

Why Are Bike-Friendly Cities Safer for All Road Users?

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1 INTRODUCTION

Bicycling as a fundamental mode of transportation is being reinvented in the United States. On one hand, Americans are becoming increasingly reliant on bicycling, as evidenced by the 61% increase in bicycling to work over the last decade [1]. At the same time, more and more U.S. cities are improving their bicycling infrastructure, particularly with respect to protected bike lanes [2]. Despite these changes, the Organization for Economic Cooperation and Development (OECD) states that Americans still bicycle less than residents of the other 33 OECD countries. Moreover, Americans are also among the most likely to die as bicyclists [3].

Just how dangerous is bicycling? Given the lack of exposure data and bicycling counts in the U.S., this is a difficult question to answer definitively. However, we can begin to estimate the relative safety of bicycling in the U.S. as compared to driving. For instance in the U.S. in 2012, 33,561 people were killed in motor vehicle crashes, of which 726 involved a bicycle. Americans drove 2,938,535 million miles over the course of that, which equates to a fatality rate of 1.14 fatalities per 100 million VMT [4]. With respect to bicycling, the National Sporting Goods Association reports that 39.3 million Americans aged 7 or older rode a bike in 2012 [5]. So given that number of bicyclists and the 726 bicyclist fatalities in 2012, each bicyclist would have to bike more than 1,600 miles each year to achieve a better fatality rate than those in motor vehicles. This would equate to 12.5% of Americans bicycling 4.5 miles every day of the year. While this level of bicycling would be encouraging on many fronts, it is not a realistic level of bicycle exposure in the U.S. context given current travel patterns [6]. Another bicycling safety estimate from Pucher and Dijkstra approximated bicycling exposure from commute data and found that the per-mile fatality rate for drivers in the U.S. was approximately ten times lower than that for bicyclists [6, 7]. Either way, these estimates suggest that there is a much higher chance of a fatality per mile cycled than per mile driven.

Transit, on the other hand, has been shown to be a much safer mode of transportation than driving. Recent numbers suggest fewer than 0.06 fatalities per 100 million passenger transit miles traveled, which is approximately nineteen times safer than driving [8]. Given this difference between transit and automobile safety, it would stand to reason that cities with a high percentage of people traveling by transit would be safer overall than the typical automobile-based city. This trend turns out to be the case. In their international study, Kenworthy and Laube concluded that cities with higher transit use also tended to have lower overall fatality rates [9]. Litman, in a separate analysis, found that the per capita fatality rates of U.S. cities were lower with increased transit use and that residents of automobile-oriented cities had a traffic fatality rate five times that of those living in transit-oriented communities [10, 11]. One reason behind these results is that more transit use tends to also lower the overall level of vehicle use. Another explanation is that transit use is higher in relatively dense metropolitan areas with urban forms designed for relatively slow speeds, thus reducing the number of deaths of travelers by just about any mode.

So given these safety trends, one might conclude that bicycling-based cities must be far more dangerous than either transit-based cities or automobile-based cities. However, the evidence strongly points to the fact that cities known for their bicycling are not just safer for bicyclists but for all road users [12]. For instance, the U.S. city with the greatest percentage of people bicycling to work – Davis, California – endured only nine fatal road crashes over a recent twelve year period. Only three of those fatalities occurred on non-limited access streets, and not one involved a bicyclist. These results equate to a fatal crash rate of less than 1.5 per 100,000 residents. With the current per capita crash rate in the U.S. more than 7.5X higher at 11.3 fatalities per 100,000 residents, it is easiest to discount Davis as an outlier. Yet, Davis is not alone. Another city that has become renowned for its bicycling over the last twenty years – Portland, Oregon – has concurrently improved its road safety record. Over a recent ten-year period, Portland’s bicycle mode share increased from 1.2% to 6.0%; at the same time, the total number of road fatalities in Portland dropped by 75% with no bicyclist fatalities in more than half of those years [13]. This is a remarkable safety record (4.5 fatalities per 100,000 residents for 2010) for a city of over 600,000 people and is only comparable internationally to countries reporting the lowest crash rates in the world such as the Netherlands with less than 4 annual road fatalities per 100,000 residents [14]. Perhaps not coincidentally, the Netherlands also boasts a bicyclist mode share of near 30% [15].

Examples such as Davis, Portland, and the Netherlands are often written off as outliers because their cultures of bicycling have been prevalent for decades. New York City, however, is a relative newcomer to the bicycling experiment, having installed over 400 lanes miles of bike lanes since 2006 [16]. Over a recent five-year period, bicycling has nearly doubled in New York City while traffic deaths are down more than 30% [17, 18].

Despite conventional logic, the evidence continues to build that bike-friendly places are not only safer for bicyclists but for all road users. The motivating question for this research, however, is: why is this the case?

A handful of existing studies have tackled the bicyclist ‘safety in numbers’ concept where individual bicyclist risk drops with an increasing number of bicyclists [19-23]. The rationale most often given for this safety benefit is a shift in driver expectations and behavior based upon the perceived possibility of encountering a bicyclist. However, these studies only attempt to understand the difference in bicyclist safety. Far fewer studies have investigated the safety effect of a bike-friendly city on the safety of all road users [12].

Beyond safety in numbers, there are other theories as to why these places seem to be safer for all road users such as: socio-demographic and socioeconomic changes; built environment changes; travel behavior changes; and traffic and operation changes. We have collected this data longitudinally for thirty American cities to help understand these issues as related to what makes high-bicycle-mode-share cities safer for all travelers.

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