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Applying a motivational stage-based approach in order to study a temporary free public transport intervention



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ABSTRACT

The present study examines temporary free public transport as an intervention for increasing public transport use, hence promoting sustainable mobility. The aims of the study are twofold: (1) to understand how psychological mechanisms relate to motivational stage-based models of behavioral change, and the role of such a model when implementing temporary free public transport, and (2) to determine the effectiveness of temporary free public transport on car-use behavior, public transport satisfaction and attitudes. A literature review of studies reporting temporary free public transport interventions was first carried out, resulting in 13 studies that yielded non-conclusive results. We then conducted an intervention and follow-up surveys of 190 participants who tested public transport for free for one month in the County of Värmland (Sweden). The results show that psychological mechanisms are crucial determinants of motivational stage-based models, whereby personal norms, attitudes and perceived behavioral control form the stage of change, and that social norms have an indirect effect through personal norms. Although an increased use of public transport was observed, only minor reduction in car use occurred. It was also found that participants moved up their motivational ladders, indicating a stronger motivation to reduce their car use post-intervention, something that may lead to a change in behavior over time. It is concluded that, although weak effects were observed on behavior in the short-term perspective, a temporary free public transport intervention may not be a waste of money, nevertheless, in a long-term perspective.

1. Introduction

Temporary free public transport is widely used as a strategy for motivating and enabling individuals to change their travel behavior (Friman et al., 2013). Temporary free public transport usually involves a free (but limited) travel card, detailed information about that card and ticketing, how to use public transport mobile phone applications, commuting zones, time schedules, and how to purchase tickets post-intervention. But how effective are these trials? Several case studies have demonstrated that they are effective (e.g., Bamberg et al., 2003; Matthies et al., 2006; Preisendörfer, 2001), but some have shown only minor or non-positive effects (e.g., Abou-Zeid et al., 2012; Beale and Bonsall, 2007). Thus, there is only weak consensus and a lack of general knowledge of the conditions under which, and for whom, this strategy is effective. A better understanding of when positive effects can be expected, and when free public transport might be a waste of money, is needed. Assembling evidence for best practice can guide future temporary free public transport in ensuring efficiency in delivering behavioral change. The present paper has two objectives: Firstly, we report

on the results of a review incorporating peer-reviewed empirical studies of the interventions and their effectiveness. By identifying and analyzing previous findings, we enhance knowledge of the generalizability and effectiveness of a behavioral change. Our review also contributes to the lack of consensus regarding the usefulness of temporary free public transport. Secondly, we analyze the role of individual motivation (e.g., applying a stage-based-model) regarding behavioral change when temporary free public transport is implemented. Including a stage-based model enables us to fill a knowledge gap and apply this to temporary free public transport. In this regard, we analyze the extent to which free public transport trials sway travel behavior and attitudes, norms, and perceived behavioral control towards a reduction in car use. The aim is to better understand the possible differences in outcome of travel behavior change, and other psychological mechanisms.

1.1. Literature review of temporary free public transport

This review includes published, scientific peer-reviewed papers. In order to identify relevant studies, search terms were entered into

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databases, including Google Scholar and Web of Science. We also examined the reference lists of topic-related papers. In total, we identified 13 papers, as of 2001, that vary in their theoretical approach, as well as in size, in type of implementation, and in outcome measurement.

One theoretical framework for understanding and explaining changes in attitudes, intentions and travel behavior is the Theory of Planned Behavior (TPB). In the TPB, it is proposed that three major mechanisms are in play, perceived behavioral control, attitudes, and norms, which determine the degree of intention to change, and that this intention then influences actual behavior (Gärling et al., 2017). One study applying the TPB (Bamberg and Schmidt, 2001) found that the subjective norm (or social pressure) had a strong effect on the intention to use public transport, even stronger than attitude toward public transport. Thus, a positive attitude is not always enough; however, in some groups, adding social pressure may increase the use of public transport. They also found that perceived behavioral control was not so important before the travel card was implemented; however, the need for control (or perceptions of the ease or difficulty of traveling by public transport) appeared to increase after its implementation. It was concluded that use of the TPB to explain changes in travel behavior due to temporary free public transport was effective. Components such as attitude, subjective norm, and perceived behavioral control have been found to account for 67% of the variance in intention, while intention and behavioral control explained 66% of the variance in public transport use (Bamberg et al., 2003). It has, however, been argued that the relationship between intention and behavior varies between contexts, and that intentions in general explain about 24% of behavior (Sheppard, Hartwick and Warshaw, 1988).

Other studies have focused on the construct of habits (Bamberg et al., 2003; Fujii and Kitamura, 2003; Thøgersen and Møller, 2008) as an important part of travel behavior change. The main question being asked in these studies has been whether or not temporary free public transport has the power to change a more or less fixed or automated way of traveling. The results show that a temporary behavior change can change attitudes toward public transport in a positive direction, seeming to strengthen the habit of using public transport and weaken the habit of using the car. A study by Fujii and Kitamura (2003) observed the increased use of public transportation and the decreased use of the car. A study by (Thøgersen and Møller, 2008) confirmed that a free public transport ticket weakens car users habits of taking the car and increases their intention to use public transport. However, a backlash was noted after completing the intervention whereby car users returned to their private cars as soon as they needed to pay for PT. In their conclusions, Thøgersen and Møller (2008) ask if economic incentives in the form of temporary free public transport really are an effective way of breaking travel habits. It has been suggested that temporary free public transport can be effective under new circumstances that feature structural changes, for example when moving or changing workplace (Bamberg et al., 2003). Providing information and removing barriers during such “windows of opportunity”, where new travel patterns need to be formed, may change car use habits (Bamberg et al., 2003; Fujii and Kitamura, 2003). Thus, one recommendation involves providing information and temporary free public transport to new inhabitants. Furthermore, it has also been shown that other household members can influence the change process, both positively and negatively (Skarin et al., 2017), leading to the conclusion that it is essential to address all household members in order to achieve sustainable changes.

The norm activation model (NAM) of Schwartz (1977) focuses on the activation processes of moral norms and the extent to which moral norms can be transformed into action. Situational cues can make us aware of the need to change our travel behavior. Strong habits may block this effect; however, if we are aware of the situation, it may be argued to be linked to personal as well as social norms. Matthies et al. (2006) propose that travel behavior is not solely guided by anticipated non-moral costs and benefits. Specifically, personal norms, or the

feeling of moral obligation to travel sustainably in a bus, rather than to travel alone in a car, seem to play an important role in the increased use of public transport.

Some studies have used a marketing framework that includes users' expectations and satisfaction, and have also shown the importance of expectations, whereby low or undefined expectations regarding public transport services explain why people use their cars. A temporary free public transport trial can be a means of correcting such mispredictions (Beale and Bonsall, 2007; Pedersen et al., 2011; Thøgersen, 2009) by means of providing car users with actual experiences. Additional studies have been performed which have focused on the experience and satisfaction perceived during free trials (Abou-Zeid et al., 2012; Abou-Zeid and Ben-Akiva, 2012; Taniguchi et al., 2014). An important conclusion here is that people who switch to public transportation are usually more satisfied with the service, while non-switchers increase their satisfaction with car use compared to pre-intervention (Abou-Zeid et al., 2012). Taniguchi et al. (2014) showed that the more frequently people used public transport, the more likely it would be to achieve the individual travel change goals that participants had stated pre-intervention, something which also had a positive effect on formulating future intentions to use public transport. Intentions to continue using public transport were also directly influenced by satisfaction with the service. Based on these studies, it is concluded that, since experiences relating to public transport use may differ from person to person, the selection of whom to provide with temporary free travel interventions needs to be done carefully.

Table 1 summarizes the above-presented research on temporary free public transport by categorizing the published papers by year, journal, country, sample group, type of intervention and theoretical framework. The included studies are chronologically ordered, starting from the oldest study (2001) to the most recent one (2017). Four of the papers were published in a psychology or consumer service journal, and nine of them were published in transportation journals.

As can be seen in Table 1, temporary free public transport has been implemented and scientifically evaluated in different countries (Germany, Japan, the UK, Denmark, Sweden, Switzerland, and the US), albeit mainly in Germany ($n = 4$) and Sweden ($n = 3$). The sample size varies between 30 and 1036 participants. Most of the studies targeted car owners or people with high car access. In two of the studies, the participants were students. The intervention was implemented either as a single measure or in combination with other soft policy measures (mostly information measures such as including maps or information leaflets). Most of the studies included the effects of the temporary free public transport trial, which are further described in Section 1.2.

1.2. Effectiveness of temporary free public transport

Based on the literature above, we now know the factors of importance in free public transport trials. This section presents and discusses the outcome measures, in the form of travel behavior, satisfaction, and attitudes, as important factors for sustainable travel (Gärling et al., 2017).

1.2.1. Mode change

Table 2 summarizes the relative percentage change in car and public transport usage during and after the temporary free public transport trial. Ten studies¹ reported mode change, where the “during the intervention” change to public transport was the most measured outcome. The findings need to be interpreted with caution, as different methods were used to calculate the change (e.g. frequency of use, number of trips, perceived change). Furthermore, in some studies, the percentage

¹ Ten studies mentioned a concrete number of increases/decreases in mode use; other studies mentioned an increase/decrease without quantifying the result. Only studies with concrete effects are included in Table 2.

Table 1
Studies on temporary free public transport.

Author(s)/(Year)	Title	Journal (Volume)	Country	Sample size and descriptive	Single measure, in combination	Theoretical framework
Bamberg and Schmidt (2001)	Theory-Driven Subgroup Specific Evaluation of an intervention to Reduce Private Car Use	Journal of Applied Social Psychology (31)	Germany	Students (N = 1036) Mean age = 24.4	Single	Theory of planned behavior
Preisendörfer (2001)	Der öffentliche Personennahverkehr im Test: Ein Monat gratis mit dem ÖPNV [Eng. <i>Public Transport in the test. One month free public transport</i>]	Zeitschrift für Verkehrswissenschaft [Eng. <i>Journal of Transportation Science</i>] (72)	Germany	Car owners (N = 60)	Single	Influence of behavior change on attitudes
Fuji and Kitamura (2003)	What does a one-month free bus ticket do to habitual drivers?	Transportation (30)	Japan	Students (N = 43) Mean age = 21.5	Combination (Map)	Habits
Bamberg et al. (2003)	Does habitual car use not lead to more resistance to change of travel mode?	Transportation (30)	Germany	Movers (N = 169) Mean age = 28.6	Combination (Information, map)	Structural change process Habits Theory of planned behavior
Matthies et al. (2006)	Applying a Modified Moral Decision Making Model to Change Habitual Car Use: How Can Commitment be Effective?	Applied psychology: an international review (55)	Germany	Good car and public transport access (N = 297) Mean age = 45	Single	Extended theory of planned behavior Norm activation model Decision making
Beale and Bonsall (2007)	Marketing in the bus industry: A psychological interpretation of some attitudinal and behavioral outcomes	Transportation Research Part F (10)	UK	Study 1: Inhabitants (N = 205) Study 2: Non-regular bus users (N = 61)	Combination (Leaflet)	Marketing behavior Theory of planned behavior Elaboration likelihood model
Thøgersen and Møller (2008)	Breaking car use habits: The effectiveness of a free one-month travelcard	Transportation (35)	Denmark	Car users (N = 817)	Combination (Customized timetable)	Habits Intention-behavior relationship
Thøgersen (2009)	Promoting public transport as a subscription service: Effects of a free month travel card	Transport Policy (16)	Denmark	Car owners (N = 597) Mean age = 43	Single	Marketing Motivation, opportunity, ability model Perception of satisfaction
Pedersen et al. (2011)	The role of predicted, on-line experienced and remembered satisfaction in current choice to use public transport services	Journal of Retailing and Consumer Services (18)	Sweden	Car users (N = 62)	Single	Influence of behavior on satisfaction
Abou-Zeid et al. (2012)	Happiness and travel mode switching: Findings from a Swiss public transportation experiment	Transport Policy (19)	Switzerland	Habitual car drivers (N = 30) Mean age = 43.3	Single	Influence of behavior on satisfaction
Abou-Zeid and Ben-Akiva (2012)	Travel mode switching: Comparison of findings from two public transportation experiments	Transport Policy (24)	Switzerland & US	Habitual car drivers (N = 30 in Switzerland) Mean age = 43.3 (N = 67 in the US) Mean age = 47	Single	Influence of behavior on satisfaction
Taniguchi et al. (2014)	Satisfaction with travel, goal achievement, and voluntary behavioral change	Transportation Research Part F (26)	Sweden	Car users (N = 321)	Single	Process model of voluntary behavior change
Skarin et al. (2017)	The household as an instrumental and affective trigger in intervention programs for travel behavior change	Travel Behavior and Society (6)	Sweden	Study 1: Car user households (N = 108) Study 2: Living in households with 2 and more people (N = 32) Mean age = 44.8	Single	Household influence

Table 2
Relative percentage change of car and public transport during and after an intervention.

	Relative percentage change		Relative percentage change	
	During the intervention		Post-intervention	
	Car	Public Transport	Car	Public Transport
Number of studies	3	8	1	6
Average	-40%	115%	0.7%	36%
SD	37%	75%	na	27%
Min	-68.0%	30.6%	0.7%	0.0%
Max	2.1%	280.0%	0.7%	80.0%

change is calculated using before and after measures (Bamberg and Schmidt, 2001; Fujii and Kitamura, 2003; Matthies et al., 2006; Preisendörfer, 2001; Thøgersen, 2009), while other studies compare the change in the participating group, with travel behavior measured in a control group (Bamberg et al., 2003; Beale and Bonsall, 2007), which can also lead to different outcomes. Due to the limited number of studies, the methods have not been separated; instead, a relative change in percentage has been calculated.

During the intervention, most of the studies reported a large increase in public transportation use. Differences in intervention achievement can be explained by individual socio-demographic factors, travel attributes, transportation policies, social influences, and other psychological variables. A comparison showed that temporary free public transport works better for commuters, who are more inclined to switch (Abou-Zeid and Ben-Akiva, 2012). Also, the intervention design and the measurement of change play a part in the outcome. Only three studies measured car use during the intervention. On average, the reduction in car usage was substantial, but not as extreme as the increase in public transport, which varied between 30% and 280%. One study showed, in contrast, a small increase in car use. One explanation for this result could be the fact that people were using their public transport tickets for additional trips, which wouldn't have taken place otherwise, or which would have been done by bike or on foot. Also, misleading or non-personalized information can have a boomerang effect on some car users (Beale and Bonsall, 2007), entailing that the intervention leads to an increase in unhealthy behavior (Byrne and Hart, 2009), also called reactance in the literature. Beale and Bonsall (2007) explain this effect using the ELM (Elaboration Likelihood Model), which shows differing outcomes on the basis of how messages are perceived. The long-term effects varied considerably between studies and were relatively small compared to the short-term effects. Time-lapse and measures for post-intervention follow-up play a part in evaluating the effectiveness of the intervention. Easy access by economic incentives seems to encourage occasional use; however, for long-term switching to public transportation, such “low-cost” measures might not be enough (Abou-Zeid et al., 2012). Also, the price-performance ratio plays a part according to Thøgersen and Møller (2008), whereby many habitual drivers say “at current prices, driving is our preferred travel mode”. People who have deep-rooted, negative attitudes towards public transport (“deniers”) are usually extremely difficult to change (Beale and Bonsall, 2007).

1.2.2. Attitude change

Changes in attitude were measured in six studies (see Table 3). As

Table 3
Change of attitude towards the car and public transport.

	Car			Public Transport		
	Positive change	Non-significant	Negative change	Positive change	Non-significant	Negative change
Number of studies	0	1	1	6	0	1

the variables used to measure the outcomes differed considerably, differentiation only occurs between a significant positive change, a non-significant change and a significant negative change of attitude towards the car and public transport.

Six studies reported a positive change in attitude towards public transport during the intervention. Only one experiment (within a study) reported an overall negative attitude towards public transport (Beale and Bonsall, 2007). Even though this study reported a lower attitude outcome for public transport, the general effect on behavior change was positive. The gap between attitude and behavior can be explained by the following statement made by the authors “the marketing may have raised expectations and prompted people to try the bus but the bus may not have lived up to heightened expectations” (Beale and Bonsall, 2007, p. 282). Abou-Zeid and Ben-Akiva (2012) found that people who changed mode showed a more positive attitude towards public transport, while more negative attitudes were observed in those who did not change mode.

1.2.3. Satisfaction change

Similar to measures of attitudes, measures of change in satisfaction were used across the studies. The results thus break down in a similar way, but also with respect to during or after the intervention (see Table 4).

Several studies reported satisfaction as an outcome, but only four studies measured the concrete outcomes of this variable. Most interventions showed increased satisfaction with public transportation, both in the short- and long-term. Taniguchi et al. (2014) reported, for example, that satisfaction with temporary free public transport influenced the frequency of public transport use positively. The study reporting a negative change long-term does not relate directly to negative satisfaction post-trial, it was rather the case that the participants remembered their satisfaction as being lower during the trial compared to how satisfied they actually were during it (Pedersen et al., 2011). People who were more likely to use public transport were usually more satisfied with their public transport experience than those who did not switch at all (Abou-Zeid et al., 2012). A strong level of car use satisfaction was reported by participants who did not switch to public transport. They became even happier to travel by car (Abou-Zeid and Ben-Akiva, 2012).

2. Theory - a stage-based approach to determining the effectiveness of an intervention

We suggest that the differences in mode change, attitude change, and satisfaction change reported in Section 1.2 depend to some extent on individuals’ stage of motivation to change (Friman et al., 2017; Olsson et al., 2018). This may, for instance, vary between not acknowledging that their current mode use is problematic - e.g. unsustainable, unhealthy - or perceiving themselves as being inhibited by change, and being prepared to test a new behavior, or already having started initiating a new habit. Previous studies have analyzed the different variables influencing behavior change (e.g. social norms, habits, satisfaction); however, no study, to our knowledge, has analyzed the effectiveness of a free public transport trial as regards the different motivational stages of behavior change.

Stage-based models are used in various forms of health research, e.g. dietary fat reduction (Curry et al., 1992), addictive substance

Table 4
Change in satisfaction with each specific mode during and after the intervention.

	During the intervention					
	Car			Public Transport		
	Positive change	Non-significant	Negative change	Positive change	Non-significant	Negative change
Number of studies	0	0	0	2	1	0
Post-intervention						
Number of studies	2	0	0	3	0	1

cessation (Evers et al., 2012; Riemsma et al., 2003), the promotion of physical activities (Hutchison et al., 2009; Lippke et al., 2005), and traffic safety (Kowalski et al., 2014; Sinelnikov and Wells, 2017). Recently, the model has been attracting more attention in research into sustainable mobility (Bamberg, 2013a; Forward, 2014; Friman et al., 2017; Gatersleben and Appleton, 2007; Olsson et al., 2018). Stage models suggest that people are at different motivational stages, and behave accordingly, and that the effectiveness of interventions is thus dependent on which stage an individual is undergoing at the moment (Armitage and Conner, 2000). These models provide some insight into why different groups of people change their behaviors (Forward, 2014).

The transtheoretical model of change (TTM) (Prochaska et al., 1993) is an important stage model often used in the behavioral change literature, and with respect to explaining mode changes (e.g., Bamberg, 2013b; Forward, 2014). The TTM consists of five stages: precontemplation (no motivation for behavior change), contemplation (thinking about making a behavior change), preparation (preparing to make a behavior change), action (actively engaged in behavior change), and maintenance (maintaining a changed behavior). The stages are ordered from no motivation to the active execution of healthy behavior (Armitage and Conner, 2000). Some criticism of the TTM is visible in the literature; Bamberg (2007) summary is that previous studies show mixed empirical support. The lack of an explanation as to why the stages were chosen, and why the defined timeframes relating to change are valid, has led to some disapproval of the TTM (West, 2005). Little is known about the variables within the stages, or about how people change, and why some of these are successful while others are not (Armitage and Conner, 2000). Therefore, new stage models have been created to overcome some of the barriers, e.g. the stage model of self-regulated behavioral change (SSBC) by Bamberg (2013b), where only four stages are used (predecisional, preactional, actional and postactional). Olsson, Huck and Friman (2018) propose that the predecision stage may further be divided into two independent stages, whereby the first is *predecisional denial*, for people who do not see any reason to change, and the second, labeled *predecisional inhibition*, is for people who believe it would be good to change but feel it is impossible to do so.

The present study investigates whether, and if so how, a free public transport trial not only influences travel behavior (public transport use and car use), but also motivational stage change as determined by attitudes, norms and perceived behavioral control (the key determinants of the intention to perform a specific behavior in the TPB). By applying a stage of change model (Olsson et al., 2018; Prochaska et al., 1993), we aim to increase our understanding of the outcomes reported in Section 1.2. According to the main argument regarding stage-based models, differences in outcome variables (e.g., travel behavior and attitudes) can be explained by the stage of change.

In Fig. 1, we merge previous findings into a conceptual model. When empirically testing the model, we considered social norms, personal norms, perceived behavioral control, and attitudes influencing the base line stage of motivation, stage change (the transformation from one stage to another) and actual behavioral change (i.e., reduced car

travel). Following previous research, social norms are assumed to influence the base line stage indirectly through personal norms (Olsson et al., 2018).

It is important to remember that not all stages, as theoretically defined, include a behavioral change. A stage change can result in a strengthened degree of motivation without a change in behavior. For instance, a transformation from a very low stage (e.g., *predecisional inhibition*) to a somewhat higher stage (e.g., *preactional*) will not generate a behavior change but a change in motivation. In our empirical test of the model, the intervention's ability to generate a transformation to a higher stage is as important as a direct behavioral change because such a transformation may trigger a long-term behavioral change.

Moreover, a body of research suggests that sociodemographic factors influence travel behavior change. For instance, high income men may be “trapped” by being more attached to their cars, making them less likely to change even though their motivation for doing so has increased due to the intervention. Thus, gender, income, and age are included in the model as sociodemographic factors. Taken together, the aim is to (i) investigate how the psychological mechanisms are related to the base line stage of motivation, (ii) to show that the intervention may increase the degree of motivation to change (stage change), (iii) that the base line stage has an indirect effect on behavior change through the stage change, and (iv) that sociodemographic factors influence behavior change.

3. Materials and methods

3.1. Participants and procedure

Online surveys were distributed among employees of 14 companies and institutions throughout the County of Värmland (Sweden). The companies and institutions were all participating in a project run by the County dealing with sustainable travel and accessibility to work-places. The target group for this study was the employees who voluntarily signed up for the project (n = 401). Each participant in the project received a small leaflet with some descriptions of public transport in Värmland and a 30-day free public transport ticket. Two online surveys were distributed pre-intervention (spring/summer 2017) and post-intervention (fall/winter 2017). All participants in the project responded to the pre-intervention survey (n = 401) while a slightly smaller group participants (n = 190) responded to the post-intervention survey.

Table 5 shows the sociodemographics of the respondents. The participants ranged from 25 to 77 years of age, with a mean age of 48. Just over half of the participants were female (n = 103). Sixty-four of the participants earned between 34 and 68 kSEK² per month, with 45 participants earning more than 68 kSEK and 24 earning less than 34 kSEK. The average distance to work was 23.6 km. Most of the participants (n = 78) had a short distance to work of less than 10 km.

² 10 SEK is approximately equal to 0.95 EUR or 1.10 USD (as at April 2018).

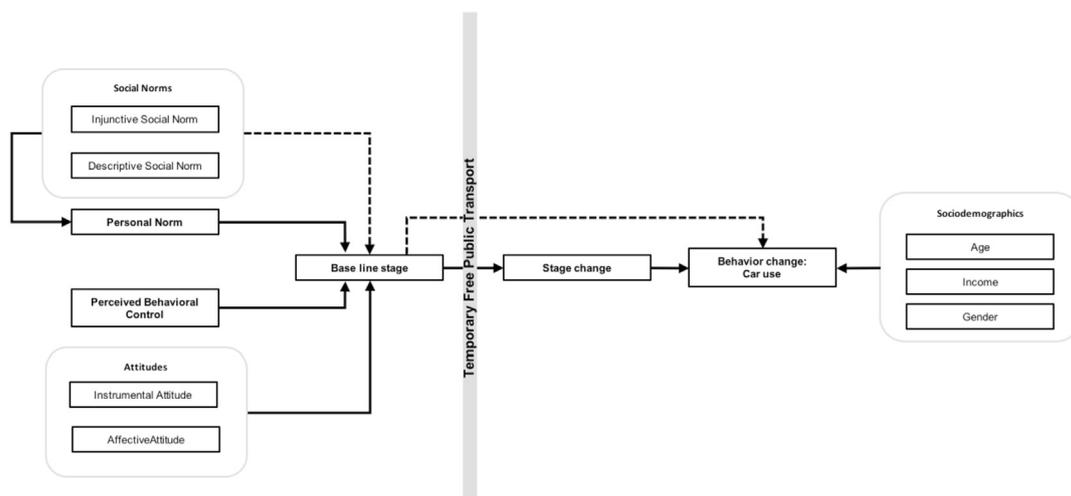


Fig. 1. Visualization of the conceptual model of the effects on motivational stage change and behavior of a temporary free public transport trial. Note: Dotted lines represent indirect effects while solid lines represent direct effects. The gray line in the middle represents the intervention phase (30-day intervention).

Table 5
Sociodemographics of the survey participants.

Variable (N = 190)	Mean	Min-Max	SD	n	%
Age	48	25–77	11.7		
Gender					
Female				103	54.2
Male				87	45.8
Income					
Less than 34 kSEK				24	12.6
Between 34–and 68 kSEK				64	33.7
More than 68 kSEK				45	23.7
No Answer/ Missing values				57	30
Distance to work in kilometers	23.6	0.5–125	23.3		
0–9.9				78	41.1
10–19.9				22	11.6
20–29.9				26	13.7
30–39.9				25	13.2
40–49.9				12	6.3
Above 50				27	14.2

3.2. Questionnaires

3.2.1. Pre-study

The pre-study was conducted two weeks pre-intervention. The questionnaire included the following three modules: (1) Sociodemographic questions concerning workplace, gender, year of birth, income, and distance between home and work, (2) Travel behavior, and (3) Psychological mechanisms relating to mode use, e.g. the stage of change, attitudes, personal and social norms, and perceived behavioral control.

3.2.2. Post-study

The post-study was conducted four weeks post-intervention. The questionnaire included four modules: (1) Use and experience of the temporary free public transport ticket, attitudes relating to public transport, and satisfaction relating to both public transport and the intervention, (2) Travel behavior post-intervention, (3) Psychological mechanisms post-intervention, and (4) General remarks.

3.3. Measures

3.3.1. Travel behavior

The travel behavior of the participants was measured by self-

reported mode use over an average working week (5 days). Every participant chose how many times a week he/she used a specific mode (choices: public transport, bike, walk, car, carpool and home office) in order to go to work. When the participants had selected several modes per day, this resulted in more than five modes per week (e.g. 4x bike, 4x Public Transport, 1x home office). During the pre-study, the participants differentiated between summer and winter mode use, while only the current mode use was reported during the post-study. To calculate mode change, we used the self-reported mode use during the winter for those participating in the free-public transport intervention during the fall/winter (N = 55), and, correspondingly, the self-reported mode use during the summertime for those participating during the spring/summer (N = 135). It is worth noting that only minor differences were observed with respect to the reported mode use during the winter and summer during the pre-study survey.

3.3.2. Stage of change

We applied a measure of stages of change based upon Olsson et al. (2018), and the stage-measures of SSBC and TTM. The measure consists of six statements relating to specific stages. The same measure was used in both the pre- and post-survey. The statements were phrased as follows: (1) As I do not travel by car, this question does not apply [maintenance], (2) I try to use other modes than car as much as possible, I will maintain or reduce my already low car use in the coming months [postactional], (3) I most frequently use my car to go to work. My aim is to reduce my current car use. I know which journeys to replace and by which modes, but have not started to do so [actional], (4) I most frequently use my car to go to work. I am thinking about reducing my car use but am unsure of how or when to do this [preactional], (5) I most frequently use my car to go to work. I would like to reduce my car use but feel this is impossible. [predecisional inhibition], (6) I most frequently use my car to go to work. I am pleased with this and see no reason to reduce my car use [predecisional denial].

3.3.3. Attitude

For the measurement of attitudes, we made a distinction between instrumental attitudes and affective attitudes, as proposed by Ajzen (2010). While instrumental attitudes reflect the benefits and costs associated with the behavior, affective attitude is an emotional judgment (Lowe et al., 2002). The questions asked were adopted from Olsson et al. (2018) and phrased thus: *Choosing a different mode than car to get to work would work ... ?* (instrumental attitude) and *Choosing a different mode than car to get to work would feel ... ?* (affective attitude). Both

Table 6
Mode use pre- and post-intervention (total frequency, average frequency, and relative mode use).

N = 190	Descriptive						Statistical test of differences
	Sum frequency (before)	Average frequency (before)	Relative mode use (before)	Sum frequency (after)	Average frequency (after)	Relative mode use (after)	Paired t-test of frequency before and after
Public transport	210	1.14	25.0%	316	1.66	32.1%	< .001
Active mode	250	1.35	29.8%	300	1.58	30.5%	.080
Car	380	2.05	45.2%	367	1.93	37.3%	.209
Total	840	4.54	100%	983	5.17	100%	< .001

questions were measured on a 7-point Likert scale, ranging from 1 (bad) to 7 (good).

3.3.4. Perceived behavioral control (PBC)

Perceived behavioral control was measured using the statement: *For me it would be easy to use another transport mode than car to get to work*, and answered on a 7-point Likert scale, ranging from 1 (do not agree at all) to 7 (fully agree) (Olsson et al., 2018).

3.3.5. Personal and social norms

Personal norms were captured via the values and principles of not using the car to get to work: *Because of my personal values and principles, I feel an obligation/guilt in respect of not using the car to get to work*. Social norms were divided into injunctive and descriptive. Injunctive norms represent perceptions as regards how others (dis)approve, and social awards are seen as motivators. The descriptive norm is the perception of other people behaving themselves according to the desired norms (Smith et al., 2012). The statement *Most people that are important to me would support my choice of leaving the car and using a different mode to get to work* represents the injunctive social norms while *Most people that are important to me would leave the car and choose a different mode themselves* represents the descriptive social norms. All the questions were answered on a 7-point Likert scale, ranging from 1 (do not agree at all) to 7 (fully agree).

3.3.6. Satisfaction and attitudes regarding public transport post-intervention

During the post-survey, one question was asked about the degree of change in attitude toward public transport post-intervention. It was phrased thus: *How did the campaign change your attitude towards Public Transport in Värmland?*, and answered on a 5-point scale, ranging from 1 = much more negative to 5 = much more positive. Two questions were asked in order to measure satisfaction with public transportation. One was a direct measure of satisfaction during the intervention, phrased thus: *If you think about your public transport trips during the trial, how satisfied were you with them?*, and answered on a 5-point scale, ranging from 1 = very dissatisfied to 5 = very satisfied. A second question captured satisfaction in a more indirect way by asking if they would now, four weeks post-intervention, recommend public transport to friends and family, specifically phrased thus: *How likely is it that you will recommend friends and family to travel by public transport in Värmland?*, and answered on a 10-point scale, ranging from 1 = not at all to 10 = very probable.

3.4. Data analysis

Initially, we performed a t-test on the frequency of mode use, an ANOVA on the stage of change, and cross-tabulation on the transformation between the stages. Furthermore, we also performed analyses of satisfaction and attitudes towards public transport post-intervention. The overall aim was to identify the differences in mode use and motivation both pre- and post-intervention.

We then made a PLS-SEM (partial least squares structural equation

model) in order to test the relationships outlined in our conceptual model (see Fig. 1). To do so, the software SmartPLS 3.0 was used to estimate the direct, indirect and overall effects of the conceptual model. Using PLS-SEM, it is possible to visually examine the relationships among the variables of interest (Wong, 2013), and to analyze small samples (Hair et al., 2017). The PLS-SEM focuses on nonparametric bootstrap procedures, whereby observations are randomly drawn in order to create subsamples (usually 5000). Another asset of the PLS-SEM is that the data does not require normal distribution, entailing that parametric tests cannot be applied in order to perform the significance testing of relationships, instead relying on a nonparametric bootstrap procedure to test the estimated path coefficients.

4. Results

4.1. Descriptives

4.1.1. Travel behavior change

Pre-intervention, the participants were traveling to work, during an average working week, 2.05 days by car, 1.14 days by public transport, and 1.35 days walking and cycling. During the intervention, 82.1% of all the participants indicated that they had used the trial card, where 64.7% of them had used their cars more than three times a week, 20.5% once or twice a week, and 14.7% once a week or less. Four weeks post-intervention, car usage was decreasing, while public transport was increasing (see Table 6). In total, more trips were reported post-intervention. A paired t-test on mode use showed that when testing for frequency of use, only public transport had changed significantly ($p < .001$), while the change for active mode and car was not significant. When looking at the relative mode use, that is the share of the different modes used in relation to the use of other modes, we can see a change in behavior for both public transport use (increase) and for car use (reduction).

4.1.2. Stage of change

Table 7 shows the frequencies for participants belonging to different stages pre- (base line stage) and post-intervention. The largest group

Table 7
Frequencies and percentages of the stage of change pre- and post-intervention.

N = 190	Frequency before (pre-intervention)	Percentage before (pre-intervention)	Frequency after (post-intervention)	Percentage after (post-intervention)
Maintenance	52	22.4	53	22.8
Postactional	49	21.1	59	25.4
Actional	16	6.9	27	11.6
Preactional	22	9.5	18	7.8
Predecisional	39	16.8	27	11.6
Inhibition				
Predecisional	12	5.2	6	2.6
Denial				

was those always leaving their cars at home when traveling to work, thus being classified as belonging to the maintenance stage (n = 52). Many identify themselves as postactional meaning that they try to use other modes as much as possible (n = 49). As can be seen, this group is increasing post-intervention. Actional, preactional, and predecisional denials are all represented with less than 10% (n = 16/22/12), while predecisional inhibition is represented with around 17% (n = 39). It is worth highlighting that twelve participants reported being at the predecisional denial stage while still accepting participation in the intervention. This means that they have stated that they see no reason to reduce their car use while still wanting the free public transport pass. We treat this group cautiously as we do not understand why they responded as they did. It may be that they did not understand the question, or that they were not honest, or that they liked free gifts whatever their purpose, or that they wanted to pass the free travel card on to others (e.g., family members). For transparency, we keep them in all the descriptive results, but exclude them from the statistical analyses.

Four weeks post-intervention, a transformation is visible from the lower stages (predecisional denial, predecisional inhibition, preactional) towards the higher ones (actional, post-actional, maintenance). A univariate ANOVA shows that the differences between the base line stages (pre-intervention) and the post-intervention stages are significant ($p < .001$).

To understand the transformation between the stages, cross-tabulation was performed of stages before and after the intervention. In Table 8, those that did not change, and thus stayed within the same stage, are marked with a larger font in bold in the diagonal. Participants that changed motivational stage negatively are marked in light gray, and those making a positive motivational change are marked in darker gray. As can be seen, one third of those in the maintenance stage relapsed to a lower stage. For the postactional stage, too, one third of them moved to other stages, with slightly more of them reporting a stronger motivation to reduce their car use. Thus, those who try using other modes than car as much as possible (maintenance and postactional) continue doing so during the intervention. During the actional stage, one in four stayed, one in four relapsed to a lower stage, and one half moved to a higher stage. About half of the participants in the preactional stage changed to stages with a stronger motivation post-intervention. Even though those in the predecisional inhibition stage initially indicated feeling it was impossible to use their cars less, about 40% of them still moved to stages with a stronger motivation to reduce car use. The deniers moved to all the other stages. In order to assess these changes statistically, a Wilcoxon Signed Ranks Test was performed, supporting that the transformation between stages is substantial ($z = 3.40, p = .001$).

Overall, we observe a number of transformations between the different stages. Although these are observed at both the lower and higher stages, the majority changed to higher motivational stages post-intervention, indicating a positive effect from the intervention on the motivation to change.

Table 8

Cross-tabulation of frequencies of participants at different stages before and stage after the intervention.

		Base-line stage (pre-intervention)						Total post-intervention
		Maintenance	Postactional	Actional	Preactional	Predecisional inhibition	Predecisional denial	
Post-intervention stage	Maintenance	34	10	4	2	2	1	53
	Postactional	17	32	4	2	2	2	59
	Actional	1	7	4	6	6	3	27
	Preactional	–	–	1	10	6	1	18
	Predecisional inhibition	–	–	2	2	22	1	27
	Predecisional denial	–	–	1	–	1	4	6
	Total pre-intervention	52	49	16	22	39	12	190

4.1.3. Public transport attitudes and satisfaction

Table 9 visualizes the attitude change per stage after the intervention. As can be seen, the intervention changed the attitude towards public transport quite positively. Those in the higher stages (postactional, actional and preactional), in particular, changed their attitudes towards public transport. The proportionately lower score for the maintenance stage can be explained by the fact that most of these participants are already familiar with the service and thus do not face any change in attitude. The table also shows the differences in satisfaction with public transport during the intervention. Not surprisingly, the higher the stage of change - the more satisfied the participants. The same result follows for the question of whether or not the participants would recommend the public transportation offer to their friends and relatives.

4.2. PLS-SEM analysis

This section presents the results of the PLS-SEM analyses of base line stage, stage change, and car use. When the PLS-SEM was run, as indicated in the conceptual model, the model fit index was not satisfactory. The Heterotrait-Monotrait ratio of correlation (HTMT) indicated that the latent construct attitude was not homogenous (Henseler et al., 2015). A second model was therefore tested using the two attitude variables (affective and instrumental), treated as individual constructs. This yielded a satisfactory model fit (SRMR of 0.06), below the suggested threshold value of 0.8 (Hu and Bentler, 1999). The outcome of the PLS-SEM, with direct and indirect effects, is given in Table 10, while in Fig. 2, the significant direct and indirect effects of the model are visualized.

Psychological mechanism variables, e.g. instrumental attitude, perceived behavioral control and personal norms, were found to have a significant direct effect ($p < .05$) on the base line stage. Also, consistent with previous findings (Olsson et al., 2018), social norms (injunctive and descriptive) had a direct effect on personal norms, but only a marginally indirect effect on the base line stage. The effect of social norms on the base line stage was thus mediated by personal norms. Instrumental attitude, as expected, had a significant direct effect on the base line stage. However, contrary to our proposed conceptual model (Fig. 1), affective attitude was not significant. A closer look at this construct showed that the participants, during all motivational stages, seem to rate affective attitude relatively highly. In line with the conceptual model, the base line stage only indirectly influences behavior. Thus, the participants first transform to another stage, due to the intervention, and then this triggers a behavior change. None of the sociodemographic factors (gender, income, age) were significant.

5. Discussion

This research provides empirical evidence as regards determining the effectiveness of temporary free public transport, showing that a

Table 9
Means and standard deviations of satisfaction and change of attitude towards public transport per stage.

Stage after	Change of attitude toward public transportation		Satisfaction with public transportation during the intervention		Recommendation for public transportation	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Maintenance	3.57	0.94	4.41	0.78	8.11	2.51
Postactional	3.87	0.63	4.38	0.66	8.29	1.71
Actional	3.70	0.56	4.04	0.77	7.07	1.90
Preactional	3.60	0.83	3.47	1.13	7.00	2.30
Predecisional Inhibition	2.94	1.44	3.41	1.12	6.52	2.41
Predecisional Denial	3.20	0.45	3.40	0.89	5.83	2.79
<i>Average</i>	<i>3.61</i>	<i>0.88</i>	<i>4.12</i>	<i>0.91</i>	<i>7.62</i>	<i>2.27</i>

Note: Means on 5-point scales (attitude and satisfaction), where a score above 3 corresponds to a positive response and on a 10-point scale (recommendation) where a score above 5 corresponds to a positive response.

stage-based approach remains inherent to understanding the nuances encompassing the transformation towards a stronger (and weaker) level of motivation to reduce car use. As outlined in our conceptual model, a number of psychological mechanisms determine the individual stage of motivation to change; in order to succeed with behavioral change, one needs to undergo a transformation from lower to higher motivational stages. Our findings, and the literature review on previous temporary free public transport trials, increase our knowledge of the generalizability and effectiveness of this type of intervention for behavioral change. In reply to Thøgersen and Møller (2008), who asked if economic incentives, in the form of temporary free public transport, really are an effective measure for breaking travel habits, we can now give a nuanced answer.

The initial degree of motivation (i.e. the base-line) to change current behavior was explained by a number of psychological mechanisms. Instrumental attitude, perceived behavioral control and personal norm were found to be of particular importance. Indirectly, social norms also played a significant role. The only targeted psychological mechanism that was found to be non-significant was affective attitude. For this specific construct, participants across all the stages rated it relatively highly, showing that all participants generally think that they would feel very good if they reduced their car use, regardless of stronger or weaker levels of motivation to change. It has been argued that, in order to trigger a change, affect may be one of the components needing to be

considered. Our results indicate, however, that, for those with at least some motivation, affective attitudes should not be the primary target. Instead, perception of control and instrumental attitudes should be the prime targets. This is supported by a recent meta-analysis of interventions and the theory of planned behavior, where the strongest effects were observed when perceived behavioral control was the target of interventions during transport-related studies (Steinmetz et al., 2016).

We also observed that the intervention generally strengthened the motivation to change. In our analyses, we included those who had stated that they do not travel by car and are strongly motivated to maintain that behavior (the maintenance stage). However, since these people cannot make a positive stage change, they were only able to stay at status quo (which is the preferred behavior), or change negatively (become less motivated). Excluding the maintenance stage from our analyses shows an even stronger effect whereby more than 75% of the changes in motivation were in a positive direction (44 made a positive motivational change while only 14 made a negative change). Among those in the maintenance stage, 18 made a negative change. These results inform us that, although the aim of interventions, e.g. temporary free public transport, is to recruit car users into using public transport, we should not solely focus on this since it may be of equal importance to take actions aimed at sustaining the motivation of those already in the system. Although in a minority, relapses to lower stages could be observed across all the stages, which confirms the basic assumptions

Table 10
Detailed results from the PLS-SEM: Direct and indirect effects (N = 178).

Direct effects													
	Personal Norms (pre-intervention)			Base line stage (pre-intervention)			Stage change (post-intervention)			Car use decrease (post-intervention)			
	β	t	p	β	t	p	β	t	p	β	t	p	
Social Norm	.54	7.80	< .001	.03	0.43	.643							
Personal norm				.12	1.98	.048							
Affective attitude				.01	0.13	.897							
Instrumental attitude				.36	3.01	.003							
Perceived behavioral control				.36	3.19	.001							
Base line stage							.43	8.33	< .001	.08	1.00	.315	
Stage change										.34	3.57	< .001	
Female										.02	0.31	.759	
Income										.05	0.69	.488	
Age										.09	1.41	.160	
	$R^2_{adj} = .28$			$R^2_{adj} = .50$			$R^2_{adj} = .18$			$R^2_{adj} = .09$			

Indirect effects			
	β	t	p
Social norm → Personal norm → Base line stage	.07	1.80	.072
Base line stage → Stage change → Car use decrease	.15	3.01	.003

Note: Numbers in bold are significant at $p < .05$, and numbers in italics are marginally significant at $p < .10$.

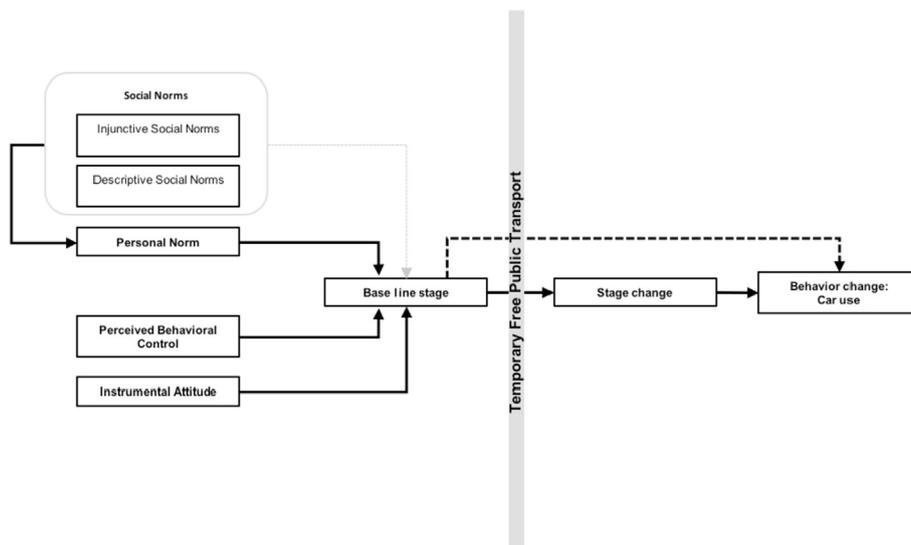


Fig. 2. Visualization of the significant effects of the PLS-SEM.
 Note: Solid lines represent significant direct effects ($p < .05$), dotted lines represent significant indirect effects ($p < .05$), and gray dotted lines represent marginally significant indirect effects ($p < .10$).

made in the theory of the transtheoretical model of change (TTM), in that motivation is constantly being shaped in a process that moves from weaker to stronger and back again, a process that is triggered by different factors and circumstances. In line with our conceptual model, the base line stage only indirectly influences behavior. Thus, the participants first transform to another stage, which then triggers a behavior change. For a behavioral change to take place, we can thus conclude that a shift is needed during the motivational stages, which can be accomplished by means of a free public transport intervention. In future research, studies with larger samples would allow modelling each stage separately, giving a more nuanced picture of the importance of the psychological mechanisms in the stage-based approach.

The aim of the intervention was to reduce car use and to increase public transport use for the work commute; this is, furthermore, what the intervention succeeded in doing, specifically with respect to public transport use. For car use, the reduction was not significant. This can partially be explained by those in the maintenance stage relapsing to lower stages. We can only speculate on the reasons as to why so many relapsed. One potential explanation could be that the intervention interfered with their intrinsic motivation. Research in other areas has shown that, if incentives are given to people who are already intrinsically motivated to act in a certain way, then economic incentives may be counter-productive and lead to the opposite of what was intended (referred to as the motivation crowding-out effect; Frey and Oberholzer-Gee, 1997), thus causing reduced motivation regarding the targeted behavior.

One issue worth mentioning, and which may have interfered with the mode use results, is that the total number of trips had significantly increased in the post-study. In our analyses, we used car-use reduction (measured as frequency) as dependent variable as this was our main target behavior. However, we also present the share of car use in relation to other modes used. In this case, we do observe an effect on behavior between the pre- and post-surveys, with a reduction in the share of car use by 8%, and an increase of the same magnitude for the share of public transport, while the share of active transport do not change. This indicates that mode choice was influenced post-survey.

We acknowledge that the study is by nature designed as self-selection, where participants volunteered to participate. Although self-selection sometimes can be seen as problematic, the very essence of the problem we address is to study effects of stage of motivation in an intervention that is freely offered. Looking at the initial distribution across motivational stages, although self-selected, we still see that they

are distributed across all stages, indicating that this is not a homogeneous group at start.

As mentioned above, we want to emphasize the potential of targeting different segments of travelers who are motivated to take action and implement a reduction in current car use. If a simple recruitment strategy is used - as in giving everyone in a workplace a free travel card, or asking randomly who wants to participate in the free trial, then a stage-based approach could be included (pre- and post-implementation) in order to effectively detect people at different motivational stages, and to follow up whether or not the transformation has been accomplished. For those already in the maintenance stage, a free public transport pass may not be the best gift; other interventions may be more beneficial. We would argue that an intervention may be regarded as a success if it enables people to transform their motivation to change into higher stages, even though this does not necessarily lead to behavioral change during the intervention. We believe this motivational change may trigger or support change over time, provided that further measures are implemented in order to maintain and support this positive development. Also, the reported positive attitude toward public transport post-intervention, and the experiencing of satisfaction during use, may further support such behavior change at a later point in time. To potentially confirm our hypothesis on behavioral change over time, we encourage both longitudinal studies and the application of the stage of motivation as the causal link to behavior.

6. Conclusion

We present empirical evidence of the effectiveness of a temporary free public transport intervention. We show that the stage-based approach remains inherent to understanding the nuances that encompass motivational transformation towards a stronger intention to reduce car use. In our conceptual model, a number of psychological mechanisms were proposed as determining the stage of motivation to change. In line with previous findings, we can conclude that not only is perceived behavioral control important, but also instrumental attitude and norms, where social norms relate to the stage via personal norms. The results also show that, in order to succeed in making a behavioral change, one needs to undergo a transformation from lower to higher stages. One important finding from the present study is that, although only a few participants reduced their car use post-intervention, more participants moved to higher stages with a stronger motivation to reduce their car use in the future. From a policy perspective, these results suggest that,

although a temporary free public transport trial may seem to produce weak effects when behavior is only looked at in a short-term perspective, the effects may, in fact, become larger over time as this leads to a stronger motivation to change.

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References

- Abou-Zeid, M., Ben-Akiva, M., 2012. Travel mode switching: comparison of findings from two public transportation experiments. *Transport Pol.* 24, 48–59. <https://doi.org/10.1016/j.tranpol.2012.07.013>.
- Abou-Zeid, M., Witter, R., Bierlaire, M., Kaufmann, V., Ben-Akiva, M., 2012. Happiness and travel mode switching: findings from a Swiss public transportation experiment. *Transport Pol.* 19, 93–104. <https://doi.org/10.1016/j.tranpol.2011.09.009>.
- Ajzen, I., 2010. Constructing a Theory of Planned Behavior Questionnaire.
- Armitage, C.J., Conner, M., 2000. Social cognition models and health behaviour: a structured review. *Psychol. Health* 15, 173–189. <https://doi.org/10.1080/08870440008400299>.
- Bamberg, S., 2013a. Applying the stage model of self-regulated behavioral change in a car use reduction intervention. *J. Environ. Psychol.* 33, 68–75. <https://doi.org/10.1016/j.jenvp.2012.10.001>.
- Bamberg, S., 2013b. Changing environmentally harmful behaviors: a stage model of self-regulated behavioral change. *J. Environ. Psychol.* 34, 151–159. <https://doi.org/10.1016/j.jenvp.2013.01.002>.
- Bamberg, S., 2007. Is a stage model a useful approach to explain car drivers' willingness to use public transportation? *J. Appl. Soc. Psychol.* 37, 1757–1783.
- Bamberg, S., Rölle, D., Weber, C., 2003. Does habitual car use not lead to more resistance to change of travel mode? *Transportation* 30, 97–108.
- Bamberg, S., Schmidt, P., 2001. Theory-driven subgroup-specific evaluation of an intervention to reduce private car use. *J. Appl. Soc. Psychol.* 31, 1300–1329.
- Beale, J.R., Bonsall, P.W., 2007. Marketing in the bus industry: a psychological interpretation of some attitudinal and behavioural outcomes. *Transport. Res. F Traffic Psychol. Behav.* 10, 271–287. <https://doi.org/10.1016/j.trf.2006.11.001>.
- Byrne, S., Hart, P.S., 2009. The boomerang effect a synthesis of findings and a preliminary theoretical framework. *Ann. Int. Commun. Assoc.* 33, 3–37. <https://doi.org/10.1080/23808985.2009.11679083>.
- Curry, S.J., Kristal, A.R., Bowen, D.J., 1992. An application of the stage model of behavior change to dietary fat reduction. *Health Educ. Res.* 7, 97–105. <https://doi.org/10.1093/her/7.1.97>.
- Evers, K.E., Paiva, A.L., Johnson, J.L., Cummins, C.O., Prochaska, J.O., Prochaska, J.M., Padula, J., Gökbayrak, N.S., 2012. Results of a transtheoretical model-based alcohol, tobacco and other drug intervention in middle schools. *Addict. Behav.* 37, 1009–1018. <https://doi.org/10.1016/j.addbeh.2012.04.008>.
- Forward, S.E., 2014. Exploring people's willingness to bike using a combination of the theory of planned behaviour and the transtheoretical model. *Rev. Eur. Psychol. Appliquée/European Rev. Appl. Psychol.* 64, 151–159. <https://doi.org/10.1016/j.era.2014.04.002>.
- Friman, M., Huck, J., Olsson, L., 2017. Transtheoretical model of change during travel behavior interventions: an integrative review. *Int. J. Environ. Res. Public Health* 14, 581. <https://doi.org/10.3390/ijerph14060581>.
- Friman, M., Larhult, L., Gärling, T., 2013. An analysis of soft transport policy measures implemented in Sweden to reduce private car use. *Transportation* 40, 109–129. <https://doi.org/10.1007/s11116-012-9412-y>.
- Fujii, S., Kitamura, R., 2003. What does a one-month free bus ticket do to habitual drivers? An experimental analysis of habit and attitude change. *Transportation* 30, 81–95.
- Frey, B.S., Oberholzer-Gee, F., 1997. The cost of price incentives: an empirical analysis of motivation crowding-out. *Am. Econ. Rev.* 87 (4), 746–755.
- Gärling, T., Bamberg, S., Friman, M., 2017. The role of attitude in choice of travel, satisfaction with travel, and change to sustainable travel. In: Albarracín, D., Johnson, B.T. (Eds.), *Handbook of Attitudes: Applications*. Routledge, London Chapter in.
- Gatersleben, B., Appleton, K.M., 2007. Contemplating cycling to work: attitudes and perceptions in different stages of change. *Transport. Res. Part Policy Pract* 41, 302–312. <https://doi.org/10.1016/j.tra.2006.09.002>.
- Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., 2017. *A Primer on Partial Least Squares Structural Equation Modeling*, second ed. Sage Publications Ltd., Thousand Oaks.
- Henseler, J., Ringle, C.M., Sarstedt, M., 2015. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Mark. Sci.* 43 (1), 115–135.
- Hu, L., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model.* 6, 1–55. <https://doi.org/10.1080/1070519909540118>.
- Hutchison, A.J., Breckon, J.D., Johnston, L.H., 2009. Physical activity behavior change interventions based on the transtheoretical model: a systematic review. *Health Educ. Behav.* 36, 829–845. <https://doi.org/10.1177/1090198108318491>.
- Kowalski, K., Jeznach, A., Tuokko, H.A., 2014. Stages of driving behavior change within the Transtheoretical Model (TM). *J. Saf. Res.* 50, 17–25. <https://doi.org/10.1016/j.jsr.2014.01.002>.
- Lippke, S., Ziegelmann, J.P., Schwarzer, R., 2005. Stage-specific adoption and maintenance of physical activity: testing a three-stage model. *Psychol. Sport Exerc.* 6, 585–603. <https://doi.org/10.1016/j.psychsport.2004.11.002>.
- Lowe, R., Eves, F., Carroll, D., 2002. The influence of affective and instrumental beliefs on exercise intentions and behavior: a longitudinal analysis. *J. Appl. Soc. Psychol.* 32, 1241–1252. <https://doi.org/10.1111/j.1559-1816.2002.tb01434.x>.
- Matthies, E., Klöckner, C.A., Preifner, C.L., 2006. Applying a modified moral decision making model to change habitual car use: how can commitment be effective? *Appl. Psychol.* 55, 91–106.
- Olsson, L., Huck, J., Friman, M., 2018. Intention for car use reduction: applying a stage-based model. *Int. J. Environ. Res. Public Health* 15, 216. <https://doi.org/10.3390/ijerph15020216>.
- Pedersen, T., Friman, M., Kristensson, P., 2011. The role of predicted, on-line experienced and remembered satisfaction in current choice to use public transport services. *J. Retail. Consum. Serv.* 18, 471–475. <https://doi.org/10.1016/j.jretconser.2011.06.013>.
- Preisendorfer, P., 2001. Der öffentliche Personennahverkehr im Test: ein Monat gratis mit dem ÖPNV (Public Transport in the test. One month free public transport). *Verkehrswissenschaften* 145–158.
- Prochaska, J.O., DiClemente, C.C., Norcross, J.C., 1993. In search of how people change: applications to addictive behaviors. *Addict. Nurs. Netw.* 5, 2–16. <https://doi.org/10.3109/10884609309149692>.
- Riemsma, R.P., Pattenden, J., Bridle, C., Sowden, A.J., Mather, L., Watt, I.S., Walker, A., 2003. Systematic review of the effectiveness of stage based interventions to promote smoking cessation. *BMJ* 326, 1175–1177. <https://doi.org/10.1136/bmj.326.7400.1175>.
- Schwartz, S.H., 1977. Normative influences on altruism. *Adv. Exp. Soc. Psychol.* 10, 221–279. [https://doi.org/10.1016/S0065-2601\(08\)60358-5](https://doi.org/10.1016/S0065-2601(08)60358-5).
- Sheppard, B.H., Hartwick, J., Warshaw, P.R., 1988. The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *J. Consum. Res.* 15 (3), 325–343.
- Sinelnikov, S., Wells, B.M., 2017. Distracted driving on the job: application of a modified stages of change model. *Saf. Sci.* 94, 161–170. <https://doi.org/10.1016/j.ssci.2017.01.007>.
- Skarin, F., Olsson, L.E., Roos, I., Friman, M., 2017. The household as an instrumental and affective trigger in intervention programs for travel behavior change. *Travel Behav. Soc.* 6, 83–89. <https://doi.org/10.1016/j.tbs.2016.08.001>.
- Smith, J.R., Louis, W.R., Terry, D.J., Greenaway, K.H., Clarke, M.R., Cheng, X., 2012. Congruent or conflicted? The impact of injunctive and descriptive norms on environmental intentions. *J. Environ. Psychol.* 32, 353–361. <https://doi.org/10.1016/j.jenvp.2012.06.001>.
- Steinmetz, H., Knappstein, M., Ajzen, I., Schmidt, P., Kabst, R., 2016. How effective are behavior change interventions based on the theory of planned behavior? *Z. für Psychol.* 224, 216–233.
- Taniguchi, A., Gräas, C., Friman, M., 2014. Satisfaction with travel, goal achievement, and voluntary behavioral change. *Transport. Res. F Traffic Psychol. Behav.* 26, 10–17. <https://doi.org/10.1016/j.trf.2014.06.004>.
- Thøgersen, J., 2009. Promoting public transport as a subscription service: effects of a free month travel card. *Transport Pol.* 16, 335–343. <https://doi.org/10.1016/j.tranpol.2009.10.008>.
- Thøgersen, J., Möller, B., 2008. Breaking car use habits: the effectiveness of a free one-month travelcard. *Transportation* 35, 329–345. <https://doi.org/10.1007/s11116-008-9160-1>.
- West, R., 2005. Time for a change: putting the transtheoretical (stages of change) model to rest. *Addiction* 100, 1036–1039. <https://doi.org/10.1111/j.1360-0443.2005.01139.x>.
- Wong, K.K.-K., 2013. Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. *Mark. Bull.* 24, 1–32.