



Changing commuters' behavior using rewards: A study of rush-hour avoidance

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ABSTRACT

In a 13-week field study conducted in The Netherlands, participants were provided with daily rewards – monetary and in-kind, in order to encourage them to avoid driving during the morning rush-hour. Participants could earn a reward (money or credits to keep a Smartphone handset), by driving to work earlier or later, by switching to another mode or by teleworking. The collected data, complemented with pre and post measurement surveys, were analyzed using longitudinal techniques and mixed logistic regression. The results assert that the reward is the main extrinsic motivation for discouraging rush-hour driving. The monetary reward exhibits diminishing sensitivity, whereas the Smartphone has endowment qualities. Although the reward influences the motivation to avoid the rush-hour, the choice how to change behavior is influenced by additional factors including education, scheduling, habitual behavior, attitudes, and travel information availability.

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1. Introduction

Congestion on urban roads throughout the European Union is increasing and is expected to worsen as the demand for trip making increases and supply of road infrastructure remains limited (European Commission, 2006a, 2006b). Loading of excess demand on the transportation system has considerable external costs such as pollution, noise and road user safety (Mayeres, Ochelen, & Proost, 1996). Road overloading disrupts vehicle flow, increases the frequency of incidents and magnifies the uncertainty of travel schedules (Lomax & Schrank, 2003). Congestion is a collective, synchronic phenomenon: massive commuting at a more or less common time-frame (e.g. the morning rush-hour). Thus, shifting of commuters' departure times to less congested times, before or after the rush-hour, change of transport mode (from car to public transport) or change of work mode (working from home), should, in theory, lead to considerable time savings, greater travel certainty and lower external costs of congestion.

Transportation demand-based solutions (e.g. road pricing, promoting modal alternatives, parking policy and land use planning policy) have been suggested to reduce congestion (Shifan & Golani, 2005). In this respect, transport economists have been arguing for the implementation of road pricing as a first-best solution to efficiently alleviate congestion externalities (Nijkamp & Shefer, 1998; Rouwendal & Verhoef, 2006; Small & Verhoef, 2007). However, road pricing is controversial and its behavioral implications are not well understood. As suggested initially by Vickrey (1969), optimal pricing requires the design of variable tolls, making them quite complex for drivers' comprehension (Bonsall, Shires, Maule, Matthews, & Beale, 2007; Verhoef, 2008). In addition, road pricing raises questions regarding social equity (Giuliano, 1994), fairness and public acceptability (Eriksson, Garvill, & Nordlund, 2006) as well as economic efficiency (Banister, 1994; Viegas, 2001).

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Second-best schemes have been suggested to circumvent the difficulties in implementing first-best pricing solutions (Small & Verhoef, 2007). In The Netherlands the notion of using rewards to achieve desired outcomes in travelers' behavior has been recently implemented in the context of the Spitsmijden¹ program (Ettema, Knockaert, & Verhoef, 2010; Knockaert et al., 2007), thus far, the largest systematic effort to analyze the potential of rewards in the field as a policy mean for changing commuter behavior. A pilot study (see Section 3 for further details), involving 340 participants and lasting over 13 weeks, was organized in the second half of 2006. Its objective was to investigate, in an empirical field study, the potential impacts of rewards on commuters' behavior during the morning rush-hour. Participants could earn a reward (money or credits to keep a Smartphone handset which also provided real-time traffic information), by driving to work earlier or later, by switching to another travel mode or by teleworking. Initial results provided evidence of substantial behavior change in response to the rewards, with commuters shifting to earlier and later departure times and more use of public transport and alternative modes or working from home (Ettema et al., 2010).

The effectiveness of rewards to reinforce a desirable behavior (e.g. identification and loyalty, work effort) is supported by a large volume of empirical evidence (Kreps, 1997; Berridge, 2001). However, in the context of travel and traffic behavior, rewards are poorly represented. Punishments and enforcement (such as policing, felony detectors, and fines), have been more widely documented than rewards (e.g. Rothengatter, 1992; Perry, Erev, & Haruvy, 2002; Schuitema, 2003). The relative salience of negative motivational means reflects, to a large extent, a disciplinary bias. Given that travel behavior has been to the most part subjected and influenced by microeconomic theories (McFadden, 2007), it is not surprising that the behavioral rationale of many demand based strategies to manage traffic congestion is based on negative incentives that associate, through learning, the act of driving with punishments (such as tolls or increased parking costs).

The few examples where rewards have been applied in a travel context are short term studies involving the use of a temporary free bus ticket as an incentive to reduce car driving. To most parts, the results of these studies are inconclusive. For example, Fujii, Gärling, and Kitamura (2001) and Fujii and Kitamura (2003) found that an incentive did encourage a change towards reducing car driving; however the level of car driving returned to previous levels once the incentive was stopped. In contrast, Bamberg, Ajzen, and Schmidt (2002) and Bamberg, Rolle, and Weber (2003), found that habitual behavior prevented substantial reductions in car use. It is not the scope of this paper to debate which policy (pricing or rewards) is more effective. However there is substantial evidence that people respond more favorably and are more motivated when rewarded rather than punished (Kahneman & Tversky, 1984; Geller, 1989). Thus, the potential of rewards as a base for traffic management policy is well worth considering if based on robust behavioral foundations.

The main aim of this paper is to comprehensively analyze and explore the changes in behavior during the course of the aforementioned pilot study and identify key factors that influence the response to the rewards. The rest of the paper is organized as follows: Section 2 sets a number of theoretically driven research questions and hypotheses. Section 3 describes the experimental setup and methods. Results, based on a mixed logistic regression analysis are presented in Section 4. A discussion is presented in Section 5, followed by summary and conclusions in Section 6.

2. Research questions and hypotheses

Several key questions are postulated: First, how effective are rewards as a means for motivating travel behavior change? The literature does not provide a clear indication. One view suggests that satisfying rewards contribute to higher rates of motivation (Cameron, Banko, & Pierce, 2001; Cameron & Pierce, 1994). The other view propounds that rewards interfere and undermine intrinsic motivation, deflecting motivation from internal to external causes and reducing the amount of effort devoted to participate in activities (Deci, 1971, 1975; Lepper & Green, 1978). *Theory of Cognitive Evaluation* (TCE) further asserts that the effect of reward will depend on how it affects perceived self-determination and competence (Deci & Ryan, 1985).

Second, does the nature of the reward (monetary, in-kind) affect the willingness to change travel behavior and its tenacity? People seem more receptive to large monetary rewards compared to small ones (Gneezy & Rustichini, 2000; Gneezy, 2003). Moreover, a monetary reward might be framed as a prospective gain. According to Prospect Theory (Kahneman & Tversky, 1979), diminishing sensitivity to money can affect the perseverance of change. Participants' apparently have greater satisfaction and motivation is higher with gifts compared to monetary rewards; however when asked, most people prefer receiving money (Shaffer & Arkes, 2009)). In-kind rewards may therefore encourage behavior change through a different cognitive path: the endowment effect. A Smartphone handset granted to some participants may be regarded as an uncertain endowment. An endowment is not easily relinquished, once given (Kahneman, Knetsch, & Thaler, 1991). The endowment effect may well motivate to change behavior just in order to avoid the emotional loss associated with the possibility to give up a valued object. In this respect, the in-kind reward, unlike the monetary one may have affective as well as motivational properties.

Third, to what extent do personal and social characteristics (e.g. gender, education level, personal income, or household composition) sustain or diminish the potential impact of rewards? The connection between socio-economic characteristics and travel choices is well documented (e.g. Harris & Tanner, 1974; Ben-Akiva & Lerman, 1985; Axhausen & Gärling, 1992). In this respect income may well affect motivation in the case of the monetary reward. Diminishing sensitivity could suggest that participants with higher incomes might be less motivated to change behavior for a rather marginal monetary gain.

¹ Translated literally as peak avoidance.

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