A Data Driven, Segmentation Approach to Real World Travel Behaviour Change, Using Incentives and Gamification

Hannah Bowden and Gabriel Hellen

Abstract This paper reviews the data from a 6-month transport project in Bologna, Italy, which aimed to reduce car journeys and increase active travel through gamification and rewards. 667 participants who had registered via a smartphone app, called BetterPoints, and identified themselves as 'everyday car users' were included in the sample. Behavioural categories based on engagement and the frequency and maintenance of tracked sustainable/active trips were proposed as a way to understand the data and to tailor future interventions. 47% of the 667 everyday car users showed some form of maintained engagement and behavioural change throughout the project. It was concluded that gamification and incentives can motivate travel behaviour change, but that more work is to be done to understand the links between user categories and intervention components in order to dynamically adapt and optimise the programme.

Keywords Behaviour change · Voluntary travel behaviour change · Motivation Incentives · Gamification · Segmentation · Persuasive technology

1 Introduction

The evolution of voluntary travel behaviour change programmes (VTBC) from purely campaigns-based social marketing, to mobile phone-based persuasive technologies is proceeding apace within the academic community (Meloni and Teulada 2015). However, academic pilots are currently limited to small sample sizes and have yet to demonstrate scalability to real-world, population level interventions. Intervention design is not the only thing that is lagging behind academia in real world interventions; evaluation methodology is often reliant on retrospective self-report measures, which, whilst still useful, need to be combined with data driven evidence to fully capture the dynamic nature of travel behaviour (Gerike and Lee-Gosselin 2015). This

H. Bowden (✉) · G. Hellen
Durham University, Durham, UK
e-mail: Hannah.bowden.16@ucl.ac.uk

B. Müller and G. Meyer (eds.), *Towards User-Centric Transport in Europe*,
Lecture Notes in Mobility, https://doi.org/10.1007/978-3-319-99756-8_12

chapter explores a data driven approach to segmenting participants based on engagement and to understand change by combining this tracked data with in-context self-report surveys. Data is obtained via a smartphone app called BetterPoints. The app is offered as part of a complex behaviour change intervention which employs gamification and incentivisation in a real world setting.

Gamification, as the name suggests, employs game-like approaches in real life contexts to elicit behaviour change, with the objective of improving health or the environment. The application of gamification to transport behaviour change, in order to reduce congestion, improve air quality and encourage greater physical activity, has gained increased interest in recent years. Examples of how gamification has been applied in practice include 'Beat the Street', which rewards schools for competing against each other in a 6-week challenge. Participants receive a card which contains radio-frequency identification (RFID) technology and they then tap them against the sensors called 'Beat Boxes' located on lampposts across the area. Players receive points for each box they tap and can create or join teams which can receive prizes for tapping the most boxes. Coombes and Jones (2016) showed that weekly active travel increased at the intervention school by 10% in an intervention compared to a control school, where active travel decreased by 7% per child (Coombes and Jones 2016).

The SUPERHUB (Wells et al. 2014) project uses a Points Accumulation Gamification model (PAG-M) to underpin gamified aspects of travel. SUPERHUB offers personalised travel plans upon which users are rewarded for selecting routes and modes of travel that improve upon previous scores for saving money, decreasing CO2 emissions and/or burning calories. This is based on the assumption that sustainable and active travel, whilst being better for the environment, also promotes better health and is more cost effective. Wells et al. point out that whilst gamification has become a popular technique that there is still little knowledge about the effective design of such systems. Highlighting the challenges associated with effective design of rewards based approaches to gamified behaviour change, specifically with regards to the cost, sustainability and scalability of such systems. Other research supports findings that user challenges within persuasive mobile applications are well-received by users but further personalisation is required (Jylhä et al. 2013).

Anable's (2005) segmentation approach draws on the psychological theory of planned behaviour (TPB) to identify psychographic groups using cluster analysis, pointing out that social-demographic factors have little bearing on the travel profiles of the segments. Forbes et al. (2014) have proposed an algorithm-based approach to tailoring motivational messages to Anabel's traveler segments. This suggestion holds promise but to be useful in real world travel interventions, it begs the question of whether user categorization based on dynamic, in-context behaviour may deliver better results through personalization and gamification than psychographic profiles.

The smart phone app and technology platform used to engage and reward participants in this study are created by BetterPoints Ltd, an evidence-led health, sustainability and social behaviour change technology company that uses a range of behaviour change techniques, including gamification, underpinned by a points based system. BetterPoints' first large scale deployment in Bologna, Italy, was delivered in

partnership with the local mobility authority, SRM. The 'Bella Mossa' programme, translated as the 'Good Move', ran for 6 months between 1st April and 30th September 2017. The project took place in the metropolitan area of Bologna, a region 3700 km^2 in size, where around 1 million people live and move daily.

This chapter reviews the data collected by participants and proposes a targeted, behavioural category based approach to assessing the data and evaluating the evidence of travel behaviour change in an everyday car users sample. It is hypothesised that behavioural categories relating to engagement; the level and maintenance of tracked positive behaviour, may assist in understanding how the intervention may be tailored for these groups to make it more effective in the future. It reviews the evidence of gamification and incentives in motivating travel behaviour change, discusses the behavioural categorisation approach taken and how to link segmentation to gamification and rewards, to reduce app churn, increase engagement and maintain behaviour change.

2 Methods

Participants were recruited to the Bella Mossa programme through a promotional campaign on radio, newspapers and TV which encouraged people to download the BetterPoints app and register with their name, email, gender and year of birth. All citizens (over the age of 14) living and travelling across Bologna could sign up and manually track their sustainable/active journeys using the free BetterPoints app (on Android and iOS devices). Participants could select from 5 modes of travel; walk, cycle, bus, train and car sharing in order to earn points for tracking journeys which could then be exchanged for real world rewards. Messaging on the users' app timeline/notifications and gamification techniques such as challenges were also employed. In the case of challenges, points earned by participants from different organisations counted towards that organisations' place in a leaderboard which could be viewed via the app and programme web portal.

Participants had several opportunities to earn BetterPoints (BP) throughout the project, primarily through the basic action of tracking a journey, earning BP, and then redeeming vouchers. This "basic loop" was available throughout the 6 months of the programme. BP could also be earned by achieving specific goals, such as the first sustainable trip of the day (25 BP) or cycling/walking at least 150 min per week (1000 BP). Special events were held for the public (e.g. the Flower Festival in Crevalcore), and partner events were held for business associates (e.g. The Extraordinary Blue Night at the Villagio della Salute Più indoor spa centre). Participants could also earn BP if they travelled to the venue sustainably.

Participants of the Bella Mossa programme could convert their BPs at any time into monetary discounts or vouchers (e.g. 5% off/€5 off at a specified supermarket.) The strong and wide public-private partnership between SRM and 85 businesses (ranging from large distributors and major retailers to smaller local stores) provided variety in the types of discounts and rewards offered, meaning every user had something to

strive towards—examples include: a €5 voucher for shopping, a free beer, a 2 × 1 ticket for the cinema, a discount for the hairdresser or a free entrance to the spa etc. The inclusion of low cost as well as high value rewards allowed for quick feedback on participants' positive behaviour. The integration of barcode scanning technology into the BetterPoints app allowed vouchers to be redeemed quickly and easily from the participants' smartphone, making rewards very accessible.

Travel behaviour was measured through GPS tracking in participants' mobile phones and in-app surveys and context linked questions. Participants were able to select their active or sustainable transport mode; walking, cycling, bus, train or car share. Tracked journeys were verified by sophisticated algorithms, OpenStreetMap and local bus company routes data. A validation system checked the waypoints against routes for the journey type (tram journeys are on tram lines, bus journeys on bus routes etc…), algorithms checked for speed and acceleration.

There were two methods of collecting self-report data: a selectable and incentivised survey activity and in-context questions. The former selected from the activities menu and the latter appearing after a participant had completed an activity. The in-context questions had to be answered for the points to be received for that activity and appeared in the app when the participant clicked the 'Complete' button upon finishing their activity. The survey questions covered existing travel behaviour such as 'How often do you use your car alone?' at the start of the programme and 'Did you reduce the use of your car/motorcycle because of the BetterPoints app?' at the end. In-context, activity-linked questions were more specific, such as 'Did this journey replace a car journey?'

The behaviour change analysis was based on the tracked GPS data from participants' smartphones. A baseline survey that users could select from the activities menu in the app was used to identify a sample of 'everyday car users'. This sample size was 667 people. Only users who downloaded the BetterPoints app and registered their account for at least 20 weeks of the overall 6-month programme were included in this sample.

The number of sustainable/active journeys these 'everyday car users' made during the beginning (weeks 1–4 from programme inception), middle (weeks 9–12) and end (weeks 17–20) periods of the programme were counted.

The 'everyday car users' were given behavioural categories based on the regularity and maintenance of their sustainable (bus, train, car share) or active (walk, cycle) travel activities, as follows:

- *Maintainers*: recorded at least 3 activities per week for 16 of the 20 weeks.
- *Fluctuators*: recorded at least 1 activity in weeks 1–4, 1 in weeks 9–12, and at least 1 activity in weeks 17–20.
- *Early stoppers*: recorded at least 3 activities in the weeks 1–4 but none after that.
- *Late stoppers*: recorded at least 3 activities in the weeks 1–4 and 9–12, but none after that that.
- *Non-starters*: registered for the project but then didn't go on to track any journeys.
- *Outliers*: didn't fall into any of the above categories.

The smartphone-tracked journey data for the 'everyday car user' group was manually reviewed for patterns in behaviour. Based on observation of data in earlier BetterPoints travel programmes, the database was queried to reveal patterns relating to broad groupings of Maintainers, Fluctuators and Non-Starters behaviour. However, the resulting data set revealed that there were groups of people who had changed their behaviour but then not maintained either the behaviour itself, or the recording of that data at different times. These were then categorized as Late and Early stoppers.

The self-report responses to both the end-of-programme survey question and in-context questions for the 'everyday car users' sample were extracted for each of the behavioural categories identified from the GPS tracked data. This was done in order to ascertain the extent to which the tracked data represented real behaviour change, and not just app use.

3 Results

Of the 667 participants who identified themselves as everyday car users, 596 (89%) demonstrated some level of behaviour change by tracking sustainable or active travel behaviour. 71 (11%) of the 667 self-identified everyday car users registered for the app but did not go on to track any sustainable/active journeys (Table 1).

12% of the 667 everyday car users were classified as Maintainers. They continued their active travel throughout the project, tracking a minimum of 3 activities per week for 16 of the 20 weeks.

47% of the 667 everyday car users showed some form of visible long-term behavioural change throughout the project (Maintainers, Fluctuators and Late Stoppers).

Of the 111 Outliers, 8 people did at least 1 activity in weeks 1–4 and at least 1 activity in weeks 17–20.

Of the 111 Outliers, 19 people did 10 or more activities in weeks 1–4. 3 of these 19 Outliers were still active in weeks 17–20 but had not recorded activity during weeks 9–12 of the programme.

Table 1 Participant behaviour change categories

Category	Count
Maintainer	79
Fluctuator	121
Early stopper	173
Late stopper	112
Non-starter	71
Outlier	111
Total	667

The remaining 84 participants in the Outliers group were recording journeys during weeks 9–12, but only 1 or 2 activities (Table 1).

Participants were asked questions during and after the programme to determine if car use actually decreased. At an interval of at most 3 days, and always after recording an activity, participants were asked 'Did this activity replace a car journey?'

The in-context question "Did this journey replace a car journey" was asked 6657 times and participants answered 'Yes' 81% of the time (N = 5395) (Table 2).

In a survey at the end of the Bella Mossa Programme, participants were asked once 'Did you reduce the use of your car/motorcycle because of the BetterPoints app?' (Table 3).

146 (79%) of the 185 'everyday car users' who responded to the end-of-programme survey said that, as a result of the BetterPoints app, they reduced the use of their car. This represents nearly 22% of the total sample of 667 'everyday car users'.

Table 2 Responses to the in-context question 'Did this journey replace a car journey?'

Category	Count	Number of times the question "Did this journey replace a car journey" asked	Yes—this replaced a car journey	No—This didn't replace a car journey
Maintainer	79	2384	1857	527
Fluctuator	121	2101	1736	365
Early stopper	173	441	350	91
Late stopper	112	1402	1180	222
Non-starter	71	0	0	0
Outlier	111	329	272	57
Total	667	6657	5395	1262

Table 3 Responses to the in-app question: 'Did you reduce the use of your car/motorcycle because of the BetterPoints app?'

Category	Count	Questions asked	Yes	No
Maintainer	79	62	52	10
Fluctuator	121	81	63	18
Early stopper	173	4	3	1
Late stopper	112	24	19	5
Non-starter	71	0	0	0
Outlier	111	14	9	5
Total	667	185	146	39

4 Discussion

The case for using gamification and incentives in voluntary travel behaviour change programmes (VTBC) seems largely closed. The analysis of data from the Bella Mossa programme supports the notion that these techniques appear to shift travel behaviour towards more sustainable modes. 89% of 'everyday car users' answered 'Yes' 81% of the time when asked, in-context, if their sustainable travel had replaced a car journey. 79% of respondents also answered 'Yes', when asked if the BetterPoints app had motivated this mode shift. However, both these questions may be considered to be leading and so it is recommended that future in-context surveys of this kind are more open-ended. Despite this limitation, the use of gamification and incentives in a smart phone app appears to offer a more scalable solution to traditional social marketing campaigns.

The challenge remains that if we are to implement large scale, real world VTBCs such as Bella Mossa, how can we target it in a way that is cost effective and elicits real mode shift as well as maintaining and increasing sustainable and active travel? Are static psychosocial segmentation approaches (Anable 2005) adequate or do we need more dynamic categories based on engagement behaviour to inform the tailoring of the intervention? A data driven approach using tracked GPS data from the Better-Points app offered 6 potential categories; *maintainers, fluctuators, early stoppers, late stoppers, non-starters* and *outliers*, that could be mapped to 'short term loops' of increased incentives, messaging and links to real world events. For example, the promise of tangible prizes, like a Bella Mossa hat, may not be important to a 'maintainer' who already uses the app frequently, however it may be vital in providing a mid-term goal for an 'early stopper' to strive towards.

Understanding the motivations or barriers that cause 'non-starters' to register on the app but not go on to track any activity may help to identify levels and types of rewards that will provide the initial push to get started. A better understanding of the relationship between engagement and the target behaviour to change is critical to the future design of digital VTBC programmes. The present analysis reviewed the data at the end of the 6 month programme to determine the categories of everyday car users. In order to *dynamically* map rewards to user segments during the programme, new approaches will need to be devised. These may include the development of algorithms for clustering data, assigning categories and delivering rewards such as the approach proposed by Forbes et al. (2014).

Maintaining behaviour change is known to be difficult and this was also observed during the Bella Mossa programme. 285 (43%) of the 667 "everyday car users" were classified as either early or late stoppers, meaning that whilst they showed promising signs of maintained sustainable/active travel, they ultimately gave up tracking this behaviour during the project. It is unknown if this means the sustainable or active travel behaviour itself continued and the disengagement was simply app churn. Churn relates to how many users will re-launch an app after downloading it. This is a persistent problem with apps across many markets, whereby an average of 63% of people don't revisit an app after the first month (O'Connell 2017). If we are to

consider the 'Non-starter' and 'Early Stopper' groups to represent app churn, then at approximately 37% of the overall group, this would be better than the industry average. If we add 'Late Stoppers' to this picture the percentage rises to 53%. If those who did not continue to use the app from the outlier group were also considered in this picture, it is likely to be looking similar to the industry average churn rate. Further work may explore the relationship between app churn and behaviour change by following up with churned users with regards to why they stopped using the app and whether the target behaviour had changed and/or new behaviour maintained.

It seems less likely that churn was a result of dissatisfaction with app functionality or the way in which people were asked to record journeys as only 2% of all participants (not just everyday car users) who completed the end of programme survey said that they would not participate again because recording journeys was 'too tiresome'. 84% of people across the whole programme said that they would participate again 'without a doubt'. Despite this positive stance on app functionality, it is recommended that future interventions use more targeted, short-term rewards to maintain engagement. Automatic tracking, rather than manually starting and stopping an activity, may also help to reduce app churn.

As well as the need for better understanding of what constitutes useful user segmentation, it is also important that going forward we define the elements of transport behaviour change interventions in a shared language. Gamification and Incentives or Rewards relate to particular Behaviour Change Techniques. The Bella Mossa research reviewed in this chapter suggests that such a complex real world behavioural challenge requires an acknowledgement of the importance of engagement behaviour, linked with a range of behaviour change techniques drawn not only from gamification and incentives based interventions but extending into social marketing and persuasive mobile apps. In order to test the most effective mix of challenges or games, rewards and messaging—the 'Reward mix' for particular user segments we will need consistent nomenclature to refer to the intervention components (Bird et al. 2013). The Behavioural Change Techniques Taxonomy (Michie et al. 2015) may offer a solution and work to 'code' future VTBC digital programmes such as Bella Mossa, may assist in this mapping.

Motivation is an important factor when trying to induce positive transport behaviour change, but, as we are reminded of by Michie et al.'s Com-B Theory (Michie et al. 2014) the context in which the behaviour takes place should not be forgotten. The holiday season in Bologna (late July/early August) caused significant changes to transport behaviour. It is possible that people were more likely to resort back to old behaviour, such as solo car use and not tracking journeys, because of the changes to routine. To counteract this possibility rewards and event related gamification were increased immediately after the holiday period to encourage people to re-engage with the app. User activity data tracked in the BetterPoints dashboard showed a 'spike' in activity during this period in weeks 17–18, possibly due to the introduction of a competition with prizes, ranging from a Bella Mossa hat to a water bottle, based on how often the app was used. The popularity of this kind of gamification to maintain interest is further supported by the finding that 22% of survey

respondents (across the whole participant population) said that they would like to see more 'special occasions' such as these short term challenges and events.

Looking forward, short-term competitions and special events that add variety and interest to the basic loop of track a journey for a set number of points, should be more frequent. The use of behavioural categories such as those proposed in this chapter could be used as a way of more effectively targeting specific sub-groups within the wider everyday car user population with these short-term loops. The ability to identify people based on their behavioural response to a digital intervention and incentives, and dynamically adapt the 'Reward mix', to optimize behaviour change, is considered to be the key to future success in VTBC programmes such as Bella Mossa.

Acknowledgements Marco Amadori and Giuseppe Liguori of SRM. via A. Calzoni, 1/3-40128 Bologna. Joe Oldak, Head of Engineering, Marietta Le, Engagement Manager, Chris Bristow, COO and Rachel Maile, Marketing Officer, all of BetterPoints Ltd.

References

Anable J (2005) 'Complacent car addicts' or 'aspiring environmentalists'? Identifying travel behaviour segments using attitude theory. Transp Policy 12(1):65–78. https://doi.org/10.1016/j.tranpol.2004.11.004

Bird EL, Baker G, Mutrie N, Ogilvie D, Sahlqvist S, Powell J (2013) Behavior change techniques used to promote walking and cycling: a systematic review. Health Psychol 32(8):829–838. https://doi.org/10.1037/a0032078

Coombes E, Jones A (2016) Gamification of active travel to school: a pilot evaluation of the beat the street physical activity intervention. Health & Place 39:62–69. https://doi.org/10.1016/j.healthplace.2016.03.001

Forbes PJ, Gabrielli S, Maimone R, Masthoff J, Wells S, Jylhä A (2014) Towards using segmentation-based techniques to personalize mobility behavior interventions. ICST Trans Ambient Syst 1(4). https://doi.org/10.4108/amsys.1.4.e4

Gerike R, Lee-Gosselin M (2015) Workshop synthesis: improving methods to collect data on dynamic behavior and processes. Transp Res Proc 11:32–42. https://doi.org/10.1016/j.trpro.2015.12.004

Jylhä A, Nurmi P, Sirén M, Hemminki S, Jacucci G (2013) Matkahupi: a persuasive mobile application for sustainable mobility. Paper presented at the Proceedings of the 2013 ACM conference on Pervasive and ubiquitous computing adjunct publication

Meloni I, Teulada BSD (2015) I-Pet individual persuasive eco-travel technology: a tool for VTBC program implementation. Transp Res Proc 11:422–433. https://doi.org/10.1016/j.trpro.2015.12.035

Michie S, Wood CE, Johnston M, Abraham C, Francis JJ, Hardeman W (2015) Behaviour change techniques: the development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data). Health Technol Assess (Winchester, England), 19(99):1–188. https://doi.org/10.3310/hta19990

Michie S, Atkins L, West R (2014) The behaviour change wheel: a guide to designing interventions. Silverback Publishing

O'Connell C (2017) [New Data] Industry App Benchmarks for H1 2017. Retrieved from http://info.localytics.com/blog/vertical-app-benchmarks-first-half-of-2017

Wells S, Kotkanen H, Schlafli M, Gabrielli S, Masthoff J, Jylhä A, Forbes P (2014) Towards an applied gamification model for tracking, managing, & encouraging sustainable travel behaviours. EAI Endorsed Trans Ambient Syst