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WHEN NUDGES AREN'T ENOUGH: INCENTIVES AND HABIT FORMATION IN PUBLIC TRANSPORT USAGE

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When nudges aren't enough: Incentives and habit formation in public transport usage

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Abstract

In three large-scale field experiments with over 32,000 individuals, we investigate whether public transport uptake can be influenced by behavioral interventions and by economic incentives. Despite their effectiveness in other domains, we find a tightly estimated zero for social norms and implementation intentions on ridership. Doubling the trial period from two to four weeks significantly increases uptake and long-term usage. This increase is sustained for months after removing the incentive. The effect is mainly driven by initial low users, which is evidence for habit formation. While there is scope for long-term behavior change, nudges might not be the right approach.

Keywords: transport, nudging, field experiment, habit formation
JEL codes: C93, D04, D91, L91

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1 Introduction

Urban transport accounts for around 40% of end-use energy consumption, and trends are increasing (IPCC 2014), posing a threat to our climate and health. Maintaining and increasing the public transport market share is on the national agenda of most industrialized nations, especially the European Union (European Commission 2019). While investments in sustainable infrastructure make up a major share of the development plans, these investments need to be complemented with changes in individual travel behavior.

Behavioral interventions, also known as nudges, are seen as low cost, easily implementable and less obtrusive compared to conventional steering instruments such as taxes and regulations (Benartzi et al. 2017, Carlsson et al. 2019). Consequently, environmental policy has seen a surge in studies on behavioral interventions that have shown to reduce household energy consumption (Allcott 2011), household water consumption (Ferraro et al. 2011, Tiefenbeck et al. 2016), meat consumption (Gravert & Kurz 2019, Kurz 2018), and food waste (Kallbekken & Sælen 2013).

Fueled by the success in these areas, several overview articles and policy reports suggest making use of behavioral interventions in the public transport sector (Alta 2018, Metcalfe & Dolan 2012, Garcia-Sierra et al. 2015). While the arguments are persuasive that nudges can correct for inattention, make social norms more salient or help with planning, there is close to no evidence of behavioral interventions affecting public transport usage. In a meta-analysis of 107 Transportation Demand Management studies Ortmann & Dixit (2017) found no sufficiently controlled study on nudges to affect transportation demand. Most studies focus on economic incentives or economic incentives in connection with behavioral elements that were not independently investigated.

This paper aims to fill this gap by presenting three large-scale randomized controlled trials testing three popular behavioral interventions: social norms, positive/negative social norm framing, and implementation intentions, on public transport usage.

In our main experiment, we furthermore directly compare a social norm nudge to a traditional economic incentive. This comparison is important for two reasons. First, it allows us to understand whether a nudge is the most cost-effective intervention, and second, in case the nudge is not successful we learn about whether individuals are generally unwilling to change their behavior or whether the nudge just was not strong enough to stimulate a change in behavior.

Together with a local transport agency in Southern Sweden, we conduct natural field experiments with over 32,500 users whose travel behavior we track over a period of 6 months.

In our main experiment, we sent out free travel cards with either two-weeks free travel, two-weeks free travel plus a social norm message or four-week free travel and tracked initial response, activation of the card, and usage over the following six months. In two additional experiments, we test the effect of including a positive vs. a negative framed social norm on uptake of free two-week travel cards and the effect of implementation intentions on the activation of free travel cards.

Our randomized and large-scale design overcomes some of the issues of the few previous studies in this area. Participants in our experiment are not aware that they are part of an experiment, and we use administrative data instead of self-reported data, which reduces potential biases or imperfect recall associated with self-reports.

In all three experiments, we find no evidence of the nudges significantly increasing public transport usage. We do find a significant effect of the economic incentive on uptake and long-term use. Six months later, individuals who received a four-week free public transport card are significantly more likely to still be in our sample of active travelers. This effect is mainly driven by individuals who were low initial users, using the free card less than two times per day during workdays of the first week of the experiment. These low users take a significantly higher number of trips in the six months after the experiment if they are assigned to the four weeks treatment than the same group in the two weeks or social norms treatment.

Our results indicate that when it comes to public transport usage, nudging might not be the appropriate policy tool. Not because individuals cannot change behavior, but because stronger incentives are necessary. Decisions about travel behavior seem to be based on a rational cost-benefit calculations rather than on cognitive mistakes that can be corrected with nudges. However, in the long-term habits can be influenced for a sub-set of individuals.

2 Behavioral economics and transport

Both Metcalfe & Dolan (2012) and Garcia-Sierra et al. (2015) provide extensive reviews of the behavioral mechanisms relevant to public transport usage and the limitations of policy instruments designed with classically rational individuals in mind.

In this paper, we focus on three popular nudges that have been both proposed in the context of public transport as well as proven successful in changing behavior in other domains. These three categories are social norms, positive/ negative framing of social norms, and implementation intentions. We also study the effect of our interventions on long-term habit

formation.

2.1 Social Norms

People care about others' behavior and seek to behave appropriately. Norms often develop automatically and have been proven to have a strong effect on behaviors. Social norms can be injunctive (i.e., describing a socially accepted behavior) or descriptive (i.e. a norm that describes a prevalent behavior) (Cialdini 2003, Schultz et al. 2007). In one of the most prominent studies on social norms in the environmental domain, Allcott (2011) evaluates a field experiment with a large US energy provider. Customers were shown their own energy consumption in comparison to their closest, most efficient neighbors. The intervention significantly reduced energy use. Similarly, letting people know that other hotel guests reuse their towels led to an increase in towel reuse (Cialdini 2003). In an overview article on green nudges, Carlsson et al. (2019) present 17 field studies on the successful use of social norms in promoting environmentally friendly behavior. Fourteen of these studies are on reducing water or electricity consumption. Further, there is evidence of using social norms to encourage other socially desirable behavior such as paying taxes (Hallsworth et al. 2017) or giving to charity (Agerstrom et al. 2016). Garcia-Sierra et al. (2015) propose the use of descriptive norms as a way to strengthen informational messages in promoting public transport. However, Donald et al. (2014) caution that descriptive norms might give an impression of public transport being overly congested and so discourage people from using it. Our paper is to our knowledge the first paper that tests the effect of a social norm on the uptake of public transport. Based on the existing literature, we hypothesize that providing people with a descriptive norm on public transport usage will increase the uptake of public transport for treated individuals.

2.2 Positive/ Negative Framing

Positively framed social norms are more common in published studies on social norms, but there is a discussion of whether negatively framed norms might be preferable in some settings. Levin et al. (1998) bases this idea on the seminal work by Kahneman & Tversky (1979), showing that people react stronger to losses than to gains. The same information framed as a loss compared to a reference point has been shown to lead to a stronger reaction than when framed as a gain. Avineri & Waygood (2013) explores positive or negative framing theoretically in relation to transport and environmental pollution, suggesting that negative

frames might be more effective than positive ones in influencing choices of travel mode. Our paper tests this assumption empirically.

2.3 Implementation Intentions

Even though people might have good intentions to change behavior, they tend to procrastinate and delay making decisions that are likely to be in their long-term interests (O'Donoghue & Rabin 1999). In the case of public transport usage compared to private car usage, individuals might intend to make more climate-friendly choices, but when it comes to act, time pressure, convenience, and weather conditions might derail their plans. A prompt to create a concrete plan for action, also known as an implementation intention has been shown to reduce the gap between intentions and actions, for example, for flu vaccination (Milkman et al. 2011), preventive screenings (Milkman et al. 2013), voting (Rogers et al. 2015) as well as for writing job applications (Abel et al. 2019). Implementation intentions work in three ways. First, merely asking the question of whether an individual is planning to engage in a particular behavior can increase the likelihood of the individual following through, as it brings the activity to the top of mind. Second, implementation intentions can help the individual to make a plan and anticipate obstacles in advance. In the case of public transport usage this could mean checking out the route to work in advance or planning which days a trip by public transport instead of by car would be feasible. Third, some implementation intentions are similar to promises, which would lead to internal discomfort if the plan is broken. While implementations have been shown to work in settings with one time behaviors, there is very limited evidence on implementation intentions on repeated behaviors. Carrera et al. (2018) provide gym-goers with prompts to schedule to go to the gym repeatedly and find no difference in exercise behavior compared to a group with no prompts. We test the hypothesis that implementation intentions increase the usage of free travel cards.

2.4 Habit formation

Lastly, our study contributes to the formation and persistence of habits. Research has shown that the choice of transportation mode is predominantly dictated by habit, rather than being a conscious evaluation of the alternatives (Klöckner & Matthies 2004, Ronis 1989) or being dependent on the quality of the public transport (Fujii & Kitamura 2003). Habits are automated behavioral patterns taking place in a consistent context (Lally & Gardner 2013). Since habits per definition are automated and energy-saving, they tend to be hard to change.

In order to break habits Gärling & Axhausen (2003) suggest they need "unfreezing." People need to be shaken out of their habits in one way or another. As Goodwin (1977) has argued "the traveler does not carefully and deliberately calculate anew each morning whether to go to work by car or bus. Such deliberation is likely to occur only occasionally, probably in response to some large change in the situation." One solution to this problem is reaching people when their habits are interrupted due to external factors rather than personal choice (Scheiner & Holz-Rau 2013). An ideal time to get people to change their travel habits is when they switch residences, as that unfreezes the usual habit of traveling the same route to work and other activities (Verplanken et al. 2008). Empirical evidence of the effect of a shock on travel routes comes from Larcom et al. (2017). The authors exploit a strike on the London underground system. They show that for those individuals who need to re-optimize their travel routes due to the strike, a significant number sticks with the new route after the strike period. Our experimental setup makes use of people changing addresses as a natural break in their travel habits.

The economic literature provides several examples of habit formation after providing economic incentives in the health domain (Finkelstein et al. 2007, Charness & Gneezy 2009, Volpp, Pauly, Loewenstein & Bangsberg 2009, Volpp, Troxel, Pauly, Glick, Puig, Asch, Galvin, Zhu, Wan, DeGuzman et al. 2009, John et al. 2011, Cawley & Price 2013, Just & Price 2013, Acland & Levy 2015, Royer et al. 2015) and the savings domain (see for example Schaner (2018)). However, in many cases, the effects are short-lived if they come without any additional interventions (Gneezy et al. 2011, John et al. 2011, Royer et al. 2015).

Habits are formed by repeatedly engaging in a behavior, with a more consistent performance of behavior leading to a habit being formed quicker (Lally et al. 2010). A longer incentivized time period increases the number of times a behavior can and will be performed, which leads to a higher chance of that behavior becoming a habit. Accordingly, we hypothesize that a longer time period of a free-travel-offer will result in a larger percentage continuing the use of public transport after the end of the trial period.

3 Experimental Design

We conduct three experiments. Experiment 1 tests the effect of social norms and of longer-lasting incentives on travel behavior. Experiment 2 tests the effect of different framing of the social norm and Experiment 3 tests the effect of implementation intentions. The experiments are conducted on different cohorts of the same population. That means every participant

was only treated once. We will first explain the general set-up and then present the design of the individual experiments.

3.1 Procedure

The experiments were designed and conducted in cooperation with Skånetrafiken, the administration for public transportation in the county Skåne in southernmost Sweden. Skåne has approximately 1.4 million inhabitants and contains urban areas such as Malmö (with 300,000 inhabitants) as well as rural villages. The public transportation managed by Skånetrafiken is used by 250,000 people daily. It consists of buses, trams and regional trains. The interventions were designed and sent out as part of a flyer campaign by Skånetrafiken, targeted at people who moved to or within the region. During the time frame of the campaign, shortly after moving to a new address, all individuals in the area receive a flyer from Skånetrafiken. The basic flyer contained the name of the resident, their closest public transport stop, information about Skånetrafiken, and the offer of a free two-week trial (see Figure A.1 in the Appendix for a picture of the flyer). The value of the free travel card was 625 Swedish Kronor (ca. USD 65). Individuals had two weeks to go online to order the card. The trial period started four weeks after the send out date. This allows even those individuals who had already bought a monthly card to make use of the offer. Initial interest was recorded by the residents logging into a webpage with a personal code from the flyer. If no reply was received, an informationally identical reminder was mailed out two weeks later (Figure A.4). If a reply was received the resident received their free public transport card, called a JoJo card, together with another letter (see Figure A.5). The card, which is identical to the ones that could be bought, could be used for the duration of the free travel time and could then be uploaded with either a monthly pass or with a balance to be used for individual trips. The letter explained that the card could be used in the region of Skåne and on all buses, trams and regional trains. It also reminded the users that they needed to activate the card every time they used a bus, tram or train by holding it against a card reader. Even when they have a monthly pass, they need to register their trip. This allows us to track trips after the trial period for both the monthly card users and pre-paid users.

The data provides us with three outcome variables. First, we measure how many cards were ordered in response to the offer. Second, we measured how many cards were activated, conditional on being ordered. And third, we track the number of cards used and trips taken over a six months period. The free trial period ended after two weeks (four weeks for one group), so the cards needed to be recharged by the participants themselves to be used at a

later point. We collect data on whether the cards have been uploaded with allowance for individual trips or with a monthly card. As the mailings were considered "business-as-usual" the participants were not informed that they were taking part in an experiment. During the summer, Skånetrafik offers a very cheap and popular summer card. We, therefore, measure travel behavior after summer to see whether any treatment differences remain.

Our data provides us with information on each card ID and how often it was used per day. We have no information on where users went with the card. We also cannot match the cards to individual people and their demographics for privacy reasons.

For our three experiments, we made use of the fact that the campaign runs in cohorts. For the first experiment, the names and addresses of everyone between the ages of 19 and 65 who moved to or within Skåne in the period between 12th of December 2017 and 16th of January 2018 were collected, which resulted in a sample of N = 14 210. These individuals received a randomized version of the first flyer. For the second experiment, we used people who had moved between the 26th of October 2017 and 11th of December 2017, who had received the control version of the first flyer and not responded. This group consisted of 11 373 individuals. For the third experiment, we contacted individuals who had responded to an initial untreated flyer between the 21st of February and 18th of March 2018 and who now were receiving their card in the mail. This group consisted of 6967 individuals. In total, 32,553 individuals were part of the three experiments, and no one was treated twice.

3.2 Experiment 1 - Social Norms

Our simple experimental design randomly assigns participants into three groups. The control group receives the usual flyer with the offer to receive a free two-week travel card (N = 4 764). The social norms group receives the same two-week free travel card and a positive social norms message truthfully stating that 3 out of 4 people in the region regularly travel by public transport (N = 4 758). The flyer says (translated to English): "Did you know that most people in Skåne travel with us? 72% of us travel by public transport occasionally. So join your neighbors and try it out". The number 72% comes from survey data that the transport agency had collected previously. To calculate 72% we aggregated the numbers of all individuals who travel at least several times per month to those who travel daily by public transport. We compare the social norm nudge to an increase in incentive duration. The four-week group receives the offer of a four-week free travel card (value 1250 Swedish Kronor (ca. USD 130) without the social norm message (N = 4 760). See Appendix Figures A.1, A.2, A.3 for pictures of the flyers.

First, based on the evidence of habit formation, we want to test whether a four-week card can lead to a more long-lasting change in travel habits. Second, we use the four-week condition next to the social norm to test whether travel behavior can be affected in principle. If individuals responded to the offer by ordering the card online, they received the standard letter with their card a couple of days later. If they did not reply, they received the standard reminder two weeks later. Otherwise, they received no further communication.

3.3 Experiment 2 - Social Norm Framing

This cohort of individuals had not responded to the first offer of a two-week free travel card and was thus sent a reminder about the offer. We randomized them into three groups. The first group (N = 3 791) received the basic reminder of the offer to travel for free for two weeks. The second group (N = 3 791) received a reminder with the descriptive social norm "Did you know that most people in Skåne travel with us? 72% of us travel by public transport occasionally. So join your neighbors and try it out". The third group (n = 3 791) received the reminder with an inverted social norm "Did you know that most people in Skåne travel with us? There are only 28% who do not travel by public transport. So join your neighbors and try it out".

If they responded to the offer, they then received the standard letter with their card a couple of days later. Otherwise, they received no further communication. See Appendix Figure A.4 for a picture of the flyers.

3.4 Experiment 3 - Implementation Intentions

This cohort of participants had responded to the initial baseline offer of a two-week free travel card. We randomized them into three equal-sized groups of 2323 individuals each. Group 1 received the baseline letter with their card. In addition to the basic information on how to use the card, group 2's letter was extended by a statement saying that "based on experience, it is easier to start traveling when one makes a plan." The letter prompts the reader to think about when and where they will travel for the first time. Group 3 has the same text as group 2, but in addition, it has empty slots to fill out when and where they will travel to. It was not necessary to write down their plan. This treatment was inspired by Milkman et al. (2011), who show that for vaccination decisions precise prompts that triggered thoughts about time day, time and place were the most effective. See Appendix Figure A.5 for a picture of the flyers.

4 Results

4.1 Experiment 1

4.1.1 Initial response, activation and long-term use

Our three outcome measures are the initial response, activation of the card during the trial period and usage after the summer vacation, six months later.

Interest in participating in the free trial was higher in the four-week group (49.6 %, n = 2359) than in both the standard group (42.8 %, n = 2038) and the social norm group (41.6 %, n = 1977), see Figure 1. Offers for the four week version were significantly more likely to be claimed than for the standard group (Chi2 (1) = 44.03, p ¡ .001)(see Figure 1). Cards in the social norm group were no more likely to be claimed than those in the standard group (Chi2 (1) = 1.47, p = .225). When comparing the percentage of activated cards based on the number of cards which were initially claimed, a larger percentage of cards was activated in the four week group (89.0 %, n = 2100) than in the standard group (80.5 %, n = 1641) and the social norm group (82.0%, n = 1622). Again the difference between the activation, conditional on having received the card, is significantly different between the four-week group and the standard group, but not for the social norms group (Chi2 (1) = 62.24, p ¡ .001 and Chi2 (1) = 1.53, p = .216, respectively). After summer, we observe significantly more active cards in the sample of the initial four week offer (n=268) than for the cards with the standard offer (n=179) or the social norms offer (n=186) (Chi2 (1) = 3.01, p = .083 and Chi2 (1) = 0.26, p = .612, respectively). At this time, users had had to upload money on their cards to use it.

The results are confirmed in a probit regression in Table 1. Column 1 shows the effects of the treatments on the initial response to the card. The standard group is used as the baseline. Columns 2 and 4 show the unconditional estimates for activation of the card and usage after summer to show the intention to treat effect. Columns 3 and 5 show the effect conditional on the card being ordered (column 3) and activated (column 5) For the four-week group all outcomes are significantly larger than the control group. There is no significant effect on the social norms message.

4.1.2 Number of days traveled

We now turn to the intensive margin. In Table 2 we present OLS regressions on the number of trips taken. We first run the regressions on the full sample and find that cards in the

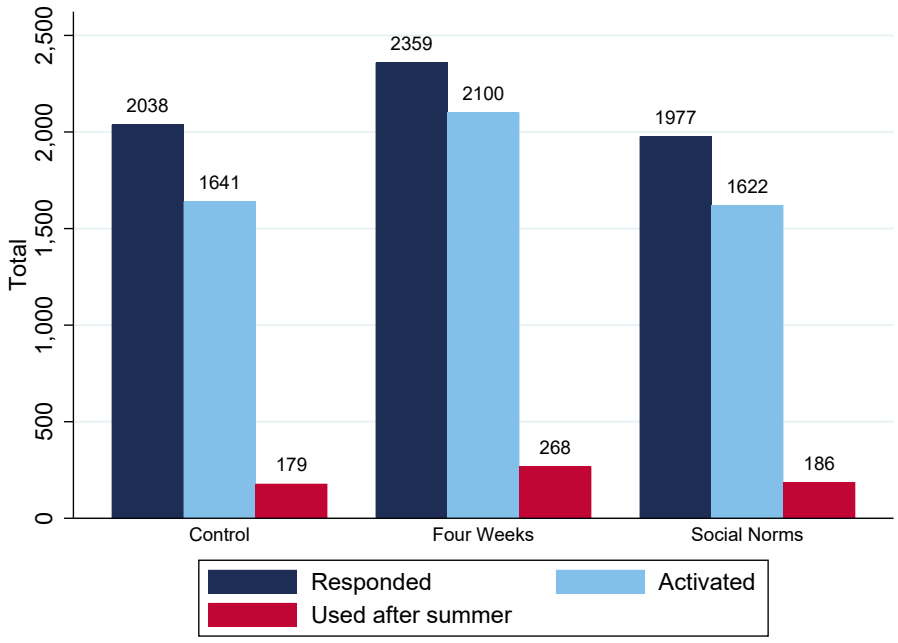

Figure 1: Number of responses, activated cards and cards used after summer

four week treatment were used significantly more in the first two weeks (ca. 1.5 trips more) and, unsurprisingly, were used far more during the time of the experiment, which was twice as long as for the other two groups (column 2). Extending the data to six months after the intervention and excluding the experimental period to make the treatments comparable shows that cards in the four-week condition were used on average 4.89 trips more than the cards in the control condition. This effect is significant and almost doubles the average usage unconditional on activation. There are no significant differences in usage between the control and the social norms condition.

Because using the unconditional data combines the opt-in effect, which we know is significantly higher in the four weeks treatment, with the usage, we run the same regression on the cards that have been activated in the first step (see Table 3). We find that, on average, each activated card was used around 17 times during the first two weeks of the experiment. There are no significant differences in usage within the first two weeks. Over the course of the experimental period the four weeks cards were used twice as often as the two-week cards. Excluding the experimental period (column 4) shows that the cards in the four weeks treatment were used for 7.6 more trips than the standard treatment cards. This is a significant 50 percent increase.

That the card is used for commuting to work or school can be seen in Figure 2. The

Table 1: Initial response, activiation of card and re-activation after summer

	Responded	Activated	Activated - C	After summer	After summer - C
Four Weeks	0.06772***	0.09663***	0.08347***	0.01892***	0.01873*
	(0.010)	(0.010)	(0.010)	(0.005)	(0.011)
Social Norms	-0.01240	-0.00367	0.01338	0.00170	0.00584
	(0.010)	(0.010)	(0.011)	(0.004)	(0.012)
N	14282	14282	6374	14282	5363
Pseudo R^2	0.004	0.007	0.013	0.005	0.001

Marginal effects; Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Number of trips taken - Complete Sample

	(First 2 weeks)	(Experiment)	(Total)	(Total excl. Exp)
Four Weeks	1.663***	9.755***	14.635***	4.880***
	(0.268)	(0.431)	(1.049)	(0.815)
Social Norms	0.055	0.055	0.175	0.120
	(0.251)	(0.251)	(0.805)	(0.687)
Constant	5.892***	5.892***	11.279***	5.386***
	(0.178)	(0.178)	(0.570)	(0.489)
N	14282	14282	14282	14282
R^2	0.004	0.057	0.020	0.004

Heteroskedastic robust standard errors are in parentheses.

No additional control variables.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Number of trips taken - Conditional on Activation of Card

	(First 2 weeks)	(Experiment)	(Total)	(Total excl. Exp)
Four Weeks	0.020	18.361***	25.994***	7.632***
	(0.527)	(0.780)	(2.320)	(1.989)
Social Norms	0.340	0.340	0.855	0.515
	(0.544)	(0.544)	(2.152)	(1.954)
Constant	17.106***	17.106***	32.744***	15.637***
	(0.386)	(0.386)	(1.521)	(1.385)
N	5363	5363	5363	5363
R^2	0.000	0.131	0.031	0.004

Heteroskedastic robust standard errors are in parentheses.

No additional control variables.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

number of trips is around double on weekdays compared to weekends. Over 75% of users use the card 20 times or more during the first two weeks, so two times per workday. This gives us confidence that the card is not only used for trips "on top" of necessary trips but is replacing other means of transport[1]. The figure shows the consistently higher usage of the four weeks cards over the whole period, except the summer period when most individuals either take the offer of the cheap summer deal or are on vacation.

4.2 Experiment 2

For Experiment 2 our outcome measures are response to the reminder and activation of the card. We find no difference in response rates to the reminder between the standard group (20.7%, n=786), the negative norm group (20.8%, n=789) and the positive norm group (21.0%, n=796) (Chi2 test (2) = 0.08, p = 0.96). Further, there is no difference in the activation of cards, conditional on receiving them. In the standard group 72.8% (n=572) of receivers activated their card, 71.0% (n=560) in the negative norm group and 73.0% (n=581) in the positive norm group (Chi2 test (2) = 0.37, p = 0.83).

[1]We acknowledge, that we do not know which means of transport are being replaced — more on this in the discussion.

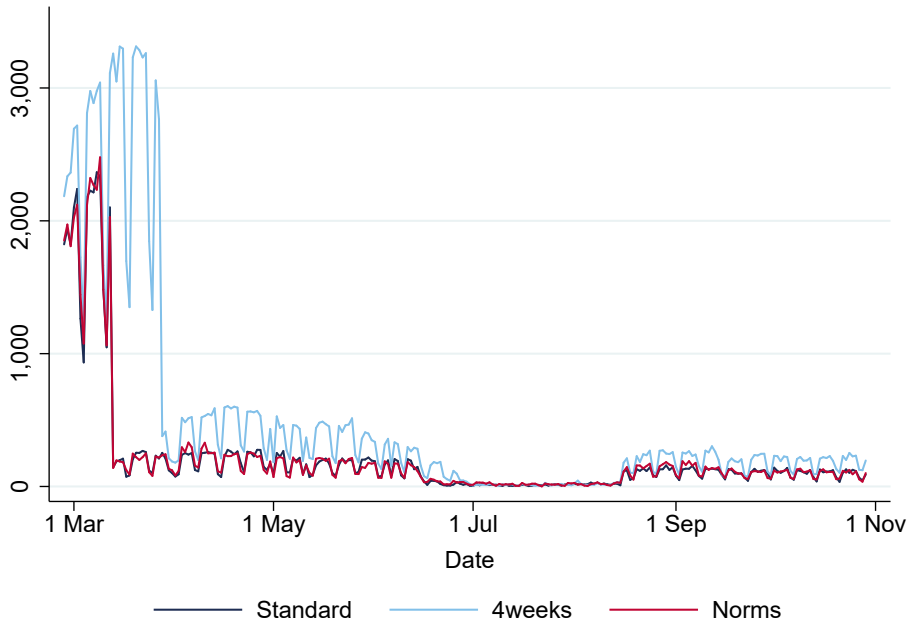

Figure 2: Number of trips taken per day

4.3 Experiment 3

For the third experiment we measure activation of the card after receiving it in the mail. In the standard group 79.0% (n=1835) activated their card, 79.3% (n=1843) in the implementations intentions group without lines to fill in and 78.3% (n=1819) in the implementations intentions group with lines to fill in. The differences are not significant (Chi2 test (2) = 0.77, p = 0.680).

5 Discussion

In the following discussion on heterogeneous effects and economic viability, we will only focus on the data from experiment 1, as participants from experiments 2 and 3 are a more selected sample and there are no measurable treatment effects.

5.1 Heterogeneous effects

As with most field experiments, we only observe the travel behavior of the compliers. Our only observable characteristic, whether individuals who reacted to the campaign, live in rural, urban or suburban areas, shows no evidence of differential selection effect.

Naturally, one might be concerned about self-selection based on unobservables. Individuals who are already planning to commute after moving might be more attracted by the four-week offer than the two-week offer. As explained in section 3, the campaign was timed to make both cards attractive regardless of already purchased cards, by creating a time gap between the offer and the start of the trial period.

To develop a better understanding of who the individuals are who use the cards, we split the data into users that follow a commuting pattern of 10 trips or more in the first week. That number corresponds to two trips per day - to and from work during workdays. We call these individuals "high users." They hit the ground running from day one and might either be particularly motivated to change their habits or have already established commuting habits previously to the campaign. Those users who use the card for less than 10 trips in the first week are classified as "low users." These individuals have the potential to increase their usage over time and do not show initial behavior that is in line with commuting and thus an existing habit.

As we show in Figure 3, looking only at the high and low users of the four-week card, the "high users" by definition start high and continue high for the duration of the experiment and after. The "low users" increase their usage for the first three weeks of the experiment and level out during the last week and for the next 6 months. We see this as evidence that for these individuals habit formation takes place. Because the group of low users is smaller (19 percent) than the group of high users (81 percent) the group remains on a lower absolute level than the high user group.[2]

Our OLS results in Table 4 show that the treatment effect of the four-week treatment is driven by the low user group, despite their small share of the sample. In the six months following the experiment, low users from the treatment group use the card, on average, 8.2 times more than low users from the control group. This effect is significant on the 1 percent level. Technically, this group has two weeks less to use the card outside of the experiment, so this is a lower bound. Unsurprisingly, by definition, initial high users use the card significantly more than low users in any treatment. They take an additional 17 trips on average after the experiment is over. This is also significant on the 1 percent level. There is no significant effect on the social norms treatment. While these effects might seem small given the time frame, one must remember that there is a large share of zeros in the data, as many cards were not used after the experimental period. These effects are identified from

[2]As a robustness check, we repeat the analysis with 20 trips the first two weeks and find comparable, significant estimates. In that estimation, the interaction term between four weeks and high users becomes significant as well. Results available by request.

ca. 15 percent of the initial response.

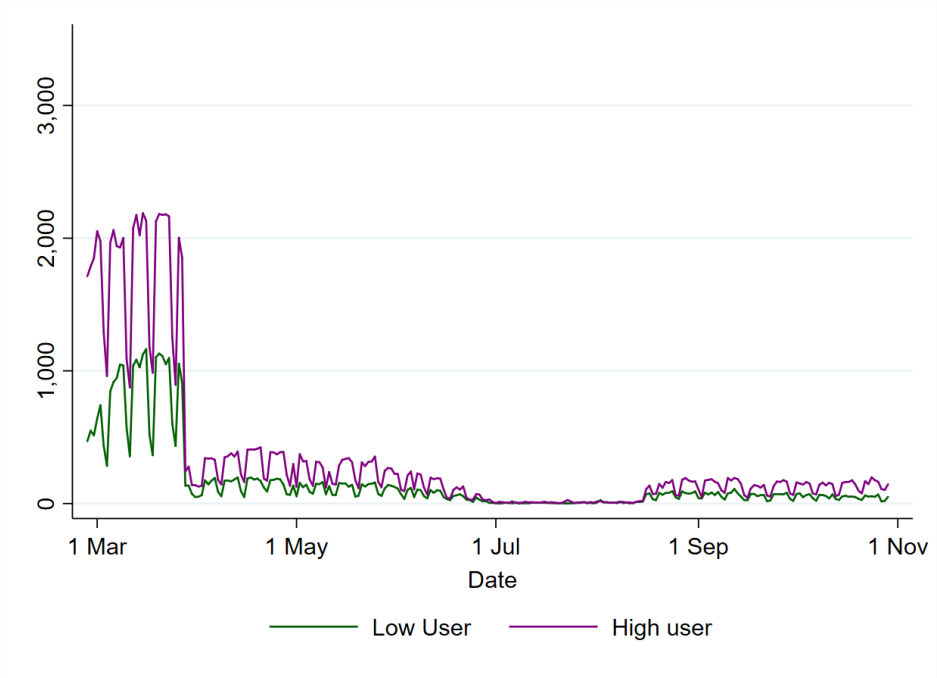

Figure 3: Number of trips

5.2 Economic viability of the campaign

After the experimental period was over, the cards could be topped-up with either a balance that could be used for individual trips or with a monthly travel card. Again we split the sample into high and low users to further our investigation on whether only individuals who were highly motivated from the start continue using the cards. Table 5 shows that both groups were significantly more likely to top up their card with monthly cards if they were in the four weeks treatment rather than any of the two weeks treatments. Within the six months after the experiment, initial low users topped up their card on average 0.22 times and high users 0.10 times. This confirms our previous results that both types of users were affected by the treatment, but that low users are affected by a larger amount.

The price of a monthly travel card is 1250 SEK (130 USD). The additional revenue created by the four-week card compared to the two-week card is thus 275 SEK per person and 273,900 SEK for the group of low users. For high users it is 122,50 SEK per person and 461,090 SEK for the group, as the proportion of high users is larger than of low users (81/19). In total the four weeks treatment generated additional revenue of 734,990 SEK (75,000 USD) compared to the standard treatment within the first 6 months. The cost of

Table 4: Total number of trips taken based on initial travel pattern

	(Total ex. Exp)
Four Weeks	8.173***
	(1.838)
Social Norms	0.635
	(1.623)
High User	17.047***
	(2.808)
High User * Four Weeks	-2.426
	(3.950)
High User * Social Norms	-0.165
	(3.958)
Constant	7.410***
	(1.038)
N	5363
R^2	0.022

Heteroskedastic robust standard errors are in parentheses.
High users take at least 10 trips during the first week.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Number of monthly card bought by high and low initial users

	(Low user)	(High user)
Four Weeks	0.219***	0.098***
	(0.040)	(0.015)
Social Norms	0.012	0.003
	(0.034)	(0.011)
Constant	0.157***	0.071***
	(0.022)	(0.008)
N	2688	11594
R^2	0.014	0.005

Heteroskedastic robust standard errors are in parentheses.
High users take at least 10 trips during the first week.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

additional riders during the campaign period to the public transport agency is negligible. There were no additional direct costs.

5.3 Salience of the social norm message

A valid concern could be that the social norm message wasn't salient enough compared to the four weeks of treatment. We did our best to restrict the information on the flyer and embed the social norm message in the text that explained how to order the card. We leave it up to the reader to make up their mind whether this was salient enough. Further, while this argument is valid for the initial reaction to the card, it does not explain the effects on activation after receiving the card or the more intense use of the card.

5.4 Substitution of means of transport

Because it is impossible to collect behavioral data on all possible means of transport (car, bus, bike, and walking), we cannot be sure whether the campaign encourages the intended transition from car to public transport. From an organizational revenue perspective, it doesn't matter from which means of transport individuals were diverted, but from an environmental perspective, a transition from bike to bus or train is not optimal. We cannot rule out that for some individuals the card made public transport attractive compared to biking. Good weather will encourage public transport for those who would have taken their car, as they might need to supplement the bus or train with walking or biking for shorter distances. It will also encourage more people to bike rather than take public transport, given it is more pleasant to bike when the weather is nice (Liu et al. 2016). So it is unclear how the weather effect would show up in the data if we do not know the proportions of people's outside options. Other studies based on survey data provide evidence that free bus cards have encouraged a transition from car to public transport (Cooper 2007, Taniguchi & Fujii 2007, Thøgersen 2009).

Our behavioral data is in line with self-reported travel behavior. Skånetrafiken conducted an online survey among the participants of our experiment after the experimental period. Naturally, a selected sample opted-in to answer the survey (N=221). Out of the individuals who had received a two week travel card (either with the social norm or without) 12% responded that they travel "much more" and 28% "a bit more" with public transport than before the trial period while for the four week group it was 20% and 34% respectively (see Figure A.6).

Figure 3 shows a steep decline in the usage of free travel cards after the free period is over. While the cards in the four-week treatment are more likely to be used after the experiment, overall most users revert back to their travel habits before the offer. For some users this might mean using an old JoJo card. However, since the free cards and the cards that can be bought are identical, and they need to be recharged every month to be used as a monthly card, there is no obvious reason why individuals would want to go back to their old card instead of continuing to use the new one. It seems more likely that they are switching back to a different mode of transport. More research is needed to identify all substitution effects.

6 Conclusion

Using behavioral interventions such as nudges has been suggested as a viable way to change individual travel behavior. However, the evidence on whether public transport usage can be affected through non-monetary and non-infrastructure means is sparse. We show in three field experiments with a public transport operator that some of the most popular nudges that have been used successfully in other domains have no impact on travel behavior in our setting. A prolonged economic incentive does affect travel habits for a sub-set of individuals, even long after the incentive has been removed. Our findings are thus in line with the limited literature comparing economic incentives against nudges such as Ito (2015) who find that economic incentives have a longer-term effect on reducing energy consumption than a moral appeal. We find no evidence of the framing of a social norms message affecting response rates or activation of free travel cards after receiving a reminder. We further find no effect of implementation intentions on travel behavior. This finding is in line with Carrera et al. (2018), who do not find any evidence of implementation intentions affecting gym attendance, but in contrast to (Milkman et al. 2011, 2013) who find positive effects of a very similar intervention. While initial interest in the free travel cards is high, almost every second recipient orders the travel card, there is a steep decline in usage after the free period is over. From a policy perspective, the steep decline could be interpreted as evidence that public transport is experienced as too expensive for many individuals. Providing free public transport in general or employers providing free travel cards to their employees might be a promising option in this setting, given that every second person is at least willing to use public transport when it is available for free.

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Appendix

Figure A.1: Initial flyer with the standard two weeks offer

Figure A.2: Initial flyer with the standard two weeks offer and social norms message

Figure A.3: Initial flyer with the four weeks offer

Figure A.4: Reminder after two weeks with positive social norm

Varsågod!

Nu börjar din resa

Som nyinflyttad har du blivit utvald att få pendla gratis med Skånetrafikens bussar och tåg i två veckor. Vi hoppas att du ska upptäcka hur enkelt och smidigt det är att resa med oss.

Ditt Jojo-kort gäller för obegränsat antal resor på våra stadsbussar regionbussar, Öresundståg, Pågatåg och Krösatåg inom hela Skåne, under angiven tidsperiod nedan. Värde 625 kronor.

Av erfarenhet vet vi att det är mer sannolikt att du kommer att använda ditt kort om du bestämmer dig för när och vart din första resa ska gå. Ta gärna och fundera igenom det redan nu. Vill du kan du också fylla i nedan för att göra det ännu enklare:

Jag ska åka från _____ till _____

_____ dagen den _____ /_____

När du reser håller du bara fram kortet nära och stilla mot kortläsaren på våra bussar tills den lyser grön. Du behöver inte säga vart du ska resa eftersom kortet gäller för resor i hela Skåne under din prova på-period. På tåget visar du upp kortet för tågvärden ombord.

Ditt Jojo-kort är klart att börja använda och gäller 30/4–14/5.
Prova på-kortet gäller inte på Ventrafikens båtar.

Trevlig resa!

Figure A.5: Letter with implementation intentions

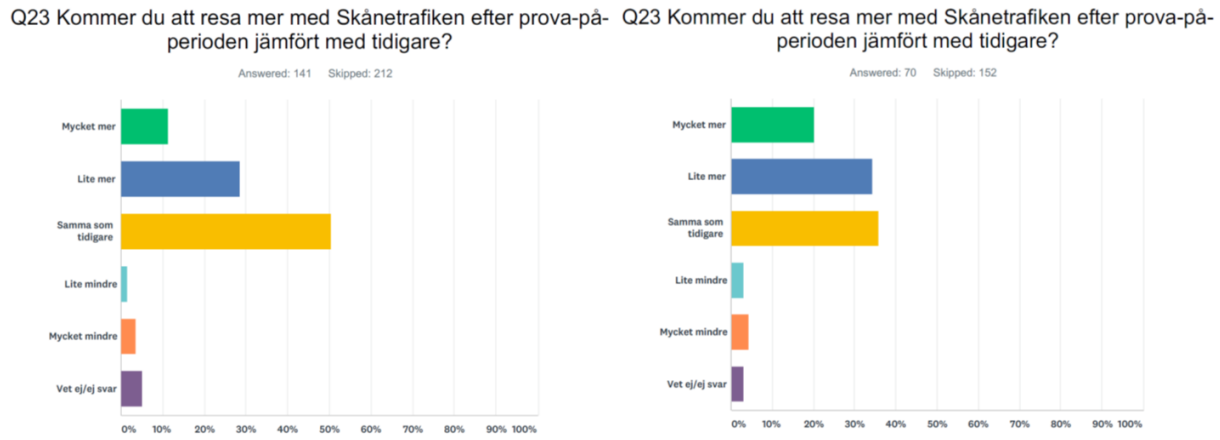

Figure A.6: Online Survey: Do you travel more with Skånetrafiken after the trial period than before? (N=221)