Applying the Health Belief Model to mobile device distracted driving

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CONTENTS

ABSTRACT

Introduction: The advancement of mobile devices has resulted in constant connectivity, but at the expense of traffic safety. The goal of this study was to apply the Health Belief Model to understand the barriers preventing drivers from driving without manipulating their devices, and what they perceived would motivate them to stop driving distracted.

Methods: We conducted a nationwide survey of 2,013 U.S. licensed drivers. Participants indicated how much they agreed with or supported 63 statements and concepts pertaining to the Health Belief Model constructs of threats, barriers, benefits, and cues to action related to manipulating devices while driving. Heath Belief Model constructs were compared between distracted drivers, or those who regularly did (during most or all drives in the previous 30 days) one or more mobile device tasks, and non-distracted drivers. Logistic regression evaluated the relationship between Health Belief Model constructs and distracted driver designation.

Results: Those who agreed more with threats (odds ratio [OR], 1.61; 95% confidence interval [CI], 1.27, 2.04) and disagreed more with barriers to stopping (OR, 0.36; 95% CI, 0.31, 0.41) were more likely to not drive distracted. Work, information, and convenience were significantly larger barriers for distracted drivers, and information, urgent, and interpersonal tasks or communications were the top barriers for distracted drivers overall. Distracted drivers felt most strongly that intrapersonal, interpersonal, and policy cues would motivate behavior termination, and more support of technological countermeasures was associated with regularly driving distracted after controlling for support for policy and organizational countermeasures.

Conclusions: Simultaneously increasing threat perceptions, targeting the top barriers identified, and implementing policy-, interpersonal-, and technological-based countermeasures may encourage device-free driving.

Practical Applications: When designing interventions or programs, state highway safety offices should find new ways to increase threat perceptions and offer solutions to the barriers most cited by distracted drivers.

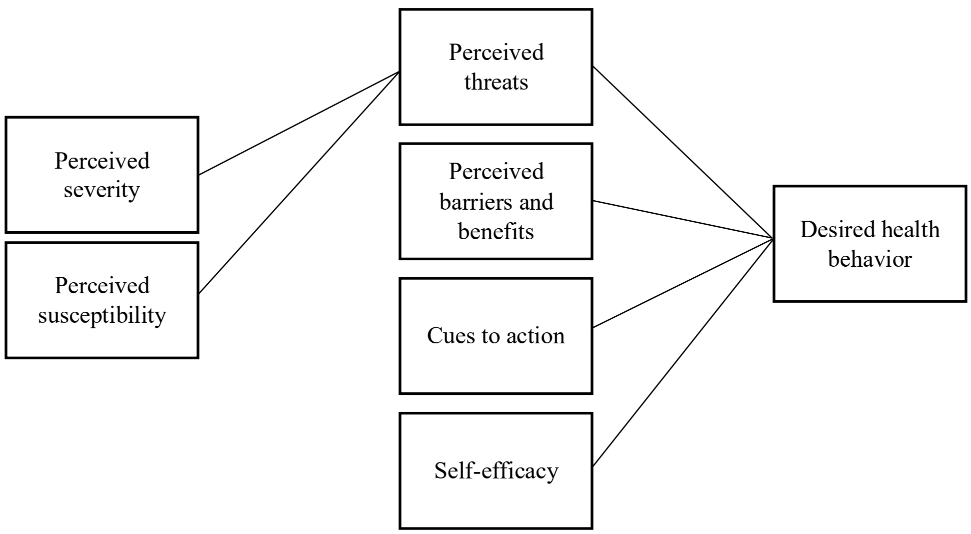
Keywords: mobile devices; Health Belief Model; distracted driving; countermeasures

1. INTRODUCTION

Today's mobile devices have opened doors for enhanced communication, connection, and entertainment. With increased capabilities comes more frequent use, even at times like while driving when it is unsafe or illegal. Half of U.S. drivers from a nationally representative survey conducted in 2022 reported regularly doing at least one device-based task while driving in the prior month (Cox, Cicchino, Reagan, & Zuby, 2022), and results from a naturalistic driving study indicated observable distraction occurred in half of baseline observations (Dingus et al., 2016). Distracted driving has become an endemic traffic safety and public health concern because diverting attention away from driving to a secondary task can degrade driving performance and increase crash risk (Choudhary, Pawar, Velaga, & Pawar, 2020; Dingus, 2014; McCartt, Hellinga, & Braitman, 2006). Among common secondary tasks, those that require the driver to manipulate the device and take their eyes off the road have been consistently found to be associated with the highest risk of crashing in naturalistic driving studies (Dingus et al., 2016; Guo et al., 2017; Kidd & McCartt, 2015; Klauer et al., 2014; Owens et al., 2018) and with rear-end crashes in simulator studies (Chen, Fu, Xu, & Yuan, 2020; Fu, Chen, Xu, Guo, & Yuan, 2020) compared with non-distracted driving. Efforts to find how to best encourage the termination of distracted driving behavior are warranted, given the new capabilities afforded by modern devices and the increase in drivers seen manipulating cellphones in roadside studies (Kidd & Chaudhary, 2019; National Center for Statistics and Analysis, 2021).

The Health Belief Model (HBM) is a behavioral change theory developed to understand the failure of some to adopt a desired health behavior and is usually applied to illness or disease prevention (Boston University School of Public Health, 2019), but is applied in the current study to any adverse outcome from using a mobile device while driving. The developers of the model (depicted in Figure 1) theorized that the likelihood a person adopts a desired health behavior can be predicted by their personal beliefs in a particular threat coupled with their belief in how effective the recommended action is at reducing a given risk. The threat construct is comprised of perceived severity (e.g., how severe an injury or crash might be from distracted driving) and susceptibility (e.g., the likelihood of injury or crash involvement from distracted driving). Perceived benefits refer to one's perception that adopting the desired health behavior will effectively reduce the threat of undesirable outcomes and are reduced by perceived barriers. Perceived barriers are obstructions to one performing a desired health behavior. Cues to action are stimuli that can generate the motivation to adopt the desired health behavior. The most recent construct added to the model is self-efficacy, or one's belief in their ability to successfully perform the desired health behavior.

Figure 1. The Health Belief Model.



Note. Source: "Social Learning Theory and the Health Belief Model," by I. M. Rosenstock, V. J. Strecher, and M. H. Becker, 1988. *Health Education Quarterly*, *15*(2), 175–183. https://doi.org/10.1177/109019818801500203

Constructs of the HBM have been partially incorporated into studies to address distracted driving behavior; researchers who incorporated these constructs more comprehensively did so among subsets of the population. For example, the cues to action construct has been researched among teen drivers, including by Adeola, Omorogbe, & Johnson (2016), who explored changes in distracted driving behaviors and attitudes following participation in a message campaign, and by Pope, Mirman, &

Stavrinos (2019), who surveyed drivers ages 15–19 years on their support for distracted driving laws. Watters & Beck (2016) more broadly applied the HBM constructs to address distracted driving but limited the study population to college students. To our knowledge, a nationally representative survey using the HBM more comprehensively to understand the failure of some to drive without manipulating their mobile devices has not been done. The purpose of this study was to apply the original constructs of the HBM to the behavior of mobile device-based distracted driving, with the primary goals of understanding the barriers preventing drivers from not driving distracted, what countermeasures drivers perceive will encourage them to stop their distracted driving behaviors, and the level of support for various countermeasures. This study concentrated on the original constructs of threats, barriers, benefits, and cues to action as these are the areas we feel are most relevant to designing countermeasures.

2. METHOD

This survey was designed to collect data on secondary task prevalence and beliefs towards distracted driving; it was also designed to gauge support for distracted driving countermeasures and their perceived efficacy. The first paper published with data from the survey focused on the prevalence of secondary tasks, defined regular use, and used logistic regression to estimate the odds of regular use while driving by driver characteristics (Cox et al., 2022). The current paper reports on beliefs towards distracted driving, barriers to device-free driving, and possible countermeasures. Advarra's Institutional Review Board approved the study instrument and protocol.

2.1 Participant recruitment and eligibility criteria

As detailed in Cox et al. (2022), OpinionAmerica Group, LLC, conducted the survey among U.S. drivers in February and March 2022. Participants were required to be licensed drivers who could drive without a parent or guardian (i.e., graduated from a learner's permit), be aged 16 or older, drive at least a few days a month, and own a cellphone. The sample was constructed to be representative of the U.S. population based on census region, age, and gender distributions using 2020 Census data (United States

Census Bureau, 2020). We implemented a mixed-modal methodology where 30% of completed surveys were drawn from national landline and cellphone records, sourced using a sample partner of OpinionAmerica group. The remaining 70% were web-based participants who were recruited with an online marketplace that primarily uses double opt-in paneling.

A total of 9,628 prospective candidates were reached by phone, of whom 8,894 refused participation. Among the 734 who agreed, 602 were included in the final sample. The remainder were ineligible or refused the eligibility screening questions (n = 126), self-terminated prior to survey completion (n = 3), were excluded to meet demographic quotas (n = 2), or were rejected due to quality control concerns (n = 1). An additional 2,780 drivers were contacted through the online web panel sourcing, with 1,411 included in the final sample. Other potential participants were ineligible or refused the eligibility screeners (n = 916), opened the link but declined consent (n = 345), self-terminated before finishing the survey (n = 56), were excluded to meet demographic quotas (n = 7), or were rejected because of quality control concerns (n = 45). The final sample consisted of 2,013 surveys and took on average 20 minutes for participants to complete. We did not offer compensation for participating.

2.2 Survey items and analysis

The current paper analyzes 63 survey questions where participants were asked to consider using their cellphone in ways that required hand-held manipulation while driving when indicating their agreement with various statements or support for interventions. The options were:

1. Strongly disagree/strongly oppose,
2. Somewhat disagree/somewhat oppose,
3. Neither agree nor disagree/neither support nor oppose,
4. Somewhat agree/somewhat support, and
5. Strongly agree/strongly support.

We categorized the questions by HBM construct to create four aggregate categories indicating levels of agreement with (1) barriers, (2) benefits, (3) threats, and (4) cues to action. A fifth category aggregated level of support for cues to action. Barriers include some common reasons why it might be difficult to drive without manipulating a mobile device, while benefits involve positive outcomes associated with driving without this type of distraction. Threats relate to risks associated with manipulating devices while driving. Cues to action statements provided examples of countermeasures designed to encourage people to drive without manipulating their mobile devices. We reverse coded three statements in the threat subcategory so that a higher score would reflect greater agreement that distracted driving is risky. For each aggregate variable, we calculated Cronbach's alpha and mean level of support or agreement.

We broke the aggregate HBM construct variables further into subcategories based on common themes. Cues to action can be internal or external, so we introduced the socioecological framework (Bronfenbrenner, 1977) to categorize questions by intrapersonal (specific to the individual), interpersonal (others in the individual's immediate network, like family or friends), organizational (the individual's work, school, social clubs, places of worship, etc.), community (the individual's societal and cultural norms), and policy (legislation and enforcement) factors, along with messages and technology. There was one question each on agreement with and support for organizational cues to action, and the remaining categories were comprised of multiple questions. We separated the aggregate barriers into themes of work, interpersonal, information, boredom, urgency, pressure, and convenience. We calculated aggregate means and Cronbach's alpha for each cue to action and barrier subcategory when it included more than one question. Table 1 displays the mean response and percent in agreement with or support of each statement or concept and Cronbach's alphas.

We additionally asked participants to rate how often they had performed a variety of secondary tasks while driving in the past 30 days using a 5-point Likert scale (1 = "every time I drive"; 2 = "most of the times I drive"; 3 = "some of the times I drive"; 4 = "rarely"; 5) = "never"). In Cox et al. (2022), drivers were considered to regularly perform device-based distractions while driving if they self-reported engaging in one or more of 14 secondary tasks involving electronic devices (listed in the Appendix) while driving during most or every drive in the prior 30 days. In this paper, we made comparisons between the 50% of drivers sampled who regularly engaged in device-based distractions while driving, also referred to in this paper as distracted drivers, and those who did not. *T* tests compared mean levels of agreement with or support for HBM aggregate categories and subcategories between these groups.

Three logistic regression models estimated the relationship between level of agreement with the HBM statements and the desired health behavior of not regularly performing device-based tasks while driving. The first model included predictors for the four HBM aggregate categories (barriers, benefits, threats, cues to action). Because we were interested in the relationship of specific types of barriers and cues to action with device-based distracted driving, two additional models included the major HBM categories plus the barrier subcategories (Model 2) or the cues to action subcategories (Model 3). A fourth logistic regression model examined the association of level of support for cues to action with not regularly using mobile devices while driving.

Cox et al. (2022) reported that regular device-based distraction while driving was most common among drivers under age 35, parents of children ages 18 or younger, and those who drive in the gig economy compared with other drivers. We calculated mean level of agreement with the cues to action and barrier subcategories for the participants who regularly performed device-based tasks while driving (n = 1,006) by age, parental status, and gig-economy employment to see if perceived barriers and cues to action varied by these demographics.

We used SAS 9.4 for all analyses and considered statistical significance at the $\alpha = 0.05$ level.

3. RESULTS

The mean response and percent in agreement with or support of each statement or question, and the categorized statements, means, and Cronbach's alphas are in Table 1. The sample agreed there are threats associated with manipulating mobile devices while driving (*M* = 4.12). The individual threat statements that received the strongest agreement were "the potential consequences that best motivate me to not use a mobile device while driving are … injury to others" (*M* = 4.42, 84%) and "ticket or other legal penalty" (*M* = 4.32, 83%), followed by "crashes from distracted driving cause major injuries and/or vehicle damage" (*M* = 4.31, 82%). The sample felt neutral that the barriers to driving without mobile-device distractions applied to them (*M* = 2.42) but being lost or in need of directions (*M* = 3.23, 53%) and if the call or text is family related (*M* = 2.98, 46%) were the top barriers cited. Overall, the sample agreed there are benefits to not driving distracted (*M* = 4.17), with most agreement with the benefit of fewer road injuries and fatalities (*M* = 4.26, 81%), followed by fewer crashes (*M* = 4.24, 81%), feeling safer on roads (*M* = 4.20, 77%), and decreased insurance costs (*M* = 3.97, 71%).

The sample perceived that the provided cues to action would motivate their behavior change, with a mean score of 4.02 (Table 1). Participants felt that interpersonal (*M* = 4.20), intrapersonal (*M* = 4.14), and policy (*M* = 3.99) cues would be the strongest motivators to not drive distracted. The highest rated cue overall fell under the interpersonal category, with 83% agreeing that they perceived hearing "you could hurt or kill someone" from someone they care about as motivating. Most of the sample perceived the organizational countermeasure relating to work and the two community-based countermeasures as efficacious, but least strongly perceived messages to motivate a change in their distracted driving behavior (*M* = 3.36).

Of support for countermeasures (Table 1), school campaigns designed to reduce distraction mirroring drinking and driving awareness received the strongest support in the sample (*M* = 4.22, 77%), followed by increased law enforcement targeting mobile device use while driving (*M* = 3.96, 69%). When asked about the use of distracted driving detection and enforcement cameras, support was slightly higher for using them to alert an officer who is present and could issue a ticket at the time of the offense (M = 3.61, 57%) versus receiving the fine in the mail (M = 3.47, 53%). Among support for technology, the strongest was for using a cellphone blocker that would block incoming notifications and disable other device functions, such as Apple iPhone's Do Not Disturb While Driving, that would automatically turn on each time the participant was in their vehicle with 66% supporting (M = 3.87). Most of the sample expressed interest in having a driver monitoring system on the next vehicle they purchase (61%). Participants indicated more support for using an app that tracked mobile device use and provided feedback on the safety of the drive if offered rewards for use.

Table 2 displays mean scores for HBM aggregate and subcategory variables for participants who regularly drove while using mobile devices and those who did not, and the p values from the t tests comparing means between the two groups of drivers. Drivers who regularly performed device-based tasks while driving indicated stronger agreement with the barriers preventing them from not driving distracted, with information, urgency, and interpersonal reasons for using devices while driving rating highest. Distracted drivers agreed less that there are benefits to not driving distracted and with the threats associated with doing so. Only cues to action involving messaging were rated higher by distracted drivers (M = 3.44) compared with non-distracted drivers (M = 3.29), but distracted drivers perceived messages as least efficacious.

Table 3 displays results from the four logistic regression models predicting the relationship between agreement with or support for the HBM constructs or subcategories and the desired health behavior (not regularly driving distracted).

In Model 1, each unit increase in agreement with the threats of distracted driving was associated with 61% higher odds of not regularly driving distracted by mobile devices. Each unit increase in agreement with barriers was associated with 64% lower odds of not regularly driving distracted (these drivers disagreed more with the barriers to non-distracted driving). There were no statistically significant differences in level of agreement with the benefits and cues to action variables between the two groups of drivers. In Model 2, for each unit increase in agreement with barriers related to work, the need for information, and convenience, the odds of not regularly driving distracted by mobile devices were 44%, 19%, and 12% lower, respectively. No significant associations were found between agreement with interpersonal, boredom, urgency, or pressure barriers and distracted driving behavior.

Under Model 3 (Table 3), each unit increase in agreement with the interpersonal and policy categories was associated with 21% and 41% higher odds, respectively, of not regularly driving while distracted by devices. Conversely, each unit increase in agreement with the messages category was associated with 27% lower odds of not regularly driving distracted by mobile devices. Level of agreement with the perceived efficacy of intrapersonal, organizational, and community cues to action were not significantly associated with distracted driving behavior. In Model 4, drivers who do not regularly drive distracted by mobile devices were more likely to support organizational and policy countermeasures but indicated more opposition to technology countermeasures than those who regularly engaged in one or more device-based secondary tasks while driving.

When examining cues to action among distracted drivers by the high-risk demographics identified in Cox et al. (2022), patterns were like those identified among the whole sample of distracted drivers, with intrapersonal, interpersonal, and policy countermeasures generally perceived as the strongest motivators of distracted-driving behavior change. The barrier patterns identified among distracted drivers under age 35 and parents were also unchanged from those identified in the sample of distracted drivers, with information, urgency, and interpersonal barriers as the top reasons they drive while using mobile devices. However, we identified a different barrier pattern among gig workers, who ranked information needs as their top barrier, followed by work, and then urgency.

4. DISCUSSION

Drivers who regularly drove distracted by mobile devices downplayed the threats of manipulating them while driving and agree more strongly that there are barriers that prevent them from stopping, relative to those who did not regularly use mobile devices while driving. Other studies have also found many drivers underestimate the risks of driving distracted (Durant, Lawson, Schubnell, & Wolf, 2016; Ehrlich, Costello, & Randal, 2020; Oviedo-Trespalacios, King, Haque, & Washington, 2017; Shoots-Reinhard, Svensson, & Peters, 2021), so better communicating the threats while finding new ways to address the commonly identified barriers may be productive in reducing roadway mobile-device distractions. Stakeholders should prioritize finding solutions for needing information while driving, as this was the top barrier cited by distracted drivers, and stronger agreement with this barrier was predictive of regularly driving distracted by devices.

In addition to needing solutions for information needs, distracted drivers also considered urgent and interpersonal communications as the other top barriers, and stronger agreement with work and convenience barriers significantly predicted distracted driving. Implementing countermeasures that incorporate interpersonal and policy cues to action are the most feasible of the three that distracted drivers felt would be the strongest motivators to not drive distracted, which could then indirectly strengthen intrapersonal, or internal cues, over time. Distracted drivers reported less support than others for organizational and policy countermeasures, but not for technological countermeasures, which suggests that technological countermeasures should also continue to be pursued. Distracted drivers didn't feel that messages would be the strongest of the motivators; however, this was the only cue to action category that distracted drivers perceived as more efficacious in encouraging behavior change than non-distracted drivers. Drivers in both groups agreed there are benefits to not driving distracted, and agreement with the benefits was not predictive of distracted driving behavior.

Drivers who regularly drove distracted consistently agreed interpersonal reasons are a top barrier and also perceived that interpersonal cues to action would be among the most effective in changing their behavior. This presents an opportunity for stakeholders to simultaneously target two demographics identified by Cox et al. (2022) as high risk through interpersonal approaches—parents and younger drivers. Durant et al. (2016) suggested parents and peers are most influential in changing the distracted driving behaviors of teens, while Shevlin and Goodwin (2019) found college students who had strong subjective norms, or who had a sense that others would disapprove of them texting and driving, had less intent to do so. However, most parents who participated in a focus group had no prior discussions with their teens on distracted driving (Ehrlich et al., 2020). Teen distracted-driving behavior is strongly associated with perceptions of what their parents do (Bingham, Zakrajsek, Almani, Shope, & Sayer, 2015), and parents have admitted to doing a variety of secondary tasks while driving when their teens are in the vehicle (Ehrlich et al., 2020).

Parents should set positive examples for their children of all ages by exhibiting safe driving behaviors and should communicate expectations and consequences regarding distracted driving and other unsafe behaviors when their teen is driving (National Highway Traffic Safety Administration [NHTSA], 2022). Parents could also consider entering parent-teen driving agreements with their licensed teen (NHTSA, 2022), as one study found that teen involvement in a program that included such contracts was associated with more reported driving restrictions and less high-risk driving relative to teens that did not participate (Zakrajsek et al., 2013). Evaluators of the “Drive Smart” program, which was designed to attract parents to download a distracted-driving tool kit to use with their teen driver, found that both teens and parents felt aspects of the program, including the parent-teen driving contract, were beneficial (Ehrlich et al., 2020). Video resources that illustrate the associated threats of distracted driving have also been used (Adeola et al., 2016; Ehrlich et al., 2020). Collectively, these countermeasures may help reduce the interpersonal barriers identified by both younger drivers and parents.

Work-related barriers were significantly associated with regularly driving distracted and distracted drivers who worked in the gig economy cited work demands as a top barrier, so organizational countermeasures within the workplace can be a tool used to encourage safe workplace driving behavior. We only asked about driving for the gig economy, but since many other sectors require drivers, it is reasonable to think that others who drive for work may feel pressure to respond to notifications when driving. Companies that utilize drivers could institute policies surrounding expectations of work-related device use while driving to address this barrier. Though a slight majority of drivers in this sample felt workplace countermeasures would motivate their behavior change, organizational pledges to not drive distracted were favored by 87% of drivers in another study (Shoots-Reinhard et al., 2021).

A variety of resources are available to companies considering implementing a workplace safe-driving policy. The National Institute for Occupational Safety and Health provides a fact sheet (www.cdc.gov/niosh/docs/2015-111/default.html) that contains tips and a checklist for implementing a successful workplace program. Another resource is from the National Safety Council, where companies can download a tool kit with materials to help develop and communicate a policy to their drivers (www.nsc.org/road/safety-topics/distracted-driving/distracted-driving-for-employers?). Companies looking for policy templates can reference the National Distracted Driving Coalition to find examples of a no-touch policy, which discourages all use of electronic communication devices while driving, and a one-touch policy, which can be useful for positions that rely on mobile connectivity and permits hands-free and voice commands (www.usnddc.org/communication-devices-workplace-policies/).

Cellphone blockers, like Apple's "Do Not Disturb," are widely available and may aid distracted drivers by removing the temptation to respond to notifications by temporarily blocking messages and informing the sender that the message recipient is driving. Most of our sample supported a blocking feature that does not require the user to opt in and would automatically turn on each time the driver is in their vehicle. This change could lead to increased use from the one in five iPhone users that reported having opted in to the "Do Not Disturb While Driving" feature in a survey conducted during 2018

(Reagan & Cicchino, 2020). Drivers have indicated a willingness to use cellphone blockers to relinquish some features like texting, but there is more unwillingness to have these functions block GPS and music-streaming capabilities (Delgado et al., 2018; Oviedo-Trespalacios, Williamson, & King, 2019; Oviedo-Trespalacios, Vaezipour, Truelove, Kaye, & King, 2020). Blockers may go unused if they restrict all device functions or the ones drivers are less willing to give up, and developers should consider that navigation systems can assist in the driving task (Dingus, 2014) if drivers refrain from programming their routes while driving. How these tools are marketed could impact use, as one study found “apps or settings that help you drive without using your phone” were more favorable than “apps or settings that prevent you from using your phone while driving” (Shoots-Reinhard et al., 2021).

Though not yet as widespread as blockers, driver monitoring systems are another form of technology that show promise in reducing driver distractions by ensuring the driver’s hands are on the steering wheel, their eyes are focused ahead on the road, or both. Sixty-one percent of our sample indicated interest in their next vehicle having a driver monitoring system to track and alert the driver when their eyes have been off the road for too long, which is similar to Shoots-Reinhard et al. (2021) who found 63% of their participants would support eye-tracking technology to alert the driver when they are distracted.

Non-distracted drivers indicated more support for policy countermeasures and had stronger agreement they would motivate behavior change, yet distracted drivers agreed these countermeasures would motivate their behavior change too. Another study found 83% of drivers were in favor of legislation that prohibits device use while driving (Shoots-Reinhard et al., 2021). States considering implementing distracted driving legislation should prioritize laws that are strong and comprehensive to be most effective and enforceable (Reagan, Cicchino, Teoh, & Cox, in press; Zhu et al., 2021). About half of drivers in our sample supported using cameras to detect distracted driving, with a ticket being sent by mail (53% support) supported slightly less than if issued from an officer on scene (57% support). This level of support is marginally lower than that for other forms of camera enforcement, with 62% of

Montgomery County, MD, residents favoring speed cameras (Hu & McCartt, 2016) and 66% of drivers from 14 cities supporting their jurisdiction's red-light-camera enforcement program (McCartt & Eichelberger, 2012). Cameras for distracted driving enforcement do not yet exist in the United States, so a lack of familiarity of the concept could have impacted responses.

This study has limitations worth noting. We attempted to balance collecting data on a variety of potential barriers and cues to action with limiting the number of questions asked to avoid respondent fatigue. That said, there may be additional barriers that exist and countermeasures that may have been thought to be effective that went uncaptured. Since we posed our cue to action questions as hypotheticals, implementing the countermeasures that drivers perceived as effective does not guarantee that they will reduce or stop manipulating their devices while driving in response to such countermeasures.

5. CONCLUSIONS

The individual HBM constructs work collectively to influence a person to adopt a desired health behavior, so efforts to reduce distracted driving using these findings should favor a multifaceted approach over using only one model construct. Among the cues to action construct, this nationwide sample of distracted drivers perceived interpersonal and policy countermeasures to be among the most effective at motivating the termination of their distracted driving behavior. More support for using technology to reduce distracted driving from mobile devices was associated with regularly driving distracted when accounting for support for other countermeasures. Participants who regularly drove distracted downplayed the associated threats and agreed more strongly with the barriers preventing them from stopping, with the top barriers relating to interpersonal or urgent communications and information needs.

6. PRACTICAL APPLICATIONS

When designing interventions or programs, highway safety offices and related stakeholders should find new ways to increase threat perceptions and provide solutions to the top barriers distracted drivers identified and the barriers of work demands, interpersonal needs, and convenience that distracted drivers had higher odds of agreeing with relative to non-distracted drivers.

7. ACKNOWLEDGEMENTS

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8. TABLES

Table 1. Means (SD) and percent in agreement or support among individual statements and means (SD) and Cronbach α for agreement and support scales and subscales, entire study population (n = 2,013).

Scale	Mean (SD)	Agree or support (%)
Threats, agree (Cronbach α = 0.90)	**4.12 (0.71)**	
Severity		
Crashes from distracted driving cause major injuries and/or vehicle damage	4.31 (1.00)	82
Driving while using a mobile device is just as dangerous as driving under the influence of alcohol or other drugs	3.99 (1.20)	73
Driving while using a mobile device is just as dangerous as speeding 15 mph over the speed limit	3.96 (1.16)	71
I am afraid of seriously hurting myself or others when I drive while using a mobile device	4.03 (1.20)	71
The potential consequences that best motivate me to not use a mobile device while driving are …		
Receiving an injury that would take a long time to recover from	4.28 (1.00)	80
Receiving an injury that I would recover from quickly	3.98 (1.15)	70
Susceptibility		
Driving while using a mobile device increases my risk of crashing	4.27 (1.13)	81
The potential consequences that best motivate me to not use a mobile device while driving are …		
Injury to others	4.42 (0.95)	84
Ticket or other legal penalty	4.32 (0.95)	83
Damage to my vehicle	4.30 (0.99)	81
Points on my license	4.27 (0.98)	81
The financial cost of being in a crash	4.20 (1.04)	77
I am willing to take the risk of driving while using a mobile device [a]	3.85 (1.30)	64
Using a mobile device while driving doesn't make me a less safe driver [a]	3.80 (1.32)	63
I can drive while using a mobile device because I have done it successfully so far [a]	3.78 (1.32)	61
Barriers, agree (Cronbach α = 0.94)	**2.42 (1.03)**	
Information (Cronbach α = 0.80)	**3.02 (1.29)**	
I am most likely to use a mobile device while driving if I'm lost or in need of directions	3.23 (1.43)	53
I am most likely to use a mobile device while driving if I need information other than directions	2.80 (1.39)	37
Urgency		
I am most likely to use a mobile device while driving if there's a time sensitive or important matter	2.78 (1.42)	36
Interpersonal (Cronbach α = 0.84)	**2.36 (1.11)**	
I am most likely to use a mobile device while driving if the call, text, or email is family related	2.98 (1.46)	46
I am most likely to use a mobile device while driving if the call text, or email is from or to a friend	2.48 (1.38)	27
I am afraid of missing out with family or friends	2.01 (1.30)	16
I feel a need to be socially connected while driving	1.96 (1.27)	15
Convenience		
I use a mobile device while driving because it is inconvenient to pull over	2.29 (1.38)	24
Work (Cronbach α = 0.81)	**2.24 (1.18)**	
I am most likely to use a mobile device while driving if the call, text, or email is work related	2.45 (1.41)	28
I need to always be available for work	2.27 (1.41)	24
I need to use a mobile device in my vehicle for gig work (Uber, Lyft, Instacart)	2.00 (1.33)	18
Pressure		
I feel pressure to respond to people immediately, even when driving	2.14 (1.31)	20
Boredom		
I am most likely to use a mobile device while driving if I'm bored	1.97 (1.28)	16
Benefits, agree (Cronbach α = 0.88)	**4.17 (0.89)**	
If there was no mobile device use while driving, there would be fewer road injuries and fatalities	4.26 (0.99)	81
If there was no mobile device use while driving, there would be fewer crashes	4.24 (1.00)	81
If there was no mobile device use while driving, I would feel safer on our roads	4.20 (1.04)	77
If there was no mobile device use while driving, insurance costs might decrease	3.97 (1.13)	71
Cues to action, agree (Cronbach α = 0.94)	**4.02 (0.73)**	
Intrapersonal (Cronbach α = 0.92)	**4.14 (0.85)**	
I want to stop using mobile devices while driving because I do not want to be in a crash	4.29 (0.99)	79
I want to stop using a mobile device while driving because I want to be a safe driver	4.25 (0.98)	79
I want to stop using mobile devices while driving so I can protect myself and my loved ones	4.24 (1.02)	77
I do not want to drive while using a mobile device	4.18 (1.07)	76
I want to stop using a mobile device while driving because it is the right thing to do	4.18 (1.04)	75
I want to stop using mobile devices while driving because it is disrespectful to other road users	4.12 (1.07)	73

Scale	Mean (SD)	Agree or support (%)
If I knew I was using a mobile device while driving because I was addicted to it, I would be motivated to not use my mobile device while driving	3.75 (1.22)	60
Interpersonal (Cronbach α = 0.90)	**4.20 (0.83)**	
I would not want to drive distracted if people I care about said to me…		
You could hurt or kill someone	4.35 (0.98)	83
You could cause a crash	4.31 (0.98)	82
Using your mobile device while driving isn't safe	4.29 (0.99)	81
It's not worth the risk	4.29 (1.02)	80
I don't feel safe when you drive me while using your mobile device	4.14 (1.11)	76
Using your mobile device while driving is against the law	4.17 (1.09)	75
You tell me not to do it but you're doing it	3.84 (1.22)	63
Organizational	-	
If my employer asked me to not use my mobile device for work while driving, I would be motivated to not use my mobile device while driving	3.82 (1.18)	62
Community (Cronbach α = 0.76)	**3.74 (1.07)**	
If using a mobile device while driving was as socially unacceptable as driving under the influence of alcohol or other drugs, I would be motivated to not use my mobile device while driving	3.80 (1.20)	61
If I knew I used a mobile device while driving more than the average person or my peers, I would be motivated to not use my mobile device while driving	3.67 (1.18)	55
Policy (Cronbach α = 0.83)	**3.99 (0.98)**	
If my risk of receiving a ticket from the police for mobile device use was high, I would be motivated to not use my mobile device while driving	4.04 (1.10)	71
If the fine for receiving a ticket from the police for mobile device use while driving was $200 or more, I would be motivated to not use my mobile device while driving	4.03 (1.13)	71
If the legal penalties associated with driving while using a mobile device were just as harsh as those for driving under the influence of alcohol or other drugs, I would be motivated to not use my mobile device while driving	3.89 (1.18)	64
Messages (Cronbach α = 0.68)	**3.36 (1.11)**	
If I heard or saw a message or ad suggesting safer ways to interact with my mobile device, such as programming your directions or playlist before beginning the drive, I would be motivated to not use my mobile device while driving	3.55 (1.21)	54
If I heard or saw messages or ads from celebrities or famous athletes telling people not to drive while using a mobile device, I would be motivated to not use my mobile device while driving	3.18 (1.32)	39
Cues to action, support		
Organizational		
How would you feel about school campaigns against mobile device use while driving, similar to those conducted to raise awareness about drunk driving?	4.22 (1.03)	77
Technology (Cronbach α = 0.83)	**3.75 (0.95)**	
Many mobile phones have a "do not disturb" feature that silences calls and texts while the mobile phone is connected to a vehicle's Bluetooth or when the device detects you may be driving, but the user has to turn on the feature. How would you feel about using a "do not disturb" feature on your mobile device if it automatically turned on each time you were in your car?	3.87 (1.16)	66
How would you feel about using an app that tracks your mobile device use while driving if you were rewarded in ways other than insurance company discounts?	3.80 (1.21)	64
How would you feel about using an app that tracks your mobile device use while driving if your insurance company discounted your rates for not using your mobile device while driving?	3.78 (1.26)	63
For my next vehicle, I would be interested in purchasing one that is equipped with a driver monitoring system, which is designed to monitor the driver's eyes and alert the driver when their eyes have been off the road for too long.	3.71 (1.24)	61
How would you feel about using an app that tracks your mobile device use while driving and provides feedback on how safe your trip was when you arrive at your destination?	3.59 (1.26)	55
Policy (Cronbach α = 0.84)	**3.68 (1.10)**	
How would you feel about…		
An increase in law enforcement targeting mobile device use while driving	3.96 (1.16)	69
Use of distracted driving detection cameras in your community, officer at scene	3.61 (1.28)	57
Use of distracted driving detection cameras in your community, fine by mail	3.47 (1.35)	53

Note. SD = standard deviation. Higher means indicate stronger agreement or support on a scale of 1 to 5.

[a] Designates the scale was reverse coded.

Table 2. Mean (SD) responses of Health Belief Model aggregate variables by device-based distracted driver designation.

Health Belief Model variable	Device-based distracted driver		*p* value
	Yes, mean (SD) (n = 1,006)	No, mean (SD) (n = 1,007)	
Barriers	2.93 (0.98)	1.90 (0.80)	<.0001
Work	2.83 (1.17)	1.66 (0.86)	<.0001
Interpersonal	2.87 (1.12)	1.86 (0.85)	<.0001
Information	3.46 (1.15)	2.57 (1.28)	<.0001
Boredom	2.44 (1.43)	1.51 (0.90)	<.0001
Urgency	3.26 (1.34)	2.30 (1.33)	<.0001
Pressure	2.68 (1.39)	1.60 (0.97)	<.0001
Convenience	2.86 (1.41)	1.72 (1.08)	<.0001
Benefits	4.01 (0.94)	4.33 (0.81)	<.0001
Threats	3.84 (0.71)	4.39 (0.60)	<.0001
Cues to action, agree	3.86 (0.77)	4.18 (0.64)	<.0001
Intrapersonal	3.98 (0.87)	4.31 (0.80)	<.0001
Interpersonal	3.97 (0.89)	4.43 (0.69)	<.0001
Organizational	3.68 (1.21)	3.96 (1.14)	<.0001
Community	3.67 (1.07)	3.81 (1.07)	0.003
Policy	3.79 (1.00)	4.18 (0.92)	<.0001
Messages	3.44 (1.11)	3.29 (1.10)	0.004
Cues to action, support			
Organizational	4.01 (1.13)	4.43 (0.87)	<.0001
Policy level	3.57 (1.14)	3.80 (1.05)	<.0001
Technology	3.75 (0.95)	3.75 (0.96)	0.89

Note. SD = standard deviation. Higher means indicate stronger agreement or support on a scale of 1 to 5, and the *p* value column indicates significance in the difference of means.

Table 3. Prediction of Health Belief Model constructs on the desired health behavior of not regularly driving distracted by mobile devices.

Health Belief Model variable	Odds ratio (95% confidence interval)			
	Model 1	Model 2	Model 3	Model 4
Threats	1.61 (1.27, 2.04) *	1.47 (1.15, 1.88) *	1.49 (1.16, 1.91) *	
Benefits	0.99 (0.85, 1.15)	0.98 (0.85, 1.14)	0.94 (0.81, 1.10)	
Barriers	0.36 (0.31, 0.41) *		0.37 (0.33, 0.43) *	
Work		0.56 (0.47, 0.65) *		
Interpersonal		0.94 (0.78, 1.14)		
Information		0.81 (0.73, 0.91) *		
Boredom		0.94 (0.84, 1.05)		
Urgency		1.05 (0.94, 1.17)		
Pressure		0.93 (0.82, 1.06)		
Convenience		0.88 (0.79, 0.98) *		
Cues to action, agree	1.11 (0.90, 1.37)	1.14 (0.92, 1.41)		
Intrapersonal			0.95 (0.79, 1.15)	
Interpersonal			1.21 (1.00, 1.47) *	
Organizational			1.01 (0.90, 1.14)	
Community			0.98 (0.83, 1.14)	
Policy			1.41 (1.20, 1.67) *	
Messages			0.73 (0.64, 0.83) *	
Cues to action, support				
Organizational				1.69 (1.51, 1.90) *
Policy				1.17 (1.04, 1.31) *
Technology				0.67 (0.58, 0.76) *

* Indicates statistical significance at the 0.05 level.

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10 APPENDIX

Table A1. Descriptions of secondary tasks and the device-based aggregate distraction category.

Secondary task	Device-based distraction
Program or edit route on a navigation system (GPS, phone's navigation app, in-vehicle navigation system)	X
Make a phone call	X
Send text messages, either using the device's primary messaging app or another platform such as Facebook Messenger or WhatsApp	X
Read text messages on the device's primary messaging app or another platform such as Facebook Messenger or WhatsApp	X
Send email	X
Read email	X
Stream and change music using a phone-or device-based app (Spotify, Pandora, Apple Music, etc.), either through a phone or the vehicle's interface	X
Make a video call (FaceTime, Zoom, etc.)	X
Watch a movie, TV show, or video clip of any length (including TikTok or YouTube)	X
Record and post or livestream a video on a social media app (TikTok, Facebook, Instagram, etc.)	X
Post text, photos, or livestream a video on a social media app (TikTok, Facebook, Instagram, etc.)	X
Scroll through or read non-video content on a social media app (Pinterest, Twitter, Instagram, Snapchat, Facebook, etc.)	X
Play any type of game on a hand-held device	X
Use an app to get information (for example, weather, gas station, restaurant, traffic conditions, business hours, or news)	X