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Selective psychological effects of nudging, gamification and rational information in converting commuters from cars to buses: A controlled field experiment

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1. Introduction

While cities across the world invest in public transport solutions, car sales and congestion continue to rise. Converting commuters to new forms of transport is far from a trivial matter and rarely a question of infrastructure alone, so other more psychological approaches are clearly needed. Persuasive techniques like nudging, gamification and attempts at reframing the benefits of a target behavior are seen across numerous domains. But what are the relative effects of such strategies in terms of psychological influence and direct impact on travel behavior?

Problems related to congestion in larger industrialized locales include decreased productivity due to time spent in traffic, adverse health effects due to air pollution, accidents, and traffic noise (Greene & Wegener, 1997; Peters et al., 2004), as well as climate change exacerbation due to high carbon dioxide (CO_2) emissions (Mees, 2000; Oskamp, 2000). But even though most car owners acknowledge these problems, few voluntarily switch to public transportation. And even if car commuters' intentions change, research has consistently shown that perceived ease (Fogg, 2009) and existing habits moderate the effect of intentions on behavior (Gardner, 2009; Thøgersen, 2006; Verplanken, Aarts, van Knippenberg, & van Knippenberg, 1994). Hence, it is inaccurate to view commuters as perfectly rational decision-makers who continually make optimal commuting decisions based on careful consideration of the cost and benefits of the options available to them (Kahneman, 2003; Thaler, 2015). Converting commuters from cars to public transportation is, in other words, a societal challenge (Steg & Sivers, 2000) with psychological, physiological, ecological, and economic dimensions.

Popular approaches to increasing usage of public transportation include infrastructural changes (e.g., making public transportation more capacious and efficient with bus priority lanes, more routes, and restraints on car traffic in certain areas (Li and Henscher, 2012; Loukopoulos, 2007)) and economic incentives like parking fees, fees for car entry to city areas, decreasing public fare prices (Li and Henscher, 2012). Such "hard" policy measures are somewhat effective in reducing congestion, but they are economically costly and infringe on individual freedom, which makes them politically debated (Gärling & Schuitema, 2007; Jones, 2003). The implication is that we need to look into new strategies to stimulate and scaffold behavioral change over time, where pure information fails (Triandis, 1977; Verplanken et al., 1994).

Suggestions of "soft" approaches to behavior change include workplace travel plans, personal travel commitments, goal setting, and providing customized behavioral feedback (Cairns et al., 2008; Fujii & Taniguchi, 2006; Gärling & Fujii, 2009; Möser & Bamberg, 2008; Steg, 2005; Taniguchi, Suzuki, & Fujii, 2007; Thøgersen, 2009). Recent reviews have revealed small but positive effects of soft transport policy measures, with focused interventions often increasing public transportation usage by 5–20% for limited audiences or time frames (Friman, Richter, & Gärling, 2010; Möser & Bamberg, 2008.

As argued by Möser and Bamberg (2008), choosing costly behavior change strategies should be based on solid empirical evidence, but many studies are plagued by weak designs, poor statistical power, and lack of proper statistical testing, making it difficult to assess causal relationships. Too few studies have used a fair control group, if there is one at all, meaning that

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interventions such as spectacular media stunts, nudging, and gamification campaigns are compared to random people going about their daily business, with no real incentive to change their behaviors. But alternatives to costly measures like handing out free bus tickets to car commuters (Fujii & Kitamura, 2003; Taniguchi, Grääs, & Friman, 2014), would usually center around signage or informational campaigns from more classical advertising traditions (Lieberoth, Møller, & Marin, 2015). As a consequence, from typical interventions, we learn how well proposed behavioral change measures compare to doing nothing, but we rarely get to know how they would fare compared to their closest—potentially less costly—realistic alternatives.

To address these scientific issues, we conducted what to our knowledge is the first ever study actively comparing the psychological and behavioral impact of nudging, gamification, and framing – in the domain of transportation or anywhere else.

2. Background

Odense is a small historic city with 200,000 inhabitants serving as a regional capital in central Denmark, with many commuters going in and out from surrounding towns and villages. Like many other locales its size and venerable age, Odense's main roads and historic center are plagued by congestion during peak hours, and public authorities are increasingly worried about economic and health problems caused by congestion. With about 73,000 cars, 500 buses, 400 trucks, 7000 vans, and 4000 motorbikes, Odense keeps a considerable automotive fleet in relation to its size (http://www.statistikbanken.dk/bil707).

The present experiment unfolded as a research–industry partnership surrounding traffic behavior in Odense. A local bureau had been tasked by a regional bus operator to run a campaign to convert car commuters into bus commuters. The campaign as a whole was framed as "the commuter experiment," and as researchers from Danish universities, we were invited to participate as advisors on possible behavior change playbooks. After initial meetings, the bureau agreed to run the campaign as a controlled field experiment, pitting three "soft" strategies against a control group.

The researchers supplied suggestions for each sub-intervention, as well as for overall data collection. The implementation itself was left to the bureau, which ran a 3-month recruiting campaign, assigned participants to treatment groups, compiled introduction packages, and designed Web pages (see below). The bus operator supplied behavioral data from usage of travel cards.

The surrounding towns included in the experiment have populations ranging from 3200 to 6200. The towns are situated within 14 to 41 km from Odense, and the travel time varies from 26 min to 75 min maximum. The bus frequency during typical commuting hours is typically two buses per hour (Table 1).

The immediate economic barrier to behavioral change was removed from all four experimental groups through a free 1-month bus pass, as has been done in several others studies (see, e.g., Abou-Zeid & Fujii, 2016; Fujii & Kitamura, 2003; Pedersen, Friman, & Kristensson, 2011; Taniguchi et al., 2014; Thøgersen & Møller, 2008), thus creating a prospect for habit disruption. The situation offered a unique opportunity to pit multiple "soft" influence strategies against each other in real life, implemented by marketing professionals rather than by researchers, who may not always have the same technical or communication skills to faithfully emulate professional practice (i.e., Lieberoth, 2015). Given recent scientific interest in gamification, nudging, and health framing, we tested how these influence strategies, respectively, could support *active bus pass use* as well as influence online engagement, attitudes and intentions to travel.

3. Theories: The four sub-interventions

This study set out to test the impact of techniques that are currently touted in the popular and scientific behavior change playbooks (e.g., Jensen & Lieberoth, 2017; Rivera, 2014; Wendel, 2014). The unifying characteristic is that they are "soft" strategies that operate *during* an intervention through situational prompting, behavior feedback, and reframing of reasons

Table 1
Inhabitants, travel distance, travel time and bus frequency for suburban cities included.

Suburban cities included	Inhabitants	Number of yearly commuters to Odense (2014)	Travel distance to Odense	Approximated travel time to Odense	Approximated bus frequency within commuting hours
Kerteminde	5900	3476[a]	19 km	38 min	Approx. every 30 min
Munkebo	5600	–	14 km	30 min	Approx. every 30 min
Bogense	3800	–	29 km	60 min	Approx. every 30 min
Søndersø	3200	–	15 km	26 min	Approx. every 30 min
Otterup	5100	–	15 km	30 min	Approx. every 30 min
Langeskov	4000	–	16 km	30 min	Approx. every 30 min
Ullerslev	2800	–	20 km	40 min	Approx. every 30 min
Glamsbjerg	3200	–	28 km	60 min	Approx. every 30 min
Assens	6200	4395[a]	41 km	75 min	Approx. every 30 min

[a] https://www.odense.dk/om-kommunen/statistikker-og-regnskaber/statistik/odense-i-tal/odense-i-tal-2015.