A Methodological Approach for Studying Transit Bus Driver Distractions

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PREFACE

Driver distraction and inattentiveness are significant causes of highway fatalities, injuries, and substantial economic losses. Many researchers have focused on driver distraction in personal vehicles, light trucks, and SUVs, and a few focus on commercial vehicles. Public transit bus driver distraction has received limited attention in the literature, even though accidents may cause more injuries due to many passengers. Incomplete reporting of distraction-related accidents by police or transit bus drivers results in limitations for pursuing further research.

The objective of *Transit Bus Driver Distraction: A Methodological Approach* is threefold. First, it will provide the transit bus drivers, supervisors, and related operations personnel with an awareness of the risk levels of distracting activities. Second, it will provide a detailed conceptual framework for studying transit driver distractions. The structure offers a transit agency with standardized methodologies for studying distraction over various cost and time intervals. An agency may choose one or more modules to suit their study requirements. Third, scholars recommend more research on transit bus driver distraction, which lags behind light-duty vehicle driver distraction studies.

The book is not wholly our creation. We acquired the concepts and methods of a driver distraction study from limited literature. We also gained a better understanding of transit bus driver distraction from student internships and faculty field studies at HRT and PRTC in the Commonwealth of Virginia and from observing transit bus operations at some large cities in the US and internationally. Many documents were published by internationally acclaimed researchers working tirelessly on the crucial but less examined area of driver distractions. We have supported these by citations from relevant research papers, final study reports, and news from reputed news agencies listed in the Reference section.

We have presented the book's content in a format that most readers with a high school diploma two-year or higher college degree can understand. Basic knowledge of statistical analysis will be advantageous but not necessary. With illustrations that include options from simple route observations to more advanced statistical modeling, this book presents research results that are easy to interpret and use by the transit agency's operations management.

We introduce a modular conceptual framework that furnishes guidance during the driver distraction study and will assist in interpreting the results and implementing relevant findings. The data collection, analysis, validation, interpretation, and usage of recommendations modules are formulated and field-tested on two agencies in the Commonwealth of Virginia. The framework's modular structure permits updating, deleting, and adding tools in each module as and when required without affecting the other modules. We have reproduced the results to illustrate the type of outputs obtainable from the framework's different modules. They do not reflect the agency's performance or the accuracy of the data and model results.

The book provides a detailed process and guidelines to study transit bus driver distraction, making it possible for a transit agency to conduct such a study. The study methods vary in complexity, from simple route observations to an existing accident database analysis to more detailed surveys.

We hope you enjoy reading this book. Do not hesitate to contact us if you have suggestions or need clarifications.

Kelwyn

ABBREVIATIONS

AAA	American Automobile Association
APTA	American Public Transportation Association
AAAM	Association for the Advancement of Automotive Medicine
ANDS	Australian Naturalistic Driving Study
ANOVA	Analysis of Variance
BIFA	Buses Involved in Fatal Accidents
BTS	Bureau of Transportation Statistics
CMV	Commercial Motor Vehicle (above 10,000 pounds)
CDA	Confirmatory Data Analysis
CSP	Cambridge Scholars Publishing
DDI	Driver Distraction and Inattention
DRI	Distraction Risk Index
DV	Dependent Variable
EDA	Exploratory Data Analysis
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FMCSA	Federal Motor Carrier Safety Administration
FARS	Fatality Analysis Reporting System
GES	General Estimates System
GLM	General Linear Model
HRT	Hampton Roads Transit
IV	Independent Variable
LDVs	Light Duty Vehicles (less than 10,000 pounds)
LCL	Lower Confidence Limit
MUARC	Monash University Accident Research Center

MLR	Multinomial Logistics Regression
NASS	National Automotive Sampling System
NDS	Naturalistic Driving Study
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
OR	Odds Ratio
OST	Office of the Secretary of Transportation
PRTC	Potomac and Rappahannock Transportation Commission
SHRP	Strategic Highway Research Program
SCEs	Safety-Critical Events
TWD	Texting while Driving
TRB	Transportation Research Board
UMTRI	University of Michigan Transportation Research Institute
USDOT	United State Department of Transportation
UCL	Upper Confidence Limit
VTTI	Virginia Tech Transportation Institute
VKT	Vehicle Kilometers Traveled
VMT	Vehicle Miles Traveled
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION AND FOCUS

1.1 Overview of US Fatal Traffic Accidents

World Health Organization (WHO) reports that worldwide road crashes were responsible for a staggering 1.35 million fatalities[1] and another 20-50 million non-fatal injuries in 2019. The "vulnerable road users," comprising pedestrians, cyclists, motorcyclists, and passengers, account for more than half of road traffic fatalities and injuries. It is the leading cause of death among children and young adults aged 5-29 (WHO, 2019).

The United States suffered 36,560 traffic fatalities in 2018, compared to 37,473 deaths in 2017 (USDOT, 2019). The 2.40 % decline in deaths was equivalent to 913 fewer fatalities. This declining trend has held for two consecutive years (2017 and 2918), and USDOT predicts it will continue for the following years. Decreased deaths encouraged the Honorable Elaine L. Chao, then USDOT Transportation Secretary. But she reminded the USDOT that:

> "This is positive news, but more work remains to be done to make our roads safer for everyone." (USDOT, 2019, 1).

NHTSA Acting Administrator James Owens identified distraction as one of the causes of accidents (USDOT, 2019,1-2).

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[1] The words fatality and death are used interchangeably to mean that the critically injured person dies from the accident.

1.1.1 US-EU Fatalities and Driving Characteristics

Table 1.1 compares traffic accidents in the United States with the combined annual accidents (EC, 2018) of the member states in the European Union (EU).

Table 1.1 Comparison of 2018 US and EU Member States Traffic Statistics.

	Population in millions	Total number fatalities	Fatalities per million population	Fatalities per 100 million VMT[2]
US	327.88	36,560	111.50	1.13
EU	510.25	25,052	49.00	1.18

Although the US has a lesser population compared to the EU member states, the total number of US fatalities is nearly one and a half times more than the total number of EU member states. Furthermore, the fatalities per capita in the US are more than two times that of the member states.

The United States is a vast country with a convenient and effective highway system that encourages more people to drive long distances. Americans generally live in the suburbs and go through towns or cities on their journey to the workplace, adding vehicles to their existing traffic flow. For instance, 60% of Hampton Road's residents work in a different city than they live in, adding additional traffic to that city's existing flow. The incoming traffic will increase congestion. According to the University of Maryland, College Park (Chang and Xiang, 2003), congestion leads to traffic accidents, and acciden*t*s will lead to more congestion. This cycle will continue until traffic police break it by re-routing the incoming traffic.

Traditionally, Americans drive long distances to visit relatives and friends during the seasonal holidays. For example,

[2] Vehicle miles traveled.

AAA expected nearly 55 million Americans to travel 50 or more miles by auto during the 2022 Thanksgiving holidays (Diaz, 2022).

Furthermore, International Comparisons (2020) examined the annual average per capita distance traveled for selected EU member states and US drivers. The average vehicle kilometers traveled per capita in the EU SUN countries (Sweden, the United Kingdom, and the Netherlands) is 6,267. A US driver's average vehicle kilometers per capita is 13,000, more than twice the per capita distance traveled by an EU driver. Also, on average, the American ownership of automobiles in 2020 per 1,000 (838) is 75% higher than the EU SUN counterpart's average (479). Higher automobile ownership means more cars on the road, resulting in more congestion, especially in large cities.

1.1.2 A Measure of Traffic Performance

The mileage-based scale directly measures the risk of a driver's accident while driving on the road and is generally helpful for long-distance travel. Jovanis and Chang (1986) found that the number of accidents or the accident frequency is closely related to the distance traveled, the hourly volume, average daily traffic, or vehicle miles traveled (VMT). Jovanis and Chang (1986) used the Poisson regression model to show that automobile and truck accidents are causally related to the VMT, proving that accident rates are proportional to the distance traveled.

The two other measures, i.e., rates per driver and per capita, measure a group's contribution to the overall traffic problem. Hence, an appropriate approach for measuring traffic performance in the US is the number of fatalities per 100 million VMT (Massie and Campbell, 1993). The USDOT (2019) reported a decrease in US fatality per 100 million VMT by 3.4%, from 1.17 in 2017 to 1.13 in 2018.

The EU also computes a performance-based measure called the number of deaths per billion vehicle kilometers traveled (VKT). After converting the VKT to VMT, a comparison shows that the EU's VMT value (1.18) is around 4% higher than the US value (1.13) computed in Table 1.1. Due to insufficient data, we could not conclude if the difference is statistically significant.

Different methods of computing traffic performance are applied worldwide, making comparisons difficult. The US (fatalities per 100 million VMT) and EU Member states (total deaths and injuries per population) could produce misleading results. The authors advise transit agencies to study performance per capita or per driver to understand the differences between countries, states, and individual agencies in one region.

1.2 Distracted Driving

1.2.1 Everyday Common Distractions

It is expected to get distracted while engaged in an activity or task. As college professors, we have experienced students getting distracted by their surroundings from external or internal noises, class lighting, listening to a boring lecture, and a host of other non-academic activities. A surgeon can get distracted while performing a critical surgical procedure, resulting in severe repercussions. A daycare worker can get distracted while tending to children, exposing them to internal and external dangers. Or a football wide receiver can fail to catch a pass due to distractions by team supporters.

According to Regan, Young, and Lee (2009, 6), getting distracted is a human trait and cannot be eliminated but can be minimized by better roadways and vehicle design.

1.2.2 Impact of Transit Driver Distraction

Over the years, major transit accidents have drawn media attention due to the potentially large number of passengers involved in each incident. Here are some examples of transit (rail and bus) driver distraction:

1.2.2.1 The Santiago Transit Rail Accident

On July 24, 2013, the Spanish Santiago rail crash, which killed 78 passengers and crew and injured 170, indicated that the operator was allegedly talking over the phone before the accident (Burgen, 2013) and failed to reduce the train speed over that section of the rail link resulting in severe derailment of the cars.

Distracted driving has become a severe concern for companies that provide employees with company-owned autos and cell phones during working and non-working hours. The National Safety Council (NSC 2023, 1) advises employers to enforce a policy banning the use of cell phones (including hands-free systems). Violation of this policy could result in disciplinary action or termination of service. What is the employer's liability when employees get into accidents using cell phones? The policy should not exempt a driver from liability due to negligent driving.

1.2.2.2 The Ottawa Transit Bus-Rail Accident

On September 18, 2013, in Ottawa, Canada, a bus-train crash claimed six lives and many more injuries (CBS News, 2013). The authorities suspected that speed and distracted driving were the possible causes of the accident. The double-decker bus driver checked the second-floor passengers via his rearview mirror, thus missing the vital stop sign at the railroad crossing.

In addition to the loss of lives and injuries, the traumatically injured passengers or their estates have begun to file lawsuits against the City of Ottawa, claiming damages and post-stress disorders negatively affecting their work and personal lives (CBS News, 2013).

Transit agencies ignoring the threat of distraction have a higher possibility of losing commuters and getting tied up in costly litigation battles. Ottawa's city has settled 31 of the 39 lawsuits filed over the fatal September 2013 crash. The claim was for $26 million, and the city settled for $8 million (CBS News, 2013).

We grouped the accidents into preventable accidents (for example. distracted driving, speeding, driver behavior) and non-preventable accidents (for example, a vehicle hit by another vehicle, adverse weather conditions, and so on). We focused on studying driver distraction, which is preventable, and offer a methodology that transit agencies can use to conduct such studies.

1.3 Growth of Public Transit Service

The American Public Transportation Association (APTA, 2023) has projected a steady growth in demand for overall transit modes. The COVID-19 pandemic caused a decline since March 2020 in transit ridership, from 10% to 40% of the pre-pandemic level. The ridership levels reached a low level of 19% in March-April 2020. It quickly recovered, estimated to be around 76% of the pre-pandemic ridership in March 2023.

There is an increase in demand for mass transit by the aging, disabled, low-income, and other riders who depend solely on one or more transit modes for their transportation needs (Gershon, 2005). With the increased use of portable electronic devices (PEDs) among transit operators, this high readership demand has made distractions more prevalent and is an increasing risk to drivers and passengers.

Generally, the demand for transit bus services fluctuates according to gasoline prices (Eng Ky, Kim, 2016). Higher gasoline prices increase transit ridership, and a corresponding price decrease will reduce the demand for public transportation. Economists measure price sensitivity using elasticities, defined as the percentage change in consumption resulting from a 1 percent change in price, and all else held constant. Litman (2006) examined the relative elasticities and cross elasticities of various factors such as prices, size of the city (population), availability and cost of parking spaces, etc. Litman (2006, 52) concluded: "…that no single transit elasticity value applies in all situations: Various factors affect price sensitivities…"

Volatile gas prices, a recovering economy, and more Americans supporting transportation investments have resulted in a rail and bus transit ridership surge. The APTA, representing all transit modes, produced a 2024-2025 strategic plan detailing actions demonstrating that public transportation means jobs, a strong economy, a healthier environment, response to safety, security, social and environmental challenges, and rebuilding ridership.

The above plan shows that transit agencies can look forward to increasing their ridership share. Let us review cases of growing transit systems in the Southwest (SW) US and the Southeast (SE) US.

1.3.1 Growing Transit Service in the SW US

A transit system will grow if it has enough riders and there are supporting services that can move you from origin to destination seamlessly.

Phoenix, the fifth most populous city in the United States, has a vibrant population. The City of Phoenix's seamless transit services (Figure 1.1) is a transit system that increases ridership. The City of Phoenix puts in added efforts to make the transit services an attractive and safe alternative to driving one's vehicle. Valley Metro offers free community transit education programs specially designed for each attendee group (Figure 1.2).

Figure 1.1 City of Phoenix's Seamless Bus and Light Rail Transit Services
(Courtesy City of Phoenix Communications Office)


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Figure 1.2 Bus and Light Rail Transit Education Services
(Courtesy Valley Metro Communications Office)

The City of Phoenix's transit services are Phoenix's local bus service and light service rail, which operate seven days a week