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The Role of Habits in Cell Phone-Related Driver Distractions

Braden Joseph Hansma
Department of Mechanical and Industrial Engineering
University of Toronto, Toronto, ON, Canada, M5S 3G8
Email: bhansma@mie.utoronto.ca

Susana Marulanda
Department of Mechanical and Industrial Engineering
University of Toronto, Toronto, ON, Canada, M5S 3G8
Email: smarulan@mie.utoronto.ca

Huei-Yen Winnie Chen
Department of Industrial and Systems Engineering
University at Buffalo, Buffalo, NY, 14260
Email: winchen@buffalo.edu

Birsen Donmez*
Department of Mechanical and Industrial Engineering
University of Toronto, Toronto, ON, Canada, M5S 3G8
Email: donmez@mie.utoronto.ca

*Corresponding author.

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DATA ACCESSIBILITY

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ABSTRACT

Despite increased media attention and legislation banning some forms of cell phone use while driving, drivers continue to engage in illegal cell phone distractions. A number of studies used the Theory of Planned Behavior (TPB) to explain why drivers voluntarily engage in cell phone distractions, and found that TPB constructs (attitudes, social norms, perceived behavioral control) predict intentions to engage in cell phone distractions while driving. Given that cell phone use is ubiquitous, habits that have formed around their general use may lead to automatic engagement in cell phone distractions while driving. This differs from voluntary engagement, in that habits are carried out automatically, with little thought given to the action or its consequences. Thus, in addition to the TPB constructs that explain intentions, habitual factors should also be considered in understanding why drivers use cell phones. A few studies have examined the role of habits in this context, but they only focused on texting behaviors. We conducted an online survey with 227 respondents to investigate the role of habitual cell phone use in driver engagement in a variety of illegal cell phone tasks (e.g. social media, email). Habitual cell phone use was found to explain unique variance in self-reported engagement after controlling for TPB constructs. Overall, the findings indicate that cell phone-related distractions may not be entirely voluntary; instead, cell phone habits developed outside of the driving context appear to have a significant effect, suggesting that cell phone use while driving may have become automatic to a certain extent.

Keywords: Driver Behavior, Theory of Planned Behavior, Survey, Attitudes, Social Norms, Traffic Safety

INTRODUCTION

Traffic crashes are a leading cause of death and injury in North America. While there are numerous factors that lead to vehicle crashes, driver distraction has been identified as a major contributor (1, 2). In 2017, 9% of all fatal crashes were reported as distraction-affected, with 3,179 people killed as a result (3). Sources of driver distraction vary significantly, however, and cell phone-related distractions have remained relatively prevalent over the past decade, with their negative impact on driving performance well noted (4, 5). In a recent survey, the National Highway Traffic Safety Administration (NHTSA) found that at any given daylight moment in 2017, 415,953 (5.3% of) drivers were using their cell phones or manipulating electronic devices while driving (3). Further, the analysis of the Second Strategic Highway Research Program Naturalistic Driving Study (SHRP2 NDS) data has found that general cell phone use increases the odds of being involved in a crash by 3.6 times (1). Initiatives have been developed and implemented to mitigate cell phone-related distractions; these have included laws banning the use of hand-held mobile devices while driving (6, 7) and educational messages delivered via public service announcements, advertisements, and radio/TV news. In order to maximize the effectiveness of such initiatives, it is crucial to understand the motivating factors or facilitators of drivers' engagement in cell phone distractions.

A commonly used theoretical framework for understanding facilitators of distraction engagement is the Theory of Planned Behavior (TPB; 8). TPB states that intentions are the main determinant of behavior and that intentions are directly influenced by attitudes (i.e. the positive or negative evaluations of a behavior), subjective/injunctive norms (i.e. perceived approval from important others), and perceived behavioral control (i.e. ease or difficulty associated with engaging in a behavior, as well as the perceived level of control one feels over their actions). Applications of TPB in understanding cell phone use while driving have found that TPB explains a statistically significant portion of the variance in driver's intentions/willingness to use a cell phone while driving (ranging from 14-51% depending on the cell phone behavior examined; 9-12). The aforementioned studies examined intentions or willingness to behave, which assess a participant's intent/willingness to perform a given behavior in the near future. As a more direct measure of actual behavior, several studies have replaced the intention/willingness measures with self-reported distraction engagement frequency and found results comparable to studies that used intentions/willingness (13-15; see Chen et al[14] for further discussion on this topic).

While the TPB framework is useful in understanding intentional behaviors in general, and voluntary engagement in cell phone distractions specifically, it does not address the potential role of habits in behaviors that might be partly automatic. Habits have been defined as "a form of automaticity in responding that develops as people repeat actions in stable circumstances" (16, p91). Habitual actions are goal-oriented behaviors that were originally motivated by an expected reward, but are currently performed without deliberate intention. Such actions can be triggered directly by the perception of situational cues that were once contiguous with the behavior (16). Situational cues can include environmental cues, such as time of day and location (17) or internal mental states, such as a particular mood (18). Although cell phone interactions are generally intentional and goal-driven, due to their frequent execution, cell phone behaviors have the potential to become automatic over time, and thus, turn into habits. With the growing advancement of smartphones that provide additional functionalities and connectivity for continuous social interactions, new smartphone habits have reportedly formed, such as the automatic actions to unlock the phone to check the start screen for notifications (19).

Only a limited number of studies have considered the role of habits in cell phone distraction engagement; they focused specifically on texting while driving and administered their survey to an undergraduate population. Nemme and White[12] found that general frequency of texting in the past significantly predicted drivers' intentions/self-reported texting behavior one week later. Bayer and Campbell[13] built upon this work by utilizing a frequency-independent measure of habitual cell phone use in addition to the frequency-specific one; while past behavior is an important determinant in the development of a habit, it is difficult to judge the extent to which a habit has become automatic based solely upon the frequency of past behavior. The authors used the Self-Report Habit Index (SRHI; 20) to assess texting habits. The participants responded to items such as: "Texting is something I do automatically". Bayer and Campbell[13] found that this measure predicted reading/sending texts while driving when controlling for self-reported past texting frequency, as well as the constructs of the TPB. This finding provides support for the idea that cell phone habits, developed outside of the vehicle, can predict cell phone use while driving. As such, it is important to consider the role habits play when examining why drivers engage in cell phone-related distractions.

Expanding upon prior work, we report an investigation of the role of cell phone habits, in addition to TPB constructs, in predicting driver engagement with a broad selection of cell phone-related distractions, including a type of distraction with social purpose—updating social media. We utilize data collected as part of a larger survey study that aimed to improve the Susceptibility to Driver Distraction Questionnaire, which has been validated in earlier studies (SDDQ; 21, 22). Similar to Bayer and Campbell[13], we also adopted the SRHI to assess habits, but the sample reported in our analysis represents a much more diverse group of drivers compared to the psychology and communication studies undergraduate students sampled in Bayer and Campbell[13].

METHODS

Participants

Survey respondents were recruited using online advertisements and posts to local communities in downtown Toronto, ON, Canada. A total of 227 survey responses were collected over a five-month period in 2015. One participant who reported their age as the current year was removed from the analysis as they may not have read the survey questions closely, along with eight respondents who chose the option 'I don't use this technology' for all surveyed cell phone distractions. In the remaining sample (n=218), 61.5% of respondents were female, and the respondents' age ranged between 17 and 79 years old, with a mean of 38.6 and standard deviation (SD) of 13.1 (**Table 1**). Respondents were not permitted to skip survey questions and were encouraged to complete the entire questionnaire to become eligible for a draw to win one of three Apple iPads and several $10 Starbucks gift cards.

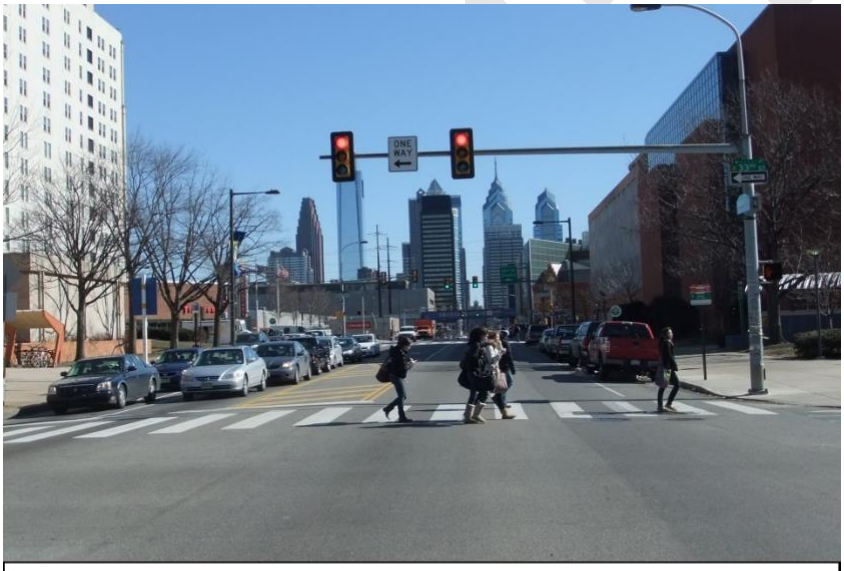
TABLE 1: Number of Respondents (Analyzed) across Different Demographic Categories

	Females	17-25 years	26-35 years	36-55 years	55+ years	**Total**
N	134	37	64	87	30	218
% of total	61.5%	17%	29%	40%	14%	100%

Measures Analyzed

Participants were presented with an image of an urban driving environment (**Figure 1**) at the beginning of the survey and were asked to respond to questions by thinking back about their experiences over the last year while driving in similar scenarios. Participants were asked to answer questions according to their actual experience rather than what they thought their experience should be.

We collected data on seven common cell phone distractions, which have been widely banned across multiple regions in North America (see **Table 2**; 6, 7). Participants were asked to report their frequency of engagement in, attitudes towards, perceived behavioral control over (i.e. self-efficacy and perceived control) and perceived social norms (i.e. injunctive and descriptive) related to these distractions within the driving scenario mentioned above. As a reminder, the image and the text shown in **Figure 1** were represented to the participants before each of these constructs, with the exception of perceived control. Since we wanted general assessments for perceived control, participants were told that they did not have to base their answers on the scenario presented to them earlier. Items (see **Table 2** for a complete list) used in the survey were those from a revised version of the SDDQ (23), which is a validated North American survey designed to study driver distraction. The revised version of the SDDQ is an enhanced version of the original that improves the wording of some of the original items, in addition to including extra items meant to better capture some of the multi-faceted constructs within the questionnaire. One example of this revision is for attitude, where five items replaced the single item used in the original SDDQ (i.e. three bi-polar semantic differential scales and two belief-based measures that assess a value of convenience and an evaluation of others performing the behavior). A detailed description of revisions to the SDDQ can be found in Marulanda[23].



Imagine yourself driving along on a 3-lane urban road with heavy traffic, high pedestrian flow, and traffic lights. When answering the following questions, please consider an environment similar to the one illustrated above.

FIGURE 1: The Context Image and Accompanying Text Provided to the Survey Respondents.

TABLE 2: Cell phone distractions surveyed and SDDQ items used to assess TPB constructs.

Surveyed Cell phone Distractions	
D1	Talk(ing) on the phone using a hand-held device
D2	Dial(ing) a phone number (not available through speed dial) using the keypad of a hand-held device (e.g. cell phone)
D3	Manually enter(ing) text messages on a hand-held device (e.g. cell phone)
D4	Read(ing) text messages on a hand-held device (e.g. cell phone)
D5	Read(ing) emails on a hand-held device (e.g. cell phone)
D6	Update(ing) social media (i.e. Facebook, Instagram, Twitter) on a hand-held device (e.g. cell phone)
D7	Manually enter(ing) an address into a navigational app on a smartphone that is NOT mounted inside the vehicle
SDDQ ITEMS (Utilizing the Above Distractions)	
Engagement Frequency	
1 = Never, 2 = Rarely, 3 = Occasionally/Sometimes, 4 = Often, 5 = Very Often, NA = I don't use this technology	
FREQ	On average, how often did you engage in each of these tasks over the last year, while driving in an environment similar to the image above?
Attitudes	
A1: 1 = Pleasant to 5 = Unpleasant; A2: 1 = Safe to 5 = Dangerous; A3: 1 = Wise to 5 = Unwise	
A4 & A5: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree	
A1 to A3	For me, driving and [D1-D7] is…
A4	While driving, it is a good use of my time to [D1-D7]
A5	I lose respect for people who drive and [D1-D7]
Self-Efficacy	
1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree	
SE	While driving, I have no difficulty [D1-D7]
Perceived Control	
1 = Strongly Disagree, 2 = Disagree, 3 = Neutral 4 = Agree, 5 = Strongly Agree	
PC1	I decide whether I drive and [D1-D7]
PC2	Circumstances determine if I [D1-D7]
Injunctive Norms	
1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree	
IN1	People who are important to me would approve of me driving and [D1-D7]
IN2	People who are important to me would think it is okay for me to drive and [D1-D7]
Descriptive Norms	
1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree	
DN	Most drivers drive and [D1-D7]

The wording of the seven cell phone distractions can be changed to accommodate different question prompts (e.g. A1-A3). For D2 and D7, the measure A4 was not collected as it was deemed to be uninformative for these two distractions. Participants were given the opportunity to select the option "I don't use this technology" for the cell phone distractions in the "Frequency of Engagement" section; if they chose this, then that distraction was removed from all subsequent sections of the survey, except those relating to injunctive and descriptive norms. The presentation of distraction items remained consistent throughout the survey, and respondents answered all questions pertaining to the TPB constructs in the same order.

The current study assessed perceived behavioral control through its two sub-constructs: self-efficacy and perceived control (24). This was done because several studies have found self-efficacy (i.e. the perceived difficulty of engaging in a specific behavior) and perceived control (i.e. a person's self-assessment of how much personal control they feel over the behavior) to be separate, but inter-related constructs (24, 25). The lack of distinction made between self-efficacy

and perceived control may explain why perceived behavioral control has been somewhat of an inconsistent predictor of driver intention/willingness to engage in cell phone distractions across studies (9-13, 26). In fact, certain studies outside of the distracted driving domain have found self-efficacy to a better predictor of behavioral intention than perceived control (24). By examining these sub-constructs separately, we aimed to obtain a clearer picture of whether and how perceived behavioral control predicts drivers' self-reported engagement in cell phone distractions. In addition, two types of social norms were examined, injunctive norms (i.e. perceived approval of important others) and descriptive norms (i.e. perceptions of others' behaviors). Injunctive norms, otherwise known as subjective norms, are an original construct of the TPB, while descriptive norms are a somewhat recent addition to the TPB. To date, research has found that descriptive norms predict both general driver distraction engagement and drivers' willingness to use a cell phone above and beyond the traditional constructs of the TPB (11, 14, 15).

To measure cell phone habits, we utilized a variation of the Self-Report Habit Index (SRHI; 20) also used by Bayer and Campbell[13] to collect data on three cell phone habits: (1) checking for new notifications, (2) answering a phone call, and (3) responding to new notifications. Only three cell phone habits were examined in order to prevent lengthening the survey. For each habit type, participants rated ten statements: e.g. "checking for new notifications is something…" (1) I do automatically, (2) I do without having to consciously remember, (3) I do without thinking, (4) I start before I realize I am doing it, (5) I have no need to think about doing, (6) I do without meaning to do it, (7) That would require effort not to do it, (8) That I would find hard not to do, (9) That is typically me, (10) That belongs to my daily routine. The responses were collected on a 5-point Likert scale ranging from 1=Strongly Disagree to 5=Strongly Agree. It should be noted that we collected data on general cell phone habits (i.e. occurring anywhere), rather than cell phone habits related to the driving context. Cell phone use is pervasive in daily life, with cell phones being used across environments, hence, we expected that situational cues that cut across environments (e.g. internal mental states or notifications from cell phones; 18, 19) can trigger habitual cell phone use in the driving context.

Average scores were calculated for each participant before our regression analysis. Self-reported frequency of engagement was averaged across all distractions, excluding ones where a participant chose "I don't use this technology". Average scores for self-efficacy and descriptive norms where calculated in a manner similar to frequency of engagement, where self-efficacy/descriptive norms were averaged across all distractions pertaining to each construct. Average scores for attitude, perceptions of control and injunctive norms were calculated by first averaging across each item for a given distraction (e.g. averaging A1-A5 across D1, averaging IN1 and IN2 across D1), and then averaging across distractions. Finally, an average habit score was calculated by averaging the SRHI items for a given cell phone habit, and then averaging those cell phone habits for a given participant.

RESULTS

Descriptive statistics are reported for self-reported engagement in each of the distractions, as well as for constructs of the TPB, and habitual cell phone use. These statistics are followed by Pearson correlation analysis between different constructs. Finally, a hierarchical multiple linear regression model is reported, which examined the effect of habitual cell phone use on frequency of engagement in cell phone-related driver distractions, while controlling for constructs of TPB. A logarithmic transformation was used on the dependent variable to ensure normality of the

residuals. No issues of multicollinearity were found through the examination of Variance Inflation Factors.

Descriptive Statistics and Correlation Analysis

Self-reported frequency of engagement in cell phone distractions was considerably low, roughly corresponding to an average rating of "rarely" on the five-point Likert Scale (**Table 3**). Age appeared to be a factor for frequency of engagement in cell phone distractions, with engagement being most frequent for drivers 26-35 years old and least for drivers older than 55. Overall, attitudes were found to be highly negative towards engaging in the cell phone distractions surveyed, with a mean of 4.39 on a scale ranging from 1 to 5 (see **Table 4** for descriptive statistics on all constructs). On average, respondents felt that engaging in these cell phone distractions while driving was difficult, while at the same time feeling neutral towards their control over engaging in them. Regarding descriptive norms, on average, respondents felt neutral towards whether most drivers engaged in these cell phone-related distractions; however, they did believe that people important to them would not approve of them engaging in these distractions while driving. Finally, respondents rated the automaticity of their cell phone behaviors on the lower side (average score of 2.24 on a scale from 1 to 5).

TABLE 3: Mean Values (and Standard Deviation in parentheses) for Self-Reported Engagement in the Different Cell Phone Distractions Surveyed.

Cell Phone Distractions	Overall	Age Group			
		17-25	26-35	36-55	55+
D1. Talk on the phone	1.79 (1.02)	1.81 (1.04)	1.98 (1.07)	1.80 (1.04)	1.31 (0.66)
D2. Dial a phone number using the keypad	1.65 (0.97)	1.89 (1.13)	1.62 (0.92)	1.71 (1.02)	1.24 (0.58)
D3. Manually enter text messages	1.74 (0.96)	1.73 (1.10)	1.97 (0.98)	1.73 (0.94)	1.22 (0.51)
D4. Read text messages	1.95 (1.06)	2.16 (1.19)	2.22 (1.07)	1.88 (1.02)	1.13 (0.34)
D5. Read emails	1.51 (0.89)	1.54 (1.01)	1.58 (0.94)	1.58 (0.90)	1.08 (0.28)
D6. Update social media (i.e. Facebook, Instagram or Twitter)	1.26 (0.73)	1.33 (0.79)	1.36 (0.87)	1.22 (0.67)	1.04 (0.20)
D7. Manually enter an address into a navigational app	1.86 (1.06)	1.97 (1.21)	2.05 (1.11)	1.91 (1.00)	1.08 (0.28)

TABLE 4: Descriptive Statistics for Average Scores of Self-Reported Engagement Frequency, TPB Constructs, and Habitual Cell Phone Use.

Construct	Mean	Standard Deviation
Engagement frequency	1.68	0.78
Attitudes	4.39	0.59
Self-efficacy	1.98	0.98
Perceived control	3.19	1.06
Injunctive norms	1.65	0.78
Descriptive norms	3.26	0.89
Habitual cell phone use	2.24	0.83

As can be seen in **Table 5**, attitudes (r = -.61) and self-efficacy (r = .55) had the largest correlations with engagement frequency, while descriptive norms had the weakest correlation (r = .20). Among TPB constructs, attitudes and self-efficacy (r = -.68) and attitudes and injunctive norms (r = -.69) were highly correlated. This indicates that those with increasingly negative attitudes towards engaging in hand-held cell phone distractions often felt they had higher difficulty executing these tasks while driving and perceived less approval from people who are important to them. It is worth noting that descriptive norms were only weakly correlated with the other variables of TPB, with correlations ranging from r = .13 to r =.23. Regarding habitual cell phone use, habits were moderately correlated with attitudes (r = -.36), perceived control (r = .29), and self-efficacy (r = .29). This indicated that stronger cell phone habits were associated with more positive attitudes, higher perception of control, and less perceived difficulty of engaging in cell phone-related distractions while driving.

TABLE 5: Bivariate Correlations among Self-Reported Engagement Frequency, TPB Constructs, and Habitual Cell Phone Use.

	1	2	3	4	5	6
1. Engagement frequency						
2. Attitudes	-0.61***					
3. Self-efficacy	0.55***	-0.68***				
4. Perceived control	0.43***	-0.32**	0.32***			
5. Injunctive norms	0.46***	-0.69***	0.55***	0.28***		
6. Descriptive norms	0.20***	0.19**	0.22**	0.22***	0.19**	
7. Cell phone habits	0.45***	-0.36***	0.29***	0.29***	0.13	0.28***

p-values: p < .05*, p < .01**, p < .001***

Multiple Linear Regression

A hierarchical multiple linear regression was conducted with two blocks (**Table 6**). In the first block, TPB constructs were entered into the model and were found to account for a significant amount of the variance in self-reported engagement frequency, $F(5, 212) = 42.69$, $p < .001$, $R^2 = .50$. Cell phone habits were added to this model in the second block, and this resulted in a statistically significant increase in the variance explained, $F(1, 211) = 13.64$, $p < .001$, $\Delta R^2 = .03$. The final model again accounted for a significant amount of the variance in self-reported engagement, $F(6, 211) = 39.97$, $p < .001$, $R^2 = .53$. All TPB constructs were significant except for

descriptive and injunctive norms. As indicated by standardized coefficient estimates, attitudes were found to be the strongest predictor of self-reported engagement, followed by perceived control, self-efficacy, and then habits. Age was not included as a predictor due to sample size limitations.

TABLE 6: Linear Models Predicting Cell Phone Distraction Engagement (Log-Transformed).

	Estimate	Standard Error	Standardized Estimate	t-value	p-value	R^2 (Adjusted R^2)
Block 1						
Intercept	0.96	0.32		3.04	< **.01**	.50 (.49)
Attitudes	-0.26	0.05	-0.36	-4.68	< **.001**	
Self-efficacy	0.12	0.02	0.22	5.68	< **.001**	
Perceived control	0.09	0.03	0.30	3.28	< **.01**	
Descriptive norms	0.02	0.02	0.03	0.55	> .05	
Injunctive norms	-0.001	0.04	-0.003	-0.04	> .05	
Block 2						
Intercept	0.67	0.32		2.14	< **.05**	.53 (.52)
Attitudes	-0.22	0.05	-0.32	-4.17	< **.001**	**ΔR^2 = .03***
Self-efficacy	0.10	0.02	0.21	5.07	< **.001**	
Perceived control	0.09	0.03	0.26	3.24	< **.01**	
Descriptive norms	0.01	0.02	0.02	0.46	0.12	
Injunctive norms	-0.01	0.04	-0.01	-0.16	0.4	
Cell phone habits	0.09	0.03	0.19	3.69	< **.001**	

DISCUSSION

We reported on the analysis of an online survey study examining the role of cell phone habits in predicting self-reported cell phone use while driving. Although previous research has found texting habits to be a significant contributor to self-reported frequency of texting while driving (13), the current analysis extended this finding by examining a broader selection of visual-manual cell phone distractions, such as reading emails, updating social media, and entering an address in a navigation app. In addition, this analysis used a more heterogeneous and representative sample than Bayer and Campbell[13] who recruited undergraduate students from psychology and communication studies classes.

Based on descriptive statistics, the cell phone distractions that were self-reported to be most frequently engaged in were reading a text message, manually entering an address into a navigational app not mounted to the dashboard and talking on a hand-held device. It is interesting to note that manually entering an address on a smartphone had a higher average frequency of engagement than talking on a hand-held phone. Thus, the current results may indicate that patterns of cell phone engagement behind the wheel may be changing with the evolution of cell phones. The two prior studies that investigated the role of habits in cell phone distractions focused specifically on texting (12, 13). However, the capabilities of smartphones are expanding, with drivers being able to use these devices for a variety of tasks other than texting. Thus, it is important to investigate new use cases of these devices within the vehicle.

Similar to Bayer and Campbell[13], we found that habitual cell phone behaviors were significant in predicting self-reported engagement in a selection of cell phone distractions, after controlling for the TPB constructs. Taken together with the results of Bayer and Campbell[13], it appears that habitual cell phone behaviors significantly predict the frequency of self-reported engagement in a variety of cell phone distractions while driving. This finding is important, as it shows that volitional facilitators of cell phone distraction do not fully explain why drivers engage in these distracted driving behaviors. Therefore, public safety awareness campaigns and educational messages that solely focus on challenging driver attitudes, perceived behavioral control, and perceived social norms may not be fully effective in reducing drivers' cell phone use while driving. Instead, such endeavors should also consider the role habits play in cell phone use behind the wheel. Research shows that people are at least aware of the existence of their current habits (27), and as such, drivers could take appropriate measures to combat their cell phone habits if the issue is brought to their attention. Examples of potential countermeasures include features such as the "Do Not Disturb Mode", which blocks all incoming notifications to the phone. This may be an effective countermeasure, as it removes cues that likely trigger habitual cell phone use (e.g. checking your phone in response to receiving a notification).

In general, we found that TPB constructs explained 50% of the variance in self-reported engagement frequency in cell phone-related distractions. In addition, attitudes, self-efficacy, and perceived control were significant predictors, with attitudes being the strongest, followed by perceived control and then self-efficacy. This result is in line with the findings from Chen et al[14], who reported that TPB accounted for 45% of the variance in self-reported engagement in distractions (including distractions other than cell phone-related ones), with attitudes and perceived behavioral control as measured through self-efficacy being the strongest predictors. Although descriptive norms were found to be significant by Chen et al[14], they were not significant in our analysis. This discrepancy may be due to the different distraction items used in our analysis. For example, in their analysis, Chen et al[14] combined legal (e.g., talking to passengers) and illegal distractions, whereas we only focused on illegal ones. Drivers may perceive legal distractions to be more common and socially acceptable; thus, perceptions of others' engagement in these distractions may be more likely to influence drivers' own engagement. Similar to our study, injunctive norms were not found to be a significant predictor in Chen et al[14], indicating that, although North American drivers appear to think that important others would not approve of them engaging in cell phone-related distracted driving, this may have no influence on their self-reported behavior. This result differs from Bayer and Campbell[13], who found norms to be significant in predicting self-reported texting while driving; however, they used a composite measure of norms, including moral, group, and injunctive norms. Thus, it is difficult to interpret which aspect of norms may have influenced behavior in Bayer and Campbell[13]. Future studies should make an effort to investigate these different aspects of social norms separately.

Limitations and Future Research

We acknowledge that the reported dataset is vulnerable to self-report bias and the non-random sampling methods used in online surveys. Given that cell phone-related distractions are largely banned, it is possible that the respondents were influenced by social desirability bias to respond in a manner that reflected them in a more positive light. This influence of social desirability may in part account for the low frequencies we found for self-reported engagement in cell phone distractions. Online surveys have been found to reduce the effects of social desirability bias due to their remote nature (28). However, Bayer and Campbell[13] found similarly low engagement

frequencies for reading and sending text messages in their study (equating to "rarely"), where participants completed a survey in a laboratory environment. Thus, it is unclear how much the online format helped with counteracting the social desirability bias for our survey. It is also possible that both our and Bayer and Campbell's[13] participants underestimated their cell phone use while driving, which may in part be attributable to our finding that cell phone use can be habitually driven. Regardless of the underlying reason, it is possible and maybe likely that there was underreporting, given that at any given daylight moment in 2017, 5.3% of U.S. drivers were estimated to be manipulating handheld electronic devices while driving (3). Naturalistic studies provide the best avenue for estimating drivers' actual cell phone use, and thus, one potential avenue for future research is to see whether the TPB constructs, as well as cell phone habits, predict actual frequencies of cell phone use in real-world driving.

Finally, we also recognize that our results and discussion about the psychological variables used in this analysis are limited to the extent that the scales we employed measured them accurately and completely. While it is hard to ensure a measure ever achieves this entirely, we started with an already validated tool (e.g. SDDQ) and further revised it from lessons learned developing this tool. We also only report data collected for an urban driving scenario. Drivers often report engaging in cell phone-related distractions when they perceive driving conditions to be less demanding and safer (e.g. when stopped at a red light; 29, 30); thus, future studies should also consider different driving environments. In a rural environment where driving demands are lower, habitual cell phone use may play a larger role in triggering drivers to engage in further distractions.

CONCLUSION

The role of habitual cell phone use in influencing drivers' self-reported engagement in a variety of cell phone distractions was examined. It was found that habitual cell phone use accounted for unique additional variance in self-reported engagement above and beyond voluntary engagement as measured by TPB. This study adds to the literature by replicating the findings of Bayer and Campbell[13] with a broader selection of cell phone distractions and a more diverse sample of participants.

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AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows -- study conception and design: Marulanda, Chen, Donmez; data collection: Marulanda, Chen; analysis and interpretation of results: Hansma, Marulanda, Chen, Donmez; draft manuscript preparation: Hansma, Marulanda, Chen, Donmez. All authors reviewed the results and approved the final version of the manuscript.

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