

Interrupting habitual car use: The importance of car habit strength and moral motivation for personal car use reduction

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Received 30 November 2006; received in revised form 21 May 2007; accepted 22 May 2007

Abstract

In this study, habitual car use was interrupted by means of an intervention attempting to induce a deliberate consideration to reduce personal car use and forming implementation intentions for the planned changes in travel behavior. The importance of car habit strength and of moral motivation for reducing car use was analyzed. The study was conducted as a field experiment where 71 car users were recruited to either an experimental group or a control group. All participants reported car habit strength and moral motivation to reduce car use (i.e. personal norm) by means of a questionnaire, and recorded car use by means of weekly car diaries pre- and post-intervention. Results demonstrate that the intervention did make the choice of travel mode more deliberate since the association between car use and car habit strength were weakened while the relation between car use and personal norm were strengthened after compared to before the intervention. Moreover, as a result of the intervention car users with a strong car habit and a strong personal norm were found to be more likely to reduce car use as compared to those with a weak car habit and a weak personal norm. Hence, a reduction in car use may be facilitated by interrupting habitual car use, specifically if the car user has a strong car habit and a strong moral motivation to reduce personal car use.

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Keywords: Car habit; Moral motivation; Car use reduction

1. Introduction

Car use is important for many households' activity patterns in western societies. Households use their car to travel to various activities, for instance work, shopping, public services, and leisure activities. However, personal car use has obvious negative effects, such as the use of non-renewable fuel, pollution, noise, and congestion. Even though improved technical solutions and the use of renewable fuel may reduce some of these

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problems, the demand for car use needs to be diminished (see e.g., Gärling, Gärling, & Loukopoulos, 2002). Hence, despite the gains individuals derive from using the car a reduction in personal car use may be essential for a more pro-environmental travel behavior.

In many attempts to influence travel behavior, the aim has been to influence the individuals' deliberate travel mode choice (e.g., Bamberg & Schmidt, 2001; Tertoolen, van Kreveld, & Verstraten, 1998). However, in several studies habitual car use has been demonstrated (see e.g., Gärling & Axhausen, 2003; Verplanken, Aarts, van Knippenberg, & Moonen, 1998; Verplanken, Aarts, van Knippenberg, & van Knippenberg, 1994). Consequently, the deliberate consideration of different travel options prior to using the car may be limited and the interventions aiming to influence deliberate processes may not be effective. Since a prerequisite for a reduction in car use is deliberation of how this reduction may be achieved, a strong car use habit is a barrier for a behavioral change. Thus, the habitual car use needs to be interrupted and the travel mode choice made in a deliberate fashion. However, in order for a change to be implemented the car user needs to be motivated to reduce car use. In this study, the reduction of car use as a result of an intervention aiming to make the travel mode choice more deliberate was examined. In particular, we investigated the importance of car habit strength and moral motivation for a personal car use reduction.

1.1. Deliberate and habitual travel mode choice

Travel mode choice is determined by several factors, for example contextual factors (e.g., available travel modes), the individual's abilities and constraints (e.g., car ownership), and various psychological factors (e.g., evaluations and motives) (Thøgersen, 2006; see also Van Raaij, 2002). From a psychological perspective, travel mode choice may be perceived as either a deliberate process, or originating from behavioral habits (see e.g., Gärling & Axhausen, 2003; Verplanken et al., 1994). A deliberate process preceding behavior has been conceptualized in different ways. According to the theory of planned behavior (TPB) (Ajzen, 1991), travel mode choice is determined by attitude, subjective norm, perceived behavioral control, and intention (see e.g., Bamberg & Schmidt, 2001; Bamberg & Schmidt, 2003). Hence, the motivation to use a particular travel mode, captured by the intention, is essential for a deliberate travel mode choice. Highlighting moral aspects (cf. Schwartz, 1977), the value-belief-norm (VBN) theory of environmentalism (Stern, Dietz, Abel, Guagnano, & Kalof, 1999; see also Stern, 2000) explains pro-environmental behaviors. The VBN theory stipulates that values (e.g., altruistic values) and environmental beliefs (i.e., awareness of the behavior's negative effects on the environment and ascribing the responsibility to act to oneself) activate a personal norm to act pro-environmentally (i.e., feelings of moral obligation to act). In turn, personal norm generates a readiness to act pro-environmentally, for instance a willingness to reduce car use (e.g., Nordlund & Garvill, 2003). Thus, according to the VBN theory, the moral motivation activated by values and environmental beliefs is important for a car use reduction.

On the other hand, travel mode choice may also be determined by habits (e.g., Bamberg & Schmidt, 2003). If the outcomes of using the car are perceived to be rewarding (e.g., a comfortable and fast way to travel), the development of a car use habit is facilitated by the frequent use in a stable context (see e.g., Verplanken & Aarts, 1999). Habit has been perceived as an automatic link between a goal and a specific behavior (Aarts & Dijksterhuis, 2000; Verplanken & Aarts, 1999) or as a behavioral script stored in memory (Fujii & Gärling, 2003; Gärling, Fujii, & Boe, 2001). Habitual behavior, in contrast to more deliberately controlled behavior, demands only a small amount of attention, and the individual's control over behavioral intention as well as the behavior itself is minor (see e.g., Bargh, 1994). A strong habit to use a particular travel mode is, in comparison with a weak habit, characterized by seeking less information and a less elaborate choice of travel mode (Aarts, Verplanken, & van Knippenberg, 1997; Verplanken, Aarts, & Van Knippenberg, 1997). When predicting behavior, habit has been proposed to interact with intention (Triandis, 1980). Hence, when a travel mode habit is strong the influence of intention on behavior is weaker and vice versa (Staats, Harland, & Wilke, 2004; Verplanken et al., 1998). Similarly, an interaction between habit and attitude has been demonstrated (Verplanken et al., 1994) and interactions have been found between habit and personal as well as social norms (Klöckner & Matthies, 2004; Klöckner, Matthies, & Hunecke, 2003). According to this view of habit, a strong habit is perceived to block the more deliberate processing prior to behavior. Before a habit is developed, travel behavior is likely to be in line with intentions and personal norms. However, when a strong car habit has been

established a strengthened motivation to reduce car use (e.g., following an increased awareness of the problems associated with car use) will not influence travel behavior since the individual act in accordance with their habit not their motivation. Hence, a strong car habit may be a barrier for reducing car use.

1.2. Interrupting habitual car use

A reduction in car use may be facilitated by interrupting habitual car use (see e.g., Fujii & Kitamura, 2003; Garvill, Marell, & Nordlund, 2003). Different strategies have been employed in the attempts to interrupt habits. According to one approach, changes in the context are expected to hinder habitual responses to situational cues since behavioral habits are connected to the situation in which they are carried out (see e.g., Wood, Tam, & Guerrero Witt, 2005). Indeed, several studies indicate that contextual changes (e.g., economic incentives such as prepaid bus tickets, alterations of the physical environment) may influence attitude, intention, habit, and/or travel behavior (Bamberg, Ajzen, & Schmidt, 2003; Bamberg, Rölle, & Weber, 2003; Bamberg & Schmidt, 1999, 2001; Brown, Werner, & Kim, 2003; Fujii & Kitamura, 2003; Matthies, Klöckner, & Preissner, 2006).

Another approach intends to induce a deliberate process prior to behavior. In some studies of travel behavior, a general deliberation intervention with the aim to make the car users consider various features of their trips (e.g., length, amount of baggage, and weather conditions) has been applied (see e.g., Garvill et al., 2003; Verplanken et al., 1998). In other studies (see e.g., Bamberg, 2000; Fujii & Taniguchi, 2005), car users were asked to make a detailed plan for a new travel behavior. To decide where, when, and how a new travel behavior will be performed, forming a so-called implementation intention (Gollwitzer, 1993), generally increases intention-behavior consistency (Gillholm, Ettema, Selart, & Gärling, 1999) and facilitates the implementation of behavior (see e.g., Aarts, Dijksterhuis, & Midden, 1999; Bamberg, 2000; Sheeran & Orbell, 1999; Verplanken & Faes, 1999). In addition to intellectual benefits, such as deciding on a strategy to use in order to reach a goal, planning has been showed to have volitional benefits, for example helping to control and maintain a behavior (Diefendorff & Lord, 2003; see also Gollwitzer, 1996). Nevertheless, studies show that the individual needs to be motivated (e.g., have a strong goal intention) if the implementation intentions are to facilitate goal attainment (Sheeran, Webb, & Gollwitzer, 2005).

In relation to travel mode choice, planning a behavioral change or deliberately evaluating own travel behavior have been found to interrupt habitual travel mode use. In a study of a new bus route, habit had a significant negative effect on behavioral enactment only among those who did not form an implementation intention (Bamberg, 2000). Furthermore, Verplanken et al. (1998) found that both habit and intention were significant predictors of car use among car users who were encouraged to deliberately think about their travel mode choice, while only habit was a significant predictor of car use in the control group. Even though these deliberation interventions seem to be successful in facilitating a deliberate choice, results are mixed concerning the effect of the intervention on travel behavior. There are studies where the intervention was found to influence car use (e.g., Fujii & Taniguchi, 2005), while in other studies no significant effect was found (see Verplanken et al., 1998). However, results by Garvill et al. (2003) demonstrate a need to consider habit strength when effects of the intervention are interpreted. In that study, individuals with a strong car use habit, but not those with a weak habit, reduced their car use as a result of deliberate processing.

1.3. Motivation to reduce car use

Even though interrupting habitual car use increases the influence of deliberate processes on travel behavior (Verplanken et al., 1998; see also Dahlstrand & Biel, 1997; Wood et al., 2005), a change in travel behavior is still not certain since the deliberate travel mode choice may be to continue using the car. If for example, the individual lack the motivation to reduce car use, then changes in travel behavior are not to be expected. According to Gärling, Eek et al. (2002) both contextual changes (e.g., economic incentives, changes in the physical environment) and individual factors (e.g., background characteristics, attitudes) are important for setting a car use reduction goal. Hence, both external and internal factors are important for motivation (see Jakobsson, 2004b). Jakobsson, Fujii, and Gärling (2002) examined the effects of an external motivator – an economic disincentive – and a planning intervention on car use. A weak reduction in car use was found

as a result of the economic disincentive although primarily if the reduction was planned. In another study, [Matthies et al. \(2006\)](#) combined a free ticket for public transport in order to interrupt the car habit and a personal commitment to encourage the individual to try using public transport. Even though the effects on behavior were small, the combination of free-ticket and commitment was most effective in a long-term perspective. The free-ticket appeared to interrupt the habitual car use, and among individuals with a personal norm to reduce car use the personal commitment was effective. Thus, motivational factors are important to consider when the travel mode habit has been interrupted.

1.4. The present study

In previous studies, habitual car use has been interrupted by contextual changes and the motivation to change travel behavior encouraged by external interventions (e.g., financially or through a commitment strategy). However, interrupting habitual car use by means of a deliberation intervention and examining effects of moral motivation (without external endorsement) has not been carried out. The present study was conducted as a field experiment and participating car users were assigned to an experimental group or to a control group. An intervention with the aim to induce a deliberate consideration of future car use and the formation of implementation intentions was applied in the experimental group. The aim with the intervention was to hinder habitual car use choice and to facilitate a reduced car use. We wanted to study the effects of car habit strength and moral motivation to reduce car use (i.e., personal norm) on car use.

First, we examined if the intervention made the travel mode choice more deliberate. A strong relationship between habit and behavior has previously been reported, and has been interpreted as indicative of habitual behavior (e.g., [Verplanken et al., 1994](#)). In addition, a strong correlation between intention and behavior has been taken as support for a deliberate decision (e.g., [Verplanken et al., 1998](#)) since the behavior then corresponds to factors important for a deliberate processing (e.g., in accordance with the TPB). In the VBN theory, personal norm is essential for a deliberate environmentally significant decision. Since the intervention in this study aims to make the travel mode decision more deliberate, we expected the correlation between car habit strength and car use to decrease and the correlation between personal norm and car use to increase after the intervention in the experimental group.

Second, we examined the extent to which the intervention caused the car habit strength and personal norm to change. Since habits are presumably formed during an extended period of time (see e.g., [Verplanken & Aarts, 1999](#)), the habitual behavior has to be avoided repeatedly in order for the habit strength to be weakened. The present study focus on behavioral change shortly after an intervention, hence even if the travel mode choice becomes more deliberate as a result of the intervention no change in the strength of car habit was expected. In addition, the main focus of the intervention was on intellectual and volitional support, not enhancing internal motivation (e.g., to strengthen the personal norm). Hence, no effect of the intervention on personal norm was anticipated.

Third, the effect of the intervention on car use was evaluated. Based on the reasoning that changes in habitual travel behavior require the habit to be interrupted and the car user to be motivated to change travel behavior, we included both car habit strength and moral motivation in the analyses. Since individuals with a weak car habit make deliberate travel mode decisions even before the intervention (see [Garvill et al., 2003](#)), mainly individuals with a strong car use habit should be influenced by the intervention. Car users with a strong car habit may have a hidden potential to reduce car use (e.g., some of the car trips may not be entirely necessary), and deliberately thinking about mode choice may accentuate the perceived possibilities to change. In addition, it is likely that car users who are more motivated will change their travel behavior following the intervention to a larger extent as compared to those who are less motivated. A moral motivation may be expressed as a personal norm to reduce car use and previously, [Matthies et al. \(2006\)](#) found that a strong personal norm enhanced the effect of a commitment to change travel behavior. Hence, we expected the three-way interaction between intervention, habit, and personal norm to be significant since a strong car habit and a strong personal norm should be associated with a larger reduction in car use in the experimental group. In sum, the following hypotheses were examined: (1) the intervention will weaken the association between car habit strength and car use as well as strengthen the association between personal norm and car use, (2) the intervention will not influence car habit strength and personal norm to reduce car use and

(3) the intervention will reduce car use most for individuals with a strong car habit and a strong personal norm.

2. Method

2.1. Participants and design

The study was conducted as part of a field-experiment, where the possibilities for a voluntary reduction in car use was examined. A random sample of citizens was selected from the city centre of two municipalities in Sweden. The participants were contacted by phone and were randomly assigned to either an experimental group or a control group. The aim was to recruit car users who used their car mostly for personal rather than business trips. However, households with children 18 years of age or older with a driving license were excluded for practical reasons (e.g., to be able to gather all participants in the household for the home-visit). Consequently, the inclusion criteria were that: (1) at least one member of the household had a driving license, (2) there was at least one car in the household, (3) there were no children 18 years of age or older with a driving license in the household, (4) the car was used at least once a week for personal trips, and (5) the car was not used for business trips more than three times a week. The experimental group was told that the aim of the study was to investigate possibilities and barriers for reducing car use in households, while the control group was informed that the aim was to study car use in households. First, the respondents answered a few questions concerning background characteristics, and if all the inclusion criteria were met, the respondents then decided whether or not they wanted to participate in the study. Following the recruitment, a pre-intervention questionnaire was mailed to the participants, enclosing a gift voucher worth 50 SEK (approximately 6 US dollars). Subsequently, all participants filled in a car diary for one week, reflecting car use prior to the intervention. During the following week, an intervention where a research assistant made a home-visit to the participants in the experimental group was carried out. The participants were asked to fill in a prospective car diary for the next-coming week, and possibilities to reduce car use were discussed. The next week, when the experimental group had planned to make changes, a second car diary was filled in by both the experimental group and the control group reflecting car use after the intervention. Finally, a post-intervention questionnaire was mailed to the participants. Each week, approximately 10 households evenly distributed over the groups, were recruited, hence the study was ongoing for a period of 3½ month.

Out of 448 in the original sample, 410 were reached over the phone. In total, 300 of the contacted respondents were excluded, 241 because they did not want to answer any questions when they were contacted over the phone and 59 because they did not meet the inclusion criteria to participate or would not be at home during the data collection period. Of the remaining 110 households, 92 households agreed to participate (44 in the experimental group and 48 in the control group), and 71 households (33 in the experimental group and 38 in the control group) answered the pre-intervention questionnaire. During the study, a number of households dropped out for different reasons (e.g., the study was perceived to be too time-consuming, scheduling the home-visit in the experimental group was perceived to be difficult). In total, the experimental group consisted of 22 households at the end of the study and the control group consisted of 29 households (see Table 1).

The main concern was relations between individual variables (e.g., car habit and car use), hence individuals rather than households is the preferred unit of analysis. Since some participants live in the same household there is a risk of non-independence between individuals, thus increasing the risk of Type I or Type II errors (see Kenny, Kashy, & Bolger, 1998). However, an evaluation of the level of dependency between individuals

Table 1
Participating households in the experimental group and the control group

	Pre-intervention questionnaire	Pre-intervention car diary	Intervention	Post-intervention car diary	Post-intervention questionnaire
Experimental group	33	28	26	24	22
Control group	38	34	–	33	29
Total	71	62	26	57	51

showed that the intraclass correlations in this study were non-significant. Consequently, the following analyses are based on individuals rather than on households. In the experimental group, 5 households contained two participating car users and in 17 households only one participated, leaving 27 individuals in the experimental group. In the control group, approximately half of the households contained two participants and the remaining half included one participant (15 and 14 households, respectively), leaving 44 individuals in the control group. In order to examine the attrition, comparisons were made between the 26 individuals answering the pre-intervention questionnaire but later dropped out and the 71 individuals completing the study. A χ^2 -test showed no significant difference in gender distribution between the two groups and *t*-tests indicated no differences concerning age, household income, annual driving distance, personal norm, or car habit strength ($p > .05$).

2.2. Measures

Background characteristics. Participants in both the experimental and control groups answered questions about background characteristics in the pre-intervention questionnaire. The respondents' gender, age, education level, employment status, number of children living at home, household income, and the participants' driving distance were recorded.

Personal norm and car habit strength. In both the pre- and post-intervention questionnaires, personal norm to reduce car use and car habit strength were measured. Personal norm was measured by one statement "I feel morally obliged to reduce my car use in order to decrease the negative effects on the environment" evaluated on a five-point scale (1 = strongly disagree, 5 = strongly agree). The use of only one indicator of personal norm may result in reduced reliability; however this is a common measure of personal norm used in several studies (e.g., Klöckner et al., 2003; Nordlund & Garvill, 2003). Since habitual behaviors are characterized by a lack of awareness, the measurement of habit has inherent difficulties (see e.g., Ajzen, 2002; Verplanken et al., 1994). In the past, several different measures of habit have been used, for example past behavior frequency (e.g., Bamberg, 2000), Likert-type statements about to what extent a behavior is perceived to be habitual (e.g., Staats et al., 2004), the response frequency (RF) measure of habit (Verplanken et al., 1994; see also Bamberg, Rölle et al., 2003; Fujii & Kitamura, 2003; Verplanken et al., 1998), and the self-report index of habit strength (SRHI) (Verplanken & Orbell, 2003). Since we wanted a measure of habit suitable for self-administration and with good reliability (see Verplanken, Myrbakk, & Rudi, 2005), a Swedish version of the SRHI was used to measure car habit strength in this study. As part of the SRHI, 12 items reflecting past behavioral frequency, the automaticity of car use, and the identity component was included in the questionnaire and evaluated on a five-point scale (1 = strongly disagree, 5 = strongly agree) (see Appendix A). An index variable of car habit strength was calculated using the mean of the 12 items. The measure of habit strength had high internal consistency ($\alpha = .94$ in both the pre-intervention and in the post-intervention questionnaires) and the test-retest reliability was high ($r = .89$). Before the intervention, car habit strength was significantly correlated with car use recorded in the pre-intervention car diary (number of car trips as driver $r = .40$, $p = .01$ and number of car trips as driver and passenger $r = .32$, $p = .01$), indicating that more frequent car use is associated with a stronger car habit.

Car use. Identical car diaries were filled in by the experimental and control groups both before and after the intervention. For each car trip, the starting point, trip purpose, car driver, passengers, trip destination, estimated trip time (min), and estimated trip length (km) were recorded. In this study, the number of car trips as driver and the total number of car trips (as driver and as passenger) during one week pre-intervention and one week post-intervention was used as measures of car use.

2.3. The intervention

The aim of the intervention in the experimental group was to make participants consider possibilities to reduce car use and to form implementation intentions for a changed travel behavior (see Gollwitzer, 1993), if a change was perceived to be feasible. During the home-visit by a research assistant, the participants first filled in a prospective car diary containing all the car trips they planned to perform the following week. Second, a list of different car reducing strategies (e.g., changing travel mode, changing destination, cancel trips,

trip chaining, car-pooling) was presented and for each car trip the participants had to decide whether they were willing to reduce car use on that particular trip or not. If they chose to modify the car trip they were asked to indicate the strategy they planned to use and make a note of the changes in the prospective car diary. For car trips where no change was planned, participants were required to give a reason to why they believed car use could not be reduced. The prospective car diary was left with the participants, and they were encouraged to check which changes they had planned during the forthcoming week. Since a large amount of car trips are not planned in advance (see e.g., Jakobsson, 2004a), possibilities to reduce car use on spontaneous trips were also discussed.

3. Results

3.1. Comparisons between the experimental group and the control group pre-intervention

Table 2 presents sample descriptives for the experimental group and the control group. Comparisons between the two groups demonstrated no significant differences concerning gender distribution (χ^2 (1, $N = 71$) = 0.27, $p = .60$), age ($t(66) = 0.02$, $p = .99$), education level (χ^2 (3, $N = 70$) = 4.32, $p = .12$), employment status (χ^2 (2, $N = 65$) = 0.18, $p = .91$), households with children living at home (χ^2 (1, $N = 70$) = 0.87, $p = .35$), household income ($t(55) = 0.41$, $p = .68$), or driving distance ($t(62) = -0.08$, $p = .93$).

The means and standard deviations for personal norm to reduce car use, car habit strength, and car use before the intervention are displayed in Table 3. The respondents had a rather weak personal norm to reduce car use and, overall, their car habit was not particularly strong. In addition, the average number of car trips as driver and as passenger was equivalent in the experimental and control groups. Independent sample t -tests showed no significant differences between the experimental and control groups concerning personal norm ($t(68) = 0.62$, $p = .54$), car habit strength ($t(69) = -1.12$, $p = .27$), and car use (number of car trips as a driver: $t(69) = 0.02$, $p = .99$, number of car trips as a passenger: $t(49) = 0.05$, $p = .96$, total number of car trips: $t(69) = 0.18$, $p = .86$) prior to the intervention.

Table 2
Sample descriptives for the experimental group and the control group

	Experimental group	Control group
Gender distribution	52% woman	46% woman
Mean age	53 years	53 years
Education level	26% high school, 26% university	40% high school, 35% university
Employment status	63% working, 7% unemployed or parental leave, 15% retired/disability pension	66% working, 8% unemployed or parental leave, 20% retired/disability pension
Children living at home	22%	33%
Household's median income/month	33,600 SEK	40,000 SEK
Individuals mean driving distance/year	10,650 km (SD 8220)	10,500 km (SD 6270)

Table 3
Means and standard deviations for personal norm to reduce car use, car habit strength, car use as driver, and car use as passenger in the experimental group and the control group pre-intervention

	Experimental group	Control group
Personal norm to reduce car use ^a	2.73 (1.08)	2.89 (0.97)
Car habit strength (SRHI) ^a	2.87 (1.39)	2.57 (0.91)
Number of trips as car driver	14.6 (10.6)	14.6 (9.3)
Number of trips as passenger	2.2 (3.9)	2.2 (4.2)

^a Scales 1–5 (1 = strongly disagree, 5 = strongly agree).

3.2. Effects of the intervention

Since we wanted to examine the relation between car use and deliberate versus habitual processes before and after the intervention, personal norm and car habit strength (measured pre-intervention) were correlated with car use pre- and post-intervention (see Table 4). In order to test whether the correlation coefficients in the experimental and control groups differed from each other the correlations were transformed into Fisher's z -score and compared. In addition, the strengths of the correlations were examined. Before the intervention, there were no significant differences in the correlations between car habit strength and car use in the two groups (car habit strength and car use as driver: $z = 0.80$, $p = .22$, car habit strength and total car use: $z = 0.79$, $p = .22$). Even though the correlations between personal norm and car use was close to significantly different in the two groups ($p < .10$) (personal norm and car use as driver: $z = 1.53$, $p = .06$, personal norm and total car use: $z = 1.34$, $p = .09$), the correlations between personal norm and car use were not significant in either of the groups before the intervention. Hence, the strength of the correlations are in line with hypothesis 1 since car use was more strongly correlated with car habit strength than with personal norm in both the experimental group and the control group prior to the intervention. Moreover, hypothesis 1 states that the association between car habit strength and car use should become weaker while personal norm and car use should be more strongly correlated after the intervention as compared to before the intervention. The results showed that the correlations between car habit strength and car use were not significantly different in the two groups (car habit strength and car use as driver: $z = 0.09$, $p = .46$, car habit strength and total car use: $z = 0.17$, $p = .43$), while personal norm was more strongly associated with car use in the experimental group as compared to the control group (personal norm and car use as driver: $z = 2.88$, $p = .01$, personal norm and total car use: $z = 2.87$, $p = .01$). Even though there were no significant differences in correlations between car habit strength and car use in the two groups after the intervention, the strength of the correlation was reduced to a level of non-significance in the experimental group. Furthermore, personal norm was significantly correlated with car use in the experimental group after the intervention. Hence, as a result of the intervention, personal norm and not car habit strength was more strongly associated with car use.

The second hypothesis stipulates that the intervention should not influence car habit strength and personal norm to reduce car use. In the experimental group, the means for car habit strength was 2.87 (SD = 1.39) pre-intervention and 2.97 (SD = 1.34) post-intervention and in the control group 2.57 (SD = 0.91) pre-intervention and 2.59 (SD = 0.92) post-intervention. The effect of the intervention on car habit strength was evaluated by an ANCOVA with intervention (intervention versus no intervention) as factor, car habit strength measured post-intervention as dependent variable, and the pre-intervention measure entered as a covariate. The results showed no significant changes in car habit strength as a result of the intervention ($F(1, 65) = 0.02$, $p = .89$). In the experimental group, the means for personal norm was 2.73 (SD = 1.08) pre-intervention and 3.18 (SD = 1.18) post-intervention and in the control group 2.89 (SD = 0.97) pre-intervention and 2.93

Table 4

Correlations between car habit strength and car use and between personal norm and car use in the experimental group and in the control group pre- and post intervention

	Experimental group		Control group	
	Car use pre-intervention	Car use post-intervention	Car use pre-intervention	Car use post-intervention
<i>Car habit strength</i>				
Number of trips as a car driver	.49**	.33	.32*	.31*
Total number of car trips	.42*	.24	.24	.28
<i>Personal norm</i>				
Number of trips as a car driver	-.27	-.45*	.12	.25
Total number of car trips	-.22	-.43*	.12	.27

* $p < .05$.

** $p < .01$.

(SD = 1.18) post-intervention. An ANCOVA with intervention (intervention versus no intervention) as factor, personal norm measured post-intervention as dependent variable, and the pre-intervention measure entered as a covariate was performed. No significant effect of the intervention on personal norm was found ($F(1,62) = 1.75$, $p = .19$). Hence, as expected, the intervention did not significantly influence the car habit strength and the personal norm.

When effects of the intervention on car use as a driver and total car use were analyzed, the importance of car habit strength and personal norm were evaluated. A regression model where car use was modeled as a function of the intervention, car habit strength, and personal norm was created. The model contained three main effects (intervention, car habit strength, and personal norm), two two-way interactions (intervention \times car habit strength, intervention \times personal norm), and one three-way interaction (intervention \times car habit strength \times personal norm). Since we wanted to examine whether car use changed as a result of the intervention, two measures of the differences between car use before and after the intervention were used as dependent variables (see e.g., Wright (2006) for a discussion of the use of change scores). In the first regression analysis, the change in number of car trips as driver was examined and the second analysis evaluated the change in total number of car trips. As recommended by for example Cohen, Cohen, West, and Aiken (2003), the predictors were centered. Table 5 shows the results of the regression analyses.

According to our third hypothesis, we expected individuals with a strong car habit and a strong personal norm to reduce car use most as a result of the intervention. As anticipated, the analysis of number of car trips as driver showed that neither the main effects nor the two-way interactions were significant. In line with our hypothesis, the three-way interaction between the intervention, car habit strength, and personal norm was significant. The regression analysis was close to significant ($p = .09$) and R^2 was .16. Comparable results were found for total number of car trips. The main effects were not significant, while the interactions between intervention and car habit and between intervention and personal norm were close to significant ($p = .09$). In addition, as hypothesized, the three-way interaction between the intervention, personal norm, and car habit was significant. The overall test of the regression analysis was significant ($p = .05$) and R^2 was .18. In order to interpret the three-way interactions, simple regression slopes were calculated. Two levels of car habit strength (weak versus strong) and personal norm (weak versus strong) were estimated at one standard deviation above the mean and one standard deviation below the mean (see e.g., Aiken & West, 1991). Fig. 1 shows the three-way interactions for both car use as driver and total car use. Hence, specifically individuals with a strong car habit and a strong personal norm reduced their car use as a result of the intervention.

Table 5

Regression analyses predicting car use as driver and total car use from intervention, car habit strength, and personal norm

	<i>B</i>	SE	β
<i>Car use as driver</i>			
Intervention	−1.05	1.71	−.08
Car habit strength	−0.67	1.10	−.11
Personal norm	0.86	1.03	.13
Intervention \times car habit strength	−2.00	1.60	−.24
Intervention \times personal norm	−2.83	1.77	−.27
Intervention \times car habit strength \times personal norm	−2.05	0.99	−.31*
<i>Total car use</i>			
Intervention	−1.59	1.69	−.11
Car habit strength	−0.10	1.10	−.02
Personal norm	0.90	1.03	.13
Intervention \times car habit strength	−2.95	1.56	−.36‡
Intervention \times personal norm	−2.94	1.72	−.28‡
Intervention \times car habit strength \times personal norm	−2.19	0.93	−.33*

Note. All predictors were entered into the regression models simultaneously. R^2 ($N = 71$) = .16 for car use as driver and .18 for total car use.

‡ $p < .09$.

* $p < .05$.

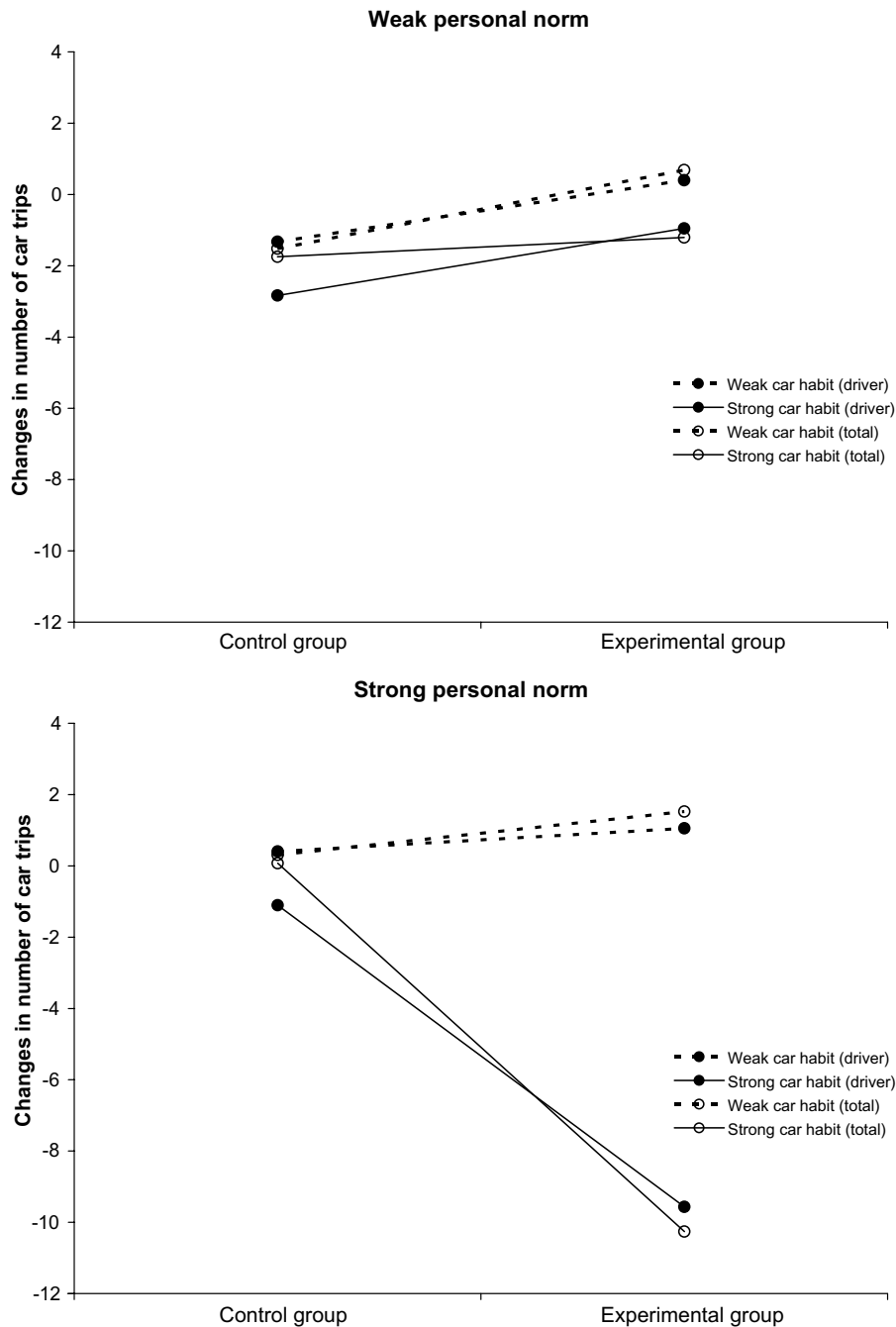


Fig. 1. The three-way interaction: changes in number of car trips as driver and total car use as a function of intervention, car habit strength, and personal norm. Upper panel: weak personal norm. Lower panel: strong personal norm.

4. Discussion

In this study, we applied an intervention with the aim to induce deliberate consideration to reduce personal car use and forming implementation intentions for the planned changes. The intervention aimed to interrupt habitual car use and we examined the effects of car habit strength and moral motivation on personal car use.

To measure car habit strength we used an independent measure, the SRHI, which had a good internal reliability and corresponded to frequency of car use (see also Verplanken & Orbell, 2003; Verplanken et al., 2005).

Based on the reasoning that habit and deliberate processes interact in predicting behavior (Triandis, 1980; see also Klöckner & Matthies, 2004; Klöckner et al., 2003), the results from this study indicate that the intervention made the travel mode choice more deliberate since the association between car habit and car use became non-significant after the intervention while the relation between personal norm and car use became significant. Hence, the car habit may have blocked the personal norm from influencing travel mode choices and it was only after a deliberate consideration the choice was influenced by the personal norm. The intervention may have made the norm-activation process, as stipulated by, for example the VBN theory, possible by unblocking the effect of the car habit (see the model proposed by Klöckner & Matthies, 2004). In previous studies of deliberation interventions the habitual behavior was not interrupted, instead intentions influenced behavior in addition to the established habit (Verplanken et al., 1998; see also Verplanken & Faes, 1999). This study demonstrates the interruption of a behavioral habit by means of a deliberation intervention.

The influence of the intervention on car habit strength and personal norm was examined. As expected, car habit strength was not influenced by the intervention. Since a changed travel behavior, with less car use, must presumably continue for an extended period of time before the strength of the car habit is weakened it is reasonable for the car habit strength to remain unchanged throughout the present study. Hence, it is possible to deliberately consider the travel mode choice while at the same time maintain a tendency to act in accordance with the old habit. Furthermore, personal norm was not influenced by the intervention. Since considering a change and planning a new behavior should not influence the motivation to change a behavior (see e.g., Sheeran et al., 2005), the rather stable personal norm was anticipated.

A main objective of the present study was to examine the effects of the intervention on car use. In line with previous studies (e.g., Garvill et al., 2003; Verplanken et al., 1998), no main effect of the intervention on car use was found. Since the intervention was designed to encourage a deliberate choice of travel mode and interrupt habitual car use, the aim of the intervention was to mainly influence individuals with a strong car habit. In addition, we expected a moral motivation to be important for a car use reduction. As predicted, the three-way interaction between intervention, car habit, and personal norm was significant for car use as a driver and for total car use. Hence, a larger reduction in car use as a result of the intervention was found among those with both a strong car habit and a strong personal norm (see Fig. 1). Presumably, individuals with a strong car habit became aware of unknown possibilities to reduce car use during the intervention. Hence, comparable to the results reported by Garvill et al. (2003), the present study further supports the need to measure and analyze habit strength when evaluating interventions aiming to break habitual car use. Previously, Matthies et al. (2006) demonstrated that a personal norm enhanced the effect of a personal commitment intervention. Notably, the intervention in the present study lacked a strategy influencing motivation and the personal norm remained unchanged. Hence, extending the results presented by Matthies et al. we found that the personal norm was important for a car use reduction even without specifically targeting the motivation. Within an intention-behavior relationship (e.g., the TPB), planning may be perceived as an aid in the transformation of the behavioral intention into a behavior (see Gärling & Fujii, 2002). The results from this study indicate that making plans for a new behavior may also facilitate the behavioral implementation of a personal norm. Once the habitual car use has been interrupted, the personal norm may serve as a motivation for a behavioral change and the implementation intentions provide strategies and help to overcome volitional problems.

Some limitations with the present study should be mentioned. The group of examined car users cannot be considered representative of car users in the examined municipalities. Even so, the experimental and control groups did not differ from each other which makes it possible to examine effects of the intervention on car use. In this study, we used only one item to assess personal norm which may be a less reliable measure compared to if several items are used. In order to improve reliability, a multi-item scale should be used to assess personal norm in future studies. Moreover, the study focuses on analyzing the effect of an existing moral motivation on car use. Obviously, car users may have other motives than a moral motivation for reducing car use, for example a wish to save money or to strive for a healthier lifestyle by using alternative travel modes (see e.g., Shannon et al., 2006). Furthermore, in order to effectively change travel behavior, interventions combining features intending to interrupt habitual car use with elements increasing the motivation to change travel behavior may be most effective. Since both contextual and individual factors influence the setting of a car use reduction goal

(Gärling, Eek et al., 2002), strategies such as external incentives and disincentives as well as informational and educational strategies may be used to enhance motivation to reduce car use. Notably, the findings in this study are limited to short-term effects of the intervention. When the aim is to change a behavior, it is not only important to interrupt a habit but also to establish a new behavior. Several models explaining behavior (e.g., the model of action phases (Gollwitzer, 1990; Heckhausen & Gollwitzer, 1987), control theory (Carver & Scheier, 1998)), and models specifically describing a behavioral change process (e.g., Dahlstrand & Biel, 1997) highlight the importance of evaluation after implementing a new behavior. For example, if a car user is to maintain the changed travel behavior, the change must be perceived to have positive consequences, that is, the behavior should correspond to the individual's goals. When the new travel behavior has been maintained for a period of time and the deliberate evaluation is no longer needed, it is likely that a pro-environmental travel habit has been established. Future studies should focus on both a behavioral change (e.g., trying a new behavior) and aspects important for maintaining a new behavior. Hence, there is a need for studies of long-term effects of behavioral interventions.

According to Stern (2000), attitudinal factors (including e.g., values, personal norm, attitudes), habits, personal resources, and contextual factors are important for environmentally significant behaviors. Thus, it is not surprising that car habit strength and an attitudinal factor such as moral motivation, analyzed in this study, explained only a small amount of the variance in reduced car use. Other factors are undoubtedly important for changes in travel behavior. For a car use reduction to occur, personal resources for instance the time and knowledge to change travel behavior as well as contextual factors such as the availability of alternative travel modes, supporting social norms and policy strategies sustaining such a shift may be crucial.

Acknowledgements

This research was carried out within the research program SHARP (Sustainable Households: Resources, Attitudes and Policy) funded by the Swedish Environmental Protection Agency. The study was administered at the Transportation Research Unit, Umeå University. We thank Fredrik Gärling for supervising the process, and Kerstin Albertsson Bränn and BrittInger Sjökvist for conducting the home-visits. In addition, we are very grateful for the comments on earlier drafts of this paper from John Thøgersen and two anonymous reviewers.

Appendix A. The self-report index of habit strength (SRHI) measuring car habit strength:

- Using the car is something I do frequently.
- Using the car is something I do automatically.
- Using the car is something I do without having to consciously remember.
- Not using the car is something that makes me feel weird.
- Not using the car is something that would require effort.
- Using the car is something that belongs to my everyday routine.
- Using the car is something I do without thinking.
- Using the car is something I do before I realize I'm doing it.
- Not using the car is something I would find hard.
- Using the car is something I have no need to think about doing.
- Using the car is something that's typically "me".
- Using the car is something I have been doing for a long time.

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