iCSC International Cycling Safety Conference

6th Annual International Cycling Safety Conference
21-22 September 2017, Davis, California, USA

The Relative (In)Effectiveness of Bicycle Sharrows on Safety Outcomes

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Keywords: Shared Lane Markings, Sharrows, Bicyclists, Safety, Injury.

1 INTRODUCTION

Shared lane markings – more commonly known as sharrows – trace their origins to Denver, Colorado in the early 1990s [1, 2]. The markings were initially purposed to improve bicyclist safety by raising driver awareness of bicyclists' presence and reducing wrong-way riding so that both road users could better coexist on city streets [3]. They have since evolved to serve a number of different functions, including avoiding crashes with the doors of parked cars (i.e. dooring crashes) and reducing sidewalk riding. The markings have become a popular substitute for more expansive and expensive alternatives such as bike lanes and cycle tracks. Today, sharrows comprise the majority of the bicycle network in nearly every major city in the United States and have become a staple in the toolboxes of transportation planners and engineers. In 2009, sharrows were added to the Manual on Uniform Traffic Control Devices (MUTCD), solidifying their place as an accepted bicycle treatment [4]. However, little past research has examined whether these markings actually make bicyclists safer. With their popularity rising in cities across the country, this paper aims to longitudinally examine the safety outcomes of sharrows in terms of bicyclist injuries.

Although their goal is to increase safety on our streets, the exact operational function of sharrows is somewhat nebulous and seems to have evolved over time. Many of the early studies examining sharrows designate this avoidance of dooring as a primary objective [1, 5, 6]. Similarly, the initial objective listed in the MUTCD was to assist bicyclists with lateral positioning so to avoid dooring crashes [4]. While results are mixed, past studies suggest that the effects of sharrows on spacing tend to be theoretically positive. In other words, the mean distance between bicycles and parked cars, between bicycles and the curb, and between bicycles and moving vehicles can increase up to 10.5 inches with the installation of sharrows [2, 7, 8, 9, 10]. However, other studies suggest no change at all at certain sites [2, 10].

Regardless of the specific objective of the sharrow installation, the overarching goal of sharrows is typically to increase safety for bicyclists, something that has been largely neglected by past researchers [9]. The purpose of this research is to therefore longitudinally examine the safety outcomes of sharrows in terms of the rate of bicyclist injuries. The City of Chicago will be examined on the level of the block group in order to understand if the installation of sharrows is correlated with changes in bicyclist safety. Specifically, changes in bicyclist injury crash rates between a before and after period are analyzed. Block groups are designated as having only sharrows installed, only bike lanes (standard, buffered, or protected) installed, or no bicycle infrastructure installed.

2 METHODS

The number of bicyclist injuries in the before and after periods were derived by spatially joining the injury point layer to the block groups in ArcGIS. We then joined the total number of bicycle commuters in the before and after periods for each block group from the ACS spreadsheets. In this way, every block group included a typology

(bike lanes, sharrows, or none), the number of bicycle injuries (both dooring and non-dooring) that occurred in the before period (2011-2012) and the after period (2013-2014), and the number of bicycle commuters in the before period and the after period. With this information, a rate of the number of bicyclist injuries per 100 bicycle commuters was created for each typology and time period. These rates were then weighted based on the number of bicyclists in each block group. For instance, the injury rate of a block group with 100 bicycle commuters was given more weight in the overall average than a block group that only had 1 bicycle commuter. We used the margin of errors provided by the ACS in order to create confidence intervals around our rates. Kruskal-Wallis tests were utilized to analyze the mean changes in bicyclist injuries per 100 bicycle commuters within each individual typology as well as to analyze the changes in the different typologies relative to one another. The Kruskal-Wallis test is a non-parametric one-way analysis of variance used to compare data when the data is not normally distributed. ANOVA was not used in this case because, although the differences among group means were being explored, the unbalanced sample sizes proved problematic for this type of statistical analysis, and the data did not fit the normal distribution [11].

3 RESULTS

Results suggest that not only are sharrows not as safe as bike lanes, but they could be more dangerous than doing nothing at all. Block groups that had bike lanes installed saw the largest increase in total bicyclist injuries per block group from the before to after period. Block groups that had no bicycle treatments installed saw a lesser increase in injuries, while block groups that had sharrows installed actually saw a decrease in overall bicyclist injuries. In order to analyze the risk for injury of individual bicyclists, these injuries had to be normalized for exposure and then weighted based on the number of bicycle commuters present in each block group. After normalizing based on the increases in ridership, block groups that had bike lanes installed had the smallest percentage increase in injury risk and the second smallest absolute increase. This is due to the fact that, although they had the largest increase in injuries, the bike lane block groups with the largest increase in injuries had the smallest increases in ridership. Block groups that had no bike infrastructure or treatments installed saw the second smallest percentage increase in injury rate and the smallest absolute increase in injury rate. Finally, block groups that had sharrows installed experienced large increases in both the percentage change in injury rate and the absolute change in injury rate. This is due to the fact that the sharrows block groups that had decreases in injury rate had few bicycle commuters, while sharrows block groups that had increases in injury rate had many bicycle commuters.

Once statistical analysis is performed on the mean changes in injury risk, the effectiveness of sharrows is truly called into question. The increase in the bicyclist injury rate for block groups with sharrows installed was larger than the rate increase experienced by either the bike lane block groups or the block groups that had no bicycle treatments installed. This relationship reached statistical significance at the 95% confidence level. The differences in bicyclist injury rate increases between bike lane block groups and block groups that had no bicycle treatments installed did not reach statistical significance.

4 CONCLUSIONS

The implications of this work could be wide ranging, supporting the overarching goal of encouraging more sustainable transportation modes and bettering transportation safety outcomes within our cities. While the conclusions of this work may be misconstrued by some as primarily a call to reduce the number of sharrows, the true goal of this research is to instead ensure that resources are focused on providing more bike infrastructure that has been proven to be effective at meeting its goals. As James McKay, the creator of sharrows, has said: “A lot of these agencies don’t want to do anything that involves change or spending money for bicycles. I was always under pressure to do less as the Denver Bicycle Planner” [12]. The goal of this work is to understand how to do more for bicyclists in terms of safety. Resonating with Mr. McKay’s statement, the results of this research suggest that sharrows are not able to provide the level of safety that bicyclists need. Even in Denver, the birthplace of

sharrows, the effectiveness of sharrows is being called into question. The recently released audit of the Denver Moves Plan explicitly states that while incorporating cheap, low-ease-of-use facilities (such as sharrows) in place of more expensive, high-ease-of-use facilities (such as bike lanes) may be "more cost effective in the near-term, the prioritization of low to moderate ease of use facilities does not align with the long-term goals of Denver Moves" [13]. While the City of Denver is well on track to complete all of its planned sharrows, it is falling far behind on its other planned facilities. This illustrates the primary issue that sharrows create for most cities that install them. As cities work under the unproven assumptions that sharrows are increasing safety, cities spend their meager budgets installing many miles of ineffective treatments, instead of investing in true infrastructure such as bike lanes, cycle tracks, and multi-use paths.

With sharrows becoming a familiar sight on our roadways, it is vital to fully understand the impact that these treatments have on the bicyclists within our cities. While past research has identified the spacing of bicyclists as an important issue, it is only a theoretical means to an end. The effectiveness of sharrows in terms of the true goal, which is reducing injuries and fatalities on our roadways, remains unclear in the current body of research. This work begins to question their effectiveness and should act as a call for more research on the subject. It is imperative that the appropriate infrastructure and treatments are in place to ensure the safety of all users on our roadways, and it may be that sharrows do not have a role to play in this pursuit.

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