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The Influence of Descriptive Social Norm Information on Sustainable Transportation Behavior: A Field Experiment

Christine Kormos[1], Robert Gifford[1], and Erinn Brown[1]

Abstract

A month-long field experiment evaluated the impact of descriptive social norm information on self-reported reduction of private vehicle use. Following a baseline week, participants were asked to reduce their vehicle use by 25% and were randomly assigned to a control condition or to a low or high social norm condition in which they received information that either under- or over-reported others' successful efforts to switch to sustainable transportation. Results indicated a significant linear trend, such that messages highlighting more prevalent descriptive social norms increased sustainable transportation behavior (relative to private vehicle use) for commuting, but not non-commuting, purposes. Participants in the high social norm condition decreased their commuting-related private vehicle use by approximately five times, compared with baseline. Car-use message campaigns can reduce private vehicle use by highlighting descriptive norms about others' sustainable transportation efforts, but these messages appear to be most effective for commuting behavior.

[1]University of Victoria, British Columbia, Canada

Corresponding Author:
Christine Kormos, Department of Psychology, University of Victoria, P. O. Box 3050, Victoria, British Columbia, Canada, V8W 3P5.
Email: ckormos@uvic.ca

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The transportation sector accounts for 27% of greenhouse gas (GHG) emissions in the United States (Davis, Diegel, & Boundy, 2012), and passenger transportation comprises approximately 65% of this sector's GHG emissions (U.S. Environmental Protection Agency, 2012). GHGs from transportation are also on the rise in Canada, largely due to an increase in energy use for personal transportation (Environment Canada, 2012). Despite economic and environmental incentives to reduce personal vehicle use, emissions stemming from these vehicles have grown at a faster rate since 1990 than total domestic emissions (40% vs. 26%, respectively; Steenhof & McInnis, 2008).

Consequently, interventions designed to encourage a reduction in the use of personal passenger vehicles hold the potential to contribute to an overall reduction in GHG emissions. One approach is to develop message campaigns informed by psychological principles (e.g., Moser & Dilling, 2007; Nisbet & Mooney, 2007); however, research on which types of messages most effectively reduce personal vehicle use is limited. This field experiment expands knowledge in this area by evaluating the impact of divergent social norm information, specifically descriptive local norms, on individuals' willingness to reduce self-reported private vehicle use.

Defining Social Norm Beliefs

Social norms refer to an individual's beliefs about the typical and condoned behavior in a given situation (Deutsch & Gerard, 1955), and they can be divided into two main categories: *injunctive social norms*, which reflect individuals' beliefs about the accepted behavior in a particular situation (Reno, Cialdini, & Kallgren, 1993), and *descriptive social norms*, which reflect individuals' beliefs about how the majority of others typically behave in that situation (Cialdini, 1988). Within the category of descriptive social norms, a further distinction can be made between two subtypes. *Descriptive subjective norms* focus on the social influence of individuals perceived to be affectively important to the individual (e.g., relatives and friends), whereas *descriptive local norms* focus on the social influence of those who share the same social-physical context (e.g., neighbors or co-workers), regardless of their emotional connection to the individual (Carrus, Bonnes, Fornara, Passafaro, & Tronu, 2009; Fornara, Carrus, Passafaro, & Bonnes, 2011).

Across a variety of pro-environmental behaviors, individuals' descriptive social normative beliefs have been shown to be positively correlated with

their behaviors, as demonstrated, for example, with littering (Cialdini, Reno, & Kallgren, 1990) and recycling (Hornik, Cherian, Madansky, & Narayana, 1995; Nigbur, Lyons, & Uzzell, 2010). According to equity theory (Adams, 1965), individuals desire an equitable distribution of final outcomes. If they perceive that the individual costs of acting pro-environmentally are not being shared among other members of their group or society, individuals may not enact pro-environmental behavior due to their desire for equity, even if cooperation is the more rational choice (Fehr & Fischbacher, 2004). Thus, the norm of reciprocity in social dilemma situations may either encourage cooperation if individuals perceive that others are cooperative, or encourage defection if it is perceived that others are uncooperative (see Biel & Thøgersen, 2007).

Not surprisingly, several theoretical models, most notably the theory of planned behavior (TPB; Ajzen, 1991), include normative beliefs as an important determinant of pro-environmental behavior. Furthermore, the explanatory abilities of the TPB to predict pro-environmental behavior have been shown to be significantly increased through the inclusion of descriptive local norms (Carrus et al., 2009).

Social Norm Interventions

Given the demonstrated correlation between social normative beliefs and pro-environmental behavior, persuasive communication strategies using social norm information have gained popularity as a means of promoting pro-environmental behavior (Thøgersen, 2009). Several intervention studies have illustrated the usefulness of social norm feedback in eliciting pro-environmental behavior change. For example, residents who were informed that their neighbors had taken steps to curb energy consumption significantly reduced their household energy use (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). In addition, hotel patrons who received messages highlighting descriptive norms (i.e., that others at the hotel typically reused their towels) and injunctive norms (i.e., that reusing hotel towels is a "good" thing to do) significantly reduced the number of towels used, compared with a control condition (Schultz, Khazian, & Zaleski, 2008). The reuse of hotel towels has also been shown to increase when the normative message emphasizes a descriptive local norm, that is, the typical behavior of previous guests in that specific hotel room (Goldstein, Griskevicius, & Cialdini, 2007). Furthermore, descriptive local norms have been found to be positive, significant predictors of both intention to recycle within a neighborhood setting (Carrus et al., 2009; Fornara et al., 2011) and self-reported recycling behavior (Nigbur et al., 2010).

Fewer studies have explored the effectiveness of experimentally varying magnitudes of social normative messages in encouraging change to pro-environmental behavior. One study experimentally manipulated descriptive social norm strength to evaluate its influence on intention to cooperate in three behavioral domains, including recycling, buying organic food, and refraining from paying on the tram (Von Borgstede, Dahlstrand, & Biel, 1999). Participants received falsified descriptive norm information that (approximately) 20%, 50%, or 80% of previous participants in a survey cooperated in the scenario. Consistent with the existing literature, manipulated norm strength exerted a causal influence on behavioral intention, and a positive correlation was demonstrated between norm strength and behavioral intention to cooperate. The lack of a control group and the absence of a measure of behavior change (self-reported or objective) limit the extent to which causality and external validity can be inferred from these findings.

Although the foregoing suggests that descriptive local norms play a key role in promoting pro-environmental behaviors that occur in specific social-physical settings, other studies suggest the alternative, conflicting possibility of a paradoxical effect of social normative beliefs on transportation behavior. Sometimes a "boomerang effect" is found in which descriptive social normative beliefs are negatively related to behavioral intention (e.g., Perkins, Haines, & Rice, 2005). For example, those who expect others to drive less have been shown to express intentions to drive more, possibly because of a perceived reduction in anticipated congestion problems (Gardner & Abraham, 2010).

A contradiction appears to exist, therefore, between the results of studies demonstrating a "boomerang effect" (Gardner & Abraham, 2010; Perkins et al., 2005) and those of studies demonstrating a positive relationship between descriptive social norm exposure and intention to cooperate (e.g., Carrus et al., 2009; Fornara et al., 2011; Von Borgstede et al., 1999). Collectively, the incongruent nature of previous findings makes it difficult to predict the extent and degree to which social norm information will affect large-scale, high carbon-impact behaviors, such as private vehicle use.

Present Study

Little research has examined the usefulness of social norm marketing campaigns in eliciting change in private vehicle use. Furthermore, a dearth of related research has examined self-reported behavior or objective behavior (as opposed to behavioral intentions). In addition, what limited research exists has yielded contradictory results (e.g., Carrus et al., 2009; Fornara et al., 2011; Von Borgstede et al., 1999; cf. Gardner & Abraham, 2010; Perkins

et al., 2005). To address these gaps and contradictions, the present study used a longitudinal field experiment to evaluate the impact of divergent descriptive social norm information on individuals' willingness to reduce self-reported private vehicle use.

Hypothesis

Based on the majority of existing findings, we hypothesized that participants in the high social norm condition (i.e., who were told that many others had reduced their private vehicle use) would exhibit a greater reduction in private vehicle use than those in the control condition and low social norm condition (i.e., who were told that relatively few others had reduced their private vehicle use). That is, we expected that as the presentation of descriptive social norm information about others' sustainable transportation behavior increased, from non-existent to low to high, the amount of sustainable transportation use (relative to private vehicle use) would increase proportionately.

Method

Overview

A longitudinal field experiment was performed to examine the impact of divergent descriptive social norm information on individuals' willingness to reduce self-reported private vehicle use. A sample of university students, faculty, and staff members were all asked to reduce their private vehicle use by 25%. In an attempt to ensure that behavior change would occur, the intervention involved goal setting plus normative information; however, normative information (but not goal setting) was manipulated, and so it was the independent variable of interest.

Participants were randomly assigned either to a control group or to one of two experimental conditions. Those in the low and high descriptive local norm conditions received information that either under- or over-reported others' successful efforts at their university to switch to sustainable transportation. Participants recorded their daily transportation behavior for commuting and non-commuting purposes for three weeks, which was later compared with their baseline transportation behavior as a measure of change.

Participants

Seventy-eight participants were recruited from a mid-sized Canadian university and randomly assigned to control (n = 28), low social norm (n = 25), or

high social norm conditions ($n = 25$). To be eligible to participate, individuals had to be more than 18 years of age and possess a vehicle.[1]

Participants' ages ranged from 18 to 63 years ($M = 31.59$ years, $SD = 15.29$ years), and the sample consisted of 50 females and 31 males. Students comprised 56.79% of the participants and 43.21% were faculty or staff members. The majority of the participants (56.79%) reported living in a suburban neighborhood more than 2 km from the city's downtown core. Others lived in a suburban area within 2 km of the downtown core (24.69%), in the downtown core (9.88%), or in a rural neighborhood (7.41%). The majority of the participants had completed either some university (58.00%), graduate school (18.50%), had an undergraduate degree (16.00%), or had completed some graduate school or some college (2.50%).

Recruitment. Participant recruitment occurred through a variety of methods, depending on whether the prospective participant was a student or faculty/staff member. Student recruitment was conducted through the undergraduate Psychology Research Participation System, and those participants earned a 3.5% course bonus. Faculty and staff recruitment occurred by several methods: a recruitment email sent to department listservs, recruitment flyers posted in common areas, presentations at staff meetings, and personalized study invitation letters sent to faculty/staff members. As compensation for participating, faculty/staff had the option to enter their names into a lottery draw to win one of four prizes of CAD$100.

Participants were informed that the purpose of the study was to investigate perceived barriers to alternative transportation. Individuals with a broad range of transportation habits were encouraged to participate. Participants were informed that the study would involve a time commitment of less than five minutes a day for a month to record daily transport behavior in a journal and complete several quality of life surveys. Furthermore, individuals were informed that after a week, they would be asked to attempt to reduce their private vehicle use by choosing from a variety of alternative transportation options. They were instructed that they may reduce their private vehicle use by however much they like, ranging from a lot to a little, and that it would be all right if they were not able to achieve a substantial reduction in private vehicle use.

Procedure

Participants were given a package that contained the study instructions, the letter of information for implied consent, Transport Booklet 1, Transport Booklet 2, two self-addressed stamped envelopes, and a lottery information

form (in the case of faculty/staff members). On a specified date, participants read the letter of information and began to complete Transport Booklet 1. Following this baseline measure, they completed the questionnaire, which included the descriptive social norm and sociodemographic scales. At the beginning of Week 2, participants received an email reminder to mail Transport Booklet 1 to the researchers. They then began to complete Transport Booklet 2 in which they were presented with a condition-specific version of the information page (i.e., control, low social norm condition, or high social norm condition). At the beginning of Weeks 3 and 4, participants were sent additional reminder emails, and they subsequently completed the corresponding weekly transport record. At the end of Week 4, they were reminded to return Transport Booklet 2 by mail. Last, participants were fully debriefed about the social norm aspect of the study as well as the study's hypotheses, and were also provided with accurate descriptive norm information, to remove the deception.

Materials

Information page. In all three conditions, participants were presented with identical information about options for sustainable commuting (i.e., for public transportation, cycling, ridesharing, or carpooling), plus fictitious descriptive social norm information in the two experimental conditions. Those in the high social norm condition were informed that "Since 1993, 26% of commuters at [our university] have switched to more sustainable modes of transport to campus," whereas those in the low social norm condition were told that since that time, "only 4% of commuters at [our university]" have made the switch. (According to the university's statistics, actual private vehicle use commuting to campus decreased by 7% over that time frame, but participants did not receive this accurate information until debriefing.) Social norm information was absent in the control condition. The participants were then asked to "please make every attempt to reduce [their] single-occupant vehicle use over the next three weeks by however much [they could], with the goal of a 25% reduction."

Transport behavior measures. Daily transportation journals (adapted from Loukopoulos, Jakobsson, Gärling, Meland, & Fujii, 2006) were used to assess participants' behavior across the four weeks of the study. Participants were asked to indicate the number of private vehicle use trips and sustainable transport trips (i.e., via bus, carpool, rideshare, cycling, or walking), as well as the total amount of time they engaged in both types of trips, for each day of the study. In addition, participants specified whether these trips were for

commuting (i.e., school or work) or non-commuting purposes (i.e., shopping, leisure, and appointments). The only difference between the transport records was that the Week 1 record, which served as a baseline assessment of behavior, included a question about how typical their behavior during the previous week was of their usual behavior, from 1 (*not at all typical*) to 7 (*extremely typical*). Space was provided on each day of the journal for participants to include any comments. Week 1 was contained within Transport Booklet 1, and Weeks 2 to 4 were contained within Transport Booklet 2.

Descriptive social norm measure. A four-item measure of descriptive normative beliefs was created for this study. Participants were asked to estimate "What percent of students [do you] think engage in some form of sustainable commuting to campus (i.e., ride the bus, walk, bike, carpool, etc.) on a fairly regular basis," from 0% to 100%. Participants also estimated "What percent of students [do you] think commute to campus using single-occupant vehicle use on a fairly regular basis." The final two questions were identical, except that the word "students" was replaced with "staff." Participants were asked to ensure that their responses for these two items totaled 100% for both staff and students.

Sociodemographic measure. A questionnaire assessed participant demographics such as age, gender, occupation in terms of student versus faculty/staff, and the distance between their residences and campus.

Reminder emails. An email was sent to participants at the beginning of Week 2 to remind them to submit Transport Booklet 1. Emails were also sent to participants at the beginning of Weeks 3 and 4, which served several functions. First, participants were again reminded to submit their first booklet if they had not already done so. Second, to reinforce the discrepancy between the two experimental conditions, participants received condition-normative fictitious information about the behavior of previous participants in the study. Specifically, those in the low and high social norm conditions were informed that previous study participants reduced their private vehicle use by an average of 5% and 19%, respectively. Third, reminder emails also repeated the 25% reduction goal and reiterated sustainable transport options. A final email was sent to participants at the end of Week 4 as a reminder to submit Transport Booklet 2. In support of the value of this additional information, recent research has demonstrated a gradual, linear decay in normative estimates over a one-month period following a single exposure to a social norm communication (Nolan, 2011).

Pre-Analysis Variable Computations

Before conducting the hypothesis-testing analyses, variable indices were created and several other changes were made to the data set. First, descriptive normative estimates about the percentage of campus commuters who engage in sustainable transportation were averaged across staff and student values for each participant to obtain more generalized norm values. Second, two transportation indices were computed for each participant: one for commuting trip purposes and one for non-commuting trip purposes. For each index, the number of daily sustainable transport trips was subtracted from the number of daily private vehicle use trips, so that positive values represent more private vehicle use relative to sustainable transportation use and negative values represent more sustainable transportation use relative to private vehicle use. Average weekly values for each participant were then computed for commuting and non-commuting indices.[2] Last, weekly transport indices for commuting and non-commuting were then averaged to yield a total transportation index value for each participant for each week.

Results

Descriptives and Correlations

As part of basic data cleaning, values from the four weekly transportation measures in excess of 3.29 ($p < .001$) were Winsorized to reduce their impact (see Field, 2005). In addition, one participant from each condition neglected to submit his or her Transport Booklet 2, for an attrition rate of 3.70%.[3] Given the low overall percentage of missing data for the four transportation measures across the 28 observation days of the study (0.5%), a mean replacement was deemed appropriate, and so missing data for the four behavioral measures were replaced with the social norm condition mean for the day that the data were missing.

Following data cleaning, means and standard deviations were calculated for variables and weekly transportation indices (see Table 1). As indicated by the negative valence of all transportation indices in Table 1, participants generally engaged in sustainable transportation more frequently than private vehicle use. Furthermore, the weekly index values for commuting were more negative than for non-commuting for three of the four weeks. Thus, participants typically engaged in more sustainable transport use, relative to private vehicle use, for commuting than for non-commuting purposes.

Table 1. Descriptive Statistics for Week 1 (n = 78) and Week 4 (n = 78) Transportation Indices for Each Experimental Condition (Control, n = 28; Low, n = 25; High, n = 25) and for Normative Beliefs about Alternative Commuting.

	M	*SD*	Minimum	Maximum
Total transportation indices				
W1: Control	−.14	1.24	−3.00	2.33
W1: Low	.06	1.16	−2.55	1.60
W1: High	−.02	1.38	−1.80	4.94
W4: Control	−.26	1.01	−2.30	1.86
W4: Low	−.34	.85	−2.30	1.33
W4: High	−.54	.84	−1.90	1.70
Commuting trip purpose indices				
W1: Control	−.21	1.84	−4.10	3.46
W1: Low	.08	1.86	−4.50	3.72
W1: High	−.09	1.44	−2.40	4.23
W4: Control	−.39	1.51	−3.20	2.40
W4: Low	−.42	1.46	−3.00	2.20
W4: High	−.83	1.01	−2.00	1.60
Non-commuting trips purpose indices				
W1: Control	−.06	1.06	−2.60	3.11
W1: Low	.04	1.27	−4.00	2.00
W1: High	.05	1.63	−3.40	5.65
W4: Control	−.12	1.07	−1.80	3.31
W4: Low	−.26	.74	−1.80	1.00
W4: High	−.25	.93	−2.00	1.80
Normative beliefs (percentage) about others' sustainable commuting				
Students	65.15	14.41	25.00	90.00
Staff	36.43	18.04	5.00	90.00
Average	50.78	12.94	15.00	82.50

Note. Index values reflect the number of private vehicle use trips minus the number of sustainable transport trips, averaged across each week. Thus, negative values represent more sustainable transport trips, relative to private vehicle use trips, and vice versa for positive index values.

Social Norm Hypothesis

Three ANCOVAs were conducted to evaluate the impact of the social norm manipulation on Week 4 total transportation behavior, commuting behavior, and non-commuting behavior, controlling for baseline transportation behavior as well as pre-existing descriptive normative beliefs about the percentage of campus commuters who engage in sustainable transportation behavior. For

each type of transportation behavior, a trend analysis of the condition effect was subsequently conducted using polynomial contrasts to assess a priori contrasts of the linear effects on the between-subjects factor of condition (treated as a continuous fixed factor) on behavior change between the baseline and Week 4. This trend analysis was deemed appropriate given that the conditions differ quantitatively in the amount of descriptive social norm information received (i.e., where the control condition did not receive any information, and the low and high conditions received information that either few or many other campus commuters, respectively, have switched to sustainable transportation).

Prior to analysis, the demographic variables were tested individually for their ability to predict change to total transportation behavior. Specifically, multiple regression analyses were performed using the regressor-variable approach to evaluate the influence of each demographic variable on change to transportation behavior between the baseline and Week 4 (e.g., Cronbach & Furby, 1970; Edwards, 1995). For each analysis, the Week 4 total transportation index was regressed on the baseline index and one demographic variable; thus, baseline behavior was treated as a covariate and its variance was partialed out of the Week 4 measure. Participant type (student vs. faculty/staff member) was the only significant unique demographic predictor of change to total transportation behavior, $t(75) = 2.12$, $p = .04$, with an adjusted $R^2 = .54$ for the model including baseline behavior, and a squared semi-partial correlation of .02 for participant type. This finding indicates that student participants demonstrated a greater reduction in private vehicle use than faculty and staff participants and, as such, participant type was also included in the analysis for total transportation behavior.

Total transportation behavior. For the ANCOVA on total transportation behavior, baseline transportation behavior was significantly related to Week 4 transportation behavior, $F(1, 72) = 96.27$, $p < .001$, $\eta_p^2 = 0.57$. There was also a significant effect of another covariate, student (vs. faculty/staff), $F(1, 72) = 5.16$, $p = .03$, $\eta_p^2 = 0.07$, indicating that student participants demonstrated a greater reduction in private vehicle use compared with faculty and staff participants. Thus, the overall effect of social norm condition on change to total transportation behavior across the study was non-significant. There was, however, a significant linear trend, $F(1, 72) = 4.37$, $p = .04$, indicating that as the presentation of descriptive social norm information increased, from nonexistent to low to high, the amount of total sustainable transportation use relative to private vehicle use increased proportionately.

Two additional ANCOVAs were conducted to evaluate whether social norm information differentially influences vehicle use for the purposes of

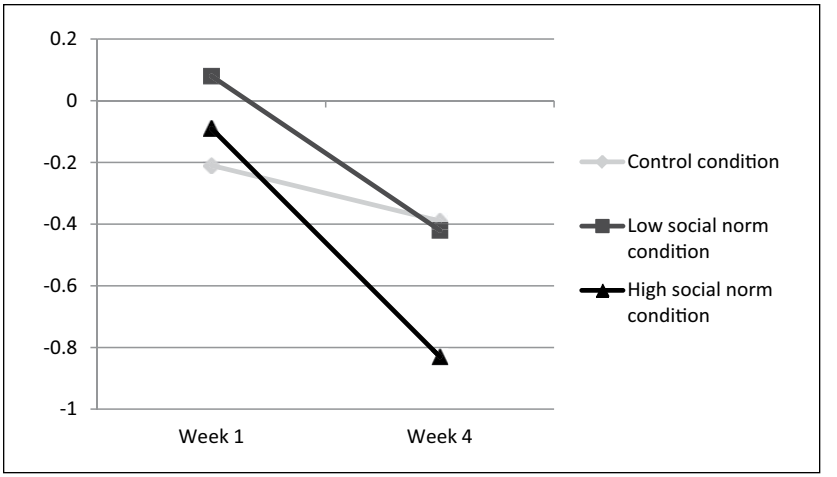

Figure 1. Mean transportation index values for Week 1 and Week 4 commuting trip purposes, according to social norm condition.
Note. Index values reflect the number of private vehicle use trips minus the number of sustainable transport trips, averaged across each week. Thus, negative values represent more sustainable transport trips, relative to private vehicle use trips, and vice versa for positive index values.

commuting and non-commuting. The demographic variables were also individually examined for the extent to which they explained change to behavior for commuting and non-commuting trip purposes, but none were significant unique predictors of change.

Commuting behavior. One covariate, baseline commuting transportation behavior, was significantly related to Week 4 commuting behavior, $F(1, 73) = 153.61$, $p < .001$, $\eta_p^2 = 0.68$. In addition, there was a marginally significant effect of social norm condition on Week 4 commuting behavior, controlling for baseline commuting behavior and average pre-existing descriptive normative beliefs about the percentage of campus commuters who engage in sustainable transportation behavior, $F(1, 73) = 2.92$, $p = .06$, $\eta_p^2 = 0.07$. Further inspection revealed a significant trend, $F(1, 72) = 5.81$, $p = .02$, indicating a linear increase in the amount of sustainable transportation use relative to private vehicle use for commuting purposes as a function of the presentation of descriptive social norm information (Figure 1). That is, as descriptive social norm information increased, from being absent to present and then from being less prevalent to more prevalent, so too did relative sustainable transportation use for commuting purposes.

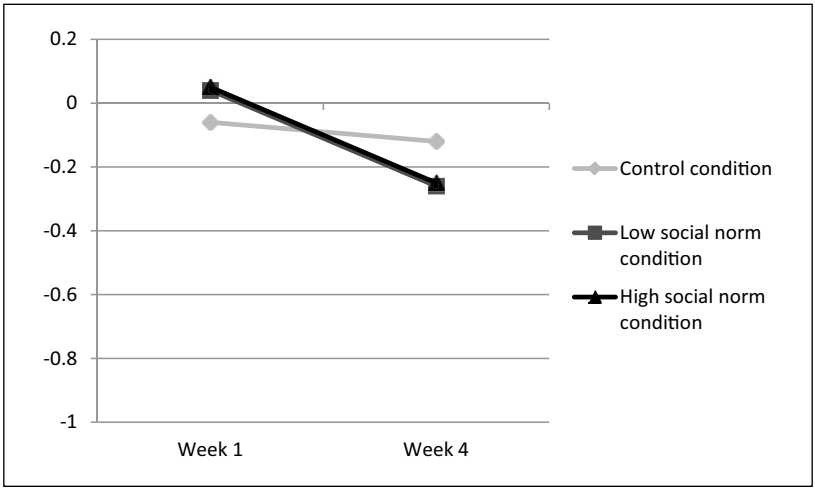

Figure 2. Mean transportation index values for Week 1 and Week 4 non-commuting trip purposes, according to social norm condition.
Note. Index values reflect the number of private vehicle use trips minus the number of sustainable transport trips, averaged across each week. Thus, negative values represent more sustainable transport trips, relative to private vehicle use trips, and vice versa for positive index values.

Non-commuting behavior. Baseline non-commuting transportation behavior was also significantly related to Week 4 non-commuting transportation behavior, $F(1, 73) = 21.26$, $p < .001$, $\eta_p^2 = 0.23$. However, social norm condition did not significantly affect non-commuting behavior, either overall or in the subsequent trend analysis, $F(1, 72) = 0.50$, *ns* (Figure 2).

Discussion

This field experiment evaluated the impact of divergent descriptive social norm information on the reduction of self-reported private vehicle use. Previous studies have demonstrated that social norms marketing campaigns can elicit changes in low carbon-impact behaviors, but less research has examined their effect on higher carbon-impact behaviors, such as transportation use. Furthermore, no study of which we are aware has considered the influence of these messages on transportation that varies according to purpose (i.e., commuting vs. non-commuting behavior). In addition, existing research has been largely correlational and has often measured behavioral intention rather than self-reported behavior itself. In addressing these gaps,

the present experiment found that messages containing high descriptive social norm information can effectively change commuting behavior.

Social Norm Information and Behavior Change

Although past behavior was by far the largest predictor of future behavior in our study, social norm information also influenced behavior change—albeit to a lesser degree—over the duration of the study. As expected, findings revealed that as the presentation of descriptive social norm information increased, from non-existent to low to high, the amount of reported sustainable transportation use relative to private vehicle use increased proportionately. These findings are consistent with numerous studies that have shown positive correlations between social normative beliefs and pro-environmental behavior (e.g., Carrus et al., 2009; Cialdini et al., 1990; Hornik et al., 1995; Nigbur et al., 2010), and they suggest that norm-based interventions can elicit pro-environmental behavior change (e.g., Nolan et al., 2008; Schultz, 1999; Schultz et al., 2008). These findings are also congruent with those of Von Borgstede et al. (1999), who found that experimentally manipulated descriptive social norms about three environmentally relevant behavioral domains were positively correlated with individuals' intentions to engage in cooperative behavior.

Interestingly, our finding that high social norm information had the desired influence on behavior change contrasts with those in studies that have observed a "boomerang effect" in which the social norm message has the opposite-than-intended effect on behavior (e.g., Perkins et al., 2005), including a transportation study that found that those who expect others to drive less tend to express intentions to drive more (Gardner & Abraham, 2010). Explicitly asking our participants to reduce their private vehicle use may have elicited compliance, which, in turn, may have decreased the likelihood of the boomerang effect. Thus, this remains an issue that warrants further investigation.

Participants in the present study were instructed to aim for a 25% reduction in transportation behavior, which, as mentioned, was done to facilitate some level of behavior change on which the effects of normative information could then be observed. Whether the normative information would still exert effects without the context of such goal setting is unclear and remains of interest for future study. However, based on related goal setting research in the pro-environmental intervention literature (e.g., McCalley & Midden, 2002), we assume that greater behavioral change was exhibited in the study than would have otherwise occurred in the absence of goal setting.

The influence of travel habits on behavior change. Social norm information differentially influenced commuting and non-commuting private vehicle use, suggesting that the influence of this intervention on travel mode choice may vary according to the purpose of the transportation behavior. Specifically, participants in the high social norm condition decreased their private vehicle use for commuting behavior, which we assume to be more habitual, but the manipulation had no effect on non-commuting behavior. This is consistent with previous literature that suggests that normative interventions have a greater potential influence on habitual car use compared with less habitual car use (Eriksson, Garvill, & Nordlund, 2008).

Trips made frequently and in stable decisional contexts are more likely to form a habit and thus result in consistent travel mode choices (Bamberg & Schmidt, 2003; Ouellette & Wood, 1998; Verplanken & Aarts, 1999). Understandably, commuting—a repetitive behavior typically performed frequently and under stable choice context conditions (i.e., time, route, and intention)—holds high potential to become habitual. In these situations that evoke a strong habit to adopt a particular travel mode, conscious decision making processes can be greatly diminished (Aarts, Verplanken, & van Knippenberg, 1998), which, barring an intervention, reduces the likelihood of behavior change.

Perhaps counter-intuitively, strong private vehicle use habits (e.g., commuting) appear to be more readily altered than weak habits (e.g., more sporadic vehicle trips); however, this effect seems to be true for habitual car users with strong, but not weak, personal norms (i.e., a sense of moral motivation) to reduce car use (Eriksson et al., 2008). Because individuals with weak vehicle use habits already make conscious and deliberate travel mode decisions (Garvill, Marell, & Nordlund, 2003), those with stronger habits may be more influenced by an intervention that prompts them to consciously evaluate the necessity of each vehicle use trip and consider potential ways to reduce their vehicle use.

According to Lewin's (1951) foundational three-stage model of change (i.e., unfreeze, change, and refreeze), the first stage is "unfreezing" in which individuals must overcome the behavioral inertia of their current habits. The second stage is where the change occurs, and this is characteristically a time of confusion, given that new behavior patterns have yet to be set. In the third stage, freezing or refreezing, new habits are crystallized and comfort returns. The interruption, or *unfreezing*, of one transportation mode habit—as facilitated by an intervention—can allow for the formation of another, more sustainable habit (Dahlstrand & Biel, 1997). Once a car-use habit has been unfrozen, a new habit can be formed by repeated engagement in a different behavior, such as the use of an alternate form of transportation (Ronis, Yates,

& Kirscht, 1989; Verplanken, Aarts, & Van Knippenberg, 1997). The fact that commuting behavior, which we assume to be more habitual, was altered by our intervention may indicate the *unfreezing* of the existing habit of transportation mode choice for commuting trips, thus presumably allowing a new habit of sustainable transportation mode choice to form, given the repetitive and habitually performed nature of commuting behavior (Dahlstrand & Biel, 1997). Indeed, some interventions designed to *unfreeze* automobile use habits (e.g., offering free public transportation on certain days) have successfully increased subsequent public transportation use (see Cone & Hayes, 1980; Everett & Watson, 1987; Geller, Winett & Everett, 1982).

Although the linkage to the role of habit in behavior change seems plausible, environmental factors may also have played a role in the differing effects of social norm exposure on transportation mode choice for commuting and non-commuting trips. Public transportation infrastructure may be more facilitative of commuting trips to the university than to other destinations in the city, making the switch to alternative transport for commuting trips an easier or more convenient choice than for non-commuting trips. Indeed, in our case, the campus is the second most active site of public transportation in the city, and available bus routes to and from the campus link directly to the greater regional transportation network (University of Victoria, 2003, n.d.). This high degree of connectivity is not universal for all possible destinations in the region, which may create a barrier for participants switching to public transportation use for non-commuting trips. The university campus also features dedicated transportation routes for cyclists and pedestrians, which may make using these modes of transport more appealing to commuters.

Limitations

Several possible limitations should be noted. First, the believability of the normative messages was not assessed and therefore could not be included as a covariate. Second, individuals' personal norms (i.e., beliefs about what is important) were not measured. Some research suggests that the relation between social normative beliefs and pro-environmental behavior is moderated by personal norms (Schultz, 2009); for example, as noted earlier, social norm information affects habitual car users who have strong personal norms to reduce private vehicle use but not those with weak personal norms (Eriksson et al., 2008). Although the present results do not address the interaction between personal norms and social norms on transportation behavior, the use of random assignment presumably ensured that participants with varied personal norms presumably were evenly distributed across social norm conditions.

Third, the social norm messages included descriptive statistics about commuting behavior but not about non-commuting behavior, which may have partly accounted for the influence of the social norm manipulation on the former but not the latter. The same results may have occurred either way, but this possibility cannot be ruled out. In addition, this study may have appealed more so to individuals who already wanted to reduce their single-occupant vehicle use, although, again, the presence of random assignment of participants to conditions should have equalized the influence of this potential limitation across study conditions.

And, finally, transportation behavior was measured via self-report, which presents a potential limitation as it makes it difficult to rule out demand characteristics. The use of self-reports rests on the assumption that they accurately reflect individuals' *actual* behavior—an assumption that has received mixed empirical support (e.g., Corral-Verdugo & Figueredo, 1999; Fuj, Hennessy, & Mak, 1985; Hamilton, 1985; Warriner, McDougall, & Claxton, 1984). As such, self-reports obtained in this current study may not accurately reflect actual transportation behavior.

Future Research

Future research could examine the durability of the observed effect of the social norm information on behavior change by including a longer time frame. Such future studies may also include larger sample sizes to be able to explore demographic differences in reactions to normative messages. These studies may also benefit from including a pre- and post-intervention measure of habit strength to help elucidate the possible moderating role of habit in the process of behavior change. Given that those with weak car-use habits naturally make deliberate travel mode decisions (see Garvill et al., 2003), individuals with strong car-use habits may be influenced most by an intervention that encourages them to consciously evaluate the necessity of each car trip; this may hold the greatest hidden potential for change (Von Borgstede et al., 1999).

However, the apparent effectiveness of fictitious social norm messages in eliciting pro-environmental behavior change raises broader ethical considerations that should be taken into account when planning future studies. Specifically, are we justified in delivering false feedback to achieve more sustainable ends? At the end of this study, we were able to debrief participants to remove the deception, whereas in the real world such debriefing is not possible. Therein lays the dilemma. The risk with any use of false feedback is that it can erode public confidence in the veracity of social norm messages over time, ultimately undermining the credibility of social scientists.

Given the possibility of this negative outcome, to the utmost extent, we suggest that social norm messages should endeavor to use factual, as opposed to fictitious, normative information. For example, future studies could benefit from further evaluating the impact of messages that emphasize accurate trends of *change* in various aspects of others' pro-environmental behavior, because previous research has focused largely on the use of static normative information.

Implications

The current results, along with insights from existing literature, suggest several recommendations for practitioners who design and implement sustainable transportation social norm campaigns. First, social norm messages should be framed to highlight the actions of those who are already engaged in sustainable modes of transportation. Second, where possible, such messages should emphasize injunctive norms that convey social approval of this behavior. Together, these two strategies minimize the risk that a campaign may inadvertently increase unintended behavior. Third, these campaigns should use norms that are as proximal, or local, as possible to the characteristics and demographics of the intended audience and to the type of behavior being considered. That is, if the goal is to encourage commuters to reduce their private vehicle use, then the normative message should focus on others' commuting behavior. Indeed, the present results indicate that car-use campaigns may exert the most beneficial impact by targeting commuting behavior, as opposed to non-commuting types of transportation behavior, because of the observed potential for change.

Conclusion

Social norms have a long, somewhat controversial history in social and environmental psychology (Cialdini et al., 1990). Researchers have been divided about the usefulness of this concept in explaining and predicting human behavior; some argue that the construct is too vague (e.g., Latané & Darley, 1970), whereas others claim that it is essential for understanding human behavior (e.g., Berkowitz, 1972). Although this study alone does not resolve these long-standing issues, it does suggest that, in general, social norms can usefully promote sustainable transportation behavior.

The present findings provide causal evidence with mundane realism that descriptive social norm messages can facilitate change to transportation behavior—a high carbon-impact behavior that constitutes a growing source of GHG emissions. More specifically, the findings suggest that these messages more effectively promote changes to commuting behavior than

to non-commuting behavior. They imply that normative interventions can perhaps help *unfreeze* private vehicle use commuting habits by encouraging commuters to consciously evaluate their travel mode choices and to subsequently establish new, more sustainable, habits.

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Notes

1. Approval was obtained from the Human Research Ethics Board to conduct this field experiment using deception.
2. Eight weekend data points were omitted from the calculation of the indices, standardizing the observations to exclusively reflect behavior during the work week.
3. The low percentage of missing data and low attrition rates may be attributable to the compensation structure (i.e., bonus credits for students), as well as the weekly reminder emails.

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Author Biographies

Christine Kormos is pursuing a doctoral degree in environmental psychology at the University of Victoria. Her research interests include transportation behavior change campaigns, self-report validity, and psychological barriers to electric vehicle adoption.

Robert Gifford is a professor of psychology and environmental studies at the University of Victoria. His main research interests are the interface of environmental psychology, social psychology, and personality psychology.

Erinn Brown has her undergraduate degree in psychology from the University of Victoria. Her interests are in the area of counseling psychology