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Nudging for responsible carsharing: using behavioral economics to change transportation behavior

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Abstract Principles of behavioral economics have been used to change human behavior effectively in a variety of disciplines. For the field of transportation, however, there have only been a few cases where behavioral economics was applied to change behavior in randomized field experiments. In our current study, we aimed to increase vehicle inspection behavior among carsharing users, as an example to apply behavioral principles to transportation. Specifically, we developed a simple nudge in the form of a reminder card to visually remind users to inspect the vehicle prior to their trip. The effects of the card were tested in a randomized field experiment by observing and interviewing users of a carsharing service. We found that significantly more users inspected the vehicle in the presence of the reminder card, compared to a control group where no card was used. Over 4 weeks, the improvement in inspection behavior was constant. Critically, the inspection increased even in the absence of the reminder card in the last 2 weeks of the experiment in one of the two observation sites, revealing a persistence effect of the reminder card. The current study not only demonstrates the effectiveness of a simple reminder based on the behavioral principle of salience, but also offers the potential to apply behavioral economics to the field of transportation.

Keywords Nudge · Reminder · Behavioral economics · Carsharing · Field experiment

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Introduction

Standard economic theory assumes that humans behave in fully rational ways, hold stable and consistent preferences, and are able to consider all possible options and make the best choice. Since prospect theory (Kahneman and Tversky 1979), behavioral economics emerged as a new field, challenging basic assumptions of economic theories and providing a more valid model of human behavior. Specifically, behavioral economics not only describes how people systematically deviate from predictions from standard economic theory, but also explains why these deviations occur based on psychological principles. For example, models of behavioral economics assume that human rationality is bounded, and despite having the best intentions, people often behave in impulsive and myopic ways, lack self-control, have limited attention and memory, and yield to social pressure (e.g., Kahneman 2003; Schultz et al. 2007; Simon 1982; Thaler 1980; Thaler and Shefrin 1981).

These psychological insights provide a deeper understanding of human behavior, and more importantly, allow the development of simple, cost-effective interventions that can have large impacts. These interventions, called nudges (Sunstein 2014; Thaler and Sunstein 2009), have been designed to change behavior in a number of domains, such as medical adherence (Mahtani et al. 2011), physical exercise (Newton et al. 2009), healthy eating (Wisdom et al. 2010), retirement savings (Thaler and Benartzi 2004), energy consumption (Allcott and Mullainathan 2010), voting (Nickerson and Rogers 2010), and charitable donation (Slovic et al. 2011).

However, few nudges have been developed and tested in the field of transportation (Metcalfe and Dolan 2012). The overall goal of our current study is to demonstrate that principles of behavioral economics can be used to design a nudge to change human behavior relevant to transportation. To achieve this goal, we focused on carsharing as a case study, where a randomized field experiment was conducted to examine the effects of a nudge on the behavior of carsharing users.

One specific problem common to carsharing services is that the users often do not inspect the vehicle before starting their trip, resulting in unreported damages to the vehicle and compromising the vehicle and driver safety. Standard economic theory would suggest that the failure to inspect the vehicle is due to a lack of knowledge about the benefits of inspection, or a lack of awareness of the obligation to inspect. A behavioral economic view would suggest that the failure of inspection is due to limitations in memory and attention, or external factors such as being in a rush, but not due to a lack of knowledge or intention. We first conducted an observation study and an interview to understand reasons for neglecting the inspection. As our interview suggests, most users are aware that it is their obligation to inspect the vehicle before their trip, and yet they fail to inspect the car because of other reasons.

From a behavioral economic perspective, we developed a nudge in the form of a reminder card placed on the windshield of the vehicle, in order to remind users to inspect the car before their trip. A number of previous studies have suggested the benefits of reminders on behavior change. For example, text message reminders increased the application for student aid among college students by 12 % (Castleman and Page 2015); increased adherence to medication by over 10 % (Hardy et al. 2011; Pop-Eleches et al. 2011; Vervloet et al. 2012); increased savings by 6 % (Karlan et al. 2016); and increased physical activity by 26 % (Newton et al. 2009).

A case study—carsharing

Carsharing is a type of short-term car-rental service and has become increasingly popular over the last few decades (Shaheen and Cohen 2013a, b). Carsharing was first launched in the late 1940s in Switzerland (Shaheen et al. 1999), and has since then expanded to 27 countries over five continents (University of California Berkeley Transportation Sustainability Research Center 2015). In 2014, more than 1,600,000 users shared more than 24,000 vehicles in North America alone (Shaheen and Cohen 2014). This enormous growth accompanies significant improvements in convenience, affordability, and flexibility in rental car usage (Brody and Pureswaran 2015; Lamberton and Rose 2012; Rifkin 2001).

One critical difference between carsharing and conventional car-rental is that carsharing is entirely self serviced, including vehicle reservation, pick-up, and return. While conventional car-rental services require customers to pick up cars at a staffed service office, most carsharing vehicles are kept at unmanned locations where users pick-up and drop-off the vehicle without any interaction with the carsharing organizations' staff. This also means that when using a carsharing vehicle, there is little provider monitoring to check on vehicle condition and attribute damages, say from a collision during the use period, to the driver of record. Instead, most carsharing organizations rely on users to inspect the vehicle before they begin their trip, and report pre-existing damage to the vehicle or self-report any damage that may have occurred during their rental period (e.g., car2go 2015; Zipcar 2015).

Despite the shared responsibility and the absence of provider monitoring of vehicle condition in carsharing, there is a lack of trust among carsharing members (Bardhi and Eckhardt 2012). In fact, carsharing organizations are struggling to make their users inspect cars and report damages in a timely fashion. Modo, the first carsharing co-op in North America has repeatedly reminded its members the necessity and importance of vehicle inspection and damage reporting (Modo the Car Co-op 2015). The CEO of a carsharing company in Canada also stressed that the lack of vehicle inspection and damage reporting can pose serious safety and security risks (Brown and Winter 2015). The lack of inspection makes it difficult to trace the specific driver who caused the damage. The user obligation to inspect vehicles is one of the characteristics distinguishing carsharing from car-renting services; however, this characteristic increases the difficulty in managing carsharing service (Kahan 2012).

Given this context, we apply principles of behavioral economics to nudge inspection behavior among carsharing users. In this study, we focused on a one-way carsharing service provided by a company called car2go. The car2go service was introduced in Vancouver, the study area, in 2011 (CNW Canada Ltd. 2012). Car2go has three distinctive features: one-way rental, a two-seater vehicle, and per-minute payment system. According to user instructions, the procedure for using a car2go vehicle involves the following steps: (1) find a car2go vehicle; (2) place the membership card on the card reader located on the windshield; (3) during the account activation period which takes 15–20 s, inspect the vehicle by walking around all four sides of the vehicle; (4) answer questions regarding the interior and exterior conditions of the car, and report damages if found; and (5) start the trip. The importance of vehicle inspection before starting a trip is explicitly stated on the user agreement (car2go 2014b), and missing damage reports "can result in that Member being held responsible for the repair or cleaning of the vehicle" (car2go 2014b). Completing an inspection is beneficial for users in order to avoid safety issues and being mistakenly charged for repairs. Rationally, users should be motivated to conduct the

inspection. However, the evidence reported below suggests that most users do not perform a proper inspection prior to starting their trip.

Observation study

The observation was conducted at a designated parking area with 16 car2go vehicle spots at the University of British Columbia (UBC) Vancouver campus. The observation occurred over 5 days (October 22nd, 23rd, and 27–29th, 2014) during the morning and afternoon rush hour period (8:00–9:00 a.m., 3:30–4:30 p.m.). The rush hour period is determined by the data of vehicle availability from car2go Vancouver's website (car2go 2014a). For each observation period, we observed trips initiated by users at the parking area. The observation was conducted surreptitiously from a distance to avoid any interaction with car2go users. In total we tracked users' inspection behavior of 34 trips. Among those, 23 trips were started without any inspection, seven trips were started after an incomplete inspection (i.e., checking two or three sides of the vehicle), and only four trips were started with a full inspection (i.e., checking all four sides of the vehicle). In other words, 88 % of the trips were started without a full inspection during the observation period. The majority of those who did not conduct an inspection simply waited next to the car during the 15–20 s account activation period.

Interview with Car2go users

To better understand the poor inspection behavior, semi-structured interviews were conducted with car2go users. The interviewees included 11 car2go users, including seven students and faculty members at UBC (See Appendix 1 in Supplementary Material). The number of participants was determined based on previous interview studies (Glaser and Strauss 1971; Mason, 2010), and the fact that little new opinion was gained after conducting 7–8 interviews. Each interview lasted 20–30 min and the questions covered basic user information, such as length of membership, motivation to join the service and frequency of usage. Interviewees were then questioned about their inspection behavior prior to starting a trip on car2go.

Six out of 11 participants admitted that they usually omit inspection before starting trips. This 55 % self-reported inspection omission is lower than that of the observation study (88 %). An interesting fact is that five out of six interviewees who omit an inspection on a regular basis knew that the inspection is their obligation given the user agreement, and nonetheless, they often skip the inspection. Respondents C, and F's responses are quoted below. Note that the interior and exterior questions are answered through choosing smiley or frown faces.

Respondent C's case

Interviewer	Do you remember how you answered the questions (of interior and exterior conditions)?
Respondent C	Happy happy, every time. Just like done done done. I wanna go, I wanna go (…) There are two reasons why I hit happy happy. One is because usually everything is totally fine (…) and the second one is just speed. (a short conversation between interviewer and respondent C)

Interviewer	In that case do you check exterior before you start trip?
Respondent C	Never, I never do that… I totally should, but I never do that.

Respondent F's case

Interviewer	Did you check outside (of the car)?
Respondent F	No I didn't walk around I just look around at the car before I get in and think if there is anything noticeable. Say if I rent a car, I walk around, and if there is a bump on the car, or something, I would take a photo and make sure that when I return it, you know, they don't debt me the damage that is already there. But I don't do that with car2go… Usually it's because I just want to get to somewhere faster and so probably to protect myself, I should do that level, but I just don't… I just wanna go to sleep so I don't wanna inspect a car.

In the both cases of respondent C and F, present-biased preference seemed to be the cause of the lack of inspection. They were aware that they should do an inspection before using the service; however, they did not. This gap in intention and action can be explained by assuming that participants C and F evaluate saving time and skipping inspection is more valuable than avoiding unnecessary charges and completing their responsibility to use the service. Another quote from respondent E is shown below.

Respondent E's case

Respondent E	"I think those questions are a bit weird. I don't know how many people is gonna take time especially I don't really know if they are charging me for that time or not. … People are not gonna look around the car"
Interviewer	"Did you check the vehicle?"
Participant F	"No, I checked inside like fast, but I didn't walk around especially since they are charging me… I don't think anybody is doing it".

In the case of respondent E, social norm seems to play a role. While the respondent did not know the behavior of other users, s/he expected them to behave as s/he did—skipping an inspection.

In addition, none of the respondents skipping an inspection was aware of using the account activation period (usually 15–20 s) to inspect the vehicle. Respondent E complained that car2go charges for the time for inspection; however, in reality, s/he was given the time to inspect, but was not aware of it. This could be explained by limited attention. For insurance, respondent C's saying, "I wanna go, I wanna go" implies that s/he focused on starting the trip as soon as possible. The pay-per-minute system of car2go may even make the user feel more rushed and keen to start the trip immediately. On the other hand, respondent F seemed to be distracted by the desire to go home and sleep.

Given these interview results, we decided to design a simple reminder to conduct an inspection before using a car2go vehicle. We believe that the reminder is practical and cost-effective, and has a minimal impact on the image of car2go service.

Field experiment

Nudge design

We designed a reminder card as the visual prompt. The reminder card was 14 cm by 8 cm, and said "Please INSPECT the car while waiting" (Fig. 1). We explicitly mentioned "while waiting" so that people realize the availability of time for inspection. Below this message we invited participants to join a prize draw with a smiley face. This smiley face was printed as an injunctive message showing that conducting an inspection is socially preferable. It is known that using injunctive message along with a nudge is an effective way to minimize the boomerang effect (Cabinet Office: Behavioural Insights Team, Department of Energy and Climate Change, Communities and Local Government 2011; Cialdini et al. 1990; Schultz et al. 2007). The red color of the text was to highlight the card on the blue and white car2go vehicles. On the back of the card, a survey link was provided, and participants were invited to take part in the survey about car2go to win a $30 Amazon gift card (Fig. 2). This reminder card was placed on the windshield of every car2go vehicle. Note that participants might notice the objective of this study (motivating inspection) by reading the project title on the back of the card. Because the reminder card already explicitly mentioned inspection, being aware of the study objective was not problematic to the experiment.

Field experiment procedure

We selected two car2go designated parking areas on the UBC campus for the field experiment based on two criteria: (1) the availability of alternative transportation options, especially public transit services, and (2) the size of parking area. The first criterion was set based on the expectation that the accessibility to other transportation options would affect car2go usage patterns. The second criterion was simply for maximizing the number of observable trips. One of the two selected parking areas is the same as the one in observation study (hereafter referred to as Location A). Location A is the largest car2go parking area on campus with space for 16 vehicles. This parking area is located at the Eastern gateway to the university campus and in close proximity to almost all bus lines serving the campus. The other parking area (hereafter referred to as Location B) has space for 12 vehicles. Location B is at the western-most parking lot on campus and about 15-min walking distance from the bus services.

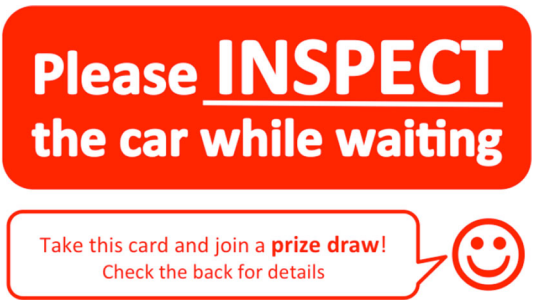

Fig. 1 A reminder card (actual scale) was designed as a visual prompt and was placed on the windshield of every car2go vehicle in the experiment

Fig. 2 The *back* of the reminder card

One location served as an intervention condition where each vehicle had the reminder card on the windshield, while the other as a control condition where none of the vehicles had the reminder card. To minimize the inherent differences between the two locations and external weather factors, the two conditions alternated every day. For example, on day 1 Location A served as the intervention condition and Location B as control, and on day 2 Location A was the control condition and Location B was the intervention condition.

Most of car2go trips started after 12 p.m., and thus the user behavior was recorded by a remote video camera in each location from 12 p.m. to the time when there was no car2go vehicles left in the parking area (around 5 p.m.). This also means that in the intervention condition, the reminder card was placed on the windshield of each vehicle at 12 p.m. The experiment was conducted every day for 4 weeks (from March 2nd to March 27th 2015, excluding weekends[1]). We did not collect information about specific car2go users, however, we recorded their inspection behavior.[2]

Field experiment results and discussion

A total of 979 trips were observed during the 4 weeks, where 684 trips were initiated at the two locations, and 295 trips were terminated at the locations (Table 1). To examine whether there were different usage patterns between the two locations, a two- way analysis of variance (ANOVA) (location × weather conditions) was conducted. Weather was included because weather condition is a major determinant of car2go service demand (car2go Vancouver, personal communication, August 4th, 2014). The dependent measure was exhaustion time, which indicates the time at which all car2go vehicles were taken out. This is one of the most direct indicators of car2go vehicle usage. The analysis indicated that the time of vehicle exhaustion in Location A was earlier than that in Location B ($F(1,30) = 6.14$, $p = .02$, $\eta p2 = .17$); on average, the supply of cars was exhausted in Location A by 4:24 p.m., and in location B by 5:19 p.m. There was no main effect of weather ($F(2,30) = 1.94$, $p = .16$, $\eta p2 = .11$) or an interaction ($F(2,20) = .71$, $p = .50$, $\eta p2 = .05$). Although the weather effect was not statistically significant, cloudy and rainy weathers hastened car exhaustion by 13 and 25 min for location A, and 34 and 98 min for location B, respectively. We suspect that faster exhaustion rate in location B during

[1] All trips observed on March 2nd were excluded due to a technical error in the video camera in Location A. Due to factors outside our control, observations on Fridays ended at 4 p.m.

[2] The Video recordings are made using a low-resolution camera from a significant distance. The image is only just clear enough to discern inspection behavior while being too blurred to identify individual users.

Table 1 Summary statistics of observed trips

	Location A	Location B	Total
Total observed trips			
Start	371	313	684
End	171	124	295
Total	542	437	979
Trips used for the analysis (single-passenger trips)			
Control	166	135	301
Intervention	79	83	162
Total	245	218	463
Average vehicle exhaustion time			
Sunny	4:33 p.m.	6:05 p.m.	5:12 p.m.
Cloudy	4:20 p.m.	5:31 p.m.	5:01 p.m.
Rainy	4:08 p.m.	4:27 p.m.	4:18 p.m.
Total	4:24 p.m.	5:19 p.m.	4:00 p.m.

inclement weather may be due to the absence of a nearby public transit alternative (the closest bus terminal is a 15-min walk away).

Moreover, on average, in Location A, 24 % of vehicles remained by 4 p.m. and were all gone by 4:24 p.m., where in Location B, 54 % of vehicles were still available at 4 p.m. and all were taken by 5:19 p.m. We suspect that Location B users contained UBC employees, while Location A was more widely used by younger student members.[3] In the analyses reported below, we focused on trips initiated by a single user who unlocked the car by swiping his or her membership card over the card reader located on the windshield[4] (total 463 trips, 245 trips from Location A and 218 trips from Location B). Since the different patterns of use indicated that the users were two distinct populations at the two locations, we examined the result at the two locations independently.

Online survey

The back of the reminder card invited participation in an online survey. A total of 29 responses were submitted (location A: 12, location B: 17). Among the respondents, 35 % answered that they never or rarely inspect car2go vehicles, while more than 60 % of the respondents answered that they often inspect the vehicles. This self-reported inspection rate was five times higher than the inspection rate observed in the observation study and repeated during the first week by the control group (12–13 %). We suspect some shared traits lead people to take responsibility to inspect their vehicles and participate in the survey.

According to the survey results, the top three reasons for skipping an inspection were: (1) being in too much of a hurry (for 100 % of the respondents), (2) believing that the cars are usually fine (for 79 % of the respondents), and (3) the lighting condition not being good enough to see (for 78 % of the respondents). These results were consistent with the

[3] This assumption is supported by the surveys completed on-line, but the self-selection aspects of the survey and small response rates do not permit us to calculate a statistical significance.

[4] A relatively new feature permits access to vehicles via users' mobile phones, but is not widely adopted.

findings from the interview. Since the sample size of the survey was small (n = 29), survey results were used as supplementary support for the experiment results.

Behavioral change by the nudge

We examined the inspection behavior from video recordings in both the intervention and the control conditions every day throughout 4 weeks. We characterized a "proper inspection" as one in which the user walks around all four sides of the car before starting a trip. In each condition, we computed the daily inspection rate as the ratio between trips started after a proper inspection and the total number of trips in a given day. Daily inspection rates by condition and location are summarized in Fig. 3. The fluctuations seen in the figure are likely from relatively small sample size. Overall, inspection rates in the intervention condition were: Location A: M = .50, SD = .20, Location B: M = .40, SD = .16, while that in the control condition were: Location A: M = .15, SD = .12, Location B: M = .24, SD = .16.

A two-way ANOVA comparing condition (intervention and control) and week (week 1–4) was conducted for Location A and Location B separately to analyze the difference statistically. The main effect of condition was found in Location A ($F(1,11) = 19.51$, $p = .001$, $\eta p2 = .64$), while the effect was marginal in Location B ($F(1,11) = 4.06$, $p = .07$, $\eta p2 = .27$). There was no main effect of week in either location (Location A: $F(3,11) = .71$, $p = .56$, $\eta p2 = .16$; Location B: $F(3,11) = 1.36$, $p = .31$, $\eta p2 = .27$), or interaction (Location A: $F(3,11) = .90$, $p = .47$, $\eta p2 = .20$, Location B: $F(3,11) = .64$, $p = .61$, $\eta p2 = .15$). The inspection rate in the intervention condition remained high throughout the 4-week period (week 1–2 vs. 3–4, Location A: $t(8) = .07$, $p = .41$, $d = .55$, Location B: $t(7) = .14$, $p = .89$, $d = .09$), suggesting that the effect of the intervention card was persistent throughout the whole experiment period. On the other hand, while the inspection rate in the control condition stayed almost constant in location A (week 1–2 vs. 3–4: $t(7) = .28$, $p = .79$, $d = .18$), Location B showed an increase in the inspection rate in the control condition in the last 2 weeks (week 1–2 vs. 3–4: $t(8) = 2.37$, $p = .05$, $d = 1.5$). Although the difference was marginal ($p = .05$), the effect size was large ($d = 1.5$).

The upward trend of the inspection rate in the control condition in location B may be driven by learning effects in repeated users. Because the intervention and the control conditions alternated between the two locations across days, the car2go users experienced

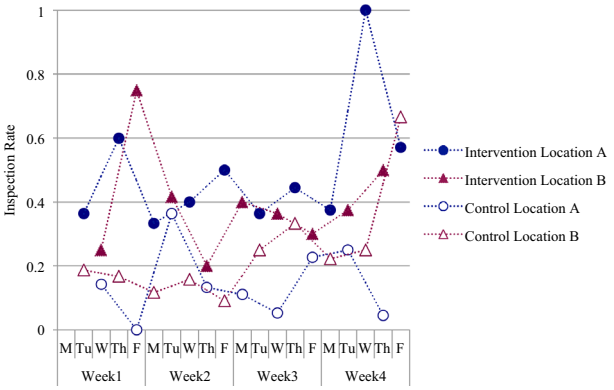

Fig. 3 Daily inspection rate by condition and location

the reminder card in location B during intervention days, and continued to inspect the car in location B even in the absence of the reminder card (control condition). This learning effect depends on the existence of repeated car2go users in location B. Given factors, such as locational factors (Location B is less exposed to the public so that probably not all car2go users know about the parking) and relatively late vehicle exhaustion time (see Table 1), Location B is more likely to have repeating users than Location A.

Nudge effect in different weather

Figure 4 presented results by weather conditions. When no intervention card was present, users inspected more often in cloudy and rainy conditions than sunny condition (sunny vs rainy or cloudy in the control condition: Location A: $\chi^2 = 5.51$, $p = .02$, Location B: $\chi^2 = 4.34$, $p = .04$).[5] This is opposite from the finding from the interview: interviewees listed bad weather condition as a reason of inspection omission. One possible explanation here is that user demographics may be different between sunny and rainy or cloudy days, because bad weather can make car2go service more attractive compared to public transit services by providing quick door-to-door mobility. Vehicle exhaustion time (in Table 1) supports this argument: cloudy and rainy weather can hasten vehicle exhaustion time by between 13 and 98 min compared to sunny days. Taking into account the inspection result, occasional car2go users, such as users who use car2go services only in rainy days, may inspect more often than regular users.

When the reminder card was present, the inspection rate increased in all weather conditions (sunny, cloudy, and rainy) in Location A (sunny: $\chi^2 = 12.70$, $p < .001$, cloudy: $\chi^2 = 3.25$, $p = .07$, and rainy: $\chi^2 = .94$, $p = .33$). On the other hand, the effect was only present in sunny condition in Location B (sunny: $\chi^2 = 9.15$, $p < .01$, cloudy: $\chi^2 < .001$, $p = .99$, rainy: $\chi^2 = 0$, $p = 1.00$) (see Footnote 5) (see Fig. 4). One possible explanation of this heterogeneity between the locations is that most of cloudy and rainy conditions were observed during the last 2 weeks (52 % and 96 % of trips started in cloudy and rainy condition were observed in the last 2 weeks). Since the inspection rate in the control

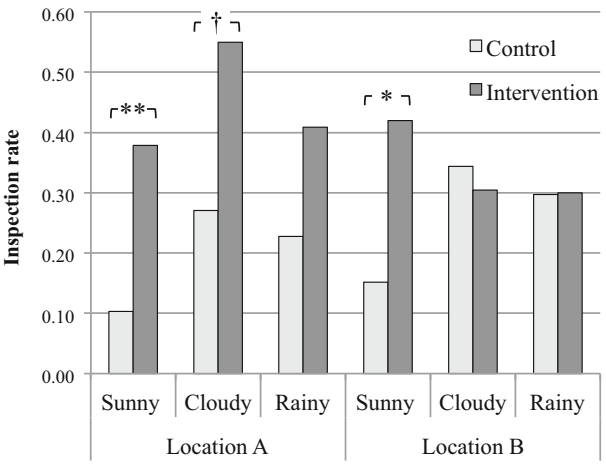

Fig. 4 Inspection rate by weather conditions. (†$p < .1$, *$p < .05$, **$p < .01$)

[5] Multiple Chi square tests were conducted since the sample size was not large enough to conduct a *t* test.

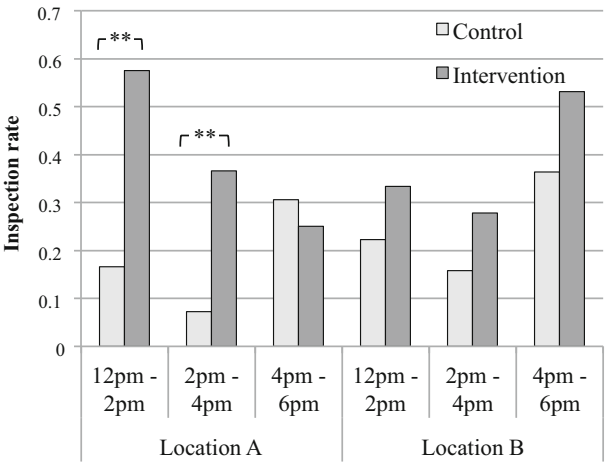

Fig. 5 Inspection rate by time frame. (†$p < .1$, *$p < .05$, **$p < .01$)

condition increased in the last 2 weeks in Location B, possibly due to the learning effect, the reminder card's effect can be weakened. Another possibility is the visibility of the card: Location B is hidden in the middle of campus where there is less lighting, reducing the salience of the card.

Nudge effect by time

The time of trip initiation also brings interesting insights (see Fig. 5). First of all, inspection rate in the control condition is higher among users starting trips after 4 p.m. in both locations (trips started before 4 p.m. vs. after 4 p.m.: Location A: $\chi^2 = 6.24$, $p = .01$, Location B: $\chi^2 = 4.43$, $p = .04$). This may result from user demographic difference between before and after 4 p.m., because after 4 p.m. trips were highly likely done by commuters returning from UBC to their home. The result implies that those commuters tend to inspect more often than others. In terms of the reminder card, it increased inspection at all times in Location A except after 4 p.m. trips (Location A: 12–2 p.m.: $\chi^2 = 14.75$, $p < .001$, 2–4 p.m.: $\chi^2 = 11.27$, $p < .001$, 4–6 p.m.: $\chi^2 = .01$, $p = .94$). The inspection rate of after 4 p.m. trips decreased in the intervention condition in Location A. One explanation is the small sample size: most cars were taken out before 4 p.m. at Location A, only 16 trips were observed after 4 p.m. in the intervention condition. In terms of Location B, the intervention card's effect is positive but not statistically significant (12–2 p.m.: $\chi^2 = .74$, $p = .74$, 2–4 p.m.: $\chi^2 = 1.28$, $p = .26$, 4–6 p.m.: $\chi^2 = 1.49$, $p = .22$).

General discussion

The goal of the current study was to develop a nudge to motivate vehicle inspection in carsharing users prior to starting their trip. In a randomized field experiment, a reminder card prompting inspection was placed on the windshield of the vehicles in the intervention condition, whereas there were no reminders in the control condition. We found that more users inspected the vehicle in the presence of the reminder card than in the control

condition (the overall inspection ratio increased to 40–50 % from 15–24 %). This suggests that the developed nudge, visual reminder was effective in promoting inspection behavior by directing users' attention to the card and facilitating immediate behavior change. Over 4 weeks, the inspection rate was consistently higher in the intervention condition than in the control condition. This benefit remained the same over time, suggesting that repeated exposures to the reminder card did not diminish the impact of the intervention on inspection behavior. Finally, the external factors and user demographics could affect the impact of the reminder card. Commuting users are likely to inspect more often even without the intervention cards, and bad weather conditions seem to diminish the effect of the reminder card especially in the more isolated location B. The users in location B continued to inspect the vehicles even in the absence of the reminder card in the last 2 weeks of the experiment, suggesting a persistence effect of the intervention, especially for repeating users.

The benefit of the reminder card was both consistent and persistent in our experiment. However, the overall inspection rate in the intervention condition was around 50 %, meaning that only one out of two users inspected the vehicle when the reminder card was present. Although this was a significant improvement from the baseline inspection rate (12 %), half of the users still did not inspect the vehicle even in the presence of the reminder card. According to the online survey, 40 % of the respondents answered that even with the reminder card, they still did not inspect the car. This suggests that the lack of inspection was not driven solely by lack of attention or forgetting, but by other factors as well.

Given this finding, how could we improve the nudge? A possible approach is to remind users of the possibility of financial charge by omitting an inspection. For the users who did inspect the vehicle, their motivation was to avoid unnecessary charges in case of previous damages. Therefore, the nudge reminder card can be improved by stating: "Please inspect the car while waiting. You may be mischarged". However, such wording can negatively affect the image of the car2go service.

Another possible approach is providing reward instead. For example, placing a sticker with a code to one of car2go vehicles, and use it as a lucky sticker. Anyone who found the sticker and report the correct code can get a reward or win a prize. This approach stimulates inspection by not only financial motivation but also regret aversion (Kessler and Zhang 2014). The lucky sticker will not affect the outcome from skipping inspection; however, with the sticker, skipping inspection may be a lost opportunity to win something. Since people feel stronger towards losing than gaining (Tversky and Kahneman 1991), this approach is likely to motivate people to inspect more than simple reward system. A possible shortcoming from this approach is that the effect is less likely to lead to persistent effect after the removal of the intervention (Kessler and Zhang 2014).

Rather than implementing a nudge, there is a possibility to minimize the misbehavior by improving customer service. In discussing our findings with frequent users of car2go, we also learned that the process of reporting damage can be very time-consuming. However, unlike voluntary vehicle refueling, time spent reporting damage to the car is charged to users, rather than leading to a credit on their account. This system might have discouraged users to conduct inspections before starting trips.

Throughout the study, the effect of nudge was examined by a randomized field experiment. This approach is more appropriate to examine the effect of a nudge compared to surveys and simulations. However, natural field experiment in which participants do not know that they are participating in an experiment may give a better environment to test the effect of a nudge, since behavior may be affected by the awareness of being in an

experiment. Conducting natural field experiment, however, requires a more careful review of the study procedure in order to avoid any violation of freedom of choice and privacy among potential survey participants.

In this study, we used carsharing as an example to apply behavioral economics to make changes in people's transportation related behavior. A small and simple reminder card could improve the inspection behavior; the inspection ratio increased to 40–50 % from 15–24 %. In addition, the reminder card seems to have a persistent effect in which behavioral change lasts even after the removal of the nudge. This type of small nudge has a huge potential to be implemented in a variety of cases in the field of transportation. We hope that the current study can motivate more nudges to be designed and tested to improve a variety of issues in transportation systems.

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