"But I already know how to drive" - exploring intervention strategies and systemic barriers to eco-driving in public transport

Helena Strömberg

Product and Production Development, Chalmers University of Technology, Göteborg, Sweden
helena.stromberg@chalmers.se

Abstract

An attractive bus system is an important part of sustainable mobility, but its environmental impact can be decreased. Encouraging bus drivers to adopt eco-driving is one way of achieving this. As eco-driving requires bus drivers to change their driving behaviour, behaviour change intervention strategies are helpful in accomplishing this. However, there are problems with achieving the potential of eco-driving interventions. Therefore, the primary aim of this paper is to relate bus drivers’ views of eco-driving and the problems they face when attempting to change their behaviour with the help of eco-driving interventions. The secondary aim is to discuss the consequences of this when designing interventions to promote eco-driving in the future.

The paper is based on data from two studies: one interview study with bus drivers regarding their work situation (n=20), and one field trial (n=54) aimed at testing the effects of two eco-driving interventions in buses. The studies reveal consensus among the drivers that eco-driving is important and they are positive to the concept, but they are divided over if eco-driving promotion is necessary. Drivers are knowledgeable on eco-driving but find it hard to translate from theory to practice. The studies exposed a multitude of barriers to the adoption of eco-driving that drivers face in their day-to-day work. These barriers relate to their occupation, the organisation in which they work, and the urban environment in which they drive. In order to overcome these barriers a systemic approach is necessary, applying a coordinated intervention system with a combination of informational and structural strategies.

KEYWORDS: design for sustainable behaviour, eco-driving, public transport
Introduction

As the populations of cities increases and the cities expand over larger areas, the demand for a sustainable public transport system grows. The inhabitants’ mobility needs must be satisfied, and at the same time, the environment must be spared. A well-functioning and attractive bus system has an important role to play here. To be attractive, the bus system should offer efficient, comfortable and safe rides in well-maintained vehicles with relaxed drivers who have been given the best preconditions to perform a good job and be on time.

Ensuring high ridership in the bus system reduces the environmental impact of each individual’s journey, compared to if they would take their car (Santos et al., 2010). However, improving the bus drivers’ driving behaviour could reduce the environmental impact further. Helping drivers adopt the driving style known as eco-driving has been stated to have great potential for reducing the environmental impact (Barkenbus, 2010). According to Vangi and Virga (2003) as much as 25 per cent fuel can be saved.

Eco-driving describes a calmer, more planned driving style, where the driver tries to establish a good overview of the traffic situation in order to avoid unnecessary acceleration and decelerations, and utilise the vehicle’s forward momentum. It consumes less fuel, and because of its calm nature, it is also said to create a more comfortable ride for both passengers and driver (FLEAT, 2010). There is less risk of accidents and incidents, as well as less wear and tear (Harmsen et al., 2003). This means that eco-driving can contribute to many of the aspects that make a bus system attractive.

Intervention strategies for behaviour change

Adopting eco-driving means shifting from one, already established, driving behaviour to a new, more sustainable, driving behaviour. Hence, when trying to promote eco-driving, it is relevant to explore research on how to promote behaviour change through interventions and how to support the mechanisms involved in the behaviour change process.

There are various intervention strategies for changing behaviour in an environment-friendly direction (Ölander & Thøgersen, 1995), emanating from different scientific fields, e.g. environmental psychology and consumer studies. Ölander and Thøgersen endorse Zaltman’s classification of these strategies as the most encompassing. Zaltman’s classification includes power strategies (e.g. legal measures), persuasive strategies (e.g. emotional appeal and incentives), reeducative strategies (communication of fact), and facilitation (making behaviour change easier for those who already want to change).

This classification focuses on interventions in the form of policy measures and public campaigns, but there are more types of interventions. Recently, a research area known as design for sustainable behaviour (see e.g. Lilley, 2009; Lockton et al., 2008; Wever et al., 2008) has been established. Here, the interventions take the form of products that are designed with the intention of creating
sustainable use patterns. The products can either be ordinary products (e.g. a car) but help the user to use them sustainably (e.g. a car with push-back in the accelerator pedal to stop harsh accelerations) or they can be products that aim to influence the use of other products in a more sustainable way (e.g. an eco-driving support system). Many of the strategies that can be used in policy can be transferred into design, but design offers additional possibilities through e.g. affordances and physical cues. One way of classifying design strategies is according to where the control lies – in the user or in the product (Figure 1, Zachrisson & Boks, 2010).

However, choosing the right strategy is not easy. Steg and Vlek (2009) highlight the importance of designing well-tuned interventions, whether they take the form of policy, campaigns, or products. They state that to create an effective promotion of behaviour change, the behaviour and its set of determinants need to be carefully examined, and the intervention strategies chosen so that it is geared towards the most important determinants of the targeted behaviour.

Searching for the set of determinants should ideally take its basis in a scientific model of behaviour (Ölander & Thøgersen, 1995). A number of such scientific models of behaviour exist, e.g. Ajzen’s (1991) Theory of Planned Behaviour. The models usually contain parts relating to people’s motivation to change their behaviour, such as their perceptions, attitudes, knowledge, and norms. These sets of determinants can be targeted with more informational strategies (Steg & Vlek, 2009), the ones to the left in Figure 1. Other parts of the models relate to issues of control over the behaviour, e.g. habits, opportunity, and perceived and actual control. These determinants require that behaviour change is facilitated or made the more attractive or natural choice (Steg & Vlek, 2009), and are placed in the middle and to the left in Figure 1. Generally there are several determinants to target, so a combination of both informational and more structural strategies is required (Gardner & Stern, 2002).

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<tr>
<th>User in control</th>
<th>Product in control</th>
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<td>Informing</td>
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Figure 1. Intervention strategies classified according to control. From Zachrisson and Boks (2010)

Aim

Despite all benefits of eco-driving, it has been difficult to get bus drivers to adopt it. Previous trials of eco-driving interventions have only managed to achieve small fuel savings that decreased over time (af Wåhlberg, 2007; Zarkadoula et al., 2007). It has not been clearly described why attempts to promote eco-driving through interventions have failed to live up to the projected potential, but there are reasons to believe that the interventions have not been well suited to the task. The primary aim of this paper, therefore, is to relate bus drivers’ views of eco-driving and
the problems they face when attempting to change their driving behaviour with the help of eco-
driving interventions. The secondary aim is to discuss the consequences of this when designing
interventions to promote eco-driving in the future.

Method

This paper is based on data from two studies: one interview study on bus driver work
environment and tasks, and one field trial aimed at testing the effects of two eco-driving
interventions at a public transport company. Both studies were performed at the same company,
and partially the same bus drivers participated in both studies.

Study one: interviews

As a part of a study on a prototype bus, bus drivers were interviewed. The prototype bus is not
of interest to this paper but the interviews are. A total of twenty drivers were interviewed: ten
drivers before the introduction of the bus, and ten after. The interviews focused on what the bus
drivers perceived as important in their role as a bus drivers, and what they felt was necessary to
enable them to perform their job in the best possible way. The interview consisted of two parts:
one structured part with questions regarding education, work environment, and technical aids,
and one semi-structured part focusing on eco-driving.

Study two: field trial

The aim of the study was to investigate the effects of eco-driving interventions for urban bus
drivers. The interventions studied were an in-vehicle eco-driving support system offering
feedback on driving style, and a combination intervention consisting of the feedback system plus
individual coaching sessions. Both interventions were reeducative in nature, using both
information and feedback strategies. The participating bus drivers (n=54) were divided into three
groups; one receiving feedback from the system, one receiving feedback and coaching, and the
third acting as control. As described in figure 2, the study had a baseline and test period of equal length (3 weeks). During the entire period, the participants’ driving was logged on a number of parameters so that any change in their driving behaviour could be analysed. After the test a questionnaire was administered to the drivers on their attitude and knowledge about eco-driving, and how they had perceived the respective interventions as well as the entire eco-driving effort. Reports of the eco-driving intervention project’s progress were also collected from the project manager and the two coaches.

Result and discussion

Overall, the drivers painted a positive and well-informed picture of eco-driving in the initial interviews. The results of the field trial were overall positive. A fuel saving of 6.8% was achieved and the number of harsh decelerations and instances of speeding were drastically reduced. Nevertheless, from the field trial, and in part the interviews, a more complex image of eco-driving emerged. These results may help explain why it is hard to get bus drivers to fully adopt eco-driving and keep it up in the long run. Following is a discussion on key themes related to the bus drivers’ views of eco-driving and the problems they faced adopting it.

Motivated and positive, mostly

Since behaviour change is partly determined by the motivation to change, the drivers’ attitudes towards eco-driving and interventions of this kind of interest. In the three themes discussed below it is evident that while there was consensus that eco-driving was important, drivers’ were divided over if promotion of it was necessary.

“Eco-driving is important – it’s the only way forward”

The 10 interviewed bus drivers all had a very positive overall image of eco-driving and felt it was important. Reasons given were e.g. “it is good for everything, for health, to save money, it is best for nature” “it is driving environmentally friendly and healthily” “more comfortable driving for passengers and driver, it saves costs, it is smooth”. The questionnaires after the field trial enhance that impression; even the drivers with a more negative attitude still rated it very important (Figure 3).

A few drivers mentioned in the interviews that the bus business was behind on the environmental issues compared to other kinds of transport, such as road freight. Those with experience from lorry driving were surprised at the lack of discussion and information surrounding eco-driving in buses, and tried to adapt their eco-driving skills when driving buses.

1 The full result of the field trial is reported elsewhere (submitted for publication)
“A bus driver should already know this”

There were, however, some negative views on eco-driving, mainly because it was introduced as a new concept during the field trial. In some of the drivers’ minds, the calm, planned way of driving that is eco-driving was simply the way a bus driver should always drive, as this is safest and most comfortable for the passengers. Like one of the drivers stated “you should drive like you want to ride”. If you, as a bus driver, needed extra education and feedback systems to help you do this, you were not a real bus driver. Extra eco-driving education was something only necessary “maybe for the young drivers” and eco-driving support systems “are unnecessary, it all depends on the driver, they drive like they want to”.

The drivers generally are very focused on passenger safety, “the passengers must come first hand”, and they feel a great responsibility for the passengers in their role as bus drivers. Those drivers with a more negative attitude towards eco-driving perceive it as slightly less safe, and worse for passenger comfort, than those with a positive attitude.

“All education is good as it makes you work better”

Even though some of the drivers thought of eco-driving education as superfluous, most of them viewed eco-driving education as a good thing. They saw any form of education as a way to evolve their skill and get more job satisfaction. If learning eco-driving meant they could perform a better service to the passengers, they wanted to learn it.

![Figure 3. Showing differences in drivers’ perception of the concept of eco-driving. Data from study two’s questionnaires.](image)
Translating eco-driving theory into practical driving skills

During both studies aspects related to the drivers’ perceived ability to practice eco-driving emerged. They theoretically know what to do, but find it difficult to actually do. The next three themes explore the frustration of trying to translate knowledge into practice and how the drivers perceived the help of the interventions.

“The education should be more practical!”

During the initial set of interviews, drivers mentioned that the eco-driving education they had received previously focused on theory and that they found it difficult to apply this during regular driving. They requested more practical training. Those few who had received training were quite astonished with the results they had achieved, “when I practiced I used 27% less fuel!”.

The two interventions used during the trial were both aimed at giving a more practical training, but when asked afterwards bus drivers reported only a small gain in practical skill (Figure 4). However, they perceived that they had gained more theoretical knowledge. Even though gaining theoretical knowledge is positive, it is problematic that drivers feel unequipped to transform this knowledge into practical skill, and that the interventions failed to help them accomplish that.

“The eco-driving feedback system works so-so”

When asked about the system, the drivers thought it was easy to use and to understand, but had trouble seeing the benefit of it. The coaching was perceived as more useful and desirable. They did not perceive that the system could help them evolve. Some drivers used the system to check if what they considered good driving was consistent with the system, as a fun one-time thing. Other drivers felt that it mostly acted as a reminder to accelerate less forcefully when they were stressed, which indeed is beneficial, but does not help develop their skill. Others still used it to challenge themselves, which produced other issues (see next section).

“I keep on trying, but I just cannot get down to the green level”

During the field trial some of the drivers expressed frustration over their own perceived lack of progress. These were the committed drivers that had tried to follow the trainer’s advice and use
the feedback from the system, but could not get their fuel consumption down to the levels that the system rated as good (colour-coded green). In hindsight, it could be said that the “good” level was set too low, as it was based on more rural traffic and smaller buses. The frustration felt by the drivers made them less positive towards the promotion, if not the whole concept as well.

**Perceived and actual barriers to practicing eco-driving**

Many of the explanations to why the drivers feel they cannot manage to turn their theoretical knowledge into practice can be found in the environment in which they work. Their occupation, the organisation in which they work, and the urban environment in which they drive offer many obstacles to practicing “perfect” eco-driving.

“I want to eco-drive, but sometimes I'm stressed and I don't want to be so late”

As bus drivers, their main task is to transport passengers around town on a set route, and according to a timetable. The timetable is a cause for stress, and decreases their performance. Research has shown that drivers generally have problems eco-driving when trying to save time (Dogan et al., 2011). However, it should be pointed out that eco-driving only has a very small effect on trip time (Evans, 1979). The public transport company promote being on time as very important. During the field trial, the design of the dashboard reinforced the conflict between these two goals. On the left hand side the eco-driving feedback system was mounted, telling drivers to go calmly and showing red when they did not, and on the right hand side the timetable monitoring system was mounted showing red when they were late. This may have stressed the drivers even further.

“They say it’s important, but they do something else”

The company that the participating drivers worked for functioned as a barrier to eco-driving. In the interviews, comments were made regarding the company using eco-driving just for publicity, but not making any efforts internally to promote or facilitate eco-driving. In the field trial drivers remained sceptical of the company’s intentions. One of the coaches reported that “the drivers were worried that the feedback system was going to monitor them”, and that they needed some convincing before they could see the benefit of the system. This distrust may be the result of inadequate communication from the company management. Several comments were made, during both the interviews and the field trial, about the bad communication between drivers and management, and the lack of commitment to the eco-driving effort. Drivers felt it was yet another obligation that was pushed upon them without proper justification and explanation, into their already hectic job. The drivers rating eco-driving right between forced and voluntary in Figure 3 reflect this.
"If you get a good bus, then it is all good"

The condition of the bus was just one of the practicalities the interviewed bus drivers felt hindered them from driving in the smooth manner that they preferred. A malfunctioning bus would in turn lead to bigger problems, but “a good bus without problems means that it is pleasant, a good climate, the passengers don’t complain, you keep the time table, and you are not stressed”. Some other factors helped them, or reminded them of the importance of driving smoothly. All of these are summed up in Table 1, and their influence explained.

The urban environment in general was something the drivers felt put extra stress on their way of driving. The company had previously tested eco-driving in a more rural environment with good results, but the drivers participating in the field trial were doubtful if the result could be reproduced in the urban environment, “it’s just in the city where you can see if things really work”.

Consequences when designing interventions

The effects of the intervention strategies used in the field trial, i.e. information and feedback, were not as large as projected. These types of strategies aim to improve the bus drivers’ motivation. As their motivation was fairly high already and their attitudes positive, these...
Interventions could not produce the results postulated in previous research. Instead, the studies revealed a multitude of barriers to the adoption of eco-driving that drivers face in their day-to-day work. The identified barriers affect the drivers’ perceived and actual control over the behaviour. Thus there is a need for structural intervention strategies targeted at increasing the drivers’ action space. This means using strategies like enabling and encouraging according to Zachrisson and Boks’s visualisation, and facilitating according to Zaltman’s classification.

This is not to say that informational strategies should not be used. There is additional potential in using these strategies, but the interventions should be designed and implemented with the discovered barriers in mind. Otherwise frustrating situations like the mixed messages from the dashboard, or not being able to reach the right level in the feedback system, can easily arise. Informational and educational interventions must fit the context they are applied in. Here, more studies are needed to understand how this is best achieved.

Structural intervention strategies for the adoption of eco-driving may be more difficult to implement than informational strategies, as they require a wider perspective on the bus system. The barriers discovered in the two studies are related to every part of the bus system, and different actors within the system can implement enabling and facilitating strategies on different levels to address these barriers. Listed below are the four main actors that emerged from the studies and the actions they can take to enable eco-driving.

» Bus system operators: change company culture

In order to remove some of the perceived barriers the drivers experienced, the company, and any company trying to promote this kind of change, must create supportive culture with good communication. To address the distrust drivers felt, the company must prove that they are serious in their effort, offering more education, information, and encouragement, perhaps through incentives.

They also need to provide good working conditions for the drivers by improving the quality and maintenance of buses so that they do not malfunction, as this was a significant stressor for the drivers.

» Bus manufacturers: create better buses

Buses can be designed with approaches from design for sustainable behaviour. As drivers mentioned stress issues and concentration problems caused by loud passengers and crowded buses as major influencing factors, this may be addressed in bus design through creating a more closed off space for the driver. Comfort and handling in icy conditions are also influential factors that should be targeted by better bus design.

» City councils and planners: rebuild the infrastructure

The infrastructure of the city can have a large influence on the opportunity to adopt eco-driving. Drivers were very appreciative of bus lanes because it offered them less interference, and better
planning abilities. As is being done in many places, separating public transport from the rest of traffic can have great facilitating potential. Bus stops, and timetables, can also be looked at so that buses do not have to wait in line to get to the bus stop. Redesigning them so that passengers cannot run in front of the bus could also help to ease some of the frustration felt by drivers.

» Public transport directors: change the operation of the bus system

Since drivers have trouble eco-driving when a time aspect is involved, a timetable is detrimental to eco-driving efforts. For bus lines with a high frequency, and with traveller information systems tracking the bus, could the timetable be removed? It is worthwhile investigating whether the operation of the entire bus system could be changed in ways that both benefit passengers and allow bus drivers the calm, smooth driving style the strive for.

However, the main lesson to be learnt from the studies is that eco-driving requires a systemic approach. It is insufficient to solely address one part of the system and expect large effects. Especially if all of the responsibility for behaviour change is put on the individual driver, as is the case when using informational strategies.

To overcome the barriers in the system, the functioning of the system must be understood as a whole. The actors within the system must understand their role and responsibility and coordinate their efforts towards a common goal. Only then can a well-designed system of both informational and structural interventions be applied, and the large estimated effects of eco-driving be achieved.

Conclusions

The studies show that in order for bus drivers to adopt eco-driving, and thusly reduce the negative environmental impact of the bus system, they need to be given the opportunity to eco-drive. This can only be done by taking a systemic approach to the bus system and designing coordinated intervention systems using informational, educational, enabling and facilitating strategies together. The bus system of the future must be crafted with care to all its included parts in order to ensure that we have the right preconditions for a future sustainable urban mobility.

References


