

## **Bicycle and Automobile Safety Perception Analysis**

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### **1 INTRODUCTION**

The purpose of this research is to capture information about bicyclist safety, and how engineers and planners can reduce the risk of crashes involving bicyclists. This research involves a vehicle-bicycle crash analysis, a cyclist safety attitude survey, and an analysis of biking-under-the-influence (BUI) laws. The first portion is a statistical analysis of Virginia bicycle-automobile crashes from 2010 to 2014 using police crash report data from the Virginia Department of Motor Vehicles (VA DMV). This dataset was analyzed for risk factors that impact bicyclist injury severity, including characteristics about the bicyclist, automobile driver, vehicles, environment, and roadway. The results of this analysis introduced avenues for further research. In particular, the analysis found that bicyclist alcohol consumption can double the risk of a fatality for the bicyclist and increase the risk of a severe injury by 37%. This was just one of the factors found to increase the risk of bicyclist fatalities and severe injuries, but has been chosen for further analysis because of the lack of previous research on the topic. A comparative analysis was performed using National Highway Traffic Safety Administration Fatality (NHTSA) Analysis Reporting System (FARS) data to examine the rates of fatal bike crashes and alcohol use across states with various BUI laws. Furthermore, to complement the quantitative nature of the crash data analysis, an attitudinal survey of bicyclist safety is being distributed in Virginia to capture information missing from the automobile-oriented crash data. The survey aims to better understand bicyclists' perception of safety as well as the nature of unreported bicycle crashes, as the under-reporting phenomenon in police crash report data is well documented (particularly for minor and no injury crashes [1]).

### **2 DATA**

Each section of this analysis utilizes a different data source, and together the analyses provide a comprehensive picture of the state of bicycling safety in Virginia. The VA DMV data consists of police reported crashes in which both automobiles and bicycles were involved (excluding bicycle-only and bicycle-pedestrian crashes). The attitudinal survey of bicyclist safety perceptions is a sample of Virginia bicyclists and non-bicyclists. The bicycling under the influence analysis consists of bicyclist and alcohol data from the nation-wide NHTSA FARS.

### 3 METHODOLOGY AND PRELIMINARY RESULTS

The VA DMV data analysis employs an ordered probit model. In the model, the response variable is the injury severity of the bicyclist in the crash, represented by the following five categories: fatal (0), severe injury (1), minor/possible injury (2), no apparent injury (3), and no injury (4). The crash, roadway, environment, vehicles (bikes and automobiles), and drivers (cyclists and automobile drivers) characteristics are the independent variables in the model. The legal analysis involves comparing states with different types of BUI laws. In the United States, states generally fall into three categories concerning BUI laws, either the driving under the influence (DUI) law applies to bicyclists, the law does not apply, or the state has established a separate law specifically impacting bicyclists that is unrelated to the motor vehicle law. Non-parametric analysis is used to determine differences in fatal bicycle crash rates between states where the DUI law does or does not include bicyclists and to compare how states with their own bicyclist drinking laws compare to states that do not. The bicycling safety survey has been designed to capture information about travelers in the Virginia area to complement the crash analysis and overcome some of its weaknesses. The survey was designed to be completed in under 15 minutes with the goal of not deterring potential respondents because of length. The survey is divided into several sections that gather information from the respondent about themselves, their typical travel modes, and their feelings about bicycling safety where they live.

From the Virginia automobile bicycle crash analysis, some characteristics are determined to impact to the risk of bicyclist fatalities and severe injuries. Most notably, this research finds that automobile driver intoxication increases the probability of a cyclist fatality six-fold and doubles the risk of a severe injury, while bicyclist intoxication increases the probability of a fatality by 36.7% and doubles the probability of severe injury. Additionally, bicycle and automobile speeds, obscured automobile driver vision, specific vehicle body types (SUV, truck, and van), vertical roadway grades and horizontal curves elevate the probability of more severe bicyclist injuries. The BUI analysis informs how to reduce fatalities and severe injuries resulting from alcohol. This is accomplished through a comparative analysis of states with differing BUI laws. In the United States, in 29 states the DUI law does not apply to bicyclists. In 18 states, the DUI law does apply to bicyclists. And in 3 states there are specific laws written to address bicyclists and alcohol. Nonparametric tests are used to determine differences in bicyclist fatality patterns among states with different laws. Furthermore, the survey adds to these components by supplying data that was not captured in the police crash report data. The questions capture information about the respondents' typical travel patterns to understand what transportation modes are most frequently used. Then, the survey inquires respondents about various dimensions of bicycling safety. The purpose is to capture information that is relevant to understanding bicycling safety but could not be captured through the available data. For example, helmet data in the police crash report data was often inaccurately reported, therefore asking respondents about how often they use helmets can help fill this gap. Similar questions ask about other types of safety equipment (reflective clothing, daytime lights, and nighttime lights). Other types of safety questions concern how bicyclists feel that automobile drivers act towards them on the road, as well as how safe they feel biking in different situations. Furthermore, a section about previous crash history attempts to capture some characteristics of reported and unreported crashes, giving insight into crashes that were missing in the VA DMV dataset. The results from the survey are forthcoming.

### REFERENCES

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