
1 Introduction

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Driving is a complex, multitask activity. Despite this, it is not unusual to see drivers engage simultaneously in other nondriving tasks. The potential consequences of doing so were borne out in a landmark incident that occurred on the morning of December 31, 2001, on Port Arlington Road, near Geelong, Australia. A 24-year-old female dentist was preparing to send an SMS message—“cu1”—using a mobile phone while driving along the road. She was writing the text message to a friend in Melbourne to let her know that she would be meeting her at one o'clock that afternoon. In doing so, she swerved into the adjacent bicycle lane and crashed into the back of a bicycle being ridden by a 36-year-old mechanical engineer, returning from a training ride. The rider was thrown against the windscreen and roof of the car, and landed on the side of the road. He died at the scene. The driver of the vehicle was brought to court in a landmark case—the first in which the use of a mobile phone had been blamed for a road fatality in the Australian State of Victoria. She pleaded guilty to culpable driving, was sentenced to 2 years' imprisonment (fully suspended), and was disqualified from driving for 2 years [1]. This incident, and the media attention that it attracted, was important in focusing attention on driver distraction as a road safety issue in Australia. The purpose of this book is to explain and avoid such tragedies.

Driver distraction can be defined as *the diversion of attention away from activities critical for safe driving toward a competing activity* (see Chapter 3). If the human brain were not limited in attending to multiple tasks at the same time, driver distraction would not be an issue. However, this is not so. Psychologists have known for more than a century that humans are fundamentally limited in their ability to divide attention between competing tasks [2] and that, under certain conditions (i.e., when the tasks are highly similar, highly demanding, and require continuous attention [3]), the performance of one or both will inevitably suffer. There has been much debate in the scientific literature about the locus of this limitation and the psychological mechanisms that give rise to it, and these issues are discussed in Part 2 of this book. Diversion of attention away from activities critical for safe driving toward a competing activity can occur willingly, such as when a driver initiates a mobile phone

conversation, or it can occur involuntarily, such as when an item of information in the road environment (e.g., a moving billboard, an ambulance siren) compels the driver to attend to it. Indeed, the human mind is easily diverted from one activity to another, and there is good reason for this. From an evolutionary perspective, it is often advantageous. It is no accident of nature that certain objects, events, and activities are more diverting than others. There is biological advantage in having the human mind unwittingly orient itself toward objects, events, and activities that signify danger (such as a child running unexpectedly onto the roadway ahead, or a spider crawling on the windscreen) or to those that may be instrumental in perpetuating the species (such as other humans deemed to be attractive). Advertising material is designed to exploit this gift of nature; billboards are designed to attract attention.

Given that driving is a complex, multitask activity, some elements of the driving task itself, such as a flashing dashboard warning light or monitoring an unaccompanied child approaching the roadway, may also divert attention away from activities critical for safe driving. In some circumstances, the consequences of distraction may be negligible. In others, such as those that occurred in the text-messaging incident described earlier, the consequences can be tragic. The effects of distraction on driving performance and safety depend on many interrelated factors, which are discussed in later chapters of this book: the demands of the driving and nondriving tasks (see Chapter 19); the current state of drivers, for example, whether they are drowsy or inebriated (see Chapters 19 and 21); the personality of the individual (see Chapter 19); what is distracting them (see Chapters 11, 12 and 13); for how long they are distracted (see Chapters 17 and 18); when and where they are distracted (see Chapters 17 and 18); the momentary configuration of physical circumstances (see Chapters 2 through 4); the degree to which drivers, their vehicle, and the physical environment surrounding them is tolerant of the consequences of the distraction (see Chapters 13, 19, 26; and Part 8); and even a certain amount of luck. The prevention, mitigation, and management of distraction are, therefore, a complex undertaking.

There is converging evidence that driver distraction is a significant road safety issue worldwide. Findings from the analysis of police-reported crashes, reviewed in this book (see Chapter 16), suggest that driver distraction is a contributing factor in around 11% of crashes. Converging data, from a recent observational study in the United States involving 100 instrumented vehicles [4], suggest that distraction may be a contributing factor in up to 23% of crashes. While there is some disparity between these estimates, due to the different measurement methods and metrics used to derive them, there is good reason to believe that they underestimate the true scale of the problem (see Chapter 16). Not surprisingly, in many Organization for Economic Cooperation and Development (OECD) countries, driver distraction is increasingly becoming ranked, alongside speeding, drink-driving, and fatigue, as a significant contributing factor to road trauma [5].

The mobile phone (see Chapter 11), which is often denigrated as a source of distraction, is only one potential source of distraction. Scores of others exist (see Chapters 12 and 13). Not all are unrelated to the driving task, and not all degrade performance to the same degree (see Chapter 12). Some competing activities with the potential to distract drivers are neither new nor technical in origin. Indeed, many are considered to be part of everyday driving. These include talking to passengers,

reaching for objects, operating and listening to the radio, smoking, eating, applying cosmetics, grooming, daydreaming, and attending to potential sources of distraction outside the vehicle cockpit (e.g., advertising and other nondriving-related material posted on billboards, the back of buses and taxis, and variable message signs).

Other activities with a potential to divert attention away from activities critical for safe driving have evolved as a consequence of the proliferation of new technologies finding their way into the vehicle cockpit. These include entertainment systems (e.g., compact disk players) and vehicle information and communication systems (e.g., traveler information systems and the Internet). Advanced driver assistance systems (e.g., route guidance systems and collision warning systems), although designed to support the driver, may distract the driver if poorly designed and located, or used inappropriately. Some of these existing and emerging technologies are hardwired into the vehicle during production, some are retrofitted as aftermarket products, and others, such as personal digital assistants (PDAs) and iPods, can be carried in and out of the vehicle. Driver interaction with these new technologies is becoming increasingly common and is likely to increase as more of these technologies find their way into the vehicle. While everyday activities such as talking with passengers and eating have the potential to distract drivers, governments have tended to focus more on the impact of distraction because of driver interaction with technologies, given that these are increasing in number and their functionality is expanding [6].

As a road safety issue, research on driver distraction is still in its infancy. Although people talk about distraction as if they know what it means, it is poorly defined, and theories and models of the mechanisms and features that characterize it are limited. There exists no universally agreed taxonomy of the sources of distraction, potential and actual, that exist, inside and outside the vehicle. Little is known about patterns of driver exposure to the various sources of distraction that exist or about the impact of these on driver performance, individually and in combination. The relationship between performance degradation, crash frequency, and crash risk is poorly understood. Programs and policies to address the issue are limited, and data on the effectiveness of existing initiatives are scant. Strategic cooperation between key stakeholders in dealing with the issue is lacking.

It is noteworthy that the study of distraction has been confined almost entirely to the road transport domain, although related work has been going on for some time in the computing and aviation domains, under the guise of “interruptions” and the closely related topic of mental workload. Even within the road transport domain, the focus of distraction efforts to date has been on drivers: distracted walking and riding, whether on bicycles or motorcycles, are potential areas of concern almost totally unexplored and researched. There is little practical guidance on how to align and prioritize research to support the development of effective distraction prevention and mitigation strategies, even for car drivers, and the design, development, and evaluation of community-based prevention and mitigation strategies are still in their infancy.

There are many sectors of the community with a vested interest in preventing and mitigating the potential effects of distracted driving: the motoring public, vehicle manufacturers, road and transport authorities, the police, the media, motoring clubs, equipment manufacturers and suppliers, standards organizations, road safety

bodies, driver trainers, academics, and others (see Chapters 2, 14, 25, and 33). Typically, each party is concerned with only a subset of the issues relevant to the causes, effects, and management of distracted driving. Because the study of distraction is still in its infancy, there is relatively little information available on the topic, and the information that is available is contained within a variety of disparate sources.

This book brings together a substantial portion of the body of knowledge that currently exists on the topic of driver distraction. It provides the reader with a broad overview of the topic: the theory underlying distraction, its effects on performance and safety, strategies for preventing and mitigating its effects, and directions for future research.

Driver distraction has the potential to escalate into a more serious problem as more and more objects, events, and activities, inside and outside the vehicle, compete for the driver's attention. To date, regulation has been the main tool of governments in dealing with the issue, without much evidence-based research to support this decision making [7]. However, simply banning the installation and use of certain devices while driving, such as mobile phones, and banning drivers from engaging in other potentially distracting activities, is not a constructive way forward in dealing with a complex road safety problem. Distraction is an inevitable consequence of being human, and it is incumbent on governments to accept that driver distraction cannot be eliminated. Attention should be given to designing a road transport system that minimizes driver exposure to avoidable sources of distraction. Such a system would mitigate the effects of distraction and tolerate the consequences of distraction through better road and vehicle design. In doing so, the system must be designed so that it does not place demands on drivers, which are inconsistent with their limited capacity to attend simultaneously to competing activities. To do so will require a sea change in current thinking (see Chapters 2 and 30 through 33). In the meantime, there is sufficient knowledge about driver distraction to support the development and implementation of a wide range of potentially effective countermeasures.

This book is divided into nine parts that are sequenced according to the title of the book, *Driver Distraction: Theory, Effects, and Mitigation*.

Part 1 introduces the reader to the topic. Part 2 defines distraction, discusses philosophical issues pertaining to it, and presents theories and models to explain the mechanisms that give rise to it. Part 3 reviews the various tools, techniques, and methods that have been developed to measure and quantify the effects of distraction on driving performance and behavior. Part 4 reviews the actual effects of distraction on driving performance. Part 5 reviews what is known about the relationship between distraction, crashes, and crash risk, presents a taxonomy for classifying known sources of distraction, and reviews what is known about driver exposure to different sources of distraction. Part 6 of the book reviews factors that mediate the effects of distraction on driving performance and safety, such as driver's age, experience, and state of mind. Part 7 reviews the various principles, guidelines, and checklists that have been developed to support the human-centered design of systems and artifacts with which drivers interact within the vehicle and on the roadway, to minimize distraction. Standards that have been developed to standardize the design and measurement of distraction are also reviewed. Part 8 reviews the range of countermeasures that have been, and are being, developed to prevent and

mitigate the effects of distraction. Recommendations are made for further counter-measure development. Finally, Part 9 draws conclusions derived from the material reviewed and makes some general recommendations for further research.

This book provides a balanced treatment of the topic of driver distraction, with contributions from more than 40 distinguished authors from around the world, representing a broad range of stakeholders: vehicle manufacturers, road and transport safety authorities, equipment manufacturers and suppliers, standards organizations, road safety bodies, academics, and human factors and injury-prevention researchers. All chapters were peer-reviewed. It is recognized that human operators in domains other than road transport, such as rail, process control, and aviation, are vulnerable to the effects of distraction. While the focus of the book is on driver distraction, the information in it is also relevant to the understanding and management of distraction in these and other domains.

There is much that can be done to manage driver distraction and to prevent it from escalating into a more serious road safety problem than it already is. It is hoped that the information, insights, and advice contained in this book will help to inform and guide this process.

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*Theory, Effects,
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