47.7% | 42 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| **11.** Thinking back over the past 12 months, how often do you charge the battery of your smart phone? | | | | |
| 1 | Everyday, more than once: |  | 26.1% | 24 |
| 2 | Once everyday: |  | 44.6% | 41 |
| 3 | Once every two days: |  | 20.7% | 19 |
| 4 | Once or twice a week: |  | 6.5% | 6 |
| **Ranking Statistics** (ranks shown above in red):<br>Median rank: **2**\| Mean rank: **2.0**\| Variance: **0.7**\| Standard Deviation: **0.9**\| Lower Quartile: **1.0**\| Upper Quartile: **3.0** | | | | |
| | Other *(please specify)*: |  | 2.2% | 2 |
| | | | | |

| | | | |
|---|---|---|---|
| **12.** What type of smart phone do you currently have? | | | |
| Android phone: |  | n/a | 40 |
| iPhone: |  | n/a | 29 |
| Windows mobile: |  | n/a | 4 |
| Blackberry: |  | n/a | 16 |
| I don't know: |  | n/a | 3 |
| Other *(please specify)*: |  | n/a | 3 |

## Section 13: About you and your household

| **31.** Are you... | | | | |
|---|---|---|---|---|
| 1 | Male: |  | 50.0% | 46 |
| 2 | Female: |  | 50.0% | 46 |
| **Ranking Statistics** (ranks shown above in red):<br>Median rank: **1.5**\| Mean rank: **1.5**\| Variance: **0.3**\| Standard Deviation: **0.5**\| Lower Quartile: **1.0**\| Upper Quartile: **2.0** | | | | |

| **32.** How old are you? | | |
|---|---|---|
| <18 | | 0 |
| 18 – 25 | 28.2% | 26 |
| 26 – 35 | 41.3% | 38 |
| 36 – 45 | 19.6% | 18 |
| 46 – 55 | 4.3% | 4 |
| 56 – 65 | 4.3% | 4 |
| >65 | 1.1% | 1 |

| **33.** Can you tell us who lives with you | | | |
|---|---|---|---|
| Children under primary school age: |  | n/a | 10 |
| Children at primary school: |  | n/a | 11 |
| Children at secondary school: |  | n/a | 7 |
| Children at further and higher education: |  | n/a | 2 |
| Partner/Wife/Husband: |  | n/a | 42 |
| Other adults: |  | n/a | 35 |
| Other *(please specify)*: |  | n/a | 17 |

| **35.** Are you... | | | |
|---|---|---|---|
| Employed or self employed full-time: |  | n/a | 65 |
| Employed or self employed part-time: |  | n/a | 14 |
| Unemployed: |  | n/a | 3 |
| Full-time carer: |  | n/a | 2 |
| Retired: | | n/a | 0 |
| Full-time student at college or University: |  | n/a | 14 |

| | | | |
|---|---|---|---|
| Long term sick or disabled: | | n/a | 0 |
| Other *(please specify)*: | | n/a | 3 |

| **38.** Please could you indicate your total household income before tax, this helps us to have a picture of who answered the survey | | | | |
|---|---|---|---|---|
| 1 | Less than £7200 per year: | | 9.2% | 8 |
| 2 | Between £7,200 and £9,999 per year: | | 3.4% | 3 |
| 3 | Between £10,000 and 19,999 per year: | | 12.6% | 11 |
| 4 | Between 20,000 and 29,999 per year: | | 18.4% | 16 |
| 5 | Between 30,000 and 45,000 per year: | | 26.4% | 23 |
| 6 | Over 45,000 per year: | | 18.4% | 16 |
| 7 | I don't know or would prefer not to say: | | 10.3% | 9 |
| **Ranking Statistics** (ranks shown above in red):<br>Median rank: **5**\| Mean rank: **4.4**\| Variance: **2.8**\| Standard Deviation: **1.7**\| Lower Quartile: **3.2**\| Upper Quartile: **6.0** | | | | |
| Other *(please specify)*: | | | 1.1% | 1 |

# Appendix E: Participants' characteristics survey Gothenburg

## Personal characteristics

**Gender (N=40)**

| | |
|---|---|
| Male | 25 (64%) |
| Female | 15 (36%) |

**Age category (N=40)**

| | |
|---|---|
| <18 | 0 (0%) |
| 18-25 | 1 (3%) |
| 26-35 | 3 (8%) |
| 36-45 | 18 (45%) |
| 46-55 | 11 (28%) |
| 56-65 | 7 (18%) |
| <65 | 0 (0%) |

**Number of kids below 18 at home (N=40)**

| | |
|---|---|
| 0 | 16 (40%) |
| 1 | 9 (23%) |
| 2 | 11 (28%) |
| 3 | 3 (8%) |
| 4 | 0 (0%) |
| 5+ | 1 (3%) |

**Number of adults at home (N=40)**

| | |
|---|---|
| 0 | 0 (0%) |
| 1 | 5 (13%) |
| 2 | 30 (75%) |
| 3 | 5 (13%) |

**Form of living**

| | |
|---|---|
| Apartment | 6 (15%) |
| House | 34 (85%) |
| Others | 0 (0%) |

## Travel pattern

**Use of public transportation when commuting**

| | |
|---|---|
| Every weekday | 20 (51%) |
| A few days a week | 4 (10%) |
| A few times a month | 10 (26%) |
| A few times a year | 3 (8%) |
| Never | 2 (5%) |

**Use of on vehicle (not bicycle) when commuting**

| | |
|---|---|
| Every weekday | 13 (33%) |
| A few days a week | 8 (21%) |
| A few days a month | 8 (21%) |
| A few times a year | 4 (10%) |
| Never | 6 (15%) |

**Use of bicycle or walking when commuting**

| | |
|---|---|
| Every weekday | 9 (23%) |
| A few days a week | 4 (10%) |

| | |
|---|---|
| A few times a month | 3 (8%) |
| A few times a year | 5 (13%) |
| Never | 18 (46%) |

**Average commuting time**

| | |
|---|---|
| Below 10 minutes | 0 (0%) |
| 10-30 minutes | 12 (31%) |
| 31-60 minutes | 19 (49%) |
| 61-90 minutes | 7 (18%) |
| 91-120 minutes | 0 (0%) |
| Above 120 minutes | 1 (3%) |

**Occupation (N=40)**

| | |
|---|---|
| I am employed in a private company | 22 (55%) |
| I am employed in a governmental organization | 18 (45%) |
| I have my own business | 0 (0%) |
| I am retired | 0 (0%) |
| I am studying | 0 (0%) |
| I am looking for work | 0 (0%) |
| I cannot work | 0 (0%) |
| Other | 0 (0%) |

**Home location**

| | |
|---|---|
| Ale | 1 (3%) |
| Alingsås | 1 (3%) |
| Göteborg | 7 (18%) |
| Härryda | 3 (8%) |
| Kungsbacka | 3 (8%) |
| Kungälv | 2 (5%) |
| Lerum | 14 (35%) |
| Lilla Edet | 1 (3%) |
| Mölndal | 2 (5%) |
| Partille | 1 (3%) |
| Stenungsund | 1 (3%) |
| Tjörn | 0 (0%) |
| Öckerö | 1 (3%) |
| Other | 3 (8%) |

Other: Borås, Brämhult, Skövde

**Work/study location**

| | |
|---|---|
| Ale | 0 (0%) |
| Alingsås | 0 (0%) |
| Göteborg | 37 (93%) |
| Härryda | 0 (0%) |
| Kungsbacka | 0 (0%) |
| Kungälv | 1 (3%) |
| Lerum | 0 (0%) |
| Lilla Edet | 0 (0%) |
| Mölndal | 1 (3%) |
| Partille | 1 (3%) |
| Stenungsund | 0 (0%) |
| Tjörn | 0 (0%) |
| Öckerö | 0 (0%) |
| Annan | 0 (0%) |

**Distance to the nearest public transportation stop from home**

| | |
|---|---|
| 0-0,5 km | 27 (68%) |
| 0,5-1 km | 9 (23%) |
| 1-2 km | 3 (8%) |

| | |
|---|---|
| More than 2 km | 1 (3%) |
| I do not know the distance | 0 (0%) |
| I do not know where the stop is located | 0 (0%) |

**Distance to the nearest public transportation stop from their occupation**

| | |
|---|---|
| 0-0,5 km | 34 (85%) |
| 0,5-1 km | 5 (13%) |
| 1-2 km | 0 (0%) |
| More than 2 km | 1 (3%) |
| I do not know the distance | 0 (0%) |
| I do not know where the stop is located | 0 (0%) |

**Frequency of shifting modality during a commute trip (e.g. walk-tram-walk-bus-walk means four shifts)**

| | |
|---|---|
| 0 | 5 (13%) |
| 1 | 3 (8%) |
| 2 | 18 (46%) |
| 3 | 4 (10%) |
| 4 | 7 (18%) |
| 5 | 1 (3%) |
| 6 | 0 (0%) |
| 7 | 1 (3%) |
| 8+ | 0 (0%) |

## Smartphone ownership & use

**ICT ownership (N=39)**

| | |
|---|---|
| Mobile phone with SMS | 23 (59%) |
| Smartphone with Wi-Fi 20 | (51%) |
| Smartphone with Wi-Fi and 3/4G | 34 (87%) |
| Tablet with Wi-Fi | 7 (18%) |
| Tablet with Wi-Fi and 3/4G | 5 (13%) |
| Fixed GPS in car | 2 (5%) |
| Removable GPS in car | 10 (26%) |
| Computer at home with Wi-Fi | 38 (97%) |
| Computer at work with Wi-Fi | 38 (97%) |

**Smartphone type (N=61)**

| | |
|---|---|
| Android | 19 (51%) |
| Apple iOS | 20 (54%) |
| Windows 7 | 2 (5%) |
| Others | 4 (11%) |
| Not known | 8 (13.1%) |

**Frequency of using the following types of apps when commuting to and from their occupation**

| | Never | Sometimes | Often | Response |
|---|---|---|---|---|
| Gaming (e.g. Wordfued/Angry Birds) | 16 (41%) | 12 (31%) | 11 (28%) | 39/41 (95%) |
| News (e.g. Svttext) | 6 (15%) | 7 (18%) | 26 (67%) | 39/41 (95%) |
| Social networks (e.g. Facebook) | 15 (38%) | 9 (23%) | 15 (38%) | 39/41 (95%) |
| Sports/exercises (e.g. RunKeeper) | 30 (77%) | 6 (15%) | 3 (8%) | 39/41 (95%) |
| Entertainment (E.g. Spotify) | 10 (26%) | 18 (45%) | 11 (28%) | 39/41 (95%) |
| Feedback (e.g. Commute Greener/Shape up) | 35 (90%) | 3 (8%) | 1 (3%) | 39/41 (95%) |
| Navigation (e.g. Navigon) | 21 (54%) | 16 (41%) | 2 (5%) | 39/41 (95%) |
| Travel planning (e.g. Reserobot) | 8 (21%) | 16 (41%) | 2 (5%) | 39/41 (95%) |
| Carpooling (e.g. Avego) | 38 (97%) | 1 (3%) | 0 (0%) | 39/41 (95%) |
| Maps (e.g. Karta) | 13 (33%) | 18 (46%) | 8 (21%) | 39/41 (95%) |
| Treasure hunt (e.g. Geocaching) | 36 (92%) | 3 (8%) | 0 (0%) | 39/41 (95%) |
| Others | 21 (54%) | 8 (21%) | 10 (26%) | 39/41 (95%) |

**General frequency of using the following types of apps**

| | Never | Sometimes | Often | Response |
|---|---|---|---|---|
| Gaming (e.g. Wordfued/Angry Birds) | 12 (31%) | 14 (36%) | 13 (33%) | 39/41 (95%) |
| News (e.g. Svttext) | 5 (13%) | 11 (28%) | 23 (59%) | 39/41 (95%) |
| Social networks (e.g. Facebook) | 10 (26%) | 10 (26%) | 19 (49%) | 39/41 (95%) |
| Sports/exercises (e.g. RunKeeper) | 23 (59%) | 11 (28%) | 5 (13%) | 39/41 (95%) |
| Entertainment (E.g. Spotify) | 8 (21%) | 16 (41%) | 15 (38%) | 39/41 (95%) |
| Feedback (e.g. Commute Greener/Shape up) | 37 (95%) | 2 (5%) | 0 (0%) | 39/41 (95%) |
| Navigation (e.g. Navigon) | 19 (49%) | 19 (49%) | 1 (3%) | 39/41 (95%) |
| Travel planning (e.g. Reserobot) | 10 (26%) | 20 (51%) | 9 (23%) | 39/41 (95%) |
| Carpooling (e.g. Avego) | 38 (97%) | 1 (3%) | 0 (0%) | 39/41 (95%) |
| Maps (e.g. Karta) | 5 (13%) | 25 (64%) | 9 (23%) | 39/41 (95%) |
| Treasure hunt (e.g. Geocaching) | 32 (82%) | 6 (15%) | 1 (3%) | 39/41 (95%) |
| Others | 27 (69%) | 4 (10%) | 8 (21%) | 39/41 (95%) |

# Appendix F: Copy of focus group Enschede

(Enclosed in PDF form: APPENDIX F-i Copy of Enschede focus group (presentation-EN))
(Enclosed in PDF form: APPENDIX F-ii Copy of Enschede focus group (questions-EN))

# Appendix G: Copy of focus group discussion guide Leeds

(Enclosed in PDF form: APPENDIX G-i Copy of Leeds focus group)
(Enclosed in PDF form: APPENDIX G-ii Copy of Leeds focus group questions)