

# Distracted Biking: A Review of the Current State-of-Knowledge

Judith L. Mwakalonge<sup>1,\*</sup>, Jamarío White<sup>1</sup>, Saidi Siuhi<sup>2</sup>

<sup>1</sup>Department of Civil and Mechanical Engineering Technology and Nuclear Engineering, South Carolina State University, Orangeburg, South Carolina, 29117

<sup>2</sup>Department of Civil Engineering, Abu Dhabi University, P. O. Box 59911, Abu Dhabi, United Arab Emirates

---

**Abstract** Cyclists, much like drivers, have always been engaged in multi-tasking activities like using hand-held devices, listening to music, snacking, or reading while bicycling. While distracted drivers endanger themselves and other, distracted bikers, in general present more risk to themselves than to others. Distracted bicycling, however, has not received similar interventions to address safety related issues. This study reviewed the state-of-knowledge on policies, programs, data sources, and identified data collection opportunities and research needs. Literature review conducted in this study revealed only six [6] past studies that investigated the effect of distracted bicycling. The review also found that several agencies/organizations listed the use of portable electronic devices while cycling as unsafe behavior. Some of the agencies/organizations in the United States, Canada, Belgium, Bermuda, Germany, and New Zealand have implemented interventions to curb distracted bicycling such as education, awareness programs, and legislation. The majority of the legislation enacted ban the use of headphones or earphones in or on one or both ears and few ban hand-held phones while cycling. In addition to these, one law common to all U.S. states and District of Columbia restricts cyclists from carrying bundles, articles or objects that prevent them from keeping at least one hand on the handlebars which indirectly addresses distracted bicycling.

**Keywords** Distracted, Mobile Devices, Bicycling, Cycling

---

## 1. Introduction

Bicycling is beneficial for health, green communities, and reduces traffic congestion and emissions. Realizing its benefits, transportation agencies and communities are planning and implementing programs that promote this form of active transportation. However, recently distracted bicycling due to the use of portable electronic devices has emerged which poses safety issues. While distracted drivers endanger themselves and other, distracted bikers, in general present more risk to themselves than to others. Unlike distracted bicycling, numerous studies have focused on the effect of using mobile devices while driving [21]. Most of the effects cited in the literature on distracted driving include reduced awareness of drivers' surroundings, increased reaction and braking times, increased incidences of collision, reduced vehicle speed, greater following variability, greater lateral variability, and reduced response time to the lead vehicle (5, 2,106). Cyclists, much like drivers, also engage in multi-tasking activities while biking such as using hand-held devices, listening to music, snacking, conversing with other bicyclists or reading. Though the amount of research on

safety of bicyclists due to distracted biking is limited, studies conducted in this area reported similar findings to those experienced in distracted driving [21,18,20,8,7,9].

Given the fact that research on distracted biking is in its infancy, so are its related interventions and policies to improve safety of bicyclists. As the market penetration of portable electronic devices among non-motorists and motorists proliferates, the incidences of distraction-related crashes are expected to escalate [22]. In addition, current figures indicate that the number of mobile electronic devices in the United States exceeds its population [3]. The US National Highway Traffic Safety Administration (NHTSA, 2013) reported that at any given moment during daylight hours over 800,000 vehicles are driven by drivers using hand-held cell phones. Like distracted motorists, the effects of cell phone use on non-motorists such pedestrians, bicyclists, and other forms of non-motorized travel have similar safety concerns.

To address safety concerns related to distracted bicycling, some agencies in the U.S. have extended their distracted driving legislation to include a texting ban or phone usage ban while operating a bicycle [16]. Some of the agencies have implemented awareness programs intended to curb distracted bicycling. However, there are limited studies on distracted bicycling invigorating the need for further research particularly to document the level of state-of-knowledge on distracted biking. This would assist in

---

\* Corresponding author:

jmwakalo@scsu.edu (Judith L. Mwakalonge)

Published online at <http://journal.sapub.org/ijtte>

Copyright © 2014 Scientific & Academic Publishing. All Rights Reserved

answering some key questions such as what type of policies and programs exist and the extent of distracted bicycling problem. The outcomes of such findings would assist state and local governments to formulate effective policies, regulations, and laws to improve bicyclist safety. On the other hand, such information would help bicycle advocates to advise bicyclists on safe bicycling practices. In addition, a comprehensive review will highlight data and research needs to address safety due to distracted bicycling. This paper aimed to review the state-of-knowledge on policies, programs, data sources, and identified data collection opportunities and research needs. Specifically, this study had the following objectives:

- To review the current state-of-knowledge on distracted bicycling on safety,
- To identify strategies and policies for effective safety interventions for distracted biking, and
- To provide future research directions for data needs for advancement and program/laws evaluation.

## 2. Bicycle and Distraction Definitions

Bicycle definitions vary across jurisdictions. The US Federal Highway Administration (FHWA) defines a bicycle as a vehicle having two tandem wheels, propelled solely by human power, upon which any person or persons may ride (FARG 23 CFR 652). The Maryland Code defines a “Bicycle” as a vehicle that:

- a) Is designed to be operated by human power,
- b) Has two or three wheels, of which one is more than 14 inches in diameter,
- c) Has a rear drive, and
- d) Has a wheel configuration as follows: (i) if the vehicle has two wheels, with both wheels in tandem; or (ii) if the vehicle has three wheels, with one front wheel and with two rear wheels that are equidistant from the center of the vehicle.

Other agencies definition of bicycle includes electric bicycles that are widely known as “e-bikes”. Due to the existence of many different definitions of bicycle, this study presents information from different sources with word “bicycle” which have two or three wheels and are human propelled or battery assisted for electric bicycles.

Distracted bicycling is defined as the act of riding a bicycle while engaged in other activities that take the bicyclist’s attention away from the bicycling task. Conventional distractions include eating, smoking, and conversing with fellow bikers. Modern distractions are technology-based like the use of portable electronic devices while bicycling. In line with recent research focus, this study concentrates on the technology-based distractions. However, conventional distractions are briefly incorporated.

## 3. Studies on Distracted Biking

In current literature, only six past studies have been

published on distracted biking with the earliest study published in 2008 as summarized in Table 1. These studies can be categorized as observational, survey, or experimental. The results of these studies are pivotal in assessing the safety risks that are involved with distracted bicycling and effective interventions for safe biking practices. With the exception of Japan, all studies were conducted in the Netherlands, a country with extensive bicycling infrastructure and bicycling population [17]. Based on observational studies [21,18], the distraction involving electronic devices was 10.5% [21] and 12.6% of all observed cyclists [18].

For the survey-based studies, Ichikawa and Nakamara [9] found that about 75% of male and 64% of female bicycle commuters reported using a mobile phone whilst cycling in the past one month. Likewise, Goldenbeld’s studies [7,8] found that 17% of the respondents used portable electronic devices during nearly all bicycle trips and 55% of cyclists used the phone at least occasionally while cycling. Comparing these findings to distracted driving, Tison et al. [19] reported that 77% of respondents reported answering incoming calls and 41% making calls on all, most, or some driving trips. Waard et al. [21] found that of the accident-involved cyclists only 0.5% stated that they were using their phone at the time of the accident.

In a study of participation in secondary tasks while cycling and their effects, Terzano [18] reported about 23% of observed cyclists performed secondary tasks. Cyclists performing secondary tasks engaged in unsafe behavior more often and forced others to evade them to avoid an accident compared to their counterparts. Ichikawa and Nakamara [9] found that using a mobile phone while riding a bicycle was very common among high school students who commuted to school by bicycle. In addition, the study found a significant relationship between mobile phone usage while riding a bicycle and a bicycle crash or near crash experience. Goldenbeld et al. [8] found that teen cyclists (12–17 years) and young adult cyclists (18–34 years) are more frequent users of portable devices while cycling than middle-aged and older adult cyclists (35–49 years, 50+ years). Further, the study found that after controlling other factors, teen cyclists and young adult cyclists who used electronic devices on every trip had higher chances of being involved in a bicycle crash compared to the same age groups who never used these devices. However, for middle-aged and older adult cyclists, the use of portable electronic devices was not a significant predictor of bicycle crashes.

In an experimental study, Waard et al. [20] found that listening to music with in-earbuds worsened the response to auditory stop signals compared to with two or one standard earbud. The study also found that hands-free operation resulted in faster performance compared to hand-held operation; however, the difference was only minor. This finding is in contrast with an earlier study by Waard et al. [21] which found that of crash-involved cyclists, only 0.5% stated that they were using their phone at the time of the accident.

**Table 1.** Summary of Studies on Distracted Bicycling

<i>Author(s)</i>	<i>Title</i>	<i>Location</i>	<i>Methodology</i>	<i>Study population</i>
Terzano (2013)	Bicycling safety and distracted behavior in The Hague, the Netherlands	Netherlands	Observational	1360 cyclists at six un-signalized intersections
Goldenbeld et al. (2012)	The use and risk of portable electronic devices while cycling among different age groups	Netherlands	Internet survey	2,553 persons who used a bicycle minimally one day per week
Waard et al. (2011)	Effects of listening to music, and of using a handheld and hands free telephone on cycling behavior	Netherlands	Experiment on a cycle path 220m long and 1.92 m wide	11 men and 14 women with age range 16 to 26 years
Goldenbeld et al. (2010)	Use of portable media and mobile phones while cycling	Netherlands	Internet survey	2500 cyclists
Waard et al. (2010)	Mobile phone use while cycling: incidence and effects on behavior and safety	Netherlands	Observational	2138 cyclists
			Questionnaire survey	1142 cyclists
			Experimental	24 cyclists
Ichikawa and Nakamura (2008)	Japanese high school students' usage of mobile phones while cycling	Japan	Questionnaire survey	2058 male and 1208 female high school students*

\*only schools commissioned by the National Agency for the Advancement of Sports and Health

Table 1 presents a summary of the past studies on distracted bicycling/cycling discussed above.

## 4. Current Efforts for Addressing Distracted Biking

To document current efforts to curb distracted biking, this paper conducted an extensive search and review to identify key products, legislation, educational materials, or curricula available that address distracted bicycling. Several biking advocate websites served as primary sources of information related to educational and awareness campaigns. General search of the keyword “distracted bicycling” yielded several websites and documents that served as information sources for available technology, legislation, and additional information for products, curricula, or educational materials. As expected, due to the infancy nature of the subject, few products, technologies, materials, or curricula were available that address distracted bicycling. Those that are available have only recently been produced and released and have not been evaluated. These efforts are categorized as educational and awareness, technological, and legislative strategies.

### 4.1. Public Awareness Programs

In this study, we searched different organizational websites for bicycle safety tips, rules and biking guides or handbooks and vehicle codes, to identify whether distracted bicycling was explicitly or implicitly mentioned or not mentioned at all. Table 2 presents a summary of some of the current public awareness programs around the world. The list provided in the table is based on the information found during literature searches from different sources including agencies, organizations, and bicycling advocates. The review revealed that in all states, vehicle codes restrict bicyclists from carrying objects that prevents them from keeping both or at least one hand on the handlebars while cycling. Only

five states, namely, Colorado, Delaware, Maryland, Michigan, and Utah, require operators of bicycles to keep both hands in the operation of the bicycle. The remaining states, including the District of Columbia, required at least one hand on the handlebars while biking. Such bicycling laws can be interpreted or extended to ban hand-held mobile phones or hand-held portable electronic devices. Since some states allow for local regulation, regions within the state may have different practices for biking from those reported earlier. Apart from vehicle codes, other organizations, mostly under bicycle safety tips, advise cyclists to keep both hands on the handlebars. For example, the University of Mississippi bicycle safety tips, reads “Keeping both hands on the handlebars allows you to make quick turns and stops. In rain, allow three times the normal distance to stop.”

The review also found that some agencies that do not list distracted biking as a safety tip in a more specific or general way. For instance, Charles River Wheelmen (CRW) [15], a group of active cyclists in the Boston area, states that cell phones are invaluable in emergencies and/or in obtaining directions, however, responding to a ring when moving, is asking for trouble. In The New Haven Handbook for Bicyclists, under safety, comfort and style tips advise, “keep your phone on you in case of an emergency—but don’t use it while you’re actually riding. Distracted biking can be just as dangerous as distracted driving.” The National Highway Transportation Safety Administration (NHTSA) website, under kids and bicycle safety states, “Use your eyes AND ears.....You need your ears to hear traffic and avoid dangerous situations; don’t wear a headset when you ride,” The City of Columbus, in the Department of Public Service list states, “Keep your eyes and mind on the road, do not be a distracted bicyclist.” as one of the rules of the road for cyclists. The National Highway Transportation Safety Administration (NHTSA), in partnership with the American Automobile Association (AAA), launched a “Role Model” campaign to encourage everyone to model safe behaviors to

enhance the safety of all road users, including bicyclists. The campaign defines, among others; a “role model” should be riding and driving focused—never distracted. Additionally, the campaign includes pledges for kids, youth, parents, and caregivers and has sections related to distracted bicycling. The youth pledge reads, “By signing this pledge, I agree to be a responsible “Role Model” by promising to ... Stay alert, scanning and listening for traffic. I will: Stop using personal electronic equipment, such as my phone or mp3 player when walking and biking around traffic.” The parents/caregiver pledge, reads, “As a “Role Model,” I promise to...Stay alert to traffic using my eyes and ears. I will: Keep my eyes on the road and not use my personal electronic equipment when walking, biking, or driving in and around traffic” [12, 13].

The U.S. Department of Defense has incorporated a policy on distracted walking/cycling. The Department of Defense Instruction (DODI) 6055.04 under listening devices section states “Prohibit the use of portable headphones, earphones, cellular phones, iPods, or other listening and entertainment devices (other than hearing aids) while walking, jogging, running, bicycling, skating, or skateboarding on roadways.” [4] The reason cited is that using listening devices impairs recognition of emergency signals, alarms, announcements, approaching vehicles, human speech, and outside noise in general.

Table 2 presents a summary of public awareness programs on distracted bicycling/cycling from different countries.

**Table 2.** Summary of Public Awareness Programs on Distracted Bicycling

No.	Country	State/Region	Location	Document Title	Distraction Mentioned?	Actual Wording
1	Australia	Brisbane, Australia	Brisbane city council	Cycling rules, signs and safety tips	No	
2	Australia	South Australia	Government of South Australia	Cyclist road rules and safety	No	
3	Canada	British Columbia	City of Richmond	Cycling Safety Tips	No	
4	Canada	British Columbia	City of Vancouver	Cycling safety tips and regulations	No	
5	Canada	British Columbia	City of Kelowna	Cycling safety	No	
6	Canada	Calgary	Bikecalgary	Cycling safety handbook	No	
7	Canada	Nova Scotia	Halifax Regional Municipality	Bicycle Safety	No	
8	Canada	Ontario	Ontario	Ontario's Guide to Safe Cycling	No	
9	USA	Arizona	Arizona governor's office for highway safety	Bicycle Safety Tips	No	
10	USA	Arizona	City of Scottsdale	Bicycle Safety Tips	No	
11	USA	California	Los Angeles County Bicycle Coalition	Safe Biking Tips	No	
12	USA	California	LADOT	Bicycle safety and etiquette	†	
13	USA	Connecticut	Bike Walk Connecticut	Bike Safety Information	No	
14	USA	Georgia	Bike Bike Roswell	Georgia BIKE SENSE: A Guide for Cyclists & Motorists	No	
15	USA	Hawaii	City & County of Honolulu DOT	Honolulu bicycle laws and regulations	†	
16	USA	Illinois	League of Illinois Bicyclists	Bike safety tips from the League of Illinois Bicyclists	No	
17	USA	Illinois	League of Illinois Bicyclists	Illinois Bicycle Laws	†	
18	USA	Indiana,		Indiana bicycle laws	†	
19	USA	Iowa	Iowa bicycle coalition	Bicycle Guide	No	
20	USA	Kentucky	Louisville	Bike Safety Tips	No	
21	USA	Maine	Maine DOT	Bicycle Safety	No	

22	USA	Missouri	Mid-America Regional Council	Bicycle Safety Tips	No	
23	USA	New Mexico	City of Albuquerque	Bicycle Laws and Safety Tips	No	
24	USA	Texas	Texas A&M University Police Department	Texas Bike Laws, Safety & Theft Prevention Tips	†	
25	UK	Manchester	Trafford Council	Our top 10 tips for safe cycling	No	
26	UK	Kent County	Kent county council	Tips for safe cycling	No	
27	USA	Utah	Utah department of health	Bicycle Safety Tips	No	
28	USA	Washington, DC	Safekids worldwide	Bike Safety tips	No	
29	USA	Washington, DC	Washington Area Bicyclist Association	WABA's Pocket Guide to DC Bike Laws	No	
30	Canada	Toronto	Cycling in Toronto	Suggested Safety Rules	Yes	Avoid wearing headphones or using cell phones while riding
31	Ireland	Ireland	bikeweek	Tips for Safer Cycling	Yes	Always be alert to what's happening around you. Wearing headphones while cycling is not advised.
32	Netherlands	Netherlands	Cycling in Wageningen	TRAFFIC RULES FOR CYCLISTS	Yes	<b>Music and mobile phone:</b> It is not forbidden by law to use your mobile phone or listen to music while cycling. It can however distract you, and is therefore discouraged.
33	USA	California	Metro	Metro Bike Safety Tips	Yes	Wearing headphones on both ears when riding is prohibited by law.
34	USA	Colorado	Bicycle Colorado	Bicycling on Colorado Roads	Yes	Listen up! Headphones prevent you from hearing warnings
35	USA	Florida	Florida bicycle association	2012 Bicycle & Pedestrian Law Enforcement Guide	Yes	A cyclist may not wear a headset, headphone or listening device, other than a hearing aid, while riding
36	USA	Florida	Sarasota Sheriff	Bicycle safety	Yes	A bicyclist may not wear a headset, headphone, or other listening device other than a hearing aid when riding. Wearing a headset blocks out important audio clues needed to detect the presence of other traffic.
37	USA	Illinois	Illinois state police bike brochure	Bicycle safety tips	??	Keep both hands on the handle bars except to signal a turn or stop
38	USA	Illinois	City of Chicago	Safe bicycling in Chicago	Yes	Headphones: Don't wear them! As a bicyclist in traffic, you can hear more of what's going on around you than motorists can. If you wear headphones you might not hear something that can help you avoid a crash.
39	USA	Mississippi	The University of Southern Mississippi	Bicycle Safety Tips		Keeping both hands on the handlebars allows you to make quick turns and stops. In rain, allow three times the normal distance to stop.
40	USA	New York City	New York City	Bike Smart: The Official Guide to Cycling in New York City	Yes	<b>Don't wear earphones.</b> By law you may wear one earbud, but keeping your ears clear is a much safer choice.
41	USA	Ohio	City of Columbus, Ohio Department of Public Service	Rules of the Road	Yes	Keep your eyes and mind on the road, do not be a distracted bicyclist.
42	USA	USA	Boy Scouts of America	BSA Bike Safety Guidelines	Yes	Keep your head and ears open and do not wear headphones while riding.

43	USA	USA	AAA	Bike safety bookmark	No	Keep both hands on the handlebars.
44	USA	USA	AAA	The AAA Guide to a Great Ride	Yes	Do not wear headphones or listen to music while riding, because you need to hear what's going on around you. This is a law in some states!
45	USA	Utah	Yieldtolife	10 Safety Tips for Cyclists	†	Always make sure you have at least one hand on your handlebars, no matter what.
46	USA	Washington	Washington State DOT	Bicycle Safety Tips	Yes	Never wear a headphone while riding a bike.
47	USA	Wisconsin	City of Madison	10 Smart Rules to Bike Safety	Yes	<b>Don't Get Distracted</b> Don't listen to music or talk on the phone while riding
48	Unknown	Unknown	Be safe	Important Cycling Safety Tips	Yes	Stay alert. Listen and Look. Headphones prevent you from hearing traffic around you. In some states it is illegal to wear them while cycling. Be safe don't wear headphones
49	South Africa	South Africa	Arrive alive	Cycling safety		Keep both hands on the handlebars unless signaling

† A person operating a bicycle may not carry any object that prevents the operator from keeping at least one hand on the handlebars.

#### 4.2. Technology-Based Solutions

In the literature, this study found two technology-based solutions specifically for hand free application such as biking. These solutions include a bone conduction headphone and a bicycle electronic device holder. Contrary to conventional headphones where sound is projected directly into the ear by creating air pressure waves, bone conduction headphones use the cheekbones to transfer auditory signals to the cochlea and are specifically designed for bicyclists. Bone conduction headphones do not cover the ear and therefore allow the bicyclists to hear sounds around them. Figure 1 shows an illustration of the bone conduction headphone [11]. The review also indicated there are few helmets with built-in headphones that are suitable for safe bicycling. Based on the information available in the literature, it seems these helmets are at an early stage of development and therefore no significant details are available.



Figure 1. Bone conduction headphones [22]

Conventionally, most cyclists would hold electronic devices in their hands, which would lead to cycling with one

hand or both hands off the handlebars. Bicycle electronic device holders are very important in ensuring that electronic devices stay properly secured while bicycling. The holders can be mounted onto the handlebar of the bicycle. Figure 2 shows a bicycle cellphone holder and how it can be mounted on the handlebars of the bicycle.



Figure 2. Bicycle cellphone holder

Although current efforts for addressing distracted bicycling are promising, their safety efficacy has not been evaluated. In other words, there is no information on safety effectiveness of a single intervention or a combination of interventions. Risk level in terms of frequency and injury severity of bicyclists with interventions compared to those without interventions is still unclear. In this context, conducting safety evaluations on current interventions is of paramount importance for safe bicycling.

#### 4.3. Distracted Biking Legislation

The review of literature from different sources revealed that legislation pertaining to distracted bicycling do exist. Considering the dangers that distracted bicycling can present, several states and countries have implemented legislation to reduce distracted bicycling. In the U.S., eight states and two cities were found to have legislation combating distracted bicycling. Of the eight states, six states prohibit the use of

headphones or earphones on or in both ears while cycling. In Maryland the law restricts the use of headphones or earphones on or in both ears while cycling on regular roads, however, this does not apply when cycling on public bicycle pathways. The state of New York prohibits cyclists from wearing more than one earphone attached to a radio, tape player or other audio device. The city of Philadelphia extended the ban on talking on hand-held cell phones while driving to bicyclists, motorcyclists, skaters, and skateboarders. The cities of Billings (Montana) and Chicago (Illinois) both limit the use of hand-held cellphones while bicycling.

In Canada, three provinces, namely Alberta, Manitoba, and Quebec, have legislation that prohibit distracted bicycling. Manitoba and Quebec legislation prohibit the use of earphones on or in both ears. Bill 16 in the province of Alberta restricts drivers from: using hand-held cell phones, texting or e-mailing, using electronic devices like laptop computers, video games, cameras, video entertainment displays and programming portable audio players (e.g., MP3 players), entering information on GPS units, reading printed materials in the vehicle, writing, printing or sketching, and

personal grooming. The Bill applies to all vehicles as defined by the Traffic Safety Act including bicycles and to all roads in both urban and rural areas of the province.

In addition to the aforementioned countries, four more including Belgium, Bermuda, Germany, and New Zealand were found to have legislation that prohibit distracted bicycling. The law in New Zealand restricts texting or talking on a mobile phone while cycling and advises cyclists to avoid using portable music players. The search for the actual legislation for Belgium and Germany was unsuccessful but based on the study by Waard *et al.* [21], these countries restrict the use of hand-held mobile phones while cycling. In Bermuda, it is a traffic offense for driving or causing or allowing another person to drive an auxiliary bicycle while using a hand-held mobile telephone, hand-held device, or hand-held electronic entertainment device. Further, the bill defines the "auxiliary bicycle" as a vehicle with two or three wheels intended or adapted for use on roads when the vehicle (a) is electrically propelled, or (b) is mechanically propelled and has a motor with a cubic capacity not exceeding 50 cubic centimeters.

**Table 3.** Summary of Legislation on Distracted Bicycling

<i>Country</i>	<i>Location</i>	<i>Year</i>	<i>Penalty</i>	<i>Comments</i>
Belgium	Belgium	2008	\$130.43	No hand held use of mobile phones.
Bermuda	Bermuda	2011	First offence- \$500, \$750 for second offence committed within 2 years	Driving or causing or allowing another person to drive an auxiliary bicycle while using a hand-held mobile telephone, a hand-held device or a handheld electronic entertainment device.
Canada	Quebec	2007	\$30-\$60	No earphones on or in both ears.
Canada	Manitoba	2010	\$200	No earphones on or in both ears.
Canada	Alberta	2011	\$172	Restricts drivers of vehicles like cars, motorcycles, motor homes, truck tractors, farm vehicles and bicycles. From using hand-held cell phones, texting or e-mailing, electronic devices, entering information on GPS units, reading printed materials in the vehicle, writing, printing or sketching, and personal grooming.
Germany	Germany	2009	\$32.61	No hand held use of mobile phones.
New Zealand	New Zealand	2009	\$80	Text or talk on a mobile phone while cycling. But must avoid using portable music players.
USA	California	2004	\$20-\$50	No headset covering, or earplugs in, both ears.
USA	Virginia	2006	\$20 first offense, \$50 for subsequent offenses	No earphones on or in both ears.
USA	Philadelphia	2009	\$150 to \$300	Philadelphia's ban on talking on handheld cell phones while driving extends to bicyclists, motorcyclists, skaters and skateboarders.
USA	Florida	2010	\$30-\$60	No headset, headphone, or other listening device.
USA	Maryland	2010	\$40 for first offense, \$100 subsequent offenses.	On public bicycle pathways: headphones are allowed. On regular roads: No headset, earplugs, or any other obstruction that covers both ears.
USA	Montana, The city of Billings's	2010	\$110-\$300 first offense, \$500 for subsequent offenses.	Ban on text messaging and use of handheld cell phones while driving includes motorcycles and bicycles.
USA	New York	2010	Up to \$150	No wearing more than one earphone attached to a radio, tape player or other audio device.
USA	Rhode Island	2010	\$85 - \$100 and \$125 for subsequent offense.	No earphones on or in both ears.
USA	Illinois (City of Chicago)	2011	\$20-\$100 and \$500 if accident results.	Bicyclists in Chicago are prohibited from using handheld cell phones and texting.
USA	Oregon	2011	\$90	No headphones on both ears.

Legislation in most cases prohibit use of portable electronics, headphones, headsets, and carrying any other item that can be distractive while cycling. There is also a penalty for the violation of the legislation, which varies in each city, state, and country. Table 3 contains a summary of the legislation that have been implemented to reduce distracted bicycling around the world.

## 5. Data Availability on Distracted Bicycling

This study also conducted a literature review on availability of data related to distracted biking from different transportation agencies. The aim focus of the data review was to evaluate data availability and completeness for safety evaluation of distracted bicycling. The outcomes of the review would help to determine adequacy as well as needs for data collection for safety evaluation of different interventions for distracted bicycling. Sections that follow discuss the data found from the review on distracted biking.

### 5.1. Fatality Analysis Reporting System (FARS) Data

As a starting point, this study used the US National Highway Transportation Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) fatal traffic crash database [14]. FARS annually collects fatal crash data from 50 States, the District of Columbia, and Puerto Rico, and is a census of all fatal crashes that occurred on the Nation's roadways. The FARS manual was reviewed to find out if there were crash information collected related to distracted bicycling both conventional (e.g. eating, smoking) or modern (portable electronic devices). The manual indicated that FARS collected crash information related to

distracted bicycling and the crash information on distracted bicycling fatalities was queried from the database for further review. The manual review showed that prior to 2010 distraction activities for a person (not a motor vehicle occupant (NM), e.g. bicyclist) was coded under "personal related factors" in the person (not a motor vehicle occupant) level form. After 2010, distraction activities are coded under three FARS variables as shown in Table 4.

Table 5 summarizes the most recent five years (2007-2011) of available data from the FARS database related to distracted bicycling by state. As shown in the table, only five fatal crashes were attributed to portable electronic devices. As observed in the table, there are more reported fatal crashes for conventional distraction activities, specifically, inattentive compared to emotional and portable electronic devices. In part, this may be attributed to the newness of the subject and the inherent limitations of FARS data with regard to distraction. The FARS data is based on police accident reports and investigations that were conducted after the event occurred. In addition, police accident reports vary across jurisdictions and distraction is not a uniform variable across jurisdictions and therefore created inconsistencies [1]. The codes that identify distraction do not assign a cause of the crash but rather a contributing factor as reported by a police officer.

Although this data suggests that electronic devices pose insignificant unsafe bicycling practices, they might have contributed indirectly to the crashes. This highlights the need to include factors that are related to distraction and standardization of crash forms across different jurisdictions. Further, since the presented data is based on fatal injuries, there is need for review of states crash data to highlight data availability for non-fatal injuries.

**Table 4.** FARS Variable Coding for Distracted Bicycling

<i>Variable Code</i>	<i>Related Factor</i>	<i>Example</i>
Person related factor (NM 25)	Portable Electronic Devices	Cell phone, MP3 Player, PDA, etc.
Non-motorist action/circumstances at time of crash (NM 12)	Inattentive	Talking, Eating, Etc.
Condition (Impairment) at time of crash (NM 14)	Emotional	Depression, Angry, Disturbed

**Table 5.** Summary of FARS Distracted Bicycling Fatal Crashes (2007-2011)

Year	<i>Cases for Portable Electronic Devices by State</i>	<i>Cases for Inattentive (Emotional)</i>
2007	0 (none)	11 (0)
2008	1 (California)	12 (1)
2009	2 (Alaska)	8 (0)
2010	1 (Idaho)	17 (0)
2011	1 (Alaska)	21 (1)



## 6. Summary and Conclusions

The review of literature revealed that there have been various legislation, awareness campaign programs, and technology-based interventions implemented in different cities, states, and countries for distracted bicyclists. Legislation are primarily focused on limiting distracted bicycling problems, enforcing, and fining violators. Finding quantifiable data for evaluating the effectiveness of these fines on distracted bicycling is very important. Nevertheless, this study was unsuccessful in determining the effectiveness of the imposed fines on improving distracted bicycling safety. Awareness programs mostly focused on alerting bicyclist about the dangers of distraction while bicycling. In essence, most of the awareness programs put more emphasis on unsafe behavior while bicycling and how to avoid them. Quantifying how public awareness programs are effective on addressing distracted bicycling could assist in formulating interventions for reducing the distraction problem. Technology-based interventions attempt to eliminate certain types of distraction while bicycling. Similarly, determining how much of an impact the technology has could also help to ascertain other technology to help distracted bicyclists. All the programs, policies, and technologies need evaluation to ascertain their safety effectiveness. In the literature, there is no comprehensive evaluation of safety effectiveness of these interventions in saving lives.

Review of data available on the FARS database showed that there are fatalities that resulted from distracted bicycling, which suggests the need for finding solutions to distracted bicycling problems to help save lives. In addition, there is a need to put more emphasis on deciphering whether bicyclists involved in crashes were actually distracted. Thus, pre-crash factors contributing to a crash are important in determining the actual type of distraction. This information would be vital in finding innovative interventions for the distracted bicycling problem in our society.

In conclusion, the current information on legislation, awareness programs, and technology-based interventions is very limited. This could be attributed to the infancy nature of distracted bicycling problems. Based on the literature reviewed in this study, the state-of-knowledge in distracted bicycling can be summarized as follows:

1. There are two technology-based solutions for distracted bicycling: hands-free and non-ear covering. These technologies may partially address the problem as De Waard *et al.* [20] reported that cyclists with hands-free devices resulted in marginally faster performance compared to hand-held devices. The safety effectiveness of these technologies are yet to be evaluated.
2. Several agencies and organizations list the use of electronic devices while cycling as unsafe behavior. However, no statistics are available to quantify the extent of distracted bicycling problems.
3. Few countries have enacted legislation that address distracted bicycling safety related problems. The majority of the legislation ban the use of headphones or earphones

in or on one or both ears and only few ban hand-held phones while cycling. In addition to these, one law common to all U.S. states and the District of Columbia restricts cyclists from carrying bundles, articles or objects that prevent them from keeping at least one hand on the handlebars indirectly addresses distracted biking. Hand-held phones prevent the cyclist from keeping both hands on the handlebars.

4. Based on the few past studies that have been conducted to date, the role of mobile phones in distracted bicycling behavior and bicycle crashes is not conclusive. For example, Terzano [18] and Waard *et al.* [21] reported that cyclists who were distracted exhibited unsafe behavior and lowered their cycling speed. However, among the crash-involved cyclists, only 0.5% reported using an electronic device at the time of the accident. While use of electronic devices can be distracting to cyclists, based on the available data, it is not at the top of the list of factors contributing to distracted bicycling related crashes.

5. Experimental-based and observational-based studies consistently revealed that cycling performance degrades (unsafe behavior and slowed response time) with cell phone use and listening to music [21,18,20]. However, the phone tasks used in experimental-based studies may need comparison with everyday phone conversations to evaluate their realism.

## 7. Recommendations for Future Research Opportunities

The review of distracted bicycling gas reviewed in this study highlights shortcomings that need further research to enhance our understanding of bicycle distraction problems. Distracted biking problems and suggested opportunities are as follows:

1. The currently existing awareness programs and technology-based solutions in different locations have not been evaluated for their safety effectiveness on distracted bicycling. The information still missing is whether these programs and interventions to reduce distracted bicycling crash risks in terms of probability of occurrences and injury severity levels.
2. There is need for conducting observational, experimental, and survey-based studies from other countries for more general conclusions. More importantly, there is need for crash-based and epidemiological-based studies that would quantify risk factors that contribute to bicycle crashes attributed to distraction.
3. Current data available have limited information on distracted bicycling. There is a need for better data collection to document the nature and extent of distracted bicycling.
4. Research is needed to identify factors that motivate or encourage bicyclists to willingly engage in distracting activities such as peer-pressure, risk perception, pleasure,

task urgency, personality, age, and biking experience. Research should also identify innovative and effective interventions and legislation that discourage bicyclists from engaging in distracting activities in high risk prone areas such as busy intersections or streets, riding on dedicated bikeways or shared roads.

5. In addition to media coverage on the subject, there is need for instructional material and safety rules/tips offered by bicycle advocates to incorporate distracted biking. This will increase public awareness on distracted bicycling safety related problems.

6. Goldenbeld et al. [8] found that cell phone use among cyclists is age specific, therefore, further research is also needed to further establish which sub-groups may be particularly susceptible to the effects of distraction such as young inexperienced cyclists, older cyclists, and fatigued or those under the influence of drugs or alcohol.

The findings of this review highlight the state-of-knowledge on distracted bicycling. In this era of rapid technology advances, distracted bicycling problems are anticipated to escalate in the foreseeable future. To that end, this review would assist different agencies and bicyclist advocates to formulate legislation, awareness programs, and effective interventions and evaluate their efficacy in improving safety of bicyclists in the communities.

---

## REFERENCES

- [1] Ascone, D., T. Tonja and C. Varghese. An Examination of Driver Distraction as Recorded in NHTSA Databases. Publication DOT HS 811 216. NHTSA, 2009.
- [2] Caird, J. K., C.R. Willness, P. Steel, and C. Scialfa. A Meta-Analysis of The Effects of Cell Phones on Driver Performance. *Journal of Accident Analysis and Prevention*, Vol. 40, (2008), pp. 1282-1293.
- [3] CTIA. U.S. Wireless Quick Facts. [www.ctia.org/advocacy/research/index.cfm/aid/10323](http://www.ctia.org/advocacy/research/index.cfm/aid/10323). Accessed July 06, 2013.
- [4] Department of Defense (DoD). Department of Defense Instruction No. 6055.04. <http://www.dtic.mil/whs/directives/corres/pdf/605504p.pdf>. Accessed October 08, 2013.
- [5] Drews, F. A., H. Yazdani, C. N. Godfrey, J. M. Cooper and D. L. Strayer. Text Messaging During Simulated Driving. *Journal of the Human Factors and Ergonomics Society*. Vol. 51, No. 5, 2009, pp. 762-770.
- [6] Fitch, G. A., S. A., Soccolich, F. Guo, J. McClafferty, Y. Fang, R. L. Olson, M. A. Perez, R. J. Hanowski, J. M. Hankey and T. A. Dingus. The Impact of Hand-Held and Hands-Free Cell Phone Use on Driving Performance and Safety-Critical Event Risk. National Highway Traffic Safety Administration, Report No. DOT HS 811 757, 2013.
- [7] Goldenbeld, C., M. Houtenbos and E. Ehlers. The Use of Portable Media Players and Mobile Phones While Cycling: Results of a Large-Scale Internet Survey. Transportation Research Board, Report No. R-2010-5, 2010.
- [8] Goldenbeld, C., M. Houtenbosa, E. Ehlersb and D. De. The Use and Risk of Portable Electronic Devices While Cycling Among Different Age Groups. *Journal of Safety Research*, Vol. 43, No. 1, 2012, pp. 1-8.
- [9] Ichikawa, M. and Shinji Nakahara. "Japanese high school students' usage of mobile phones while cycling." *Traffic injury prevention* 9.1 (2008): 42-47.
- [10] Jamson, S. Two Hands Better Than One. Institute for Transport Studies", Research Report, University of Leeds, UK., 2012.
- [11] Laker, L. Headphones That Don't Distract from Cycling Safely. *The Guardian News and Media. Bike*. [www.guardian.co.uk/environment/bike-blog/2012/mar/26/bike-headphones-music-cycling](http://www.guardian.co.uk/environment/bike-blog/2012/mar/26/bike-headphones-music-cycling). Accessed May 21, 2013.
- [12] National Highway Transportation Safety Administration (NHTSA). NHTSA Survey Finds 660,000 Drivers Using Cell Phones or Manipulating Electronic Devices While Driving At Any Given Daylight Moment. [www.nhtsa.gov/About+NHTSA/Press+Releases/NHTSA+Survey+Finds+660,000+Drivers+Using+Cell+Phones+or+Manipulating+Electronic+Devices+While+Driving+At+Any+Given+Daylight+Moment](http://www.nhtsa.gov/About+NHTSA/Press+Releases/NHTSA+Survey+Finds+660,000+Drivers+Using+Cell+Phones+or+Manipulating+Electronic+Devices+While+Driving+At+Any+Given+Daylight+Moment). Accessed May 21, 2013.
- [13] National Highway Transportation Sa. fety Administration (NHTSA). Distracted Driving: Frequently Asked Questions. [www.distraction.gov/content/get-the-facts/faq.html](http://www.distraction.gov/content/get-the-facts/faq.html). Accessed Jun. 10, 2013.
- [14] National Highway Transportation Safety Administration (NHTSA). Fatality Analysis Reporting System (FARS). [www.nhtsa.gov/FARS](http://www.nhtsa.gov/FARS). Accessed May 21, 2013.
- [15] Post, E. Concentrate While Cycling. *Charles River Wheelmen*. <http://www.crw.org/safety/12safetyPgs/12feb-concentrate.php>. Accessed May 21, 2013.
- [16] Somaiya, R. Drivers Are Still Distracted, Study Finds. *The New York Times*. [http://wheels.blogs.nytimes.com/2013/04/06/drivers-are-still-distracted-study-finds/?\\_r=0](http://wheels.blogs.nytimes.com/2013/04/06/drivers-are-still-distracted-study-finds/?_r=0). Accessed May 21, 2013.
- [17] Stoffers, M. Cycling As Heritage: Representing The History Of Cycling In The Netherlands. *Journal of Transport History* Vol. 33, No. 1, 2012, pp. 92-114.
- [18] Terzano, K. Bicycling safety and distracted behavior in The Hague, the Netherlands. *Journal of Accident Analysis and Prevention*. Vol. 57, 2013, pp. 87-90.
- [19] Tison, J., N. Chaudhary and L. Cosgrove. National Phone Survey on Distracted Driving Attitudes and Behaviors. Highway Traffic Safety Administration, Report No. DOT HS 811 555, 2011.
- [20] Waard, D., K. Edlinger and K. Brookhuis. Effects of Listening to Music, and of Using a Handheld and Handsfree Telephone on Cycling Behavior. *Journal of Transportation Research Part F: Traffic Psychology and Behaviour*, Vol. 14, No. 6, 2011, pp. 626-637.
- [21] Waard, D., P. Schepers, W. Ormel, K. Brookhuis. Mobile Phone Use While Cycling: Incidence and Effects on Behaviour and Safety. *Journal of Ergonomics*, Vol. 53, No. 1, 2010, pp. 30-42.
- [22] Young, K. and M. Regan. Driver Distraction: A Review of the Literature. MonashUniversity Accident Research Centre, Report No. 206, 2003.