NATIONAL DISTRACTED DRIVING COALITION


# Distracted Driving Prevalence Data

## Sources, Challenges & Technological Solutions

December 2022


PREPARED BY

Robyn D. Robertson | Traffic Injury Research Foundation
Steve Brown | Traffic Injury Research Foundation
Josh Graver | PathZero.ai
Dan Trainor | Pulse Labs
Barbara Banz | Yale University School of Medicine
Jessica Legnos Kearney | Travelers Institute

# NATIONAL DISTRACTED DRIVING COALITION (NDDC)

The National Distracted Driving Coalition (NDDC) was formed in March 2021 to address distracted driving which is a contributing factor to road deaths and injuries. This road safety issue is a priority concern shared by many organizations across many sectors. A diverse cross-section of entities, representing academia, non-profits, government, advocacy, and industry, including insurance, transportation, automotive and technology, have come together to create a National Action Plan to tackle this important issue.

## Vision

To accelerate national efforts to implement effective interventions and encourage attentive driving by eliminating distractions.

## Mission

To promote innovative and collaborative approaches to create a traffic safety culture of attentive drivers.

## Disclaimer

The National Distracted Driving Coalition (NDDC), formed by the National Transportation Safety Board, is composed of diverse members and stakeholders representing a variety of organizations, including non-profits, industries, governments and communities. The diversity of views and opinions is a key feature of the NDDC designed to encourage the development of innovative approaches to preventing distracted driving. This strategy enables the NDDC to explore multiple tactics to reduce distracted driving crashes. In light of this diversity, it is unlikely consensus can be achieved across all organizations with respect to materials produced. NDDC participation does not suggest all organizations necessarily agree with, or support, NDDC proposals, recommendations, or educational materials, and it would be improper to impute any one organization's agreement with, or support for, NDDC proposals, recommendations or materials solely on the basis of NDDC participation. Similarly, organizations may advance views or positions that do not necessarily represent the NDDC. Those beliefs, opinions, or statements should be considered to be solely those of the individual organization and not of the NDDC.

The NDDC does not, and will not, engage in any lobbying efforts, specifically, attempts to influence Federal or state legislation or policy. While NDDC participants may engage in lobbying with, or for their respective organizations, they are not permitted to do so on behalf of the NDDC, nor to engage in any lobbying activities in a manner that would suggest, or imply, they are doing so for, or on behalf of the NDDC. If organizations do engage in lobbying, it must be clear that they do so on their behalf, and not on behalf of the NDDC.  All materials produced by the NDDC are strictly intended as educational materials for educational purposes.

# Distracted Driving Prevalence Data
## Sources, Challenges & Technological Solutions


Robyn D. Robertson | Traffic Injury Research Foundation

Steve Brown | Traffic Injury Research Foundation

Josh Graver | PathZero.ai

Dan Trainor | Pulse Labs

Barbara Banz | Yale University School of Medicine

Jessica Legnos Kearney | Travelers Institute

# Acknowledgements

The National Distracted Driving Coalition (NDDC) gratefully acknowledges the contribution of the authors who shared their expertise and time to prepare this report. The NDDC also extends its appreciation to all the members of the sub-committee on Data Prevalence who provided input regarding the scope of knowledge included in this report as well as helped identify relevant data sources. In addition, the NDDC thanks the Steering Committee members who contributed to the review of this work prior to publication.

## Sub-committee members:

Dan Trainor
Global Head, Business Development & Customer Success
Pulse Labs

Josh Graver
Founder, CEO, & Lead Scientist
PathZero.ai

Doug Shupe
Corporate Communications & Programs Manager
Automobile Club of Southern California

Cory Woinarowicz
Chief Revenue Office
NoCell Technologies, LLC

Matt Sheffer
Director of Business Development
ORIGOSafeDriver

Barbara C. Banz, PhD
Assistant Professor of Emergency Medicine
Yale DrivSim Lab
Yale University School of Medicine

Ryan McMahon
Vice President of Insurance and Government Affairs
Cambridge Mobile Telematics

Jessica Legnos Kearney
Assistant Vice President
Travelers Institute

## Steering Committee:

A list of members of the NDDC Steering Committee is available at:
usnddc.org/wp-content/uploads/2022/05/NDDC-Steering-Committee-16.pdf

# Table of Contents

# Introduction

Distracted driving is a leading contributor to road deaths and injuries in the United States and many other countries around the world. It is estimated to play a role in 25%-30% of fatal crashes. According to the National Highway Traffic Safety Administration (NHTSA), in 2020, there were 3,142 deaths and an estimated additional 324,652 injured on US roadways as a result of distracted driving. Of concern, eight percent of fatal crashes, 14% of injury crashes, and 13% of vehicle collisions in 2020 reported to police involved distraction as a contributing factor (NHTSA, 2022). Equally concerning in Canada, according to the Traffic Injury Research Foundation's (TIRF) National Fatality Database (TIRF, 2021), there are more than 450 deaths annually involving distraction and it is a contributing factor in almost one in four road fatalities.

Self-report data also demonstrate the magnitude of the problem warrants attention. In 2015-2016, an E-Survey of Road Users' Attitudes (ESRA 1) was fielded in 25 countries including the United States and Canada. It revealed respondents from Canada, the United States, and Europe reported disquieting rates of talking on a hand-held mobile and sending text messages or emails while driving. A descriptive analysis revealed one in four Canadians reported talking on a hand-held mobile device at least once during the past 12 months. Larger proportions were reported in Europe (37.8%) and the largest proportion was in the United States, where almost half (49.7%) of respondents said they had talked on a hand-held mobile phone while driving. When asked how often they had sent a text message or email while driving within the last 12 months, just under one-quarter of Canadians and 27.2 % of Europeans had done so at least once. The largest proportion was again reported in the United States, where 35.3% indicated they had done so. Based on these indicators of self-reported mobile use, these behaviors are quite prevalent in all three regions, and highest in the United States.

This problem is worrisome because crash data sources, and to a lesser extent self-report data, generally under-estimate the prevalence of the problem (Robertson, Bowman, & Charles, 2015) as a result of data collection barriers including:

- It is difficult for police at roadside identifying distraction because drivers/passengers may not admit distraction, or because they are killed.
- There are limitations of existing crash report forms and the absence of specific data elements to record distraction as a factor.
- State data systems are not structured to capture and/or query distraction-related data.

Self-report surveys in more recent years during the COVID-19 pandemic suggest distracted drivers in the US may be taking more risk as compared to prior to the pandemic. According to the Traffic Injury Research Foundation USA's 2021 Road Safety Monitor annual poll:

- In 2019, prior to the COVID-19 pandemic, more than 13% of drivers drove distracted, 12.7% reported texting while driving, and 17.1% were talking on their phone while driving.
- Despite small declines in these behaviors in 2020, these behaviors increased in 2021 with 13.9% driving distracted, 14% texting and 17.3% talking on their cell phone while.
- In 2021, more than 1 in 10 respondents (11.6%) indicated they were more likely to have driven distracted during the COVID-19 pandemic than prior to it.
- In 2021, among US drivers reporting driving while distracted, 37.4% noted talking on their cell phone was the primary reason for their distraction.

Despite the prevalence of these behaviors in the US only 67% were concerned about handheld phone use between 2016 and 2021, whereas more than 80% of respondents reported concern about texting and driving.

In Canada, self-report data present a comparable picture of the problem. According to the 2021 Traffic Injury Research Foundation Road Safety Monitor, a total of 7.4% of Canadian drivers reported they were more likely to drive distracted during the pandemic, as compared to before, whereas in 2020, 4.2% of drivers reported this, corresponding to a significant increase between 2020 and 2021 (Woods-Fry, Vanlaar, & Robertson, 2021).

Other risk-taking driving behaviors also increased during the pandemic. For example, NHTSA reported drivers often engaged in riskier behavior, including speeding, failure to wear seat belts, and driving under the influence of alcohol or other drugs. Data showed average speeds increased during the 1st and 3rd quarters of 2020 and extreme speeds became more common (Office of Behavioral Safety Research, 2021). Most notably, there is concern among some experts that as the pandemic subsides, distracted driving and other risk-taking behaviors will persist.

However, self-reported data in national surveys can similarly suffer from various limitations. Some commonly recognized limitations of self-report surveys are that respondents may not admit to driving while distracted because it is not the socially desirable response, or they may not be able to accurately recall whether they drove during the time period being asked in the survey (i.e., telescoping). The same is true for hospitalization data in that inconsistent or inadequate data are typically collected about crash factors during hospital admission and/or this data may not be easily queried. For example, hospital data may record patients were crash-involved as a reason for admission but information about crash factors is most likely, if at all, included in narrative notes which are not easily compiled and searched.

**It is challenging to demonstrate the need for action or inspire leadership at all levels when the magnitude of the problem or its effects cannot be easily quantified.**

The gaps in crash data and survey data have important implications for the development and implementation of policy and legislation to prevent and reduce distracted driving. Of importance, it is challenging to demonstrate the need for action or inspire leadership at all levels when the magnitude of the problem or its effects cannot be easily quantified.

For this reason, the collection of more robust, complete and timely distracted driving data is urgent and essential to determine the relative importance of distraction within myriad and competing road safety priorities. Notably, in Canada, improvements in data collection have clearly demonstrated distracted driving is a factor in one in four fatal crashes, and distracted drivers are most likely to kill other, non-distracted road users. (TIRF National Fatality Database, 2021). Collecting similar data in the US data can help ensure this issue receives the necessary attention and resources warranted to address it.

In addition, more accurate, complete and accessible distracted driving data can also provide much-needed guidance and direction in the development of policies and legislation. Similarly, it provides the foundation to evaluate a variety of countermeasures to determine which ones are most effective to address distracted driving, enabling agencies and staff to be efficient in their efforts to reduce distracted driving.

As a starting point in the process of improving distracted driving data, the NDDC has developed this fact sheet which contains a high-level overview of available prevalence data sources which provide important windows into the magnitude and characteristics of the distracted driving problem. Important limitations of each data source are described to provide context for the case to improve and augment data collection tools and processes to answer important questions.

This factsheet also presents new opportunities to improve data collection using technological solutions which can greatly increase understanding, not only about the prevalence of distracted driving, but also the types of distraction which are most common and those which pose the greatest risk. These technologies show potential to answer critical questions about the frequency of instances of distracted driving among different types of drivers. This knowledge is vital to understanding social norms and the persistence of this risky behavior to underpin the development of targeted education campaigns which tap into the most powerful factors to motivate behavior change and promote a culture of attentive drivers.

# Distracted driving prevalence data sources in the United States

This section contains a high-level overview of data sources which provide insight to help measure the prevalence of distracted driving. The strengths and limitations of each data source is summarized. Data sources are discussed according to the following categories:

- Collision data
- Citation or conviction data
- Naturalistic driving studies
- Roadside or observational surveys
- Telephone and online self-report surveys
- In-person surveys; and,
- Cellphone user data.

## Collision data

Annual distracted driving collision data is collected and published using the Fatality Analysis Reporting System (FARS) data collected by the National Center for Statistics and Analysis (NCSA) within the NHTSA. It includes descriptive data about the number of fatal crashes and persons killed (by age and sex). Fatal victims are divided into occupants and non-occupants (pedestrians and cyclists). Historical data are provided from 2015-2019 and descriptions of different types of distraction (e.g., texting, smoking, eating) are provided (NCSA, 2021). FARS data are collected on a voluntary basis through cooperative agreements between NHTSA and each of the 50 states, the District of Columbia, and Puerto Rico.

FARS data can be used to compare the efficacy of legislation between jurisdictions. For example, a time series analysis of fatal crashes involving drivers and passengers aged 16-19 years from 2007 to 2017 was undertaken in 2020. Crash rates were compared between states based on different types and strengths of distracted driving laws. States with primarily enforced texting bans were shown to have lower motor vehicle collision (MVC) fatality rates overall involving drivers aged 16-19 years old. Bans of all handheld device use and texting bans for all drivers were associated with the greatest decrease in fatal MVCs (Flaherty et al., 2020).

However, limitations of FARS data include:

1. Surviving drivers may not admit to driving while distracted.
2. Police collision reports may not include data on different types of devices that may distract drivers.
3. Prior to 2001, FARS data did not differentiate between different types of distraction.
4. Witnesses involved in a crash may have been killed or injured.
5. Potential technological distractions may have been damaged or broken in a crash, making it difficult to detect whether it was in use.
6. Other than witness reports, there may be a lack of evidence to determine if a driver was reaching for an object or adjusting controls.
7. Types of data variables collected in police reports about distraction vary in detail and by jurisdiction (NCSA, 2021, Marchese, 2019).

Regarding the first limitation, a possible remedial action is to use UDAs (unsafe driver actions) as a proxy measure for responsibility since no legal proof or responsibility is needed (Marchese, 2019). However, the other limitations are more difficult to overcome. In addition, while crash data are useful to provide information on drivers involved in crashes, reliable baseline data are needed which includes non-crash involved drivers as well. This helps to measure the prevalence of distracted driving and the level of exposure (Angell, 2014).

## Conviction data

National conviction data related to distracted driving is quite limited. Some states (e.g., Nebraska) include traffic conviction data and distinguish between different sources of distraction, but other states, such as Colorado, do not include distracted driving infractions in their annual violation data. As such it is quite difficult to draw conclusions about the prevalence of the problem using this data source.

Another limitation compounding this problem is the ability of police departments to sustain a consistent level of enforcement of distracted driving laws. In some respects, the reliability of conviction data is contingent on the ability of police officers to maintain adequate enforcement which is quite difficult in light of their other competing responsibilities. Moreover, highway traffic enforcement of distracted driving is most effective in slower moving traffic, and officers need to position their patrol vehicle to afford a view of driver actions while ensuring their own attention to driving is not diverted. In other words, enforcement is more practicable in some environments than others.

## Naturalistic driving studies

Driving performance and behavior data were gathered by multiple cameras and sensors in situ for drivers who participated in the Second Strategic Highway Research Program Naturalistic Driving Study which spanned three years (Guo et al., 2017). Secondary-task engagement was identified from videos. An estimate was undertaken for crash odds ratios associated with, and the prevalence of, secondary tasks for four age groups: 16-20, 21-29, 30-64 and 65-98 years of age. Property damage and higher severity crashes were included in the analysis. Secondary-task-induced distraction posed a consistently higher risk for drivers younger than 30 and above 65 when compared with middle-aged drivers. However, senior drivers engaged in secondary tasks much less frequently than their younger counterparts. Teenaged, young adult, and senior drivers were more adversely impacted by secondary-task engagement than middle-aged drivers (Guo et al., 2017).

- **Younger drivers.** Private vehicles of 83 newly-licensed teenage drivers were equipped with Data Acquisition Systems (DAS) which documented driving performance measures, including secondary task engagement and driving environment characteristics. It was shown that teens engaged in a potentially distracting secondary task in 58% of sampled road clips. The most common types of secondary tasks were interaction with a passenger, talking/singing (no passenger), external distraction, and texting/dialing the cell phone. Secondary task engagement was more prevalent among drivers with primary vehicle access and those drivers who drove alone (Gershon, 2017).

**Data Acquisition Systems were installed in the private vehicles of 83 newly-licensed teenage drivers to document driving performance measures. Data revealed teen drivers engaged in a potentially distracting secondary task in 58% of sampled road clips.**

- **Commercial vehicle drivers**. A naturalistic study was undertaken to investigate driver distraction and the role it plays in commercial motor vehicle (CMV) operations, and to answer critical questions related to hours of service (HOS) regulations and fatigue. More than 3.8 million miles of naturalistic data were collected under the original Onboard Monitoring System Field Operational Test (OBMS FOT) study. A total of 43 motorcoaches, 73 motorcoach drivers, 182 trucks and 172 truck drivers participated in this study. There was an overall decrease in cell phone use compared to previous research. Hands-free cell phone use was considered to be protective as it likely helped drivers alleviate boredom, while hand-held cell phone use was shown to be risky as it took drivers' attention away from driving tasks (Hammond, 2021).

  Another analysis of naturalistic driving videos among fleet services drivers for errors and potentially distracting behaviors occurring in the six seconds before crash impact was carried out for driver fleet errors. Of the analyzed crashes, 44% were rear-end and 56% were angle crashes. On average, drivers spent 4.4 seconds with their eyes off the road while they operated their cell phones (Harland, 2016).

## Roadside or observational surveys

NHTSA funded enforcement demonstration programs held at six sites across the US. Key lessons learned suggested ideas for law enforcement personnel on ways to combat distracted driving. Among these tactics were placing spotters on overpasses and elevated roadways and using taller SUVs and trucks to get better elevated observation angles. Police were aware that texting offenders frequently commit traffic violations such as lane departure, traveling too slowly, or weaving on high-speed highways. Targeted enforcement using stationary patrols, spotters, and roving patrols also resulted in high levels of observed violations (Lemaster-Sandbank, 2020).

In Virginia, a 2018 observational study replicated a 2014 study conducted in Northern Virginia. The purpose was to examine whether the prevalence of distracted driving overall and if individual secondary behaviors had changed. The presence of 12 secondary behaviors was recorded during the daytime from drivers of moving or stopped vehicles. Although cellphone use was frequently observed in 2014 and 2018, collectively, other non-cellphone secondary behaviors were more prevalent (Kidd, 2019).

## Telephone and online self-report surveys

The following studies used online surveys of respondents to gauge attitudes towards distracted driving as well as driving practices.

- **General population.** NHTSA conducted its third national telephone survey of distracted driving in 2015 to monitor public attitudes, knowledge, and self-reported behavior about cell phone use and texting while driving, and driver choices. Previous surveys were conducted in 2010 and 2012. The 2015 survey was administered by phone to 6,011 respondents aged 16 years and older. Although a trend analysis was conducted, there were some distinctions between the 2015 survey and previous versions. For example, some activities were included in the 2015 survey but not in previous surveys. In addition, the 2015 survey differentiated between making calls and receiving calls (Schroeder et al., 2018).

  In 2020, the AAA Foundation for Traffic Safety released the 2019 Traffic Safety Culture Index (TSCI) that included results about:

  1. perceived danger, perceived risk of apprehension, social approval, self-reporting of behaviors, and support of safety laws related to various risky driving behaviors;
  2. discordances between drivers' attitudes/perceptions and their behaviors; and,
  3. comparisons of the behaviors of drivers involved in at least one crash in the past two years with those not crash-involved in any crashes (AAA Foundation for Traffic Safety, 2020).

  The 2019 TSCI was the 12th annual report on road safety issues. One of the areas of focus was distracted driving (primarily cellphone use, including talking, texting, and emailing). Although a large majority of drivers viewed typing, reading, and talking on a hand-held cellphone while driving to be very or extremely dangerous, 43.2% reported driving while talking on a hand-held cellphone at least once in past 30 days. Data from the TSCI can also be compared between states with stricter cell phone bans with those states with more lenient laws (Rudisill et al., 2018).

- **Younger drivers.** NHTSA sponsored a survey (Young Driver Survey) of almost 18,000 drivers aged 16-21 who resided in Florida, Georgia, Massachusetts, Nebraska, and Oklahoma. This questionnaire explored issues with the driving experiences of younger drivers and identified key challenges to safety measures (Wilbur, 2019). A total of 2,340 drivers from high schools and universities in Alaska, Idaho, Oregon, and Washington responded to an online survey instrument. Respondents were asked to self-report their frequency of distraction and which activities they considered to be driving distractions. The objective was to determine what factors impact the driver choice to interact with a cell phone (talking or texting) while driving. The presence of friends in the car, parents frequently exhibiting distracted driving, more miles of driving, history of speeding tickets, crash history, having a full driver's license, owning an iPhone, and being female increased the likelihood of self-reported distracted driving. Also, more experienced drivers were more likely to talk and less likely to text while driving (Jashimi et al., 2017).

- **Commercial vehicle drivers.** Due to work responsibilities, truck drivers are more likely than drivers of other vehicles to use a cell phone or other communication devices (e.g., CB radio). An online survey was conducted to identify the factors contributing to decisions by drivers of large trucks to use a cell phone while driving. Survey data was collected in 2017 from drivers of large trucks who either picked up or delivered goods in Oregon, Washington, Idaho, or British Columbia. Almost half of respondents (45%) indicated they used a cell phone while driving. Driver behaviors, demographic, work, temporal, and management characteristics were examined to measure the likelihood of truck drivers using their cell phones while driving. Drivers working for: 1) carriers who manage fatigue by imposing schedules to make it easier to take breaks; and 2) carriers who restrict the number of hours worked, were less likely to use cell phones while driving. In addition, drivers who participated in road safety driving were less likely to use their cell phones while driving (Claveria et al., 2019). The American Transportation Research Institute (ATRI) conducts an annual survey among truck drivers about road safety issues. While distraction ranked as the 11th most important issue of concern in 2020, it has historically been an issue of concern among respondents since the first survey conducted in 2005 (ATRI, 2020).

## Insurers

Travelers Risk Index measures attitudes towards distracted driving as well as driving behaviors and workplace policies and tools to prevent distracted driving. In January of each year, two separate online surveys are fielded nationally: one among ~1000 consumers aged 18 to 69 and one among ~1000 business executives from businesses of all sizes. The surveys are commissioned by Travelers and executed by Hart Research, a leader in survey research and opinion polling. Results are released each April during Distracted Driving Awareness month and published at (https://www.travelers.com/resources/risk-index). Key findings from the 2022 survey are below:

1. Even though distracted driving is risky, many respondents admitted to using technology behind the wheel:
    - 77% talked on or used a cellphone through hands-free technology;
    - 74% looked at map directions on a cellphone;
    - 56% read a text message or email;
    - 27% updated or checked social media; and,
    - 19% shopped online.
2. Despite what drivers think, post pandemic driving fatalities are at record highs. According to NHTSA, there is a 21% increase of roadway fatalities from 2019:
    - 57% thought roadway safety was unchanged from before the pandemic.
    - 34% of drivers admitted they nearly crashed while driving distracted.
3. When asked about speaking up, no matter who is driving:
    - 87% of consumers who use a phone while driving said they would be less likely to do so if a passenger 'spoke-up'.
    - Only 44% said they have spoken up to a friend or family member when they were driving distracted.

Limitations of telephone and online surveys include how accurately a driver recollects use of a communications device and how willing they are to admit using such a device while driving. Further, when examining surveys to understand distracted driving insights, it is estimated that most individuals do not know what actions constitute a distraction, although NHTSA defines distraction as any activity diverting attention from driving for more than 2 seconds. Moreover, there is some evidence from naturalistic driving study panels to suggest potentially 70% or more of respondents would not admit to being distracted in an event due to the implications associated with a distracted driver designation. As such, there is a fundamental limitation which makes self-reporting data unreliable and thereby undermines the reliability of survey data around this topic. However, this gap could be better understood by combining naturalistic video data with survey data from the same panel, not with only survey data alone.

## In-person surveys

The Centers for Disease Control and Prevention (CDC) conducts the national Youth Risk Behavior Survey (YRBS) every two years among students in grades 9-12. The survey is administered in-person at high schools and includes a question on texting or e-mailing while driving. Differences by student characteristics (e.g., age, sex, race/ethnicity, academic grades, and sexual identity) can be calculated. Results from the 2019 survey showed three-fifths (59.9%) of students had driven a car during the 30 days before the survey and among these students, 39% had texted or e-mailed while driving at least once in the past 30 days. Texting or e-mailing while driving was higher among older students and white students (Yellman et al., 2020). Limitations of the national YRBS include a lack of information about the number of trips drivers took, the amount of time they spent on the road, and the distance they travelled. Additionally, the distracted driving question on the national YRBS only covers texting or emailing and not phone calls or app use (Yellman et al., 2020; Li et al., 2018).

There are also separate state and local YRBS surveys of high school students conducted in some states/localities by education and health agencies. States/localities can add optional questions about additional distracted driving behaviors, such as talking on a cell phone while driving a car or other vehicle (Li et al., 2020; CDC, 2022).

## Cellphone user data

A study by Cambridge Mobile Telematics (CMT) revealed how claims frequencies increase from best to worst drivers. The 10% most-distracted drivers had loss frequencies 2.2 times greater than that for the 10% least-distracted drivers. As may be expected, younger drivers had significantly higher phone distraction than older drivers. More importantly, data showed less distracted young drivers are safer than the most distracted young drivers.

Data from Zendrive (2018) indicated calls made during nighttime hours were 20% longer than calls made during the day. Their data also showed most calls were made in the first 5% of a trip (Zendrive, 2018).

**A 2018 study revealed calls made while driving at nighttime are 20% longer in duration than calls made during the day.**

Strengths of cellphone user data include the size of the dataset and the ability to 'time-stamped' the data; near-miss data can also be included. In the future, eye scanning technology may be used to measure driver distraction (Murphy et al., 2021). Although it was not mentioned in the report, eye scanning technology may be subject to privacy challenges. While it has been accepted in commercial vehicles, installing this technology may face more obstacles with respect to installation in private vehicles.

## Summary of prevalence data strengths and limitations

While available data sources provide some insight into the prevalence of distracted driving, existing data suffer from critical gaps which impede decision-making in terms of the relative priority of the problem, the allocation of resources, and the development of effective strategies to prevent distracted driving. It is important to consider the strengths and limitations of data sources to maintain a well-rounded understanding of the data available.

NHTSA' s reporting of collision data that differentiates occupants vs. non-occupants is a useful means of showing how harmful distracted driving is to road users who are not distracted drivers. Given the annual collection of this data, comparisons can be made and trends can be identified over time, which is a strength for both collision and FARS data reported by NHTSA. Important limitations include only the most serious crashes, representing a portion of the problem, are captured, and there are numerous variations across crash report forms which can be an impediment to comparisons or analysis.

Limitations of conviction data include the small number of persons convicted for distracted driving offenses, slow court processes, plea agreements, and the reliance on officers appearing in court hearings. Furthermore, in some jurisdictions there are no offenses specifically for distracted driving; some distracted drivers in fatal crashes may be charged with dangerous driving causing death. However, some of these charges may similarly be laid against speeding or aggressive drivers (Brown, Robertson, & Vanlaar, 2021).

Despite the advantages of naturalistic driving studies, there are limitations associated with this data source.

**While available data sources provide some insight into the prevalence of distracted driving, existing data suffer from critical gaps which impede decision-making in terms of the relative priority of the problem, the allocation of resources, and the development of effective strategies to prevent distracted driving.**

Naturalistic driving studies heavily rely on data collected through various sensors, video cameras, and other devices to analyze driver behavior data which require a large and costly storage space. Additionally, the data collection process requires intensive, and expensive, resources. Furthermore, when using GPS devices, the GPS data cannot be used in its raw form as these devices are sometimes influenced by external factors, giving unreliable results. Lastly, driver privacy is a concern and limitation of naturalistic driving studies as the method collects driver location and video data for analysis (Ellison, Greaves, & Bliemer, 2015; Singh & Kathuria, 2021).

Trend data are found among different annual or bi-annual data sources such as observational surveys, telephone/online surveys, and cellphone user data. The frequency of this data collection enables researchers to examine distracted driving trends. It should be noted, however, that some questions and distracted driving topics may not be included for all years of a particular survey, therefore limiting some analyses.

While beneficial in examining behavior, observational studies are limited in that bias, confounding, and issues with validity are more common within this method (Hess & Abd-Elsayed, 2019). Additionally, the observation of road behaviors is difficult at high-speeds and data only capture a short snapshot of time.

Telephone surveys allow researchers to access a wide geographical area, allowing for a potentially more diverse survey population at a relatively low cost. However, data reveal the percentage of calls which were successful in contacting an eligible member of the public fell, from 52.9% to 31.8% in just five years (Boland, 2016). The increased reliance on cell phones, as opposed to landlines, make it more difficult to contact eligible participants. Lastly, telephone surveys require a limited complexity of questions, where surveys should last approximately 5 to 10 minutes to maintain cooperation of respondents.

Similar to telephone surveys, online surveys allow researchers to access a wide geographical area at a low cost and can be easily distributed via emails, mailing lists, and social media platforms. However, online surveys are completed only by persons who are literate and who have access to the internet, and by those who are sufficiently biased to be interested in the subject (Andrade, 2020).

A notable advantage of in-person surveys is the use of trained, professional interviewers, and the ability to control the interviewing environment and sample groups with a low internet use presence (i.e., seniors, non-English-speakers, low-income residents). However, this data collection method is costly and requires more time than online or phone surveys. They also allow for interviewer and interpretation error, where some interviewers may forget instructions or lack understanding of what to do. As a result, in-person surveys should be validated to verify they were completed properly (Kramers, 2009).

A noteworthy limitation of studies and surveys dealing with driver opinions is that perceptions are not actions. Thus, it is not entirely clear how self-reported perceptions translate to real world behavior even though strong correlations may be observed (Jashimi, 2017).

Cellphone user data is a useful data source to examine the effectiveness of legislation in reducing the prevalence of distracted driving. Data may be measured to compare the use of cellphones among drivers by jurisdiction. While useful, a limitation of this data source is the lack of context. As such, a study of prevalence should not only examine the frequency of distraction but also the duration of time that drivers are distracted. For this reason, naturalistic data is valuable as it shows how long drivers are not watching the road. However, given cellphone user data show phone calls made by nighttime drivers are longer than calls made during the day, this may indicate the limitations of observational surveys made during daytime hours. Furthermore, data showing that many calls are made in the early part of a trip may show drivers are less attentive when leaving a parking spot or entering a roadway.

# Technological opportunities to improve the collection of distracted driving prevalence data

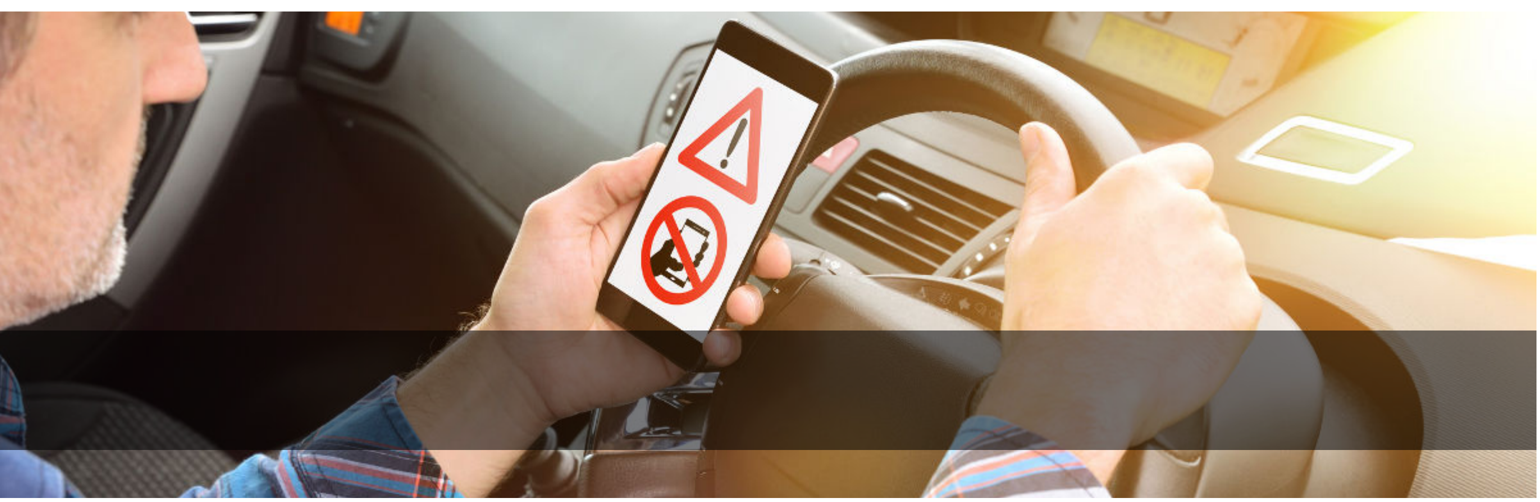
## Phone apps

Phone applications are one tool with potential to provide insight into driver behaviour. Generally, these applications typically lock the phone screen or prevent access of certain phone applications which may be distracting while the vehicle is in motion. For example, these tools may block incoming calls or text messaging, access to social media or other potential sources of distraction. The monitoring applications can detect attempts to access the phone and thereby provide some insight into the propensity and frequency of drivers to use their phone for distraction-related activities while driving. Below are some examples of phone applications and the types of prevalence data that may be gathered through their use.

- **NoCell.** With the NoCell Solution, the data source is the drivers' mobile device(s). Through the web portal, fleet managers/portal admins are able to detect if a phone handling event occurs. An initial sampling of data showed phone handling events were reduced by nearly 70% after the first 10 days of implementation, because the unauthorized apps are not available to drivers when the vehicle was in motion. After the first 10 days, drivers appeared to experience a Pavlovian type of self-training and learned they cannot access the unauthorized apps. As such, they are far less tempted to pick up the mobile device. Using the phone handling feature, it would be possible for an investigation to determine whether drivers were actively handling the phone immediately prior to the crash event.

  This solution/platform is a proactive anti-distracted driving solution which can virtually eliminate phone-related distractions from the cab of the vehicle by physically removing unauthorized (by the fleet manager or other designated portal admin) apps from the phone while the vehicle is in motion. Combining this solution along with inward facing cameras, virtually eliminates the cell phone as the main point of distraction in the vehicle

  Alerts available via this solution are Phone Handling Alerts (showing where and when violation occurred with a pin dropped on the map), Multiple Device Detection, Blue Tooth Kill and App Kill. These alerts inform fleet managers or other portal admin when drivers attempted to circumvent the system, at what location, and how often.

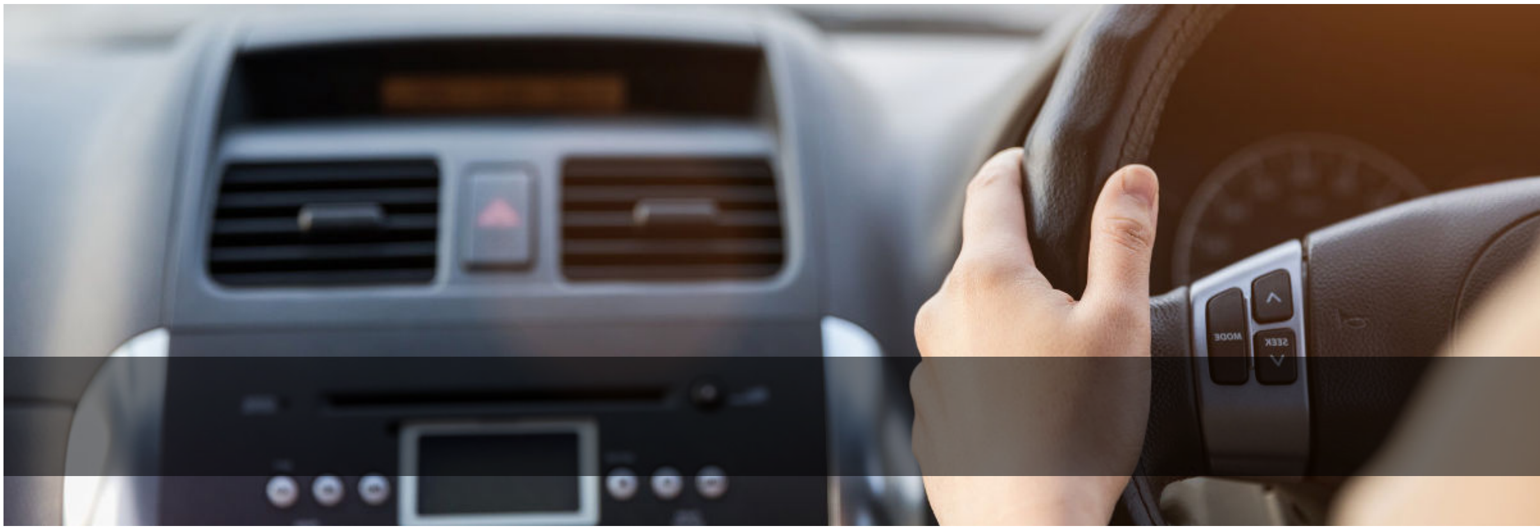


- **ORIGOSafeDriver.** This solution provides data from drivers and identifies when drivers attempt to use their phone and also captures their location and speed at the time of the event. As a proactive solution, the driver's phone screen would lock when the vehicle is in motion to prevent dangerous cell phone use. The hardware provides active coaching to change driver perceptions and encourage safer choices on the road. In addition, the system has many customizable features and alerts/reports would be generated according to customized settings. For example, Bluetooth phone calls can be permitted or prohibited.
- **CMT DriveWell®.** Data collected from Cambridge Mobile Telematics' (CMT) DriveWell® platform measures driving behavior from millions of drivers daily. It uses sensors to detect driving behavior and when paired with a DriveWell tag, more accurate telematics data is available. The sensors can identify phone distraction, classify drivers and passengers, recognize speeding and hard braking, all without complicated installation.

  A recent report by CMT described data collected during an one-year period, from February 2021 to February 2022. Data showed a spike in phone distraction compared to 2019 data. Drivers in February 2022 averaged 1:38 seconds of distraction per hour of driving, which was the highest in three years. Compared to February 2019, this was a 25.5% increase and a 30.3% increase from February 2020. Further, distracted driving increased drastically during nighttime driving. After-work, or "evening", hours (i.e., 6:00pm – 10:59pm) were impacted the most. In February 2020 drivers who started trips during evening hours were distracted for 1:26 per hour on average. By April 2020, minutes of distracted driving per hour increased 34.7% to 1:56 per hour (CMT, 2022).

## Naturalistic driving data

Another method of capturing distracted driving data involves naturalistic driving studies in which test subjects drive instrumented vehicles containing a variety of cameras to capture information within the driver compartment. These types of studies capture real world daily driver behavior for a fixed period of time and enables researchers to study driving behaviors in a variety of settings and road conditions to investigate many different topics. While some concerns have been expressed that drivers may modify their behavior knowing that cameras are present, research has shown drivers quickly forget the data capture devices are present and this facilitates a truly naturalistic environment (See Ehsani et al., 2017).



- **Pulse Labs.** Pulse Labs provides a platform for the acquisition, management, and exploration of naturalistic driver data. This data is acquired through cameras configured at key vantage points within the vehicle cabin, capturing a complete view of driver and passenger behavior and attention. This driver behavioral data is augmented with data from cameras placed to capture the environment outside the car, and telematic data from the car itself. These data sources are combined and analyzed using proprietary machine learning models that identify and classify activities of interest, allowing, for example, the automatic detection of key distracted driving metrics and insights. This is done without the need for people to review potentially thousands of hours of video data from multiple sources, facilitating a level of scale and consistency previously unavailable.

Pulse Labs maintains a large panel of drivers from a representative demographic and vehicular cross-section of the population and can facilitate data collection for up to 2,000 cars simultaneously. The cameras and data capture instrumentation, once installed and configured, automatically turn on and record whenever the car is in use, uploading all data to the cloud without any additional action from the driver.

**A 2021 study of 26 drivers showed out of 534 minutes of driving, drivers were distracted for 72.26 minutes (14%) and the average frequency of distraction was once every 45.2 seconds.**

The Pulse Labs platform also supports customizable and targetable surveys based on actual observed driver behavior. These surveys incorporate relevant video clips of the interactions for which feedback is solicited, so drivers can review exactly what happened and what they did without needing to rely on their memory, enabling the acquisition of far more accurate qualitative driver feedback. This combination of observational and contextual data allows a deeper understanding of both the "what" and the "why" behind driver actions and reactions.

**Pulse Labs sample study.** In December 2021, Pulse Labs conducted a micro-study to provide insight to the NDDC Data Prevalence subcommittee about its platform capabilities and share interesting distraction metrics which could potentially be used to measure real world prevalence of this problem behavior. A summary of results is below; it is underscored these findings are simply to illustrate opportunities to better measure prevalence. These findings should not be used to make any research or policy decisions due to the narrow scope and duration.

A small sample of 26 drivers in a variety of 2020 and 2021 vehicle makes and models was created with a total driving time of 534 minutes (8.54 hours). Drivers in the sample were distracted for 72.26 minutes or approximately 14% of the driving time. The average occurrence of distractions was once every 45.2 seconds.

Drivers in the sample engaged in a total of 617 distractions. The duration of these distractions ranged from 2 -19 seconds, with the average length of distraction being 4.22 seconds, and a median distraction length of 2.25 seconds.

Overall, communication tasks comprised two-thirds of all distractions (67.3%), navigation-related distractions were just 8.5% and other distractions accounted for 24.2%. In addition, other driver distraction metrics which could be captured by the Pulse Labs platform include:

- **Human Machine Interface Insights.** Pulse Labs can gauge the quality of the HMI in emerging automotive technologies through the combination of its targeted surveys and driver behavioral data. For example, in a study Pulse Labs conducted on the relative distraction times of different messaging systems, data showed messaging through voice control is not only perceived to be less distracting by 84% of drivers but is also the preferred way to do it by 79% of drivers, indicating a feature that is both safer and provides a superior user experience.
- **Mobile phone monitoring.** Pulse Labs can track all interactions on a driver's mobile phone. This can be combined with observational video data to determine what was happening inside the vehicle as well as what was happening on the phone when a driver takes their focus off the road and onto their mobile screen.

- **Vehicle telematics.** Pulse Labs can instrument a driver's vehicle to track telematic data like speed, acceleration, and fuel to augment the observational video data and provide more context for any moment on a drive.
    - **External video data.** Pulse Labs can provide observational video data for events outside the car as well as inside. Road conditions, the proximity and behavior of nearby vehicles, and the view of the external environment can all be captured and combined with the other data sources for a complete picture of the driver experience from all important perspectives.

## Roadside smart camera technology data

Within the past few years, several transportation agencies globally have deployed roadside 'smart cameras' that can detect distracted drivers holding cell phones and other electronic devices. These systems can operate and detect distracted drivers in traffic moving at highway speeds and can operate day and night. These cameras can be mounted in multiple fixed or mobile locations: on an overpass, gantry, pole, or on a mobile roadside trailer. They use recent advantages in computerized image processing technology to automatically identify handheld phone use.

Of importance, these systems are built with extensive privacy controls and utilize encryption and data minimization to provide protection around all data collected. Prevalence data can be collected with fully anonymized data. For example, measuring handheld cell phone prevalence does not require identifying drivers or vehicles or retaining data related to specific vehicles.

Deployments of these types of systems have been reported in Australia, The Netherlands, and Abu Dhabi, with demonstrations and trials reported in several other locations including the US and UK. This technology presents an important new source of real-world data on distracted driving cell phone use across the full set of vehicles and drivers on the roadway. Reports from exiting deployments show excellent performance and accuracy in identifying distracted drivers and data collection.

- **PathZero.ai.** Current methods for surveys to measure the prevalence of distracted driving include human observation using people standing at the roadside. Accurate observations can be difficult or impossible at highway speeds, so many manual studies are limited to observing stopped cars at streetlights, intersections, or travelling on rural roads. The flexibility in smart camera positioning, day-and-night operation, and ability to detect distracted driving in moving vehicles offer significant advantages and have the potential to improve the accuracy, breadth, and timeliness of data collection.

  Reported data from current deployments of this technology highlight several interesting findings. First, a significant fraction of driver handheld cell phone and electronic device use occurs 'below the window line', for example by drivers holding a cell phone near or on their lap. These observations might be missed by manual 'by-eye' observational data collection by a person standing on the side of the road, who cannot directly observe the cell phone in this position. Smart camera systems may be positioned flexibly to overcome this difficulty, for example by using raised locations and viewing angles that afford a clear view of these phone positions. Second, data from these deployments indicate driver distraction and use of handheld phones increases significantly at night. Both of these findings may be difficult or impossible to measure over an extended time using manual observation.

  These systems also allow distracted driving prevalence data to be collected continuously and over longer time periods in a variety of locations. In addition to collecting prevalence data, they could also be used to measure the effectiveness over time of other interventions. For example, prevalence data may be collected before, during and after educational campaigns, high-visibility enforcement campaigns, or changes to distracted driving laws such as the introduction of new hands-free driving laws. National and regional safety campaigns can also be bolstered by hard data on prevalence gathered from local roads. By gathering data across multiple locations, these systems can also be used to study what road types and driving conditions have the highest incidence of distracted driver phone use.

Key strengths of this system:

- Collect more accurate, real world prevalence data about distracted driver cellphone use across an entire driver and vehicle population at a roadway location.
- Detect phone use by drivers at full highway speeds, which is difficult or impossible using human observation methods.
- Collect data at locations 24/7 in all seasons.
- Technology is highly scalable and can be cost-effective with economies of scale.
- Does not require installation of equipment in individual cars or on cell phones.
- Does not require recruitment and hiring of a large survey panel of drivers.
- The same sensor technology can also be used to gather prevalence data on seat-belt use.
- Can be deployed in place for extended studies or relocated to new locations.
- There are also some limitations of the system:
- These systems are highly accurate at determining whether drivers are holding a phone, but other types of driver distraction (e.g., watching in-dash video displays, engaging in hands-free phone calls or conversations with passengers) may not be detectable with this technology.
- Vehicles are observed at a 'point in time and space' as they pass the roadside sensor system. At most a few images of each vehicle are observed and processed each time they drive past a camera location. This is distinct from in-car observation systems like Pulse Labs or telematics apps on driver's phones, which observe one driver over a longer period of time. These different systems for data collection are likely to be highly complementary for the purpose of prevalence data measurement and analysis to build a more complete understanding of distracted driving behavior.

Finally, although this technology has been deployed in recent years in some jurisdictions, to date no published academic studies have been published using distracted driving prevalence data using these systems. However, news articles, press releases, and other reports on this technology have reported driver electronic device usage between 5-10% and higher during peak driving periods of the day.

## Technological opportunities summary

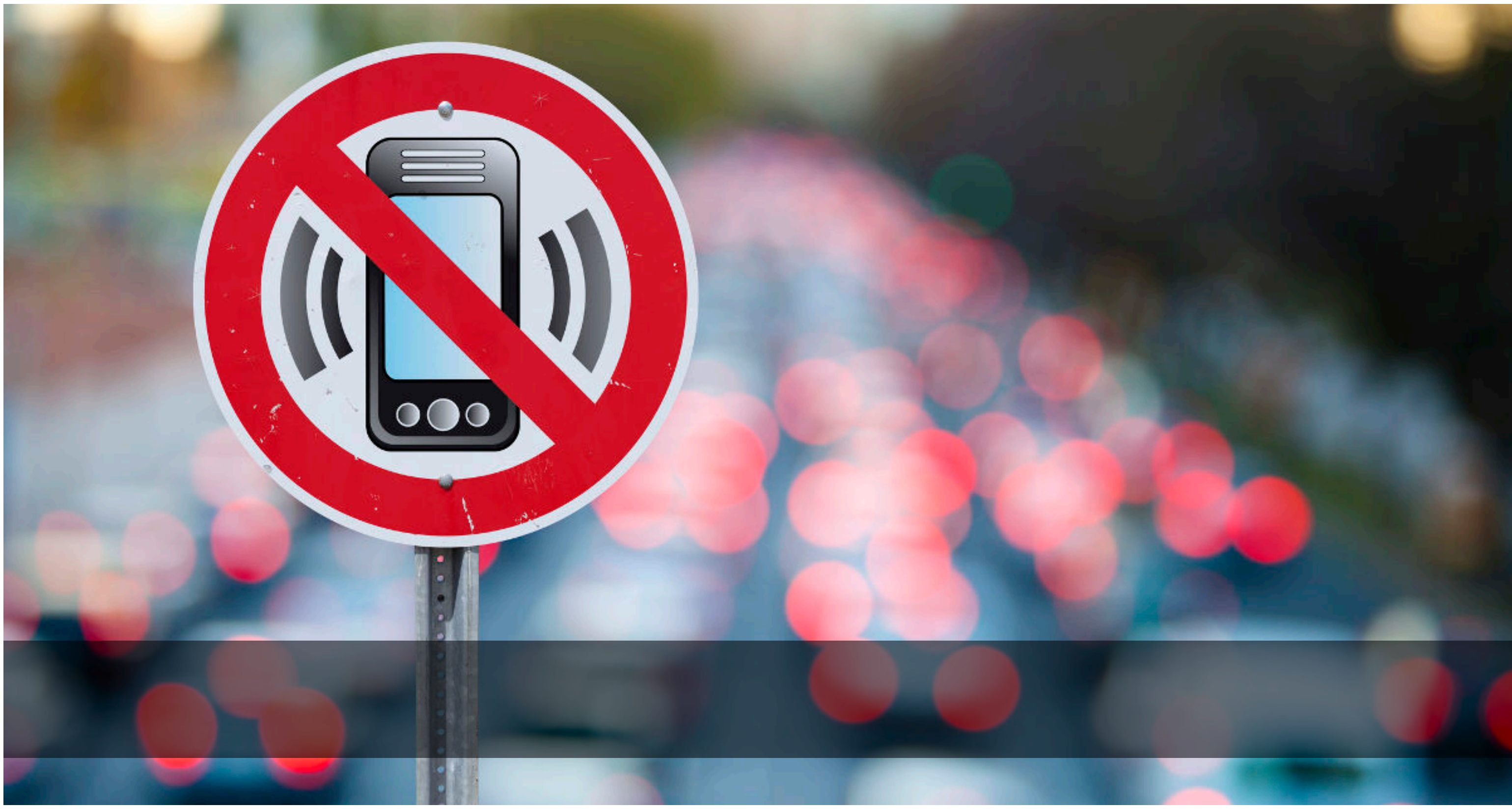
The development of innovative technologies creates new opportunities to improve the collection of prevalence data and more accurately quantify the magnitude of the distracted driving problem. Equally important, these technologies also provide different windows on the problem, and collectively can improve understanding of the types of distractions that are most common and the frequency with which drivers engage in them, as well as under what conditions. As such, the application of these technologies as data collection devices in research studies can do much to identify populations of distracted drivers who pose the greatest risk, to quantify risk, and also to inform the development of effective and appropriate countermeasures.

# Conclusions

There is an urgent need to improve the collection of distracted driving prevalence data to inspire leadership and develop effective countermeasures to address this pressing problem. In the absence of better data to understand the distracted driving problem, it will be exceptionally challenging to motivate leadership to drive change. There are other significant road safety problems, such as speeding and impaired driving, which already compete for attention and resources. These problems are well-documented and considerable resources are devoted towards them as a result.

More and better distracted driving prevalence data are needed to demonstrate the urgency of the problem as well as to identify the most needed measures to address it. The inability to quantify risk or prioritize the most significant or prevalent sources of distraction will lead to very broad-brush solutions such as complete bans on the use of handheld electronic communications. Yet, this approach will undoubtedly face significant push back and thereby engender reluctance to pursue such measures due to low public support. In other words, it will be difficult to address the 'chicken or the egg' debate that currently exists. The absence of data to demonstrate the problem makes it impossible to create action to improve data collection to demonstrate it is a problem. This means the status quo will remain with road users continuing to engage in distracting behaviors which ultimately create risk and contribute to road fatalities.

The emergence of new and innovative technologies can help to increase the collection of more robust and detailed data. The use of phone apps and telematics data can provide insight into the frequency with which drivers attempt to use their phone while driving and the length of those interactions. Instrumented vehicles and roadside cameras can provide additional information with respect to the types of distractions that are most common inside and outside the vehicle and how these interactions impact driving skills.



This work to improve data and inform countermeasures is so important because there is compelling evidence to suggest there are many sources of distraction, particularly manual, visual and cognitive distractions, which contribute to crash risk. However, more research is needed to examine the impact of different types of verbal interactions and the use of voice-activated technologies as a source of distraction. The effects of these sources of distraction have been measured to some extent using neuroscience studies and are a source of concern. These studies have used non-invasive methods (i.e., functional magnetic resonance imaging (fMRI) and electrophysiology (EEG) with driving simulation to understand the brain correlates of driving abilities, including divided attention and secondary task engagement while driving. In fact, two fMRI studies have shown changes in neural activation while attending to a verbal spoken word task during simulated driving. When comparing brain activity while driving without distractions to actual distracted driving activities, mental resources shift away from regions responsible for visual and spatial attention and alertness and towards those responsible for cognitive processing (Just, 2008; Schweizer, 2013). Although a limitation for these neuroscience studies is the nature of fMRI study design (i.e., laying on one's back, confined, not in a vehicle setting) which means fMRI studies lack high fidelity, a more recent EEG study which used high-fidelity driving simulation provided further evidence of limitations in attention abilities during distracted driving due to an auditory task (Banz, 2020). These studies are critical to addressing concerns that attention is multimodal and therefore auditory stimuli can be distractors, and new technologies can help to further explore these factors. A major public health message and many research studies focus specifically on visual distractors. These studies show us how spoken words and even tones draw resources away from the resources needed for driving.

Finally, and perhaps most importantly, these new phone application and camera technologies as well as naturalistic data can also aid research which is essential to develop and evaluate countermeasures which are more precise and targeted. This tactic is much needed to encourage the adoption of solutions. Important questions warrant attention such as whether there is a distinction between 'social distracted drivers' and 'persistent distracted drivers', very similar to identified differences between 'social drink drivers' targeted by education campaigns in the 1990s versus the 'persistent' impaired drivers who were resistant to them (Simpson et al., 1991; 1996). Whereas the former was more easily influenced to change their behavior through campaigns and social norming, the latter required stronger penalties, alcohol monitoring technologies, and treatment interventions. Another important issue is whether some distracted drivers are in fact high-risk drivers (i.e., the 'ten-percenters') who actually engage in a range of high-risk driving behaviors including speeding, the use of impairing substances, and non-use of occupant restraints (Robertson et al. 2006). Increasing understanding of sub-groups of distracted drivers is necessary to strike an appropriate balance between the use of laws and penalties to create deterrent effects and the protection of personal freedoms to engage in reasonable behaviors that do not create risk for other road users.

**More and better distracted driving prevalence data are needed to demonstrate the urgency of the problem as well as to identify the most needed measures to address it. The inability to quantify risk or prioritize the most significant or prevalent sources of distraction will lead to very broad-brush solutions such as complete bans on the use of handheld electronic communications.**

# References


AAA Foundation for Traffic Safety. (2020). 2019 Traffic Safety Culture Index. https://aaafoundation.org/2020-traffic-safety-culture-index/

American Transportation Research Institute. (2020). Critical Issues in the Trucking Industry – 2020. https://truckingresearch.org/wp-content/uploads/2020/10/ATRI-Top-Industry-Issues-2020.pdf

Andrade, C. (2020). The limitations of online surveys. Indian journal of psychological medicine, 42(6), 575-576. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7735245/

Angell, L. S. (2014). An opportunity for convergence? Understanding the prevalence and risk of distracted driving through the use of crash databases, crash investigations, and other approaches. Annals of Advances in Automotive Medicine 58: 40-59. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4001669/

Atwood, J., et al. (2018). The driver-level crash risk associated with daily cellphone use and cellphone use while driving. Accident Analysis and Prevention 119: 149-154. https://pubmed.ncbi.nlm.nih.gov/30031295/

Banz BC, Wu J, Camenga DR, Mayes LC, Crowley MJ, Vaca FE. Brain-based limitations in attention and secondary task engagement during high-fidelity driving simulation among young adults. Neuroreport. 2020 May 22;31(8):619-623. doi: 10.1097/WNR.0000000000001451. PMID: 32366810. https://www.ingentaconnect.com/content/wk/nerep/2020/00000031/00000008/art00007

Boland, M., Sweeney, M. R., Scallan, E., Harrington, M., & Staines, A. (2006). Emerging advantages and drawbacks of telephone surveying in public health research in Ireland and the UK. BMC Public Health, 6(1), 1-7. https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-6-208

Brown, S., Robertson, R. D., & Vanlaar, W. G. M. (2021). Impaired & Distracted Driving. Data comparison. Traffic Injury Research Foundation, Ottawa, ON. https://tirf.ca/publications/impaired-distracted-driving-data-comparison/

Cambridge Mobile Telematics. (2020). The Harsh Realities of Phone Distraction, Cambridge Mobile Telematics. https://www.cmtelematics.com/phone_distraction_report/

Cambridge Mobile Telematics. (2022). 2022 US Distracted Driving Report, Cambridge Mobile Telematics. https://www.cmtelematics.com/the-2022-us-distracted-driving-report/

Carney, C., et al. (2016). Using event-triggered naturalistic data to examine the prevalence of teen driver distractions in rear-end crashes. Journal of Safety Research 57: 47-52. https://pubmed.ncbi.nlm.nih.gov/27178079/

Centers for Disease Control and Prevention. (2022). Youth Risk Behavior Surveillance System (YRBSS). https://www.cdc.gov/healthyyouth/data/yrbs/index.htm

Claveria, J. B., et al. (2019). Understanding truck driver behavior with respect to cell phone use and vehicle operation. Transportation Research Part F: Traffic Psychology and Behaviour 65: pp 389-401. http://research.engr.oregonstate.edu/hernandez/sites/research.engr.oregonstate.edu.hernandez/files/understanding_truck_driver_behavior_with_respect_to_cell_phone_use_and_vehicle_operation.pdf

Delgado, M. K., et al. (2018). Attitudes on technological, social, and behavioral economic strategies to reduce cellphone use among teens while driving. Traffic Injury Prevention 19(6): 569-576. https://pubmed.ncbi.nlm.nih.gov/29652523/

Dingus, T. A., et al. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. Proceedings of the National Academy of Sciences 113(10): 2636-2641. https://www.pnas.org/doi/10.1073/pnas.1513271113

Ellison, A.B., Greaves, S.P., Bliemer, M.C.J. (2015). Driver behaviour profiles for road safety analysis. Accid. Anal. Prev. 76, 118–132. https://doi.org/10.1016/j. aap.2015.01.009.

Flaherty, M. R., et al. (2020). Distracted Driving Laws and Motor Vehicle Crash Fatalities. Pediatrics 145(6). https://publications.aap.org/pediatrics/article/145/6/e20193621/76936/Distracted-Driving-Laws-and-Motor-Vehicle-Crash

Gershon, P., et al. (2017). Teens' distracted driving behavior: Prevalence and predictors. Journal of Safety Research 63: 157-161. https://pubmed.ncbi.nlm.nih.gov/29203014/

Guo, F., et al. (2017). The Effects of Age on Crash Risk Associated with Driver Distraction. International Journal of Epidemiology 46(1): pp 258-265. https://pubmed.ncbi.nlm.nih.gov/28338711/

Hammond, R. L., et al. (2016). Distraction and Drowsiness in Motorcoach Drivers. https://rosap.ntl.bts.gov/view/dot/31577/dot_31577_DS1.pdf

Hammond, R. L., et al. (2021). Analysis of Naturalistic Driving Data to Assess Distraction and Drowsiness in Drivers of Commercial Motor Vehicles. https://rosap.ntl.bts.gov/view/dot/57153/dot_57153_DS1.pdf

Harland, K. K., et al. (2016). Analysis of naturalistic driving videos of fleet services drivers to estimate driver error and potentially distracting behaviors as risk factors for rear-end versus angle crashes. Traffic Injury Prevention 17(5): 465-471. https://www.tandfonline.com/doi/abs/10.1080/15389588.2015.1118655

Hernandez, S., Anderson, J. C., Claveria, J., & Olsen, A. (2020). A Framework to Evaluate Causes and Effects of Truck Driver At-Fault Crashes (No. FHWA-OR-RD-21-05). Oregon Department of Transportation. Research Section. https://rosap.ntl.bts.gov/view/dot/57465/dot_57465_DS1.pdf

Hess, A. S., & Abd-Elsayed, A. (2019). Observational studies: uses and limitations. In Pain (pp. 123-125). Springer, Cham. https://www.semanticscholar.org/paper/Observational-Studies%3A-Uses-and-Limitations-Hess-Abd-Elsayed/5403f46c5fe8bae6a09e4406ace91e88fbd38aaf

Hill, L., et al. (2020). 'Just Drive': An Employee-Based Intervention to Reduce Distracted Driving. Journal of Community Health 45(2): 370-376. https://pubmed.ncbi.nlm.nih.gov/31564025/

Jashami, H., et al. (2017). Factors on Contributing to Self-Reported Cell Phone Usage by Younger Drivers in the Pacific Northwest. https://www.researchgate.net/publication/318009302_Factors_Contributing_to_Self-Reported_Cell_Phone_Usage_by_Younger_Drivers_in_the_Pacific_Northwest

Just MA, Keller TA, Cynkar J. A decrease in brain activation associated with driving when listening to someone speak. Brain Res 2008; 1205:70–80. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2713933/

Kidd, D.G. and N. K. Chaudhary (2019). Changes in the sources of distracted driving among Northern Virginia drivers in 2014 and 2018: A comparison of results from two roadside observation surveys. Journal of Safety Research 68: 131-138. https://www.sciencedirect.com/science/article/pii/S0022437518306625

Kramers, R. E. (2009). User Surveys–"Who, What, Where, When, Why". In Proceedings of the 24th International Cartographic Conference. https://icaci.org/files/documents/ICC_proceedings/ICC2009/html/nonref/17_7.pdf

Lemaster-Sandbank, L., et al. (2020). Distracted Driving Enforcement Demonstrations: Lessons Learned. A. United States. Department of Transportation. National Highway Traffic Safety. https://rosap.ntl.bts.gov/view/dot/53958

Li, L., Shults, R. A., Andridge, R. R., Yellman, M. A., Xiang, H., & Zhu, M. (2018). Texting/emailing while driving among high school students in 35 states, United States, 2015. Journal of Adolescent Health, 63(6), 701-708. https://www.sciencedirect.com/science/article/pii/S1054139X18302507

Li, L., Pope, C.N., Andridge, R.R., Bower, J.K., Hu, G., Zhu, M. (2020). Cellphone Laws and Teens Calling While Driving: Analysis of repeated cross-sectional surveys in 2013, 2015, 2017 and 2019. Injury Epidemiology 7(65): https://doi.org/10.1186/s40621-020-00290-x

Marchese, C. (2019). Distracted driving and crash responsibility in fatal USA collisions 1991-2015. http://knowledgecommons.lakeheadu.ca/handle/2453/4356

Murphy, I. et al. (2021). Measuring and Pricing Phone Distraction Risk, Cambridge Mobile Telematics. https://

www.cmtelematics.com/wp-content/uploads/2021/05/CMT_DDR_5-20_FINAL.pdf

National Center for Statistics and Analysis. (2018). Distracted Driving 2016, National Highway Traffic Safety Administration. https://crashstats.nhtsa.dot.gov/Api/Public/Publication/812517

National Center for Statistics and Analysis. (2017). Distracted Driving 2015. National Highway Traffic Safety Administration. https://crashstats.nhtsa.dot.gov/Api/Public/Publication/812381

National Center for Statistics and Analysis. (2019). Driver Electronic Device Use in 2017, National Highway Traffic Safety Administration. https://crashstats.nhtsa.dot.gov/Api/Public/Publication/812665

National Center for Statistics and Analysis. (2019). Driver Electronic Device Use in 2018, National Highway Traffic Safety Administration. https://crashstats.nhtsa.dot.gov/Api/Public/Publication/812818

National Highway Traffic Safety Administration. (2018). National Telephone Survey on Distracted Driving Attitudes and Behaviors - 2015, National Highway Traffic Safety Administration. https://www.nhtsa.gov/staticfiles/nti/pdf/811555.pdf

National Highway Traffic Safety Administration. (2022). Traffic Safety Facts. Distracted Driving 2020. National Highway Traffic Safety Administration. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813309

National Highway Traffic Safety Administration. (2021). Driver Electronic Device Use in 2019, National Highway Traffic Safety Administration. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813184

National Traffic Law Center. (2017, May). Investigation and prosecution of distracted driving cases (Report No. DOT HS 812 407). Washington, DC: National Highway Traffic Safety Administration. https://www.nhtsa.gov/document/investigation-and-prosecution-distracted-driving-cases

Office of Behavioral Safety Research. (2021, June). Update to special reports on traffic safety during the COVID-19 public health emergency: Fourth quarter data (Report No. DOT HS 813 135). National Highway Traffic Safety Administration. https://www.nhtsa.gov/sites/nhtsa.gov/files/2021-06/Update_Traffic%20Safety%20During%20COVID-19_4thQtr-060121-web.pdf

Otto, J., Finley, K., Green, K., & Ward, N. J. (2019). Understanding law enforcement attitudes and beliefs about traffic safety (No. FHWA/MT-19-003/8882-309-08). Montana. Dept. of Transportation. Research Programs. https://rosap.ntl.bts.gov/view/dot/42266

Owens, J. M., et al. (2018). Crash Risk of Cell Phone Use While Driving: A Case-Crossover Analysis of Naturalistic Driving Data, AAA Foundation for Traffic Safety. https://aaafoundation.org/crash-risk-cell-phone-use-driving-case-crossover-analysis-naturalistic-driving-data/

Parr, M. N., et al. (2016). Differential impact of personality traits on distracted driving behaviors in teens and older adults. Accident Analysis and Prevention 92: 107-112. https://www.sciencedirect.com/science/article/pii/S0001457516300823

Robertson, R. D., Bowman, K. & Charles, J.-M. (2015). Distracted driving in Canada: Making progress, taking action. Traffic Injury Research Foundation, Ottawa, ON. https://diad.tirf.ca/research/distracted-driving-canada-making-progress-taking-action/

Robertson, R.D., Marcoux, K., Wood, K., Vanlaar, W. & Simpson, S. (2010). Ten Percenters: Final Report. I-95 Corridor Coalition. https://rosap.ntl.bts.gov/view/dot/34342

Root Insurance. (2019). 2019 Focused Driving Report, Root Insurance. https://cdn.brandfolder.io/5S4BNCY2/as/v4tvkc44btbqwn67p93snf/root-insurance-focused-driving-report-2019_1.pdf

Root Insurance. (2020). 2020 Focused Driving Report, Root Insurance. https://www.joinroot.com/focused-driving-survey-2020/

Root Insurance. (2021). 2021 Distracted Driving Report, Root Insurance. https://www.joinroot.com/distracted-driving-2021/

Rudisill, T. M., Smith, G., Chu, H., & Zhu, M. (2018). Cellphone legislation and self-reported behaviors among subgroups of adolescent US drivers. Journal of Adolescent Health, 62(5), 618-625. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5931338/

Schroeder, P., Wilbur, M., & Peña, R. (2018). National survey on distracted driving attitudes and behaviors-2015 (No. DOT HS 812 461). United States. National Highway Traffic Safety Administration. https://rosap.ntl.bts.gov/view/dot/35960

Schweizer TA, Kan K, Hung Y, Tam F, Naglie G, Graham SJ. Brain activity during driving with distraction: an immersive fMRI study. Front Hum Neurosci 2013; 7:53. https://www.frontiersin.org/articles/10.3389/fnhum.2013.00053/full

Shoots-Reinhard, B., Svensson, H., & Peters, E. (2021). Support for legislative, technological, and organizational strategies to reduce cellphone use while driving: Psychological predictors and influences of language. Traffic injury prevention, 22(7), 507-513. https://www.tandfonline.com/doi/abs/10.1080/15389588.2021.1964076

Simpson, H.M., Mayhew, D.R., and Beirness, D.J. (1996). Dealing with the hardcore drinking driver. Traffic Injury Research Foundation. https://tirf.ca/wp-content/uploads/2017/02/Dealing_with_HC_Report_1996.pdf

Simpson, H.M., Beirness, D.J., Mayhew, D.R. (1991). The Hard Core Drinking Driver. Ottawa: Traffic Injury Research Foundation of Canada. https://tirf.ca/publications/hard-core-drinking-driver-2/

Singh, H., & Kathuria, A. (2021). Analyzing driver behavior under naturalistic driving conditions: A review. Accident Analysis & Prevention, 150, 105908. https://www.sciencedirect.com/science/article/pii/S0001457520317280

TIRF National Fatality Database. (2021). National Fatality Database. https://tirf.ca/projects/the-national-fatality-database/

Vanlaar, W.G.M., Brown, S. Wicklund, C. & Robertson, R.D. (December 2021) TIRF USA Road Safety Monitor 2021: Alcohol-impaired driving & COVID-19 in the United States. Traffic Injury Research Foundation, USA. https://trid.trb.org/view/1900915

Wilbur, M. (2019). Young driver survey (Report No. DOT HS 812 761). Washington, DC: National Highway Traffic Safety Administration. https://rosap.ntl.bts.gov/view/dot/42691

Woods-Fry, H. Vanlaar, W.G.M., Robertson, R.D., Torfs, K., Kim, W., Van den Berghe, W., and Meesmann, U. (2018). Comparison of Self-Declared Mobile Use While Driving in Canada, the United States, and Europe: Results from the European Survey of Road Users' Safety Attitudes. Transportation Research Record Journal of the Transportation Research Board 07/2018. https://journals.sagepub.com/doi/abs/10.1177/0361198118787631

Woods-Fry, H., Vanlaar, W. G. M., Robertson, R. D. (2021). COVID-19 Road Safety Monitor 2021. The impact of the pandemic on road safety & mobility. Traffic Injury Research Foundation, Ottawa, ON. https://trid.trb.org/view/1898919

Yellman, M. A., Bryan, L., Sauber-Schatz, E. K., & Brener, N. (2020). Transportation risk behaviors among high school students—Youth Risk Behavior Survey, United States, 2019. MMWR supplements, 69(1), 77. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7440196/

Zendrive (2018). Zendrive's 2018 Distracted Driving Snapshot: What We Learned from Driving 100 Billion Miles. https://d1x6dm64pjo2h2.cloudfront.net/casestudies/Zendrive_Distracted_Driving_2018.pdf

Zendrive (2020). Mobility Amidst Lockdown: Every Minute on the Road is Riskier, Zendrive. https://cdn2.hubspot.net/hubfs/6619093/COVID-19%20Global%20Mobility%20Study%20-%20Zendrive%20-%20May%207,%202020.pdf

## Other media references


Centre for Road Safety." Mobile Phone Detection Cameras - Mobile Phone Use - Staying Safe - NSW Centre for Road Safety https://roadsafety.transport.nsw.gov.au/stayingsafe/mobilephones/technology.html

Centre for Road Safety." Mobile Phone Detection Cameras - Mobile Phone Use - Staying Safe - NSW Centre for Road Safety, https://roadsafety.transport.nsw.gov.au/stayingsafe/mobilephones/technology.html

Queensland, The State of. "Mobile Phone and Seatbelt Cameras." Queensland Government, CorporateName=The State of Queensland; Jurisdiction=Queensland, 29 Nov. 2021, https://www.qld.gov.au/transport/safety/fines/cameras

Samihah Zaman, Staff Reporter. "Abu Dhabi Introduces New System to Automatically Detect Seat Belt Violations, Mobile Phone Use While Driving." Government – Gulf News, Gulf News, 7 Dec. 2020, https://gulfnews.com/uae/government/abu-dhabi-introduces-new-system-to-automatically-detect-seat-belt-violations-mobile-phone-use-while-driving-1.75726571

"Smart Cameras to Catch Texting Drivers from Monday." NL Times, 13 Nov. 2020, https://nltimes.nl/2020/11/13/smart-cameras-catch-texting-drivers-monday#:~:text=Smart%20traffic%20cameras%20capable%20of,Prosecution%20Service%20(OM)%20said

Swanston, Tim. "100 Drivers a Day Being Caught on Phones or Not Wearing Seatbelts." ABC News, ABC News, 2 Oct. 2020, https://www.abc.net.au/news/2020-10-03/cameras-reveal-queensland-drivers-no-seatbelts-and-mobile-phones/12726014

"World's First Smartphone Detection Camera Launched Down Under." Traffic Technology Today, 26 Sept. 2019, https://www.traffictechnologytoday.com/news/incident-detection/worlds-first-smartphone-detection-camera-launched-down-under.html

NATIONAL DISTRACTED DRIVING COALITION


## FOLLOW US

National Distracted Driving Coalition

@NatlDDCoalition

National Distracted Driving Coalition

info@usnddc.org