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Comparative effects of eco-driving initiatives aimed at urban bus drivers – Results from a field trial

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ABSTRACT

A field trial is used to investigate effects of two programmes aimed at encouraging bus drivers to develop and maintain ecological driving behaviour. Drivers on one bus line were divided into three groups, one received feedback from an in-vehicle system, the second received the same feedback coupled with personal training sessions, and the third acting as a control. A 6.8% fuel saving and large decreases in instances of harsh deceleration and speeding were found, but with no difference in the effect of the two eco-driving strategies. The drivers reported perceived gains in theoretical knowledge of eco-driving, but found it more difficult to put that knowledge into practice. Several contextual factors were found to limit drivers' to eco-driving, most noticeably shaped by their work tasks, but also the commitment of the company where they were employed.

1. Introduction

Buses, along with other forms of transport, have a negative impact on the quality of the atmospheric environment. Driver behaviour has a large influence on this impact, and therefore eco-driving seems like a promising strategy,[1] but changing driver behaviour has proven problematic.

Earlier initiatives to change driver behaviour have mainly focused on training, but Symmons and Rose (2009) found this effective only if it includes both theory sessions and test drives with an instructor. Even then the modified behaviour is difficult to maintain (af Wåhlberg, 2007; Zarkadoula et al., 2007), and highly dependent on the individual driver (Beusen et al., 2009). In-vehicle systems with instantaneous feedback have had some short-term success with reported fuel savings of around 7–6%, although long-term trials of these systems only provide tentative fuel economy gains (af Wåhlberg, 2007), or find no reduction at all (Larsson and Ericsson (2009). A combination of training and feedback system has been suggested as a prerequisite for sustained results.

This paper is concerned with comparing the effectiveness and reception of such a combined initiative including both training and real-time feedback, with that of an approach including only real-time feedback, using a field trial of bus driving behaviour in Sweden as an example.

2. Methodology

This paper makes use of information gathered from a trial conducted by a Swedish public transport operator. During the trial, the two initiatives were introduced on a particular bus line and involved 54 drivers who worked on this route. The bus

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[1] Potential fuel savings of up to 25% have been reported for eco-driving in buses (Vangi and Virga, 2003).

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service runs through the centre of a large city and is about 16 km long. Route frequency is one bus every 5 min in peak hours and occupation rates are high. The commercial speed varies across the day from 21 km/h in peak hour to 23 km/h off peak. The average distance between stops is 713 m (the shortest distance 230 m and the longest 2150 m). The bus route runs on a high percentage of bus lanes, which means that there is relatively low impact from other traffic. For operating the line 20 bi-articulated Volvo buses (Euro 5 standard) are used, all of which were equipped with the in-vehicle support system.

A between-subject design was used for the study, which included both a baseline and a control group (Fig. 1). The participating drivers were thus divided into three groups;

- One group that received an introduction to the support system and were asked to use it.
- A second group that received the same introduction accompanied by individual training on two occasions.
- A third group, the control group, that were informed that there was a test going on.

The drivers were assigned into groups by managers at the company who tried to ensure groups with as equal distribution as possible in terms of age, sex, driving experience and driving style based on their knowledge of the drivers. The study was carried out in late autumn 2011; the baseline covered three weeks in October/November and the test three weeks in November/December.

Several types of data were collected, as indicated in Fig. 1. The drivers' behaviour was logged using the same technical system that produced the driver feedback. The specific parameters measured are listed in Table 1, along with the compound measures that were displayed as feedback to the driver. The logging system used offered the possibility to obtain data sorted by bus or, if the driver had logged into the system, sorted by driver.

The logged driving data was supplemented by driver questionnaires administered after the test period. The questionnaires were used to gain information about how the drivers perceived the two specific approaches examined, as well as the entire eco-driving effort. The questionnaire consisted mainly of closed-ended questions using a seven-point semantic differential scale, except for two open-ended questions regarding the drivers' experience of the company's activities during the trial and general comments about the trial. The closed-ended questions concerned the following topics;

- *Attitude (3Qs)*. Drivers were asked to rate their general attitude towards eco-driving before and after the trial (''very negative'' to ''very positive''), and to give eco-driving a score according to; importance, fun, difficulty to understand and to do, suitability for passengers, traffic, and bus, prioritisation, and voluntariness.
- *Knowledge and skill (4 Qs)*. Drivers rated their knowledge and skill before and after the trial (''not at all good'' to ''very good'').
- *Support system (6Qs)*. Drivers were asked how they had used the system, what they believed they had gained from using it in terms of knowledge and skill (''nothing at all'' to ''very much''), and whether they would like to keep the system (''absolutely not'' to ''very much so'').
- *Acceptance of system*. Drivers answered 20 items that together measured their acceptance of the system.
- *Training sessions (4Qs)*. Drivers who had received training were asked for their opinions (''very bad'' – ''very good''), and what they perceived they had gained from training in terms of knowledge and skill, and if the training helped them take advantage of the system better (''nothing at all'' to ''very much'').

In addition, the instructors responsible for the individual training, as well as the project manager responsible for the eco-driving project at the company, where the drivers were employed, provided written reports of their experiences from the project. They were asked to document their activities during the project and also to give their views on the drivers' advancement and receptivity to the eco-driving efforts, and their views on the project's progress. The written reports were collected after the project and were between one and three pages long.

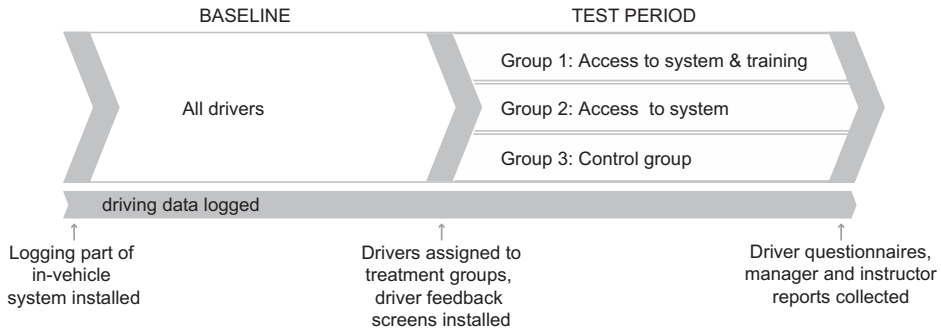

Fig. 1. The study time line.