Transport Smartphone Applications Survey

Mr William Brazil

Ph.D. Research Student

Trinity College Dublin

Dr. Brian Caulfield

Assistant Professor

Trinity College Dublin

Dr. Nadine Rieser-Schüssler

Lecturer

ETH Zürich

Abstract

This paper examines methods of communicating and presenting information to individuals about transport and travel related carbon emissions for online journey planners and smartphone applications. As users may not be familiar with the magnitude of such emissions, many of these calculators employ techniques designed to help the user better understand their emissions and provide some context for the user. This study examines four different methods of communicating and contextualising trip related carbon emissions based upon methods already in used by a variety of carbon calculators. These methods included a simple numerical representation of emissions in the form of kilograms of CO_2 produced, a "lightbulb" method used to contextualize the emissions, a weekly carbon budget, and a graphical "traffic light system".

Results indicate that while that there is a strong correlation between understanding of methods and likelihood of altering mode choice. Significant preferences exist for each of the methods, and age and gender appear to be indicators of personal preference.

Introduction and Background

Due to on-going advancements in mobile internet and smartphone technology, users are gaining access to increasing accurate travel information at the touch of a button. It is now possible to develop applications and websites which can provide a wide array of information related to potential trips, such as suggested routes, trip costs and real time public transport information. These resources also provide an opportunity to inform users about the carbon emissions that each mode or route would produce if chosen. By providing information on carbon emissions at the time when the user is making a mode choice decision, it may be possible to make the environmental impact of the trip more immediate and relevant to the user and therefore a more important consideration [1].

As any journey planner either on-line on the tradition internet or as part of smartphone applications is likely to provide users with information regarding multiple trip attributes, it is essential that any information on emissions is able to compete for the user's attention while at the same time avoiding an information overload. It is also important that emissions information is clearly presented and easily understood, while still being personally relevant to the user.

This paper discusses the results of a study carried out to examine four different methods of potentially displaying trip information for environmentally orientated smartphone applications based on methods of communicating carbon emissions currently in use across a number of sectors and platforms.

Methodology

To examine the research questions posed in this paper a survey was undertaken to assess user requirements for a persuasive travel advisor with the aiming of reducing travel related CO_2 emissions. This survey was conducted in the form of an on-line questionnaire distributed via a number of sources including the electronic notice boards of semi-state organizations. 457 responses were received in total with a completion rate of 78.3%.

Due to the approach taken during the distribution of the survey, the sample is not representative of the Irish population as a whole. The sample has more respondents in the higher brackets for education and employment type than would be expected from the results of Irish census data for 2011 [2]. It is likely that the electronic questionnaire format used for the survey would be more accessible to those individuals engaged in office based employment with consistent access to information systems than those engaged in manual labour.

Survey respondents were presented with four methods of understanding carbon emission arising from their trips. Each method presented the respondent with information on the attributes of the three modes available bus, driving and heavy rail. Information on travel times and trip costs associated with each mode were also presented as these attributes are likely to be included on any transport related application interface. To ensure that respondents were aware that they were being asked to assess the method of presenting emissions, rather than choose the mode they would take, the attribute levels for each mode (time, cost and emissions) were kept constant for each method.

Method 1: the "Basic Numerical Method", presented respondents with simple numerical information regarding the emissions that would be produced by each mode. Emissions information was presented in terms of kilograms of CO_2 with no additional information available to the user. This format be similar to the approach taken by many carbon calculators and is comparable to methods of communicating other intangible units such as calorie information on the packaging of food products.

Method 2: also known as the "Light Bulb Method", contained the same information as provided in Method 1 as well as additional information designed to help respondents put their emissions into context. Respondents were told how long a 60 watt incandescent light bulb would need to be left turned on to produce the equivalent amount of emissions of CO_2 as their trip. This calculation was based upon the current Irish electricity mix [3]. The choice of the 60 watt bulb was due to a number of factors including the simplicity of the device, the status of light bulbs as iconic images in previous energy saving campaigns, and its widespread use in Irish homes until very recently. This device also represented a brand neutral appliance as its power consumption and emissions are not specific to a given model or manufacturer. This method is similar in nature to the approach taken by Caulfield and Brazil 2011 [4]. Method 2 was accompanied by images of lightbulbs which increased in size as emissions rose to provide a visual stimulus. It should be noted that these images were merely illustrative and did not relate directly in scale to the emissions produced due to constraints with the format of the images, this was also communicated to the survey respondents.

Method 3: known as the "Carbon Budget Method" presented respondents with the same basic information as provided in Method 1 as well as additional information regarding a daily carbon budget. Respondents were told what percentage of their daily carbon budget each mode would consume per trip and what percentage would remain. The idea of personal carbon budgets is already well developed with a large body of literature addressing the concept of enforced carbon budgets and personal carbon trading schemes [5]. This budget based upon McNamara and Caulfield 2011[6] and assigned respondents a hypothetical daily carbon budget of 5kg per day for travel activities, which could be divided across modes. The budget is purely informative and is unenforced, meaning that users suffer no quantifiable personal loss for exceeding their limit such as a fiscal penalty. It was hoped that the effect of this information would help respondents to put their emissions into context and highlight the fact that sustainable approaches do exist.

Method 4: known as the "Traffic Light Method" was constructed in such a manner that while it contained the same information as the previous three methods with regard to travel time and trip cost, it omitted information on carbon emissions. This was intended to test whether respondents had a preference for visual rather than quantitative information on carbon emissions. Instead of numerical information, Method 4 provided respondents with a traffic light colour coding system where the highest emitting mode was assigned a red light, the medium mode a yellow light and the lowest emitting mode a green light. This method reflects the approach being taken by a number of carbon calculators as well as the use of traffic light style colour coding in the white goods and building energy sectors in Ireland.

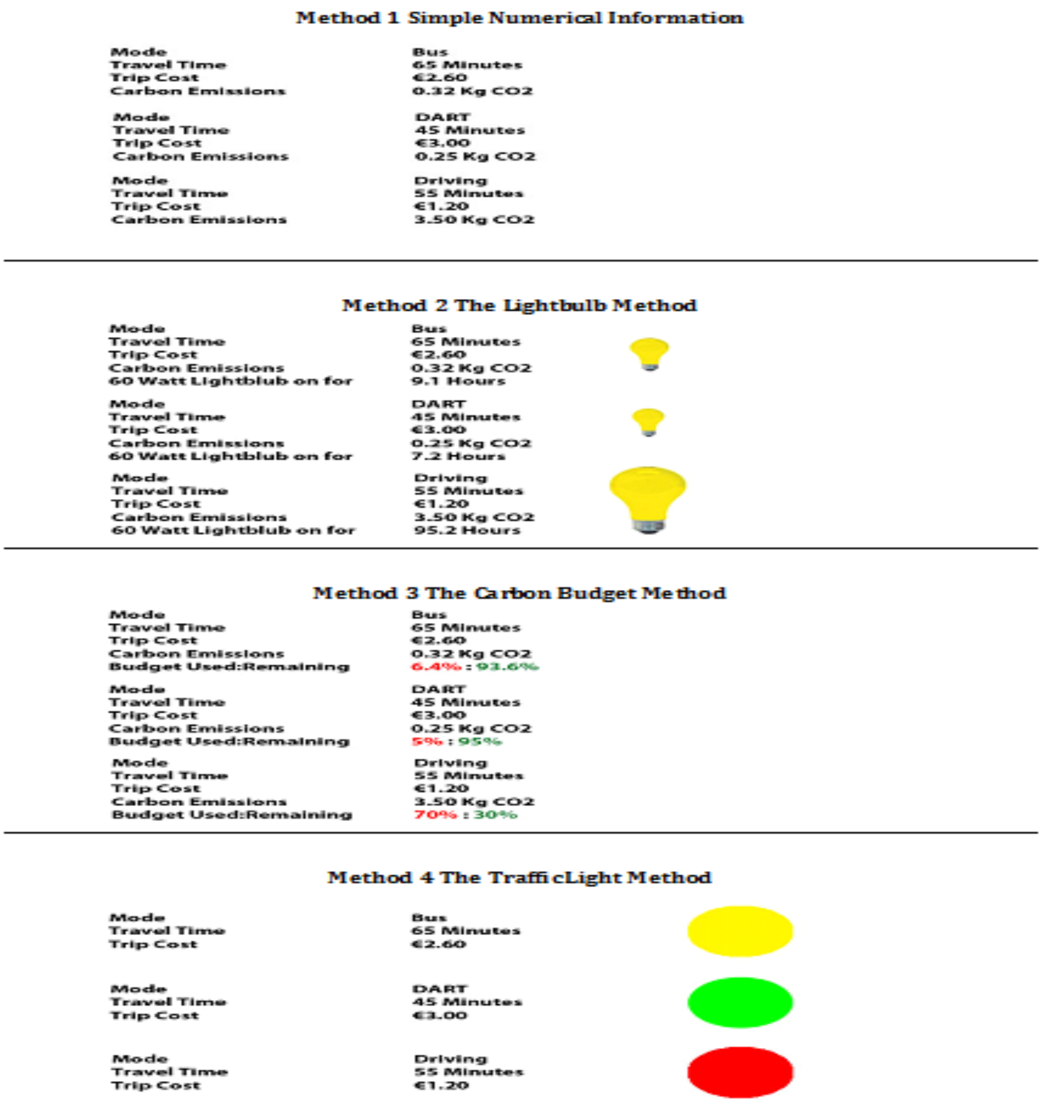

FIGURE 1 Methods used to display CO_2 emissions

Results

After viewing the four methods of carbon presentation respondents were asked to indicate which method they had found the “easiest” and “hardest” to understand and which method was “most likely” and least likely” to entice them to move to a lower emitting mode. This question format forced respondents to make a choice between methods, while also addressing some of the issues of response similarity that may occurs with Likert scales.

Table 1 displays the respondents’ method preference both in terms of understanding of the method, and the methods’ likelihood to influence mode choice Basic Numerical Information provided by Method 1 was deemed to be both the easiest understood and the most influential method with scores of 38.3% and 32.7% respectively. Responses for the Light Bulb Method are very similar for both understanding and influence with scores of 27.9% and 28.2% respectively. The largest variance between understanding and influence was for the Carbon Budget Method where 17.9% of respondents stated that it was the easiest method to understand but 24.6% chose it as the most influential method.

The Traffic Light Method has been selected as both the method that is hardest to understand and least influential by largest section of respondents with scores of 39.9% and

46.6% respectively. The Carbon Budget Method was chosen as the hardest to understand by 28.8% of respondents and chosen as the least influential by 21.5%. This suggests that the Carbon Budget Method may be perceived as more influential than understandable. An implication of this may be that if users can be educated to operate a carbon budget system it may offer a more effective method of communicating and therefore controlling carbon emissions.

Table 1 Perception of Methods

	Basic Numerical	Lightbulb Method	Carbon Budget	Traffic Light Method
Easiest Method to Understand	38.3% (137)	27.9% (100)	17.9% (64)	15.9% (57)
Hardest Method to Understand	14.5% (52)	16.8% (60)	28.8% (103)	39.9 (143)%
Most Likely to Alter Mode	32.7% (117)	28.2% (101)	24.6% (88)	14.5% (52)
Least Likely to Alter Mode	15.9% (57)	15.9% (57)	21.5% (77)	46.6% (167)

Cross Tabulations

To assess the relationships between demographic variables, travel behaviour variables, and the respondents assessment of the methods, a number of Chi Squared cross tabulations were run. Table 2 displays the results of these cross tabulations.

Previous studies have identified an attitude-behaviour or value-action gap with relation to individual's pro-environmental attitudes and the high carbon activities in which they actually engage in [1, 7, 8]. Rather than canvas opinions or attitudes, respondents were instead asked to state how often they undertook trips using with different modes, allowing classification by actions rather than attitudes or alleged intentions.

Only cross-tabulations which resulted in frequency distributions which are significantly difference than random are discussed further.

Table 2 Cross-tabulations of Understanding and Influence of Methods

Understanding of Methods	Gender	Age	Education	Walking	Driving	PT Use	Cycling
Chi^2	11.785	14.25	10.701	11.559	12.64	14.88	9.075
DF	3	12	6	12	12	12	12
P	0.008*	0.285	0.098**	0.482	0.396	0.265	0.696

Influence of Methods	Gender	Age	Education	Walking	Driving	PT Use	Cycling
Chi^2	1.979	27.34	10.556	9.387	9.009	22.911	14.335
DF	3	12	6	12	12	12	12
P	0.577	0.007*	0.103	0.670	0.702	0.028*	0.280

*Rejects the null hypotheses at 95% Probability

**Rejects the null hypotheses at 90% Probability

Figure 2 displays the variance in ease of understanding of methods with regard to gender. It is clear that while Method 1 and Method 3 display increased levels of male selection, Method 4, the Traffic Light Method has been selected as the easiest method to understand by 24.76% of females in contrast to 12.35% of males. Method 2, the Light Bulb Method, has been selected as the easiest method to understand by a similar percentage of males and females.

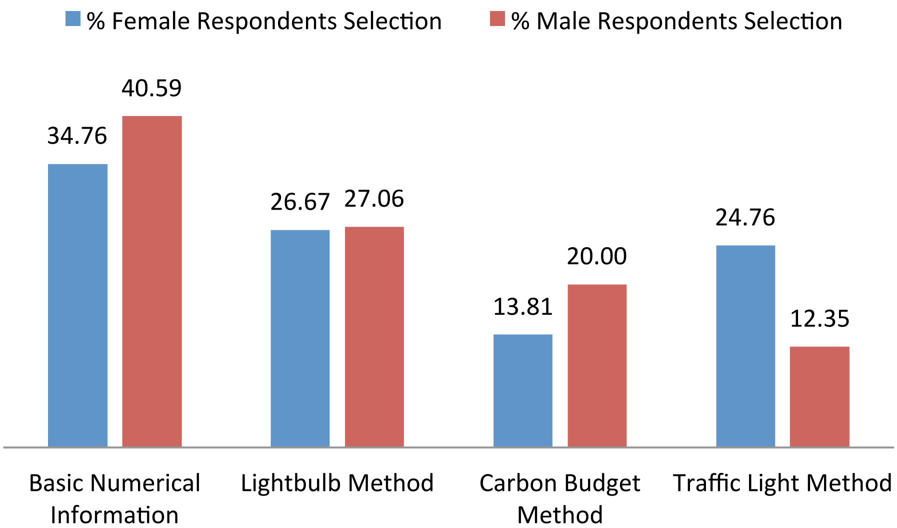

Figure 2 Gender and easiest method to understand

Figure 3 outlines the results of the cross tabulation between the influence of methods and the age of the respondents. The graph indicates that influence of the Method 1and Method 4 increase in relation to the age of the respondents while the influence of Methods 2 and 3 decrease. A marked change in preference exists between each end of the age spectrum for each of the methods. Positive changes of 22.53% for Method 1 and 19.75% for Method 4 occur, while negative changes of 18.7% for Method 2 and 23.57% for Method 3 are observed.

If Methods 2 and 3 are considered “contextualising methods” insofar as they provide the respondents with some context to allow them to relate to their emissions, it is evident that the influence of these contextualising methods decreases with respect to age and the influence of the two “non-contextualising” methods increases.

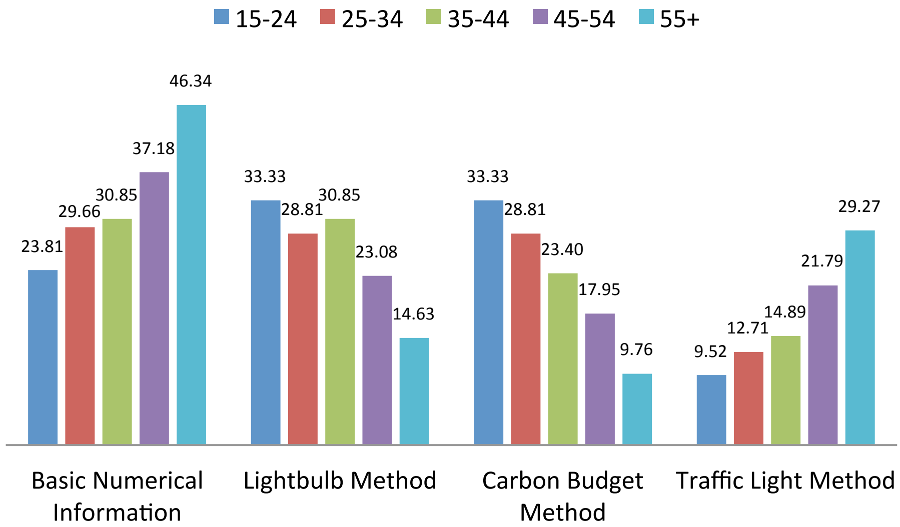

Figure 3 Most influential method versus age

Table 3 highlights the relationship between understanding of scenarios and influence. The columns represent individual's selection of the mode which is easiest to understand (denoted by Und.) while the rows represent individual's selection of the most influential mode (denoted by Inf.). For example 15 respondents selected Basic Numerical Information as the easiest to understand but the Lightbulb Method as the most likely to influence their behaviour The diagonal represents individuals who a given method as both the easiest to understand and the most likely to influence their mode choice. The results of this cross tabulation produced a Chi squared value of 515 for 9 degrees of freedom suggesting a very strong correlation between the understanding and influence.

Table 3 Understanding and Influence of Methods

Understanding vs. Most Influential	Und. Basic Numerical	Und. Lightbulb Method	Und. Carbon Budget	Und. Traffic Light Method
Inf.Basic Numerical	27.6% (99)	2% (7)	1.1% (4)	2% (7)
Inf.Lightbulb Method	4.1% (15)	23% (82)	0.5% (2)	0.5% (2)
Inf.Carbon Budget	5% (18)	2% (7)	15.4% (55)	2.2% (8)
Inf.Traffic LightMethod	1.4% (5)	1.1% (4)	0.8% (3)	11.1% (40)

Summary of Findings

This study examined the effectiveness of four different methods of presenting transport related carbon emissions. Results indicate that there is a significant level of demand for all four methods used. While no method received preferential selection from the majority of respondents, presenting information on carbon emissions in a simple numerical form appears to be the method that is both the easiest to understand and the most likely to influence individual's behaviour. There is also a high level of support for methods that help respondents to put their emissions into context.

There is a very strong relationship between the ease with which the user can understand the method of communicating carbon emissions and the likely influence the method will have upon the respondent altering mode.

Some significant variances in method preference were observed with regard to age, gender. Cross tabulations of respondent's mode choices with their method preferences produced insignificant results, suggesting that an individual's behaviour with regard to sustainable transport may not be related with their perception of carbon emissions.

Conclusions

Provision of tailored information has been identified as a method of overcoming internal barriers individuals face when attempting to reduce their personal carbon footprint. While this study only examined four relatively basic methods of presenting emissions information, it is clear that individuals have varying preferences with regard to how this information should be communicated. As it would be relatively inexpensive to provide a combination of alternative methods of emissions presentation, organisations operating carbon calculators and journey planners should endeavour to present this information in as many formats as feasible. As many of these on-line resources enable users to create their own personal profiles, users should have the ability to specify the method of information presentation which most appeals to them.

It should be noted that for the purpose of the study the different methods where presented as independent and isolated from each other, however in reality many cases carbon calculators and journey planners use a combination or variation of the methods examined.

Acknowledgements

This research was funded as part of the PEACOX Project under the European Union's 7th Framework Programme

References

Howarth, C., B. Waterson, and M. McDonald. Public Understanding of Climate Change and Gaps between Knowledge, Attitudes and Travel Behaviour. TRB2009 Annual Meeting CD-ROM

Central Statistics Office. This is Ireland 2011Part 2,2012

Howley, M., B. O'Gallachoir and E. Dennehy. Energy in Ireland: Key Statistics 2009. Sustainable Energy Ireland, 2009

Caulfield, B., and W. Brazil. Examining the Factors that Impact Upon Mode Choice for Frequent Short trips TRB2011 Annual Meeting

Bristow, A.L. Framing Policies to Deliver Behavioural Changes to Reduce Carbon Emissions from transport TRB2010 Annual Meeting CD-ROM

McNamara, D. and B. Caulfield. Determining the Welfare Effects of Introducing a Cap-and share Scheme on Rural Commuters. Transportation Research Part D, Vol. 16, 2011, pp547-553

Anable, J., B. Lane, and T. Kelay. An Evidence Base Review of Public Attitudes to Climate Change and Transport Behaviour. Department for Transport, 2006

Gardner, G.T, and P.C. Stern. Environmental Problems and Human Behavior. Allyn & Bacon, Boston, 1996.